Post-tsunami Thailand yields lessons for coastal construction

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Engineering experts see how buildings and materials fared against walls of water

An inspection of Thai villages and ports struck by tsunami waves has uncovered some engineering lessons that might reduce casualties and destruction in future oceanic upheavals, a Johns Hopkins researcher said. Robert A. Dalrymple, an internationally recognized expert on water waves and coastal engineering, was part of a nine-member team that recently toured southern Thailand, examining landscape and structural damage in areas that had been battered by waves up to 10 meters (more than 30 feet) high. The research trip to Thailand, along with similar expeditions to Sri Lanka and India, was organized and funded by the American Society of Civil Engineers, in cooperation with the Institution of Civil Engineers.

An earthquake in the Indian Ocean triggered the Dec. 26 tsunami, which killed more than 200,000 people in 11 nations and caused immense property damage. "The force of the fast-moving waves on structures was tremendous," said Dalrymple, who is the Willard and Lillian Hackerman Professor of Civil Engineering at Johns Hopkins. "We wanted to see which buildings and other structures held up against the waves–and which didn't."

The American Society of Civil Engineers is preparing a detailed technical report. But Dalrymple said team and personal observations in post-tsunami Thailand led him to compile a list of general lessons for

builders in coastal areas where future tsunamis may occur:

Elevated structures survive better

The waves were powerful enough to smash through a building's ocean-facing wall and break out the opposite side, and high enough to inundate a second-story level. Elevated buildings that allowed the moving water to pass through the lower level with little interference fared better than those with solid first-floor walls. Taller buildings that allowed people to reach heights above the wave's crest helped reduce casualties.

Materials matter

Reinforced concrete structures were more likely to survive the wave forces. In general, masonry (brick) and wooden structures did not fare as well.

Orientation is important

Walls facing the ocean, allowing perpendicular impact from the waves, sustained more damage. Walls oriented in the direction of the flow sustained less.

Strong foundations are necessary

In addition, landscaping or other features can protect the foundations against scouring, which is soil erosion caused by the moving water. Seawalls can be a very effective way to reduce wave damage. The structures must be continuous, however, with no gaps for pedestrian crossings. Also, such structures should not slope inland, allowing waves to slide up and over the walls like a skier.

Debris in the flow is hazardous. Many tsunami victims were injured or killed by debris pushed along by the powerful waves. Debris can be minimized if vehicles are parked and heavy items stored on the inland side of buildings. Ports are particularly vulnerable to tsunami waves. Boats and piers in a harbor hit by a tsunami have little protection.

Beaches in Thailand recover rapidly. The ASCE researchers discovered that within weeks of the disaster, natural ocean forces had returned the sandy beaches nearly to their pre-tsunami condition. The beaches have reopened, Dalrymple said, and Thais are encouraging tourists to return.

Dalrymple said several questions raised during the trip require further research. These include why the height of the tsunami varied dramatically along the coast of Thailand and how engineers can construct a mathematical model of wave forces as they pass through coastal structures.

Source: Johns Hopkins University