

# REBUILDING DECISIONS IN CENTRAL OKLAHOMA

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## 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 2013 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.

## 1. INTRODUCTION

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). Many people took shelter in their homes and braced for the destruction the tornado caused. The National Weather Service office based in Norman, OK issued many statements on social media gateways such as Facebook and Twitter to warn its followers of the path of the tornado.

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. A door-to-door survey was conducted in the damaged area of Moore and Oklahoma City to see what mitigation techniques homeowners are now implementing or have already implemented in their homes since the tornado.

According to Merrell et al. (2002) residents have several options to choose from when it comes to dealing with household preparedness. Residents and homeowners can purchase a National Oceanic and Atmospheric Administration (NOAA) weather radio, which will allow them to receive warnings about severe weather and tornadoes in the area and enable a plan for seeking shelter. Employing this risk-reducing action is known as a type of hazard adjustment. The most reliable source is a NOAA weather radio (battery operated). During the survey it was found that this percentage tended to be higher throughout the Moore and Oklahoma City area.

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Fratinaro and Schroeder (2014), provide a review of previous damaging tornadoes in Moore, OK. Since 1890 there have been 23 recorded events in or near Moore. 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 (Table 1). The Oklahoma Uniform Building Code Commission (OUBCC) was created in 2009 and they adopted the codes of the 2009 International Residential Code (IRC 2009) with some modifications and took on effect on July 15th, 2011. The IRC used the (ASCE 2005) (American Society of Civil Engineers) titled “Minimum Designs Loads for Buildings and Other Structures,” which dictated how buildings were designed in central Oklahoma. Typical residential homes in central Oklahoma did not have basements, as most of the foundations are “concrete slab-type systems”. Despite these updates, hurricane clips (metal ties that secure the roof rafter and wall) were also not generally required by code for residential construction and storm shelters were not mandated unless required by the local jurisdiction.

Operational EF Scale	
EF Number	3 second Gust (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	over 200

Table 1: The Operational EF (Enhanced Fujita) Scale for categorizing tornado wind speed by damage indicators. Source: Fratinaro and Schroeder (2014)

Lewis *et al* (2014) state that 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. The city of Moore also required that homeowners and commercial businesses complete a building permit application to make sure that the structure will fully be in compliance with the regulations set in place by the city.

## 2.METHODOLOGY

After researching mitigation techniques and papers, a survey tool was created that looked into focus areas concerning mitigation and severe weather preparedness to a home and was used for data collection. Inside the survey the terms mitigation and emergency preparedness are used. Using the definition from McBean (2005), mitigation is seen as the adoption, implementation of codes to protect infrastructure and people from extreme events and the costs of implementation when mitigating their homes. In Chaney *et al.* (2013) emergency preparedness is a function of a person’s perception of their personal resources relative to the hazard threat.

For data collection a paper interview guide was used when visiting homeowners in the Moore and Oklahoma City area (Appendix A). The purpose of the survey was to talk to homeowners or people living inside the home that were at least 18 years of age and had a familiar sense of the home’s damage if any had been done from the storms. The survey consisted of 13 questions, 7 of the questions were multiple choice/checklist questions while 6 of the questions were open-ended and the last 3 question were overall general conclusions questions to make sure all aspects had been covered.

The survey consisted of five parts that asked questions on mitigation measures and emergency preparedness. The first part begins with 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. The second part moves into 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 and also if other mitigation options like roof or rafter ties were incorporated during rebuilding. The third part moves into covering 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. The fourth part of the survey pertains to if the homeowner had a personal budget for rebuilding their home if homeowner's insurance did not cover it. The survey also included questions that pertained to the costs homeowners were responsible for after the storm. Lastly, the conclusion part of the survey asks homeowners about how they learn about severe weather as it approaches and what emergency preparedness options they have implemented in their severe weather plan.

Along with the survey a pictorial brochure guide (see Appendix B) was made and given to each homeowner to assist them in answering questions that pertained to identifying damage done to their homes. The guide included some common mitigation applications that are applied to homes, which also stated its use inside the home and proper definition. Information was obtained from the Safe Strong Home website: (<http://www.safestronghome.com/resources/glossary.asp>) where it states the definition and use of it inside a home.

The only demographic that was collected for the survey was the home address of the owner surveyed in order to keep track of the neighborhoods and homes visited. In order to test the validity of the survey a sample draft of the survey was given to other colleagues and researchers in the National Weather Center in a collaborative group discussion to see if the questions were understood correctly, and to gain any possible improvement on some of the options of the questions. Researchers provided feedback and offered suggestions on re-ordering some of the questions on the survey so that it would flow easily during the interview process.

### 3. 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. Table 2 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%

Table 2: Response rate percentages are shown for each day of surveying including the mail response rate. The response rate was calculated by dividing the complete number of surveys done for each day by the total number of answered doors.

### 4. LIMITATIONS

There were some limitations came with mailing out the surveys to homeowners. Some people may have viewed the survey as junk mail. Many homeowners are still not back in their new homes due to renovations and construction and consequently could not be reached. Some homeowners may have forgotten some of the damages done to their home since it is now over a year since the event. There are new homeowners in the area that are unfamiliar with any repairs or construction done on the home. Another limitation was that some people were just renters of the home and not actually owners so some would not also be familiar with the repairs done on the home as well. A lot of homeowners are still currently working on rebuilding their homes so some of the responses were current estimates on the work they had already done to their home at the time of the survey and could potentially add on more to their home.

## 5. RESULTS

### 5.1 Categorizing damage and features damages

The first two questions asked the homeowner to categorize the damage done ranging from no damage, minimal damage, moderate damage, severe damage, and complete destruction. Residents were then asked to identify the specific features that were damaged during the tornado. If a homeowner selected severe damage or complete destruction it was inferred that the homeowner had to completely rebuild their home. If they selected minimal or moderate damage it was inferred that the homeowner had to do minor or major repairs to the home.

After analyzing results from the door-to-door surveys, the most picked answer choice was moderate damage with 52% of homeowners stating that their home suffered moderate damage (see figure 1). If damage was done to the home, the most common was roof damage with over 97% of homeowners having to replace either the rafter ties in the roof, roof frame, or the shingles on the roof; windows were the second most picked damage done to the home at 70%, followed by 59% of homeowners stating that they experienced exterior damage (ex. fencing damage, patios, awnings, or chimneys) from the tornado.

The next question asked homeowners if they had a storm shelter prior to the May 20 tornado in which 87% of homeowners responded with them not having one installed. But, 80% of homeowners surveyed are now either considering or have already installed a storm shelter or safe room inside their home. Cost and affordability were also associated with factors as to why some homeowners have not yet installed a storm shelter. The percentage of residents who qualified for a rebate program for a storm shelter was about 19%.

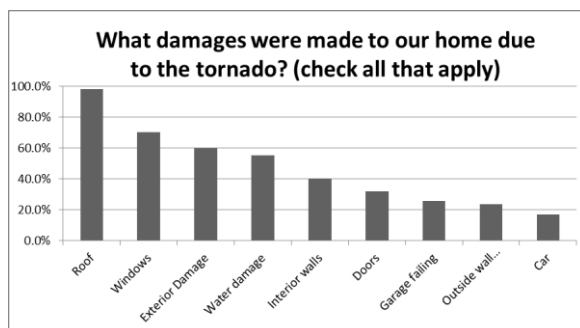


Figure 1. The chart shows the options homeowners could select for features damaged on or inside the home. Results show the overall responses picked on the survey.

### 5.2 Factors or reasons for mitigation strategies

The survey asked homeowners what motivated them to make any changes to their home. They were given a list of options to choose from (insurance premium discount, complying with Moore building code requirements, use of online resources such as FEMA, personal safety concern, rebate program, or just not sure or none of the above). 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.

Another question asked homeowners how they learned about some of the mitigation options they chose to install in their home (word of mouth, insurance company, construction, or other). The results showed that 48% of homeowners chose other as options with various entries stating they did their own personal research on which option they chose or they learned about them from local advertisements.

### 5.3 Out of pocket costs

Homeowners were asked if they had to pay out of pocket for additional costs, if their insurance claims were not covered or a rebate did not fully cover all expenses or were beyond insurance replacement costs. Responses showed that 25% of homeowners had out of pocket costs of at least \$2,000 but no more than \$5,000 dollars. There were 20% of homeowners who did not have any additional costs because either homeowners' insurance covered or rebate program covered everything or no extensive damage was done to the home. 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.

### 5.4 Emergency preparedness options

The last section of the survey consisted of asking homeowners their emergency preparedness strategies they use during severe weather (Figure 2). A growing trend in emergency preparedness is the use of mobile phone apps to get alerts when severe weather is

approaching in the area. 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 second most common strategy was the NOAA weather radio with 48% of residents selecting this option as well.

Since the tornado, do you currently or plan to look into new emergency preparedness options such as:		
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

Figure 2: The emergency preparedness options residents were given to pick from and the varying results from doing the door to door surveys as well as the mail in surveys.

### 5.5 Other responses and concerns from homeowners

Homeowners and residents had a lot of considerations pertaining to some of the mitigation options they selected. Some homeowners stated that they do not have a preparedness strategy other than watching the news when they know severe weather is about to approach. A lot of problems arose after the May 20th tornado with homeowners and their insurance claims. During the survey, one resident stated that after the storm they did a self-repair on their roof to cover up a hole with plywood before a representative for their insurance could come out to survey the damage done to the home. This resulted in them losing some of the insurance replacement cost money allotted to them.

Another concern some residents brought up during the survey is the policies and rules of picking up children from school during severe weather. Some parents did not think the policy of early child pick up are time effective because of the papers and verification they have to go through in order to pick up their children.

With the new rebuilding codes set in place by the city of Moore, another resident said it has set back construction time for six weeks. Results from the survey showed residents were split with 49% being familiar with the new residential codes in Moore and the other 51%

being unfamiliar with them. For some of the residents that stated they were unfamiliar with the codes it was because some people lived in Oklahoma City and not in Moore. Also, the codes only apply to those residents in Moore who are rebuilding new homes. The question was used to analyze if it was a trending topic in the Moore and Oklahoma City area. While surveying, most homeowners who had large storm shelters installed would inform their neighbors that when severe weather is approaching they could use the shelter. Some homeowners even left instructions for neighbors on how to get inside the shelter if they were not home.

## 6. CONCLUSION

Mitigation strategies and emergency preparedness has 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. 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. Cost and affordability is still a big factor as to why some homeowners are not getting mitigation options such as a storm shelter. Programs and government rebates have helped to alleviate some of the costs for mitigation preparedness for homeowners if they qualify.

Some homeowners did not qualify for the terms of a rebate and therefore had to pay out of pocket or seek funding elsewhere which created a hassle for some homeowners in the area. A lot of homeowners are not aware of some of the mitigation applications they can have on their home such as wind resistant garage doors or enhanced plywood sheathing on the roof. It would be helpful for communities in tornado prone areas to have a list of some common mitigation applications and their use for new and existing homeowners and residents on municipal websites so they can become more

readily available to homeowners. In future work or studies, researchers could examine how homeowners obtain their knowledge of mitigation preparedness and how well they apply it to their homes.

## 7. ACKNOWLEDGMENTS

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ADDENDUM: Appendix A

**Rebuilding Decisions in Moore Interview Guide**

1. How damaged was your home after the May 20, 2013 tornado?
  - Complete destruction
  - Severe damage
  - Moderate damage
  - Minimal damage
  - No damage
  
2. What damages were made to your home due to the tornado? (check all that apply)
  - Roof
  - Garage failing
  - Windows
  - Doors
  - Water damage
  - Outside wall siding
  - Car
  - Interior walls
  - Exterior damages (chimneys, awning, etc.)
  - Other: \_\_\_\_\_
  
3. Did you have a storm shelter prior to the May 20, 2013 tornado? (circle one) YES NO
  
4. Since the recent tornado that hit last year, which of the following do you plan to implement or currently have installed in your home? (Check all that apply)
  - Rafter/Roof Tie (Hurricane Clips)
  - Storm shelter/Safe Room
  - Anchor Bolts
  - Fasteners (nails, screws, etc.)
  - Brick/Masonry (for rebuilding a house)
  - Wind resistant garage doors
  - Plywood sheathing
  - Storm Shutters
  - Not Sure/ I don't know
  - Other: \_\_\_\_\_
  
5. How did you learn about these options to install in your new home? (check all that apply)
  - Word-of-Mouth
    - Neighbor: \_\_\_\_\_
    - Family/Friends: \_\_\_\_\_
    - Other: \_\_\_\_\_
  - Insurance Company
    - If so, who? \_\_\_\_\_
  - Construction Company
    - who? \_\_\_\_\_
  - Other
    - Please list: \_\_\_\_\_

6. What were some factors that helped you to choose some of the mitigation techniques implemented?
- Insurance premium deductions/discounts
  - Personal/safety concern
  - Moore building code requirements
  - Shelter Moore Storm Shelter Rebate Program
  - Online resources (NOAA, FEMA.gov)
  - Other: \_\_\_\_\_
  - None/Not Sure
7. Did you have a personal budget for additional cost for implementing some of the mitigation features the building contractor might have recommend or were beyond replacement costs?
- If so, how much?
- I don't own my home
  - \$5,000 or more
  - Up to \$500
  - I have already taken actions. I spent approximately: \_\_\_\_\_
  - At least \$500 but no more than \$1,000
  - At least \$1,000 but no more than \$2,000
  - At least \$2,000 but no more than \$5,000
8. If damage was done to your home, did your home owner's insurance cover your claims or was it from a reimbursement rebate through FEMA or other government organizations?
9. Are you familiar with the new residential codes set in place by Moore?
10. Since the tornado, do you currently or plan to look into new mitigation strategies such as:
- Severe weather plan (home/family)
  - Safe deposit box (bank)
  - Lock box (home)
  - Emergency Kit
  - NOAA weather radio
  - Twitter/Facebook Sources
    - If so, what pages do you follow? \_\_\_\_\_
  - Mobile phone apps
    - If so, what apps do you use? \_\_\_\_\_
  - Other: \_\_\_\_\_
11. Are there any other ways you changed your severe weather preparedness that we did not cover?
12. Have the changes you made to your home or currently have implemented in your home given you a better sense of safety?
13. Is there anyone else in the neighborhood you think would be interested in taking this survey?



## Appendix B: Pictorial Guide

### Common Mitigation Applications:



**Hurricane Rafter/Roof Tie:**  
Metal connectors specially manufactured to fasten the roof to the wall framing

**Anchor Bolt:**

Steel rod threaded on one end that is fixed in concrete (or masonry) to attach a structure to its foundation. (Anchor bolts in new construction are placed in concrete before it cures or hardens.)



**Fasteners:**

In reference to the fasteners that are used to attach the roof sheathing to the roof framing members. Roof decks can be attached with a wide range of fasteners that include staples, 6D nails, SD nails, screws, etc.



**Storm Shutters:**

Hurricane shutters are used to prevent windows from being broken by flying objects during a storm



**Wind resistant garage doors:**  
Types of protection for garage doors are hurricane panels. These systems use a series of metal or aluminum panels affixed to the outside of the garage door and secured with screws, clips or track systems. Adding metals braces to a garage door. Also install garage-door netting.



**Plywood sheathing:**

The layer of material attached to the structural frame of the roof. After you frame the rafters and ridge board, you lay the sheathing on top to cover the entire frame. The tarpaper and composite shingles (or other roofing materials) go on top of the sheathing plywood.



**Brick/Masonry:**

Type of stone/brick used to rebuild homes.

### Rebuilding Decisions in Central Oklahoma Picture Guide



This pictorial guide will help to assist you while answering the questionnaire.



<http://climate.ok.gov/>

For more information visit:  
[www.safestronghome.com/resources/glossary.asp](http://www.safestronghome.com/resources/glossary.asp)

**Appendix B:  
Pictorial Guide continued**

**Categorizing Residential  
Damage Pictures**

**Minimal Damage:**



**Moderate Damage:**



**Severe Damage:**



**Complete Destruction:**

