Researchers say Oregon can learn from Joplin structural problems

This house was destroyed by a tornado in Joplin, Mo., last month. Without connections between the foundation and walls, only gravity and friction was keeping the structure upright," said Oregon State University researcher Arijit Sinha.

Oregon State University graduate student Kathryn Pfretzschner is writing a thesis about problems that arise when strong winds impact wood structures. But until a recent trip to Joplin, Mo., she hadn’t seen a case study with such a clear illustration.

“It was devastated,” she said. “Houses didn’t even look like houses. Cars didn’t look like cars. It was just scraps, everywhere.”

The tornado in Joplin last month left more than 130 people dead and more than 8,000 homes destroyed. OSU researchers joined a team partially funded by the National Science Foundation and American Society of Civil Engineers to analyze the damage. Some of the lessons learned about the destruction in Joplin could apply to natural events in Oregon as well, researchers said.

“If there is ever an EF5 (level) tornado in Oregon, we might see similar types of damage, but chances of that are very, very slim,” said Rakesh Gupta, a professor in the Department of Wood Science and Engineering at OSU.

“All of these kind of events – whether they are seismic or high wind speed – introduce a lateral load onto the structure,” said Arijit Sinha, an OSU graduate and researcher.

“The concepts are the same, and there are similar construction problems.”

Winds greater than 200 miles per hour toppled buildings not constructed to withstand such force. But some of the devastation resulted from structural issues in buildings.

A house in Joplin, Mo., was completely swept off its foundation. A research team with Oregon State University faculty and students examined wood houses in Joplin to see what structural engineering issues might have compounded the devastation caused by a recent tornado.

“A lot of it has to do with not designing for uplift; walls and garages were not anchored to the foundation” and were blown away, Pfretzschner said.

“Even the more expensive, custom-built, newer homes were completely destroyed,” Gupta said.

“Some of the damage was due to lack of or weaker connections at critical locations in the building,” such as between walls and foundation or between roof and walls.

Sinha called the problems “connection issues” – such as excessively small washers, and anchor bolts connecting walls to foundations spaced too widely. Issues also arose from unreinforced masonry – a buzzword in Oregon for buildings lacking seismic strength.

There are ways to mitigate this sort of damage in the future, Sinha said.

“It’s not that you can’t design for the wind speed,” he said. “And you have to make sure that construction practices are adequate to the design.”

Stricter code enforcement and a more collaborative design process could help, Pfretzschner said.

“A lot of houses aren’t designed by an engineer,” she said. “An engineer would be able to look at a house in a location and say that you have to anchor it down.”

Depending on the location and hazard risk of a house, designers should “use codes that help them calculate design loads for wind and seismic,” Pfretzschner said.

Sinha noted that certain engineering codes, such as the International Building Code, are better at addressing residential construction issues.

The research team’s recommendations will be limited to an analysis of wood-framed houses, but there is more to be done, Gupta said.

“Even the bigger buildings, like Walmart, Home Depot, Joplin High School and Joplin Middle School, were completely destroyed even though they were not wood-frame construction,” Gupta said, “partly due to the high wind speed, but my guess is partly due to construction quality issues.

“We could always look for high-tech materials, but the question there is: If they are more expensive, is a homeowner willing to pay for it? We can always make our codes stricter, but enforcement and construction quality remains a problem. I believe the solution is in education.”

Builders, contractors, framers and inspectors should be educated about proper construction techniques, he said.

“This may not eliminate the damage, but will definitely reduce the damage, especially for the lower-rating tornadoes.”