

## [In tornado alley, building practices boost damage](#)

Yahoo

View Photo Reuters/Reuters - Memorial Day fireworks explode over a house damaged by the May 20 afternoon tornado in Moore, Oklahoma May 26, 2013. REUTERS/Lucas Jackson By Greg McCune(Reuters) - In a residential neighborhood near the center of a monster tornado that struck Moore, Oklahoma last month, two partially damaged houses stand like an island among others flattened by the storm. The walls and roofs of the buildings in a new housing development called Featherstone Addition are still upright while there is nothing left but a concrete foundation where other homes once stood nearby. The two homes were not completely spared but are salvageable, according to David Prevatt, a civil engineer who saw them when he surveyed the damage after Moore took a direct hit from an EF5 tornado, the strongest rating. He is convinced that the two houses survived because they were built stronger than most in Oklahoma and the rest of "tornado alley" - the region stretching from Texas to Iowa that accounts for roughly a fourth of all U.S. tornadoes. "This notion that we cannot engineer buildings economically to withstand tornado loads is a fallacy," said Prevatt, who has studied damage from hurricanes and the devastating tornadoes in 2011 in Joplin, Missouri and Tuscaloosa, Alabama. The cost of damage from tornadoes is soaring in the United States even though National Weather Service historical data shows no significant rise in the number of storms. The last five years have seen the highest losses from thunderstorm damage in U.S. history, according to an analysis by insurer Munich RE. Tornadoes were the costliest natural catastrophes in the U.S. in 2011 - the year of Joplin and Tuscaloosa - with an estimated \$47 billion in overall economic damage, and insured losses of \$26 billion, Munich RE said. Tropical storms topped the natural disaster list in 2012 because of Hurricane Sandy. But even in a relatively quiet tornado year, economic losses from severe thunderstorms reached \$28 billion in 2012 and insured losses \$14 billion, Munich RE said. The Moore, Oklahoma tornado on May 20, and associated storms, could cost up to \$5 billion in insured losses, disaster modeling company Eqecat has estimated, making it the second costliest tornado outbreak on record after Tuscaloosa. Damage costs are rising because of increased population density, even in mostly rural states such as Oklahoma, which has seen substantial urban

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sprawl in the last decade, said Greg Carbin, Warning Coordination Meteorologist for the National Weather Service's Storm Prediction Center in Norman, Oklahoma. Another important reason that has received less attention, is that most homes in tornado alley are not built to withstand even a modest tornado. The result is that residents of tornado alley, insurance companies and the U.S. government are footing a mounting bill from damage that could be limited with better construction, according to several engineers, meteorologists and consumer advocates interviewed by Reuters. "We have to stop this cycle of a storm coming along destroying things and we build them back the same," said Leslie Chapman-Henderson, chief executive of the Federal Alliance for Safe Homes, a consumer group. "That is the official definition of insanity." Oklahoma should follow the example of Florida after Hurricane Andrew in 1992 and adopt a tougher building code to reduce damage in future, said Prevatt, Assistant Professor of Civil and Coastal Engineering at the University of Florida. Most experts cautioned that even a strengthened building code would probably not lead to homes that could survive unscathed from an EF5 tornado. Prevatt believes they can be built but with new housing materials. UNIQUE LABORATORY Moore, Oklahoma is a unique laboratory to study construction and tornado damage because it has been hit by four tornadoes in the last 15 years, including a 1999 storm similar to May 20. Better advance warning systems through the National Weather Service and the news media are credited with what some call a remarkably low 24 fatalities from the May 20 Moore tornado. This compares with 40 in 1999 even though the population of Moore has risen more than a third since, according to U.S. Census data. Forecasters did not perform as well on May 31 when a second monster storm system bore down on the area and another 20 people were killed. One television meteorologist advised people to get in their cars and flee, putting some at grave risk. Another improvement in the last 15 years is that more residents of Oklahoma have rebuilt their homes with storm shelters or safe rooms, which also may have saved lives. Seven children were killed on May 20 in a school without a shelter. Federal Emergency Management Agency spokesman Dan Watson said that since 1993, FEMA has invested more than \$57 million in 11,768 private and public safe rooms in Oklahoma, more structures than in any other state. The chances of two tornadoes of such magnitude striking in one place such as Moore, let alone four tornadoes in 15 years, are very small, according to Carbin, who studies the odds. Even at the height of U.S. tornado season on any day in May in central Oklahoma, the chances of a tornado hitting within 25 miles are only about 1 percent, Carbin said. EF5 tornadoes packing enormous winds of 200 miles per hour and higher, the strongest rating on the Fujita scale used to measure tornadoes, account for less than one-tenth of one percent of all tornadoes, Carbin said. These slim chances have led many residents of tornado alley to conclude there is no point building to survive tornadoes. But some 95 percent of all tornadoes are in the lower strength categories to EF2 with winds up to 135 mph, said Carbin. And the current building code minimum applied in Oklahoma and

tornado alley calls for the structure to withstand 90 mph straight line winds for 3 seconds. "Why should we be surprised if a house collapses if the load is four times more powerful than it was designed to withstand," said Prevatt. BUILDING CODES

Tim Marshall, a meteorologist and engineer for Haag Engineering Co in Irving, Texas, said he told the city of Moore about poor construction practices after the huge 1999 tornado. "We didn't really change the building codes after the last tornado (1999)," said Elizabeth Jones, community development director of the city of Moore. "For people on a limited income, they look at the probability of being in a tornado. The chances are not that great," she said. In lightly regulated Oklahoma, Republican Governor Mary Fallin has ruled out requiring a safe room or shelter in every school as too expensive, despite the recent deaths, prompting criticism from Democrats who say she is ignoring school safety. Asked in a telephone interview if Oklahoma would toughen its building codes, Fallin said: "That is certainly something we are going to look at this summer. What makes sense. What is doable. What's not doable." She said that people have limited budgets and the cost would be a consideration. Oklahoma has been in touch with Joplin officials to ask what it did after the 2011 tornado there killed 161 people, Fallin said. Steve Cope, building and neighborhoods supervisor for Joplin, said the city made a few upgrades to building codes that did not add much to construction costs. Unlike its neighbors Texas and Kansas, Oklahoma has formed a state agency to set building codes. The first statewide rules went into effect on residential construction only two years ago so they have had little time to work. Prior to that, local towns and cities set the codes, and they can still set stronger codes than the state. Oklahoma opted to use the 2009 version of the basic minimum U.S. building code and not to update when strengthened rules were issued in 2012, according to Billy Pope, chief executive of the Oklahoma Uniform Building Code Commission. There is no state mechanism to enforce the code, said Pope. Enforcement is left up to local communities and some with populations of 10,000 or less have no inspectors. "We saw numerous violations of the building codes (in Moore)," said Marshall, a veteran member of the National Weather Service's rapid response team which went into the town immediately after the May 20 tornado to assess damage. The basic "minimum" residential building code in the United States is agreed through the International Code Council (ICC), a body that brings together homebuilders, architects, engineers and government officials to update rules every three years. The process is slow and deliberate, and most of the changes agreed are subtle rather than dramatic, officials said. STRONGER HOUSES

Building a house to limit tornado damage involves making strong connections from the foundation to the walls to the roof, said Prevatt. Nails hammered into the wood at a 90 degree angle provide little resistance to the upward suction of a tornado, several construction and engineering experts said. "We saw that in many places in Moore," said Randy Shackelford, Research Engineer and Code Specialist for Simpson Strong-Tie Company in McKinney, Texas. "Two nails sticking up where the stud

(wall frame) once was."The next best connection is what is called a "toenail" in construction jargon, which involves driving the nail into the wood at a 45 degree angle. This provides significantly more resistance than nails driven at a 90 degree angle. The 2012 national code which Oklahoma decided not to adopt immediately calls for three toenails per connection but Oklahoma's code allows two nails, which is significantly weaker, Shackelford said. The two houses Prevatt saw standing in Moore amid the devastation were built with what are called "hurricane ties" or metal straps to bind the roof to the walls, which are stronger than nails, he said. These are required by the robust Florida building code but not in Oklahoma and most of tornado alley. Connections between walls and the concrete foundations of homes were another area where Moore construction was poor, Prevatt and Marshall said. The ideal in a storm region would be to use "anchor bolts" - a steel rod embedded in the concrete foundation and bolted to the wall frame. In Moore, both engineers said they saw numerous cases of nails binding the walls to foundations rather than bolts. Tanya Brown, a research engineer for the Institute for Business and Home Safety, which studies tornadoes for insurance companies, said she saw many examples in Moore of the house failing because of a collapsed garage door. The wind blew prefabricated garage doors in, allowing a rush of air into the house and destroying the structure, she said. The garage doors needed braces to avoid collapse, which are not required in Oklahoma. "They are not commonly used outside hurricane areas," she said. The wise thing for tornado alley to do would be to adopt building codes similar to Florida which at least marginally improve the ability of the building to withstand wind, said Carbin, the meteorologist. The increased building cost would be partially offset by savings from buildings which are not destroyed, he said. A 2002 University of Florida study found more robust construction to withstand hurricane winds could add up to 10 percent to the selling price of a house. The National Association of Home Builders did not respond to several requests to comment for this story. Pope of the Oklahoma building commission said he had just returned from Moore, where he inspected damage along with several other people involved in setting the state's standards. "Florida has been in that process for a lot of years. We will probably get there," he said. "It looks like we are behind and are playing catch-up." (Reporting By Greg McCune in Chicago; Additional reporting by Ian Simpson in Washington, Heide Brandes in Oklahoma City, Alice Mannedette in Wichita, Kansas and Kevin Murphy in Kansas City, Missouri; Editing by Tim Dobbyn)