

Building a better bridge to survive tsunamis

By **BRENNA VISSER**
EO Media Group

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 Daily Astorian/Colin Murphy

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

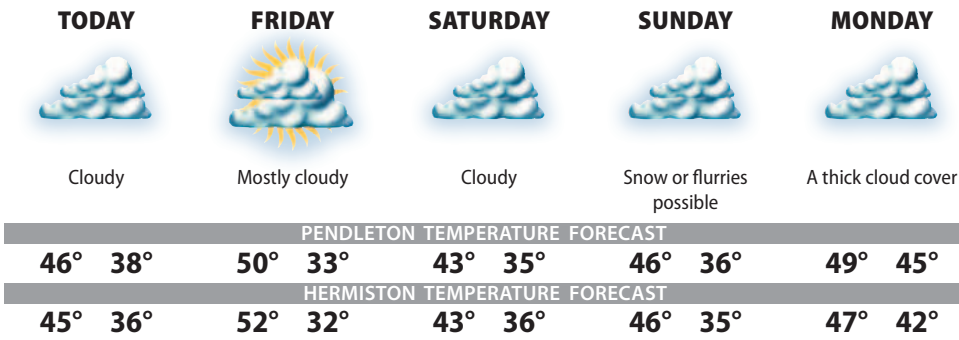
More research

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.

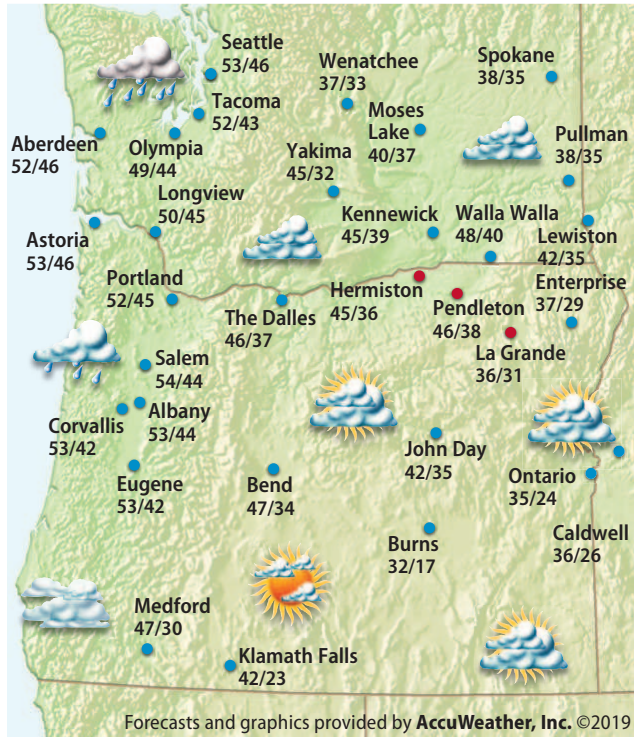
"Think back 10, 15 years ago, the tsunami was not even considered," Yim said. "We've come a long ways."

Forecast for Pendleton Area



OREGON FORECAST

Shown is today's weather. Temperatures are today's highs and tonight's lows.



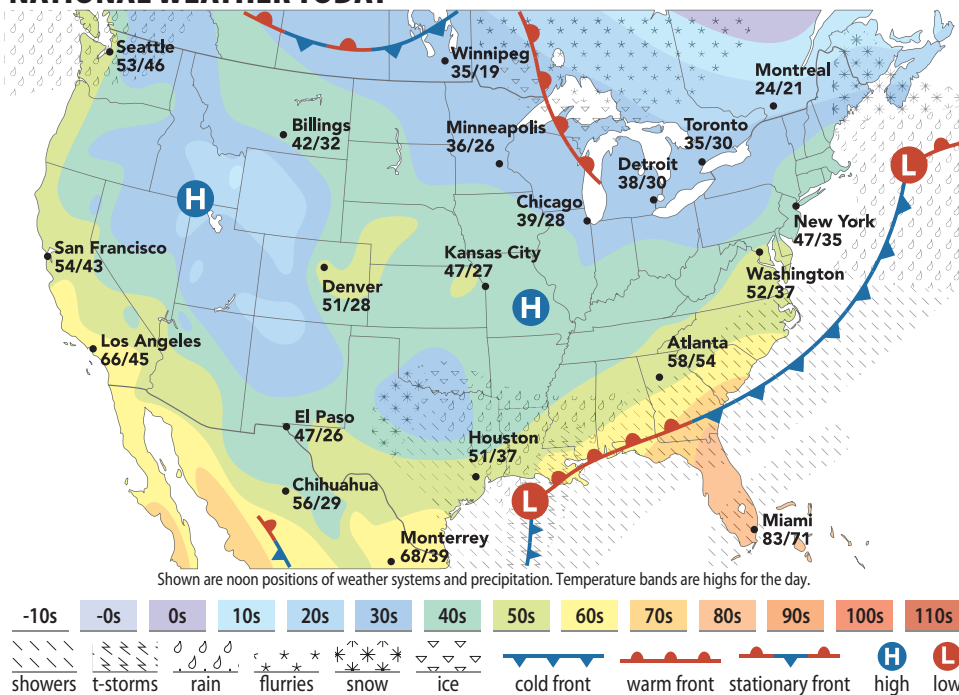
ALMANAC

PENDLETON through 3 p.m. yest.		
TEMP.	HIGH	LOW
Yesterday	38°	23°
Normals	40°	26°
Records	63° (1913)	-9° (1924)
PRECIPITATION		
24 hours ending 3 p.m.	0.00"	
Month to date	0.00"	
Normal month to date	0.12"	
Year to date	0.00"	
Last year to date	0.00"	
Normal year to date	0.12"	
HERMISTON through 3 p.m. yest.		
TEMP.	HIGH	LOW
Yesterday	37°	20°
Normals	39°	27°
Records	62° (1939)	-7° (1979)
PRECIPITATION		
24 hours ending 3 p.m.	0.00"	
Month to date	0.00"	
Normal month to date	0.08"	
Year to date	0.00"	
Last year to date	0.00"	
Normal year to date	0.08"	
WINDS (in mph)		
Today	Fri.	
Boardman	SSW 4-8	
Pendleton	SSE 7-14	
SUN AND MOON		
Sunrise today	7:36 a.m.	
Sunset tonight	4:23 p.m.	
Moonrise today	5:23 a.m.	
Moonset today	2:51 p.m.	

NATIONAL EXTREMES

Yesterday's National Extremes: (for the 48 contiguous states)
High 88° in Immokalee, Fla. Low -38° in Daniel, Wyo.

NATIONAL WEATHER TODAY



Oregon shifts hepatitis A prevention efforts

BEND (AP) — Oregon health officials are working to redirect hepatitis A prevention strategies toward homeless populations following a shift in how outbreaks of the disease occur.

The *Bulletin* reports the Oregon Health Authority has purchased additional hepatitis A vaccines this year, distributing them to county health departments in areas with large homeless populations.

Previously, hepatitis A outbreaks were mostly linked to international travelers or foodborne outbreaks, with infections occurring mainly in children.

Oregon has documented 20 cases of the disease through November 2018. Four of the cases last year involved people younger than age 40.

The federal Centers for

Disease Control and Prevention recorded 1,521 cases of hepatitis A in 2017 from California, Kentucky, Michigan and Utah. Of those, 57 percent had reported drug use, homelessness or both. As a result, the Advisory Committee on Immunization Practices recommended in October adding homelessness to the list of reasons why some should be vaccinated.

Hepatitis A is typically transmitted when someone ingests something that has been contaminated with the feces of an infected person. Symptoms include fever, fatigue, nausea, abdominal pain, dark urine, joint pain and jaundice. Most people recover with limited treatment, but complications can occur especially among people already in poor health.

"The homeless population just seems like the per-

fect setup for this transmission," said Dr. Paul Cieslak, medical director for communicable diseases and immunizations at the Oregon Health Authority's Public Health Division. "You've got people living without the benefit of running water and often without toilet or sewage."

Multnomah County was already routinely screening people at its shelters for tuberculosis, and began offering the additional hepatitis A vaccines provided by the state at the same time.

"It really is a very effective vaccine, so that's been our main push," said Lisa Ferguson, who oversees the county's communicable disease services team. "We've been trying to connect with homeless services providers and making sure people out in the field know what to be looking for."

BRIEFLY

Buehler plans to stay engaged in Oregon issues

SALEM (AP) — Republican gubernatorial candidate Knute Buehler, who lost the November election, says he's repurposing his campaign web site to highlight issues that concern him, including improving the welfare of foster children.

Buehler, who is now officially out of politics since he didn't seek re-election to the Oregon House of Representatives in order to campaign for the governorship, said in a video message on Monday

that he wants to highlight state budget and health care issues, and bring civility to politics.

Buehler, an orthopedic surgeon from the Central Oregon town of Bend, received roughly 815,000 votes compared to incumbent Democratic Gov. Kate Brown's 934,500.

3 bullet-riddled bodies hidden near WA state home

PORT ANGELES, Wash. (AP) — Authorities on Wednesday were investigating the deaths of a man, his

son and the son's girlfriend whose bullet-riddled bodies were found concealed on a property known for hosting transients in Washington state.

Police discovered the bodies when they were sent to the home near the waterfront city of Port Angeles for a welfare check, the *Peninsula Daily News* reported.

Investigators found the door to the home ajar and then found the bodies of Darrell C. Iverson, 57, and his son Jordan D. Iverson, 27, covered by tarps and debris in front of the house, Clallam County Sheriff Bill Benedict said. The elder Iverson owned the home, county documents say.

CORRECTION: The Dec. 22 story "Realtors Board has equity in Agape House" incorrectly stated that the Columbia Basin Board of Realtors had collected money for the Agape House at the Peace and Goodwill Hermiston Community Christmas Concert. The board raised the money at its annual Christmas party.

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