



## Abstract

A large tornado struck the central Oklahoma communities of Newcastle, Oklahoma City, and Moore on May 20th, 2013. A door-to-door survey was conducted of homeowners throughout the cities of Moore and Oklahoma City in the month of June 2014 to understand how residents may have incorporated mitigation techniques and emergency preparedness options since the May 20th, 2013 tornado. The survey was broken into categories of: damage done to homes, factors or reasons for homeowners implementing mitigation strategies, costs of implementing mitigation applications, and emergency preparedness strategies homeowners use to prepare for severe weather. Most homeowners were either considering or had already installed a storm shelter inside their home to help bring them a better sense of safety. Many homeowners were unaware of other mitigation techniques they could add to their homes to help protect them from wind damage and other severe weather. Some of the reasons why homeowners did not implement mitigation strategies were because of the additional cost of having to pay for them and most homeowners did not have a personal budget for out of pocket costs.

## Background

On May 20th, 2013 an EF-5 tornado moved through central Oklahoma, through south of Oklahoma City, Newcastle, and Moore. The tornado was on the ground for approximately 40 minutes, beginning at 2:56 PM CDT. The tornado had a maximum width of 1.3 miles and covered over 17 miles in its destructive path. The tornado claimed the lives of 24 people including 9 children, injured over 300 people and the storms caused billions of dollars in damage (National Weather Service Norman, OK Weather Forecast Office, 2014).

Due to nature of the tornado there were high amounts of wind damage to most homes affected in the area. Heavy rains contributed to the damage caused by the tornado and affected several homes with severe water damage. While some people had mitigation techniques already implemented for severe storms, such as an underground shelter, some residents did not.

The May 20th, 2013 tornado was rated as an EF-5 with winds estimated to be over 200 miles per hour. Prior to the tornado most of the Oklahoma building codes had not been updated to address tornado mitigation. Most homes in central Oklahoma were designed to withstand up to a three-second gust wind speed of 90 miles per hour. These building codes measured to only withstand an EF-1 tornado winds based on the Enhanced Fujita Scale.

Due to the severe damage, the city of Moore, Oklahoma decided to make changes to the building and homeowners codes after the tornado events that happened in May 2013. The ordinance was passed by Moore City Council to help improve current regulation set in place and help new homes in Moore be able to more likely to withstand severe weather. The ordinance passed 12 regulations in all and they were recommendations from structural engineering experts for residential building codes. Some of the changes include the installation of hurricane clips and/or framing anchors for wall connections, as well as plywood sheathing on the roof of residential homes, and that garage doors should be able to withstand winds up to 135 mph or above. The permit was passed and took effect on March 17, 2014.

## Method Used for Data Collection

The survey consisted of five parts that asked questions on mitigation measures and emergency preparedness. The survey consists of question asking the homeowner to:

- Identify the damage done to their home from the May 20, 2013 tornado, which then narrows in to what features on the home were damaged or replaced.
- What options residents implemented or plan to have implemented inside their home. Questions were asked on the survey about if adding a storm shelter was planned or if one was at the home prior to the storm.
- Their motivation or reasons for having those mitigation techniques. Questions were asked on the survey about how homeowners learned about such options and why they chose to forgo them.
- If the homeowner had a personal budget for rebuilding their home if homeowner's insurance did not cover it.
- How they learn about severe weather as it approaches and what emergency preparedness options they have implemented in their severe weather plan.

## Sampling Procedure

The target streets for surveying were ones in south Oklahoma City and Moore that were tornado path and received damage. Door to door surveys were collected on eight streets between the hours of 2PM and 7PM, when most residents were arriving home from work.

In addition, 200 surveys were mailed to homes on other streets that were in the tornado's path. Homeowners were asked to return the surveys by Sunday, July 6th, 2014 so they could be collected and analyzed properly. Ten surveys were mailed back to the National Weather Center – Oklahoma Climatological Survey Office.

A lot of homes in the most damaged part of the tornado path are still under construction or are now vacant; so 77 letters were returned to the office as they could not be forwarded to the pre-existing homeowners. In all, a total of 174 potential respondents were approached of these 69 answered the door and, only 19 of these decline to partake in the survey.

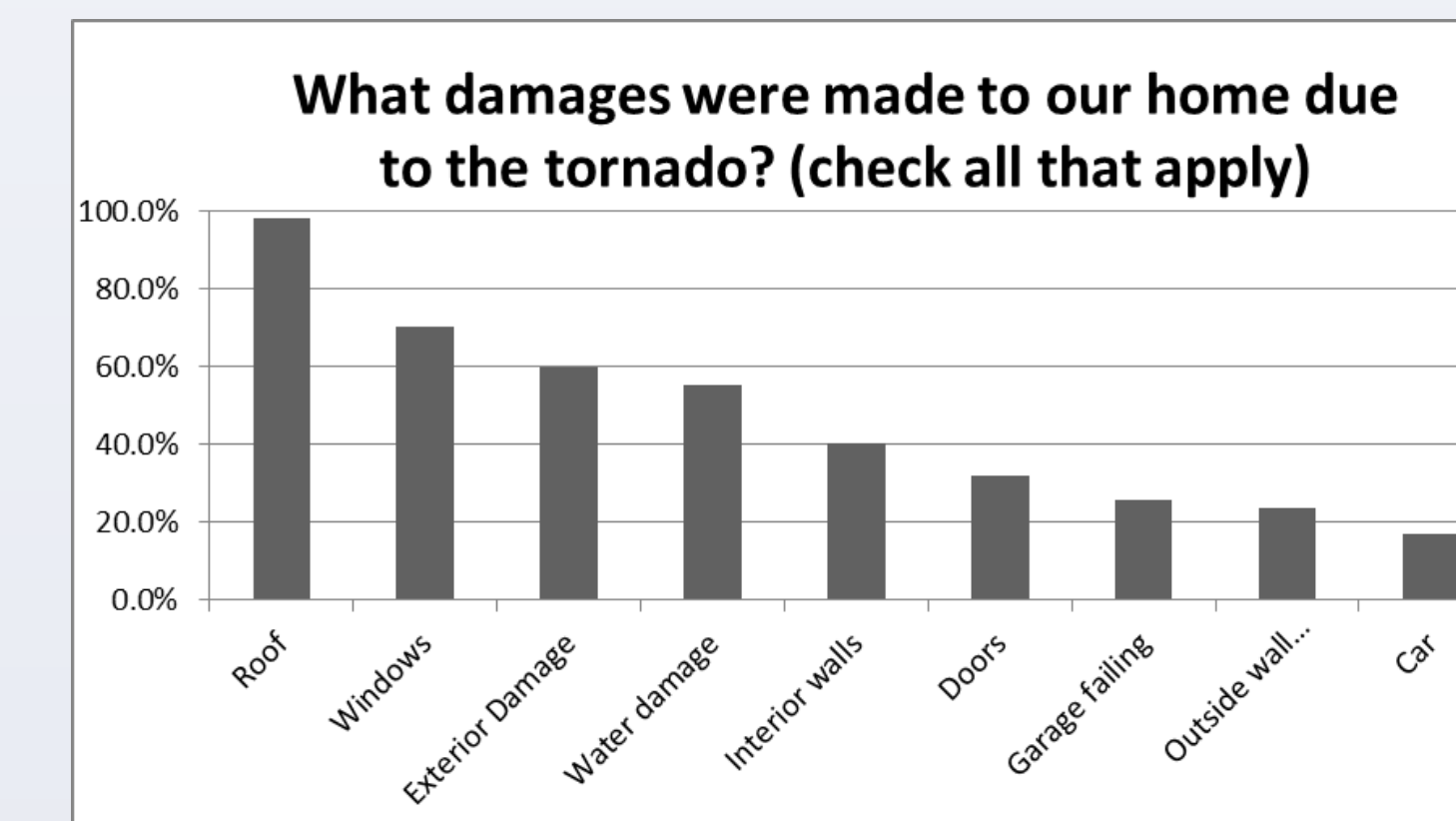
The overall response rate to the survey was 72% for those that were directly contacted. The table below depicts the response rates throughout the days of surveying.

Overall Responses to Surveys					
Door to Door Responses	Attempts	Declines	Complete	Answered Door	Response Rate
Day 1	69	6	16	22	73%
Day 2	72	10	19	29	66%
Day 3	33	3	15	18	83%
Total	174	19	50	69	72%
Mail Responses	Attempts	Return to Sender	Complete	Delivered	Response Rate
	200	77	10	123	8%

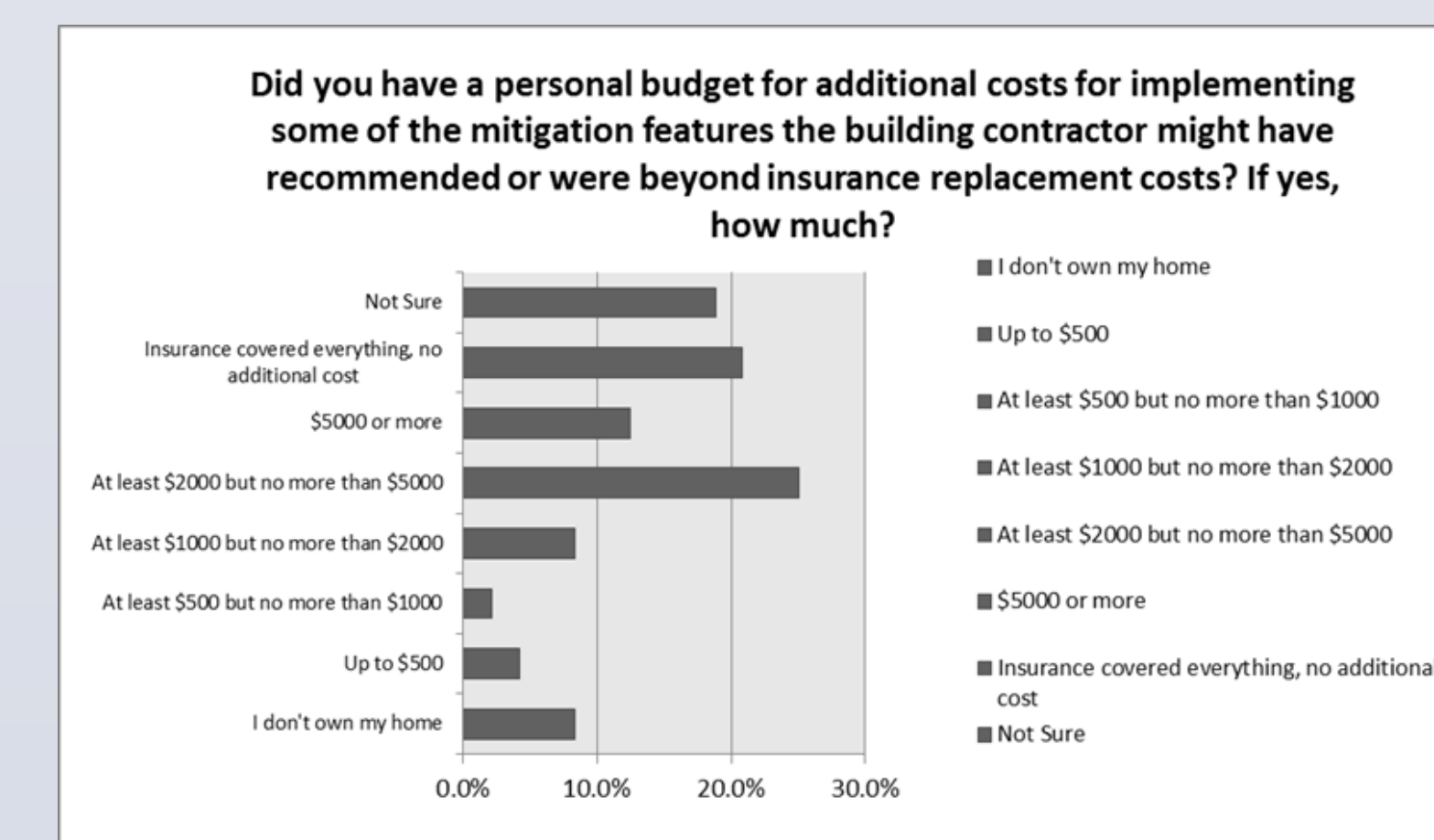
## Results

Results from the survey conducted in June 2014 show that:

- 52% of homeowners had moderate damages. The figure below shows the most typical damages done to homes in the May 20<sup>th</sup>, 2013 tornado, with roof damage being the top picked answer choice with a 97% selection rate.



- 87% of homeowners did not have a storm shelter installed prior to the storm. But, now more than 80% of homeowners were either considering or had already installed a storm shelter or safe room inside their home.
- The leading factor was personal safety concern with 73% of homeowners selecting it as their motivation. Over 20% of homeowners they mitigated their homes in order to receive an insurance premium discount.
- Responses showed that 25% of homeowners had out of pocket costs of at least \$2,000 but no more than \$5,000 dollars. From the 20% of no additional cost homeowners, 70% of those homeowners were covered by home insurance but, most of the homeowners that were surveyed stated that they did not qualify for any FEMA rebates or discounts because of their annual income. The results of this questions are shown below.



- The use of mobile phone apps to for emergency preparedness is becoming a growing trend. The local news TV station News 9 weather app was the most popular app from the people we surveyed in the Moore and Oklahoma City area. Over 50% of people surveyed selected mobile phone applications as part of their severe weather preparedness. The results are depicted below.

Answer Options	Response Percent	Response Count
Mobile Phone Apps	52%	26
NOAA Weather Radio	48%	24
Emergency Kit	44%	22
Severe weather plan	36%	18
Lock Box	36%	18
Twitter/Facebook Sources	12%	6
Safe deposit box	4%	2
Other	50%	25

## Conclusion

### Final Outlook:

Mitigation strategies and emergency preparedness have increased since the May 20th, 2013 tornado with more homeowners in the area becoming more aware of what they can use for their homes when severe weather is approaching. Many mitigation measures were not available to existing homes without a great amount of damage being done to their homes. Few destroyed homes were included in the survey.

### Future Research:

A later survey could show more re-designed homes with the adoption of other mitigation measures as more homes are rebuilt. The purpose of doing the door-to-door survey was to see how aware homeowners are of mitigation and preparedness when severe weather is approaching. Some homeowners who have a storm shelter in place had stated they now had a better sense of safety with this measure now installed.

## References

Chaney, Philip L., Greg S. Weaver, Susan A. Youngblood, Kristin Pitts, 2013: Household Preparedness for Tornado Hazards: The 2011 Disaster in DeKalb County, Alabama. Wea. Climate Soc., 5, 345–358.

Fratinaro, Vincent F. and Scott A. Schroeder (2014) Lessons Learned: How Changes in Code, Construction and Preparedness Affected Tornado Damage in Moore, Oklahoma, 1999 to 2013. Structures Congress 2014: pp. 1383-1391. DOI: 10.1061/9780784413357.122

Lewis, G., Brink, R. and Corbett, J. (2014). Ordinance NO. 768 (14). 1st ed. [ebook] Moore, Ok, pp.1-2. Available at: <http://www.cityofmoore.com/sites/default/files/main-site/high-winds-codes-passed.pdf> [Accessed 10 Jul. 2014].

McBean, G. A. (2005). Risk mitigation strategies for tornadoes in the context of climate change and development. Mitigation and Adaptation Strategies for Global Change, 10 (3), 357-366. <http://dx.doi.org/10.1007/s11027-005-0051-x>

Merrell, David, Kevin M. Simmons, and Daniel Sutter, 2002: Taking Shelter: Estimating the Safety Benefits of Tornado Safe Rooms. Wea. Forecasting, 17, 619–625.

National Weather Service Norman, OK Weather Forecast Office, cited 2014, May 20, 2013 Tornado Outbreak. [Available online <http://www.srh.noaa.gov/oun/?n=events-20130520>]

## Acknowledgments

The corresponding author would like to thank her mentors Alek Krautmann and Dr. Mark Shafer for their assistance in helping to create the interview guide survey and their support throughout the term of the internship. Another special thank you to Daphne LaDue for her feedback and recommendations on the interview guide survey as well; and selecting her to participate in the National Weather Center's Research Experience for Undergraduates Program in Norman, Oklahoma. This material is based upon work supported by the National Science Foundation under Grant No. AGS-1062932.

## For More Information

Please Contact: Nadajalah Bennett, National Weather Center Research Experiences for Undergraduates Program, Oklahoma Climatological Survey - 120 David L. Boren Blvd., Suite 2900 Norman, OK 73072  
E-mail: nadajalahbennett@gmail.com

