Oregon may build nation's first tsunami evacuation structure

May 24 2010

Researchers at Oregon State University are using their Tsunami Wave Basin to test theoretical models of what could become the nation's first structure built specifically to withstand the force of a tsunami and serve as an emergency shelter people could run to. This is under consideration in Cannon Beach, Ore. (Photo courtesy of Oregon State University)

Residents of a small Oregon coastal community are moving closer to the creation of something that's never before been built in the United States - a structure designed specifically to withstand a major earthquake and the force of a tsunami, and give people somewhere to run to for safety.

The earthquake is coming, on the Cascadia subduction zone off the Pacific Northwest coast. It could be massive, and almost certainly will produce a tsunami. With buildings shattered, bridges collapsed and only minutes to spare, the only way to save lives may be the concept of

"vertical evacuation" to a sturdy, sufficiently tall building.

Working closely with experts from Oregon State University, the Oregon Department of Geology and Mineral Industry, and local residents, the small town of Cannon Beach wants to build a new city hall that could serve a dual purpose - public business all of its life, and a life-saving shelter on the one day that the water sweeps ashore.

A conceptual design for the 9,800-square-foot structure has been completed, a cost of $4 million estimated, public hearings held and funding support is being sought from the federal government.

But the forces of a tsunami are literally uncharted waters. Only in Japan have any structures designed to survive a tsunami been built, and none actually put to the test. So among other support efforts, engineers at OSU are now testing a model of the proposed structure in their Tsunami Wave Basin, the most sophisticated facility of its type in the world.

"We're heading in the right direction, but this is new territory," said Dan Cox, a professor of coastal and ocean engineering at OSU. "There's a lot we still need to learn about the impact of forces from waves, cars, collapsed buildings and other debris, and just how strong a building must be to resist that. But our tests should help add a higher degree of confidence in this design."

It's known that a building that is strong enough, with a deep foundation and perhaps protective seawalls, can withstand these forces. But cost is also an issue. With current plans it's estimated the Cannon Beach structure will cost twice as much as one that otherwise might be built, so an engineering challenge is to keep costs down while ensuring the structure will do its job.

These issues are being faced not just in this small community, but in

other low-lying, coastal cities from northern California to British Columbia, all of which are exposed to earthquakes on the Cascadia subduction zone.

In the massive earthquake and tsunami in Sumatra and the Indian Ocean in 2004, more than 200,000 people died, most of them not from the earthquake but rather the resulting tsunami. That event was quite similar geologically to what the Pacific Northwest faces. Subduction zone ruptures cause the most powerful earthquakes in the world. And research - including major studies at OSU - have now tracked repeated earthquakes on the Cascadia subduction zone, the last one on a winter day in 1700. It's possible the next event could happen at any time, and OSU experts have estimated a 37 percent possibility of a rupture within the next 50 years.

"Every community from Cape Mendocino in California to Vancouver Island in Canada is vulnerable to some extent to the Cascadia subduction zone earthquake and tsunamis," said Patrick Corcoran, an OSU Sea Grant Extension hazards outreach specialist. "This is arguably the greatest recurring natural hazard in the lower 48 states. Our cities are not engineered to deal with it and our residents are not prepared for it. We need evacuation routes, assembly sites, public education and outreach. And in some places, we need vertical evacuation structures.

"The only way to potentially save thousands of lives is through more education and better engineering."

Part of the problem, experts say, is that only in the past 25 years did a scientific understanding develop of the profound risks posed by this subduction zone. Thirty years ago it wasn't even clear that Cascadia caused major earthquakes. It's now believed capable of an earthquake of magnitude nine or larger, similar to that of the deadly Indian Ocean event in 2004.

As cities and smaller towns wrestle with what to do, officials in Cannon Beach want to act.

"In all but the most catastrophic scenarios, it's been estimated that the water level from an incoming tsunami at the site we propose to build the new city hall could be up to 15 feet," said Jay Raskin, a local architect and one of the community leaders working to create the new structure. "We think this building could shelter at least 1,500 people. It will cost more, but so far there has been a pretty positive public reaction to the idea."

If funded and constructed, Raskin said, this structure could serve as a both a physical and inspirational model for many other cities potentially affected by a tsunami. The project has already gained some international attention, he said. And a building that could stand slightly above the incoming water and withstand its force is not the only approach to vertical evacuation - in Washington state's Long Beach peninsula where more land is available, officials are considered building a series of berms, essentially artificial hills that would be high enough to get above the water. If structures are built, they could be designed to serve various purposes, such as ocean viewing platforms or picnic areas.

Harry Yeh, holder of the Miles Lowell and Margaret Watt Edwards Distinguished Chair in Engineering at OSU, is also helping Cannon Beach do a tsunami evacuation study, which will help outline the scope of the problem. It assumes, for instance, that a major earthquake will collapse the bridge over Ecola Creek, cutting off part of the town's population from the rest. A pedestrian bridge over the creek that might at least survive the earthquake, if not the tsunami, is one thing that could be considered, Raskin said.

Cannon Beach has about 1,700 residents, and thousands more visitors are possible during some peak tourist days. But the problems it faces are

similar to dozens of coastal communities in California, Oregon and Washington.

"We probably would have built these communities differently if we knew 50 years ago what we know today," Corcoran said. "But it's also worth noting this isn't just their problem. This coastline is very beautiful and people come from all over the world to see it, many thousands of them on nice days. This earthquake is coming. So we all have a stake in doing what we can to prepare for it."

Provided by Oregon State University