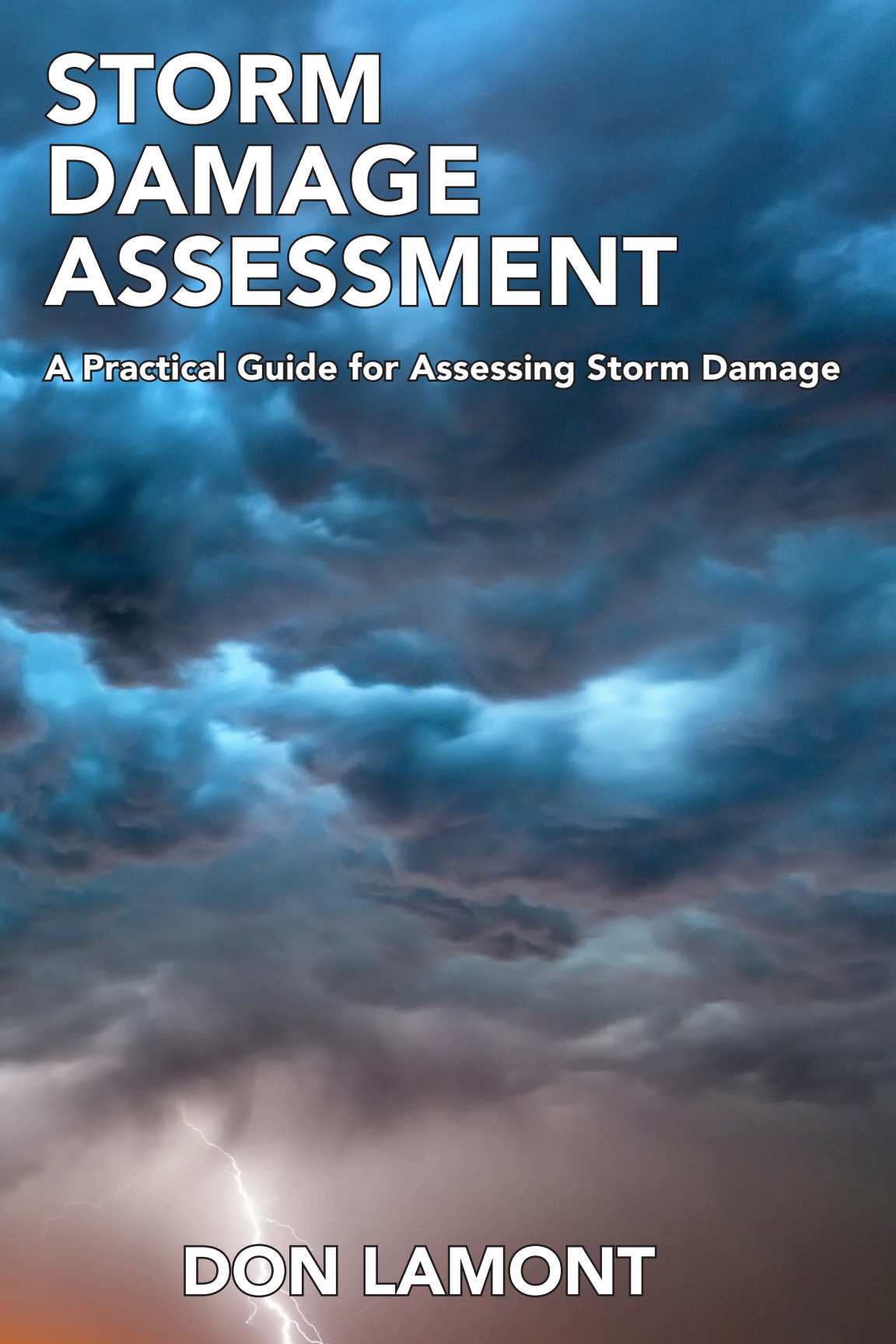
STORM
DAMAGE
ASSESSMENT
A Practical Guide for Assessing Storm Damage
DON LAMONT

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Second Edition

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First of all, I would like to thank my beautiful wife Ronda who has given me the space and the liberty to spend the time needed to write and think.

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Thank you to my friends and colleagues, Javier Delgado and Rocco Calaci for your time and contribution to my adventure.

Finally, many thanks to Stephany Lara for all your time, your help editing and helping me bring it all together. Thank you.

Assessing Storm Damage is a comprehensive tool for the world of accurate, professional Storm Damage Assessment. Don Lamont delivers the information in a straight-forward easy to understand manner.

Don Lamont serves as CEO of DA Lamont Public Adjusters; LLC is based in the Dallas/Ft. Worth Metroplex. DA Lamont services large claim clients in all aspects of Storm Damage Assessment. Don is a regular speaker to Roofing Companies, General Contractors, Insurance Companies, Adjustors and Attorneys. Don and DA Lamont provide expert representation on large claims across the US and Caribbean.

Schedule Don to speak at your next event or consult with DA Lamont Public Adjusters, LLC on your next claim.

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Introduction

"Mr. Lamont, do you see this photo marked exhibit number 102?" I am handed a copy of a photo to which I respond, "Yes, I see it," my eyes still on the photo when he asks his next question, "Can you please tell me, is this a photo you took?" I pause and examine the photo before responding, "I am not sure, but it looks like a photo I took." Again, his next question started the moment I finished my sentence: "Can you tell me anything about this photo?" I was scrambling in my mind trying to identify something in that photo that I could recognize. Needless to say, it was a photo I had indeed taken, but I didn't know where on the roof I had taken it. After that long and grueling deposition, I changed everything about how I document and inspect damage.

This book is a basic overview of storm damage assessments. It is designed to help property owners, contractors, adjusters, public adjusters and experts, to document and gather information in a systematic and organized way. Although many of the techniques and protocols may only serve some, I believe they are best practices used by many adjusters and experts in our field today. Most of what I will be sharing are practices I have learned along the way or created for my own use in the industry. The protocols I use are also used by my employees and individuals I've taught over the past 42 years in the construction and consulting businesses.

My journey in this field started very early on. I was born into a family of carpenters, roofers and contactors, so I learned early-on in life how to use tools and work hard in construction; I loved it. There was nothing greater than taking my shirt off and building something from nothing. I loved seeing my work unfold into something practical and useful. I also liked the physical change I went through, gaining a good tan and muscles, and hearing that occasional whistle from a passing car. Lord knows those days are long gone!

In 1977 I worked for Moore Construction Company as a carpenter and foreman in charge of excavation concrete forming. This was my first real job outside of my family. It was then I realized I had a real gift for construction. I enrolled in the mail-order course at Chicago Technical College that taught building and construction disciplines. In the short years following I was eventually hired on as a carpenter to build a high-rise in Daytona Beach Florida, but soon I was lead carpenter and foreman in charge of the form setting crew. Then I started traveling through Florida, Louisiana and finally Texas where I started my first construction company in 1980. Other than a few short-term jobs working commercial construction I have owned and operated my own companies.

My education continued through the years, always self-educating to become better. I attended TCC college and have earned certifications through various schools and classes I have taken. In our current age with so much information available, one can have a great education through self-lead studies. If you look in my library, you will find books from construction and building principles to code details and ASTM standards. I will talk more about this later in this book. I have represented many large school districts, cities, commercial property owners and managers during my time in the industry. I also inspect thousands of square feet a year. I believe most people can become an expert if they take the time to learn.

Legal/Compliance

With this book I do not intend to offer any legal advice to my readers.

This book is not intended to offer legal advice and does not in any way take place of consultation with an attorney or other professionals with appropriate expertise and experience. Readers are strongly cautioned to evaluate the information, ideas and opinions outlined in this book in light of their own experience and judgement and make independent decisions in applying it. The author disclaims any liability or responsibility for loss or damage as a result from the use of this book or the information, ideas or opinions contained herein.

Storms

Storms in the United States happen often and are spread throughout the country with varying magnitudes and types. Every year, depending on where you live, there is always a potential for a major storm to hit somewhere in your state. Many types of storms affect our nation including hailstorms, thunderstorms, ice storms, tornados, lightning, heavy snow, floods, tropical storms and hurricanes. The coast lines are especially susceptible to tropical storms and hurricanes as well as other perils. Every year is different, but as we all know the storms are becoming more frequent along highly populated areas and therefore more expensive.

As of March, 2019	Number of Events	Fatalities	Estimated Overall Losses (US $bn)	Estimated Insured Losses (US $bn)
Severe Thunderstorms	56	66	$18.8	$14.1
Winter Storms & Cold Waves	9	26	$4.2	$3
Earthquakes & Geophysical	2		$0.5	$0.4
Tropical Cyclone	5	107	$30.4	$15.6
Wildfire, Heat Waves & Drought (Ongoing drought condition without loss estimation for the half year)	16	107	$25.4	$18
Totals	**108**	**355**	**$81.9**	**$52.3**

Estimated losses incurred as of March 2019 in the United States
(Insurance Information Institute, 2019)

In this book we will specifically analyze three types of storms that affect a high rate of Americans, and that have become significantly more expensive over the past two decades according to studies: Hurricanes, Hailstorms and Tornadoes.

Hurricanes

Although statistics may vary, most experts agree that hurricanes are the most expensive natural disaster. The list is long and overwhelming, but simply looking at the top five storms by cost of loss can give us a snapshot of what these storms have totaled in our recent history. At the top of that list is Hurricane Katrina that hit the Louisiana Coast in 2005 with a staggering cost of 161 billion dollars. Second was Hurricane Harvey which slammed into Texas in 2017 with a cost of 125 billion dollars. The third also hit in 2017, Hurricane Maria, damaging Puerto Rico and the lower US, and costing 90 billion dollars. Hurricane Sandy was number four, affecting the US, Caribbean, and Canada in 2012 and costing 71 billion dollars. And finally, at number five was Hurricane Irma impacting the US, Puerto Rico and the US Virgin Islands, costing 50 billion dollars. There have been many hurricanes and natural disasters that have affected the United States in the past, today is no different, but because of population growth and economic inflation they are predicted to cost more each year.

Hurricane damages are especially widespread with differing types of damage occurring depending on the storm category and areas that are affected. Hurricanes can be rated anywhere between a Tropical Storm to a Category 5 Hurricane. A tropical storm is a rapidly moving storm system around a Low-Pressure System with strong winds and bands of thunderstorms with winds from 39-70 MPH. A Category 1 will have winds between 74-95 MPH. Category 2 hurricanes have winds between 96-110 MPH. A Category 3 hurricane will have winds between 111-129 MPH and will be considered a major hurricane. A Category 4 hurricane is projected to have winds between 130-156 MPH. Finally, the strongest hurricanes are considered Category 5 and have winds at 157 MPH or higher. What exactly do these numbers mean anyway? Below is a table with more information on the rating of a hurricane with more detailed descriptions of types of damage expected for each category.

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. *(Source nhc.noaa.gov)*
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks. *(Source nhc.noaa.gov)*
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. *(Source nhc.noaa.gov)*

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. *(Source nhc.noaa.gov)*
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. *(Source nhc.noaa.gov)*

At ground zero of the eye of a hurricane between a Category 3 to 5 is usually visibly total destruction but moving outward from the storm's center the damage is harder to determine; this is where an expert is needed. An expert can determine what the damages are and what it will take to bring the property back to pre-loss conditions.

Here is a list of important items to consider when documenting initial damage:

- Type of Terrain.
  - Terrain type B: urban and suburban areas.
  - Terrain type C: open terrain with scattered obstacles.
  - Terrain type D: flat unobstructed areas.
- Building height: buildings over 30' tall have greater wind loads.
- Is the building fully enclosed or open?
- Does it have storm rated windows and doors?
- Are there broken windows or doors present?
- Document all debris. Flying debris is a real threat to structures.
- Storm surge and flooding areas establish waterline and debris fields.
- Record official wind speeds.
- Document collateral damage: trees down, power lines, wind damage.
- Record any flashing damages, any water penetration is important.
- Record and document any HVAC damage.
- Roof and Deck damage should be recorded if inspection is possible.
- Drains clogged by debris should be considered.
- Structural damage: Engage a structural engineer for this.

It is imperative to ensure safe conditions when documenting for hurricane damage. Adjusters and damage experts are generally some of the first people allowed into a hurricane damaged area. The expert must be very careful about their surroundings and dangers such as electric lines, debris and pollutants which are very possible. Often, gas lines are leaking and could be life threating. One of the most dangerous aspects of inspections are roof inspections. If a roof deck is damaged, the whole roof could cave in with the weight of a single man walking on it. Look before you walk out into subject areas; if there is any deformity on the roof such as sunken areas, stay away! I never allow others to walk directly next to me during damage inspections in case the deck is damaged or deteriorated.

Performing hurricane damage assessments has other interesting challenges such as where to stay. When Hurricane Ike hit Galveston and Houston Texas in 2008, there were little to no hotels on the island. I decided to stay on the beach for the night as I could not find a place to stay and the debris on the roads made it almost impossible to commute between the island and Houston. On top of that the islands were under Martial Law after dark, so before long the police were there telling me I could not stay on the beach. Bad deal! I honestly thought I would end up in some military prison! I called a buddy who happened to be staying in a room with about 10 other guys and no running water or power. I put my flashers on and skated through town to the beat-up hotel. That was a long night!

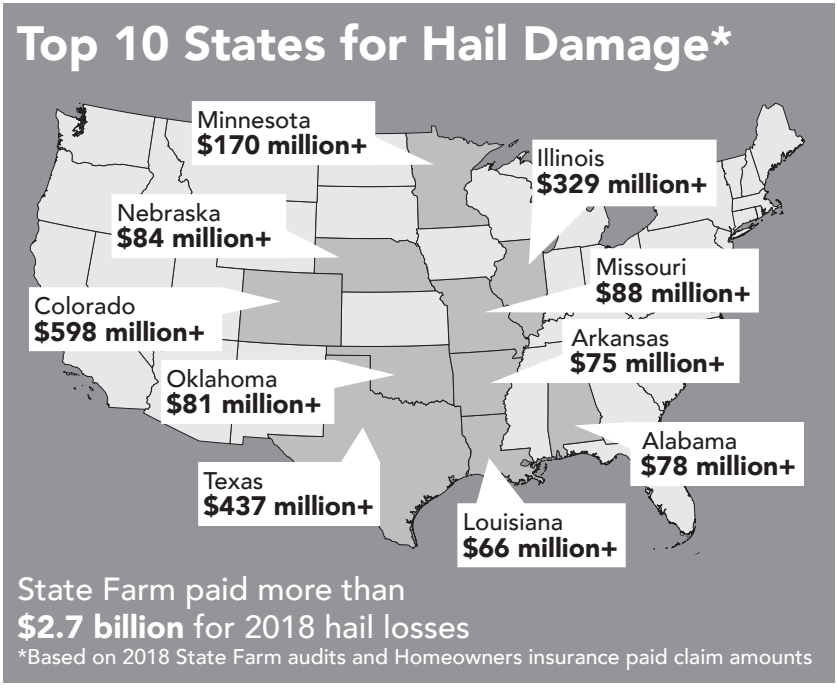
Not to worry, though, there's a happy ending to my story. The next day I met a customer who had a beach house and needed the security of someone staying at their home. That became my home for the next 9 months. Power

finally came on about three weeks later. In 2017, Hurricane Maria devastated the US Virgin Islands, and I was called to look at several damaged homes. The first inspection was a piece of cake as the customer had us flown in his private jet to Saint Thomas, then a helicopter flew us to Saint John where his house was located. We completed the initial inspection and flew back to the US the same day. About a week later I had to return, and the trip was quite different. After flying commercial into Saint Thomas, it was a crazy taxi ride to the ferry that took us to Saint John. Fortunately, my customer knew a hotel owner so I had a room but there was still no power. I finished my job and went home. Many experts, contractors and adjusters get caught without accommodations after big storms. We have to be very careful because things are not as safe as they appear after a storm.

There are hundreds of stories like mine of adjusters, experts, contractors or even families and employees who have lived in devastating conditions after a hurricane with no power or running water. Many of the individuals living in these conditions for weeks at a time are simply trying to document or mitigate damage for their clients or for themselves. Safety should be your number one rule if you find yourself in a similar situation. Working on ensuring you have a safe place to sleep, water, food and that you are watching your surroundings constantly to avoid potential injury. Staying through a hurricane's landing is not only a terrifying situation, it's risky, and the circumstances after a storm can be about as dangerous. Keep this in mind while considering your plan of action after a storm.

Hailstorms

Hailstorms are not the most expensive storm per event but are the most common of damaging perils. Each year thousands of homes and businesses are damaged by hail. They usually cover a wide area and vary in size from location to location. In fact, in 2018 State Farm paid more than 2.7 billion on approximately 280,000 auto and home claims for which they provided the image below ***2***.



There are approximately 3,000 hailstorms each year in the United States. The largest hailstone ever recorded in the US was 8 inches in diameter and weighed nearly 2 pounds. It fell in Vivian, South Dakota on July 23, 2010 ***3***. I actually investigated a loss in Oklahoma City in 2011 where the hail was so large it broke through the asphalt shingles, through the 1x8 solid wood planks, through the insulation and sheetrock and lastly breaking the glass table in the living room. The customer had saved the hailstones; they were the size of softballs and appeared to be hard as a rock. In that same storm a jogger was saved when a passerby let him into their car as he was being plummeted

by hail. Images of his battered back and shoulders made the news. It's rare for people to be killed by hail; the last reported case of a death by a hailstorm was in 2000 when a young man was struck on the head by a softball-sized hailstone ***4***.

It goes without saying that most hail is hard. It is hard because the super cooled raindrops are being sucked upward into freezing cold conditions within the supercell thunderstorm. Depending on the storm, the updrafts become like a popcorn maker recycling the hail until the updraft can no longer support the weight of the hailstone and it falls to the ground. I have noticed that the taller the anvil cloud, the larger the hail usually is.

In April of 2016 I was traveling back from Abilene, Texas after conducting inspections for hail damage and noticed a large cumulus anvil cloud headed for the Dallas/Fort Worth area. I looked at the aviation app on my phone and noticed the tops were 50,000 feet tall! I called one of my expert buddies and told him to watch out as this was going to be a big one. That storm produced hail over 4 inches in diameter crushing the city of Wylie, Texas and other parts of the metroplex. As an expert it is important to try to determine the size of hail, the direction of the storm path and if it has been wind driven or

not (learn more about wind driven hail in Rocco's section of this book).

Many believe that the indention in soft metals is the actual size of the hail, but this is far from true. Often, hail is hard, so it stays intact when it impacts an object, especially if that object has some give to it like soft metals. Aluminum vents or caps are very soft and you can damage them with little effort, so they are great for determining the hail size that fell on the roof. Let's consider the facts, most hail is round and looks a lot like a ball, thus the examples of size like baseball, softball, golf ball or dime size make sense. The impact area on a ball, whether it is small or large, is much smaller than the actual size of the ball. If you take a 2 ½" baseball and throw it against an HVAC unit, the size of the impact will be approximately 1/3 of the size of the ball. Some experts take several ball shapes with them to verify the approximate size of the hail. I will often use a tile comb to see the couture of the damage.

Here is a list of factors that make a roof more susceptible to hail damage:

- Age of roof
- Type of roofing materials
- Exposure of the membrane (gravel displacement/ granular loss)
- Environment (chemicals, seaside, etc.)
- Manufacture defects
- Improper installation
- Wet insulation
- Wind driven

So, what size hail damages roofs? This is a heated and much contested discussion. My answer is: it depends on many factors.

Many years ago, I met an expert from an insurance company on an older Thermoplastic Polyolefin roof (TPO.) The hail size was fairly small, 1 to 1 ¼ inches, but the winds had been crazy. We both agreed the entire roof had to be replaced because the damage was so severe. Some individuals in our industry have gone as far as to publish "threshold hail size" that could damage a roof depending on the roof type. This is ridiculous as there are too many factors with every roof to consider. In fact, some hail is jagged or have spikes so even a smaller hailstone can penetrate the toughest of roofs.

Tornadoes

Tornadoes are both devastating and costly. Some of the highest winds ever recorded came from within tornadoes. Although they can land just about anywhere, most tornadoes often land within tornado alley. On October 20, 2019 an EF3 tornado ripped through Dallas, Texas destroying hundreds of buildings in its 18-mile-long path. Based on the amount of damage and devastation left in the path of the tornado, it was amazing that no deaths were recorded. Still, it has been determined to be the costliest tornado to ever hit Texas with damages totaling over 2 billion dollars. ***5***

During our inspections we have seen the most unbelievable damage from this EF3. Interior walls blown 2 feet out of line, but the roof remained in place. Entire roofs were lifted then set right back down in their original place. It's only when I walk through the damages that I know how strong tornadoes really are. Most tornadoes require a structural engineer to determine the structural integrity of the buildings affected. Remember that tornadoes are the wild card, and anything can happen with them. Do not let anything go unnoticed.

According to the Glossary of Meteorology, a tornado is *"a rotating column of air, in contact with the surface, pendant from a cumuliform cloud, and often visible as a funnel cloud and/or circulating debris/dust at the ground."* ***6*** Tornadoes can be defined in many ways; still, one constant in all definitions is that a tornado must come in contact with the ground and a convective cloud at the same time, so 'tornado on the ground' is redundant because by definition, a tornado is only a tornado when it has touched the ground.

Here are some signs where a structural engineer should be called:

- Fresh cracks around bar joists or supports
- Bulging brick or cracks on the corners
- Cracks in the drywall
- Doors and windows do not shut properly
- Cabinet doors do not shut
- Cracks around windows and doors
- Nail Pops or fastener pops
- Bowed or leaning walls
- Insulation sucked down

- **THE MAY 10, 1905**
  SNYDER, OKLAHOMA F5 TORNADO
  The violent tornado that killed at least 97 people and ravaged the town of Snyder is still ranked as the second deadliest Oklahoma tornado of all time.

- **THE MAY 25, 1955**
  BLACKWELL, OKLAHOMA F5 TORNADO
  This F5 tornado killed 20 people in and near Blackwell during the late evening of May 25, 1955. Another tornado that formed in northern Kay County later that evening would produce F5 damage in Kansas and kill 80 people at Udall, Kansas, making it the deadliest Kansas tornado.

- **THE APRIL 9, 1947**
  WOODWARD, OKLAHOMA F5 TORNADO
  This wide, violent tornado literally wiped towns off the map in the eastern Texas panhandle and obliterated parts of Woodward, OK. It killed 116 persons in the state and is ranked as the deadliest Oklahoma tornado.

- **THE APRIL 10, 1979**
  RED RIVER TORNADO OUTBREAK
  This outbreak included a tornado which devastated parts of Wichita Falls, Texas, and was the most costly tornado until the May 3, 1999 Bridge Creek/Moore/OKC Area tornado.

- **JUNE 13, 1998**
  OKLAHOMA CITY AREA TORNADOES
  The Oklahoma City metropolitan area had not seen any tornadoes since October 1992 when a supercell thunderstorm dropped three tornadoes in Canadian County and four more tornadoes over the northern Oklahoma City metro area.

- **THE OCTOBER 4, 1998**
  TORNADO OUTBREAK
  Twenty-eight tornadoes occurred in central and eastern

Oklahoma, including an F2 tornado which damaged parts of Moore. It was the largest autumnal outbreak of tornadoes ever recorded in Oklahoma.

- **THE MAY 3, 1999 TORNADO OUTBREAK**

  This outbreak included nearly 60 tornadoes in central Oklahoma. It was the largest tornado outbreak ever recorded in Oklahoma. The first F5 tornado to ever hit the Oklahoma City metro area killed 36 people and the damage total was estimated at $1 billion, making the it the most costly tornado in the state until the May 20, 2013 EF5 tornado in central Oklahoma. Two F4 tornadoes also ravaged parts of Kingfisher and Logan counties.

- **THE OCTOBER 9, 2001 TORNADO OUTBREAK**

  Nineteen tornadoes hit parts of western Oklahoma. Three F3 tornadoes occurred, including a tornado that damaged the southern and eastern sections of Cordell, Oklahoma.

- **MAY 8, 2003 OKLAHOMA CITY AREA TORNADOES**

  The central United States experienced a record-breaking week of tornadoes from May 4 through May 10, 2003, when nearly 400 tornadoes occurred in 19 states and caused 42 deaths during the seven days. Included in this total were the tornadoes which hit the southern Oklahoma City metropolitan area on May 8, 2003 including an F4 tornado which tore through parts of Moore, Oklahoma City and Choctaw.

- **MAY 9, 2003 OKLAHOMA CITY AREA TORNADOES**

  One day after an F4 tornado struck the southern Oklahoma City metropolitan area, a single supercell thunderstorm produced ten tornadoes in central Oklahoma, including one F3 and two F1 tornadoes in the northern Oklahoma City metropolitan area.

- **THE MAY 10, 2010 TORNADO OUTBREAK**

  This outbreak produced 35 tornadoes in the NWS Norman forecast area alone, and a total of 55 tornadoes in Oklahoma. Two EF4 tornadoes struck the Oklahoma City metro area, killing 3 people and injuring over 80 others.

- **THE MAY 24, 2011 TORNADO OUTBREAK**

  While this outbreak included only 12 tornadoes in the NWS Norman forecast area, 3 of these were violent (1 EF5 and 2 EF4s). The killer tornado that went through Canadian, Kingfisher and Logan Counties was the first F5/EF5 tornado in Oklahoma since the May 3, 1999 outbreak.

- **THE MAY 19, 2013 TORNADO OUTBREAK**

  Two supercells in central Oklahoma also produced a total of 8 tornadoes, including one violent tornado that hit parts of Cleveland and Pottawatomie Counties.

- **THE MAY 20, 2013 TORNADO OUTBREAK**

  An outbreak of 15 tornadoes occurred in parts of central and eastern Oklahoma. A violent, EF5 tornado struck parts of McClain and Cleveland Counties, including the cities of Newcastle, south Oklahoma City and Moore and killed a total of 24 people. Damage estimates were $2 billion, making this the most costly tornado to ever occur in Oklahoma. ***7***

Are You an Expert?

The dictionary defines an expert as *"a person who has a comprehensive and authoritative knowledge or skill in a particular area."*

We all become experts a little each day in our defined fields. Every success, every failure, each time we tackle a problem or work on a project we become a little better at what we do (or what not to do). In the world of roofing and construction, it really starts with the little things. In my 40 plus years in the construction and roofing industry I would tell men and women, do the little things right and the rest will come easy. Whether it's rolling up an extension cord or nailing up shingles, do it right and to your best ability. I have seen clumsy uneducated people become expert roofers and carpenters through hard work and always pushing for excellence. They became experts in their field, and when most could not figure out a difficult termination or flashing, they were the guy who knew how to do it so that it never leaked. They had knowledge, skill, experience and the ability to problem solve.

> "
>
> Experience is a tool that nobody can take away from you. Every time you speak to a contractor, order supplies, hire subcontractors, look at roofs, etc. keep a log of *everything* you do.
>
> "

Keys to Becoming an Expert

EXPERIENCE

One of the smartest men I have ever met in the roofing industry is Dale Acord. I think he was present during the age of the dinosaur. He has over 50 years of roofing experience and has worked for some of the best companies in the nation. Dale will tell you he never went to Yale or Harvard but his experience on roofs is unmatched. He and I have taught many roofing classes together, and his stories of failed material, problems they solved, and how to install roofing types correctly are paramount. Our industry is changing rapidly, from asphalt to TPO and PVC and many other changes, but your experience working with these products gives you skill and knowledge. I tell my students to document every job they are involved in, whether it's an inspection, an installation, design or lab work; always keep a report and record for your own personal expertise file. It will help you in the future.

Every time you speak to a contractor, order supplies, hire subcontractors, look at roofs, etc., keep a log of everything you do… with details. Experience is a tool that nobody can take away from you. I place all of my reports, expert testimony and important related items in personal binders for reference and documentation of my work.

Things you will learn over time:

- Proper ladder set-up
- Walking on a steep slope
- The importance of safety
- Ability to assess roof type, age, and condition
- Ability to find and know deck type and insulation
- Ability to gauge the extent of the damage
- The difference between storm and non-storm damage
- How to document damage
- Determine different dates of loss
- Storm and weather research, benefits and strategies

EDUCATION

The second part of being an expert is education, so educate yourself continually in your field. If you are a roof consultant, a roofing expert, or a building envelope expert, you must continually keep up to date with the changing trends such as elements of waterproofing, roofing materials and their composite, installation methods, and also new codes that come out every few years. You need to understand wind uplift tests and wind uplift code requirements. Be familiar with all the ASTM, ISO and ANSI standards of all of the products or tools that you are an expert on. You need to be a part of associations such as IIBEC, or NRCA, or even your local chapters of roofing contractor associations. In north Texas we have the NTRCA, a great and very active organization that lobbies for new law changes and offers education.

It is also important to attend yearly educational seminars. If you are or want to be a roof consultant, then join an organization like IIBEC and begin to work towards your RRO (registered roof observer) or RRC (registered roof consultant). Also, there is a free online educational resource called AEC daily that will teach you different segments of the construction industry and then give you a certification. I believe an expert is always learning and educating themselves. The more education that you and your employees have, the more credibility you will gain in the industry.

Education helps deepen your knowledge on all sorts of levels. There are several options at your disposal to help you gain that education. Thickening your education helps to broaden your scope of expertise. Also, do not forget to study the manufacture bulletins and product specifications, you will need them during your assessment and report writing. Self-Education is a tool that should be used and can be done with little or no cost. There are many free resources that you can use. I advise you to do weekly self-education.

Keep a binder and document all education that you have as well as all experience. This will not only help you to build your portfolio toward becoming an expert but will also create a great resource for you when needed. You will always have your binder and can look back at certifications, research, and previous jobs to get details and help with decision making etc.

Education websites that I recommend are:

- **AEC DAILY**
  www.aecdaily.com
  AEC daily is a developer of online education courses for the construction sector. AEC Daily provides an e-learning experience for a variety of construction professionals. AEC provides certifications that are not always time consuming and are free of charge. These certifications don't take long but help to enhance your education and expertise. I do these while watching football on the weekends or have a couple hours in the evening.

- **IIBEC**
  www.IIBEC.org
  International Institute of Building Enclosure Consultants- This is one of the best resources for education and one that I recommend the most. IIBEC is an international association of professionals who are working to advance the profession of building enclosures by offering online training, news on the field, consultants, and a community of experts that are working towards the same goal.

- **ASTM**
  www.astm.org
  ASTM International, formerly known as American Society for Testing and Materials, is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services. Some 12,575 ASTM voluntary consensus standards operate globally.

- **NRCA**
  www.nrca.net
  National Roofing and Contractor Association- It is known as the voice of the roofing professionals and provides resources for education, certifications and also advocacy.

- **ANSI**
  www.ansi.org
  The American National Standards Institute is a private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States.

- **ISO**
  www.iso.org
  The International Organization for Standardization is an international standard-setting body composed of representatives from various national standards organizations from all regions of the world. This organization promotes worldwide proprietary, industrial and commercial standards.

KNOWLEDGE

Knowledge is facts, information and skills acquired by a person through experience and education. Knowledge of a particular job can be gained through various means. You can request data about the building from the owner or use tools like Pictometry, Google Earth, Co-Star, tax records and more.

It becomes easier to understand what you are looking at with right information; this is knowledge at work, and there is always something new to know. Many times, we show up to building inspections where we were not properly informed; like when there was another building next door that was part of the same business. That would have been good to know, so now we have another trip to plan and request for access. I have several stories of where more information saved me and my team, one being of damage to a smokestack that we attributed to a hailstorm we were documenting. After further examination of our weather data and historical aerial images, we found that the damage had in fact occurred during a different storm a year prior.

I always do a short list of information before my inspections:

- Last 5 years of aerial photos from an online source.
- Last 5 years of storms reported (Interactive Hail Maps has some great free options if you sign up. Other hail websites can also produce reports for a price.)
- Age of building, which can be found by the client on property insurance policies or home records.
- Age of roof, which can also be provided by the client usually.
- Contractor and manufacture of the roof.
- Type of building construction: Exterior and interior details if possible.
- Access to building: Do we need a ladder? What size ladder? Boom-lift?
- Building use: Is it a single-family home, office spaces, single business, or warehouse?
- Manufacturer specifications for the roof. If we know the roof type, we prepare.
- Maintenance program, if any, such as roofing companies involved with repairs and maintenance staff names and phone numbers, if any.

PROTOCOL

This is the discipline of a proven method that is adhered to, so mistakes are not made. Discipline yourself to always use a protocol. Having a protocol and checklists allow for everything to be documented and organized and will be used in all aspects of the inspection. It will also help you to connect the dots to damage. From the way that I have my staff take photos, report writing, to sending things to the lab, going about things the same way every time will save you time and allow others to trust your work. My team has several protocols for different types of inspections, such as the following Commercial Documentation Protocol.

Commercial Documentation Protocol

Duties and Responsibilities:

You will often be first on the scene, so capturing as much of the evidence as possible, as quickly as possible is invaluable. From the moment that you arrive until the moment that the claim or potential claim is resolved, photos, measurements and markings are your responsibility. If you document as if you were going to trial, you likely won't miss a thing.

Before Inspection:

1. Verify the type of loss and Date of Loss. This is highly important.
2. Verify the weather data. There are several sources available (NOAA, Hail Watch, CORE logic.)
3. Start a RoofLogic Profile with all the data available. Be sure to have a sketch added- you will need this sketch for the inspection.
4. Get permission and set up a time to inspect the property with property owner or staff. Notify the office manager of who will be documenting the loss and when.
5. Get your equipment ready for inspection.

Check Tools Before Inspections:

1. Camera – digital, cellphone, drone
2. Measuring – tape measure, ruler, micrometer, laser measurement tool, etc.
3. Marking – chalk, wax crayon, inverted spray paint (red works best)
4. Moisture detection – moisture meter, infra-red camera, moisture probe
5. Cutting tools – round coring tool, box knife, reciprocating saw
6. Repair Material – caulk gun, caulking, self-adhering strips, trowels, etc.
7. Notes – clipboard, pen, pencil, markers, graph paper
8. Storage – large sealing bags for cores, tool bag or

backpack for small items

9. Additional – broom, spud bar, leaf blower, shop vac, rags or towels, water

10. Exterior/Surrounding and Roof Documentation

11. Your first photo should be of your roof CAD or aerial image and the address of the front of the building.

12. Begin to take your photos working either clockwise or counterclockwise and take all photos of the exterior of the building as a large-scale look.

13. Identify and photograph all collateral damage; spatter marks or other noticeable or significant items.

14. Mark on your roof CAD any damages you see and identify where the gutters are or if there are any or where parapet walls are.

15. Find a secure location to set up your ladder. Make sure your ladder complies to OSHA regulations and is tied off and extreme measures of safety are used on ladder access.

16. Once on the roof, take your photographs either clockwise or counterclockwise and go to every four major corners of each roof section, panning and overlaying your pictures to ensure you have photographs of the roof from all directions.

17. Begin to walk the perimeter looking for damage to soft metals, parapet walls, and areas of interest.

18. Walk the entire roof looking for anomalies, impact marks, fractures, and wind damage.

19. Be sure to paint any anomalies, areas of interest, hail impacts, or fractures. Mark the fractures with an F to distinguish the difference.

20. Mark the direction on each HVAC north, south, east, or west.

21. Number each HVAC if they are not already number.

22. Photograph all damage; make sure your first photograph is far enough away that you can identify where the damage is, the second photograph is a little closer, and the final photograph is close enough to see the damage within the impact area.

23. Use a magnifier if you have one for final shot.
24. Identify and mark the areas were cores need to be taken, all cores need to be 12”x 12”.
25. After the roof is painted and marked, use a drone if you are a 107 pilot, and document from different levels.
26. Perform a moisture survey, if possible, using a deck scanner or schedule a nighttime infrared.
27. Core the roof: if there are multiple roof sections of different ages, core each section and do repairs as recommended by NTRCA.
28. Take notes both handwritten and recorded. You can use your cellphone.
29. Perform an interior inspection. Interview the owner or occupants as to any leaks that may be occurring before and after the weather event.
30. Document the leaks on your roof CAD. Using a floor plan is suggested.
31. Identify any storm created opening or storm created leaks and photograph.
32. Download all photographs onto a hard drive or computer. Have multiple copies of your work.
33. Create a report detailing your observations.
34. Schedule any cores or testing that may need to be done with the owner.
35. Interior Documentation
36. Interview the owner or occupants as to any leaks that may be occurring before and after the weather event.
37. Document the leaks on your roof CAD. Using a floor plan is suggested.
38. Identify any storm created opening or storm created leaks and photograph.
39. Download all photographs onto a hard drive or computer. Have multiple copies of your work.
40. Create a report detailing your observations.

Our team also carries with them a tablet with the RoofLogic application which helps their documenting process go a bit faster. In case of connectivity issues or issues with computers or servers, which can happen (and has happened to us in the past), the expert inspecting can use the following checklist.

Inspection Checklist

Job Name: _____ Date: _____
Job Address: _____ Time: _____

❏ Weather Conditions: _____
_____
_____
_____
_____

❏ Present at Inspection: _____
_____
_____
_____
_____

Roof Details

❏ Area Size (Square Feet): _____
❏ Approximate Age of Roof (Years): _____
❏ Roof Type: _____
❏ Slope: _____
❏ Method of Attachment: _____
❏ Membrane Type: _____
❏ General Condition: _____
❏ Seam Types and Spacing: _____
❏ Height of Parapets: _____
❏ Height of curbs: _____
❏ Electrical outlets present? _____
❏ Flexible gas line connectors at HVAC units?
_____
❏ Stone Ballasted? _____

❏ Coverboard? _____ Thickness: _____
❏ Top Insulation Thickness: _____
❏ Bottom Insulation Type: _____
Thickness: _____
❏ Deck Type: _____
❏ Type of Drainage _____
❏ Is there roof access or accessed only by ladder?
_____

Other Notes:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Hail Impact Details

❏ Total Impact: _____
❏ Damaged Areas Identified per 100 Sq. Ft.: _____
❏ Apparent Maximum Hail Size: _____
❏ Apparent Angle of Impact (Degrees): _____
❏ Types of Hail damage: _____
❏ Impacts per sq. ft. on metal components, Mechanical Units:
_____
Heater Flues: _____ Exhaust Vents: _____
Vehicles: _____
❏ Direct hits on mechanical fasteners or other cutting edges on roof membranes? _____
❏ Damage to vertical flashings? _____
❏ Damage or hail hits to skylights, EIFS, window screens/ fencing? _____

Wind/Moisture Damage Details

❏ Are there evidences of wind damage? _____
❏ Apparent areas of ponding water? _____
❏ Apparent areas of blistering? _____
❏ Moisture present under roof membrane? _____
❏ Granular Loss? _____
❏ Signs of impacts, other than hail, i.e. wind blow debris?
_____

Other Questions

Have multiple hail events occurred at this location since this roof was installed? _____
_____
_____
Is there known roof leakage from this hailstorm?
_____
_____
Is the roof scheduled for replacement? _____
Does roof seem repairable? _____
_____
_____

Notes:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

❏ I certify that this roof inspection was conducted at the time and date recorded, and that I answered all questions truthfully and at the best of my ability.

Inspector Name:

_____

CERTIFICATIONS

Certifications are an essential part of being an expert. There are many certifications needed to round out your knowledge and credibility. Let's take for example Infrared Imaging. Infrared photography is a highly complex skill that must be done right to ensure accuracy and quality. First, what are you taking a thermogram photo of, is it a roof? If so, there is an ASTM standard (#C1153) to follow. The camera must be set correctly for emissivity, distance, ambient air temperature, humidity, and reflective temperature. The winds must be lower than 15mph (as the images will wick away) not a cloudy day and so on.

I met an engineer on a roof where we were to do an infrared survey to determine the moisture in the insulation on a BUR (built up roof). I asked the thermographer what emissivity he was using, and he replied that it did not matter, because he was doing a qualitative not quantitative survey. I did not respond but realized he did not know what he was doing. I looked at his thermograms and they were completely different than mine. I pulled the engineer aside and we agreed to use my images after I explained emissivity and compared the photos.

If this thermographer had taken the certification class, he would have known how important emissivity settings are on an infrared camera for this type of survey.

Here is a short list of certifications used in our industry:

- Infrared Certification
- sUAS (drone) Thermography Certification
- Certified Uplift Test Specialist
- A2LA Lab Certified
- RRO - Registered Roof Observer
- RRC - Registered Roof Consultant
- Certified Appraiser
- Certified Umpire
- Professional Engineer
- Professional Architect
- NRCA Installer Certification

Telling a Story with Your Photos

"Mr. Lamont, did you take this photo?"

"Yes I did."

"Can you please tell us where on the building you took the photo?"

I was scrambling to try to remember, heck it was two years ago when I took that photo. That experience totally forever changed the way I take photos.

Taking photos on an expert case is the most important thing you will do on the case, but the photos should be a work product that can stand alone, or in other words, tell the story on their own. When you think about it critically, it's like shooting a movie one frame at a time. So, the first photo should be of a RoofCAD, or drawing of the roof sections, then the address of subject property and front elevation. It should then move in a systematic and deliberate way around the building. I teach each person that they should find out what is natural for them, (clockwise or counterclockwise) then always do it the same way. (Protocol!) After the elevations, photograph collateral damage, fences, trees, AC condensers, windows, screens and soft metals. Treat the location like a crime scene, everything matters. Also, how you take photos is so important, for example, if you find damage, your first photo should be far enough away that you can tell where you are on the building. The next photos are closer and closer to the final photo of damage. The photos are telling the story.

After documenting the exterior, I request to see the interiors. Often, there is not interior damage, but an inspector that is thorough will always look inside. I like to see the deck when I am inside because it helps me understand what I am looking at when I am on the roof. Remember you might need a flashlight to see the deck or screw pattern if mechanically attached insulation is used. Looking at the deck from the interior may also reveal damage that is not particularly visible from the outside.

You will also want to look at the seals around all the windows making sure that they have not been compromised. Seals can be sucked out and the thermal break broken on double pane windows. We also will use an infrared camera to see if there is a thermal break in any of the windows that are double pane, as that can be detected through infrared thermography.

Here is a short checklist for interiors:

- Request information from the owner or tenant such as: Age of roof, warranty information, installation contractor.
- Leaks, stained ceiling tiles, wet carpets or floors.
- Document the type of deck, (gyp deck/metal deck narrow or wide rib,)
- Fasteners? If fasteners were used, look at the pattern and notate.
- Deck Damage or Rust
- Space Use: Heated and cooled areas/ warehouse.
- Classification of use. (Warehouse, office, retail, etc., You will need this if a valuation comes into play.)
- Code Issues: handicap, insulation, HVAC, Access, safety.
- Interior Damage
- Asbestos/Lead paint
- Joist Spacing
- Deck Thickness
- Slope of Roof
- Interview Occupants and Maintenance Staff (if any.)

After I have completed the exteriors and interiors I move to the roof. I start with over-all photos from corner to corner, allowing my photos to overlap in succession. Starting at the corner closest to where I accessed the roof, ladder or scuttle hole. I move in a clockwise manner from corner to corner until the overall photos are complete. It is important to find what comes natural for you, clockwise or counterclockwise, as you should have consistency in everything you do and feel comfortable as you perform the inspections. Remember to never walk backwards on a roof, no matter which direction you're going - always moving forward is the golden rule.

I then put my camera down and document or inspect the roof, marking in some fashion the damage I find. There are times when you cannot or do not

want to mark the damage. When lawyers are with me on the roof, I try to photograph only because everything you "mark" can and will be used against you, Ha-Ha! But seriously, there are times when marking the roof cannot be done. We were working for a city and they had many historical buildings that were damaged by hail and we were not allowed to mark the damage. There was a lot of finger pointing while taking photos at those inspections!

In most cases I use paint to mark the damage. I also like to use red as it stays on the roof longer than orange. I use paint because it is very hard sometimes to see the damage months later when you may be arguing with the opposing side about the damages. The marks also show up in the opposing sides photos, and I like that. I do not use paint if the roof is sloped or you can see it from the ground or out a window. In those cases, I use chalk and grease pencils. I also use chalk and grease pencils on the HVAC units. If the units are not numbered, I number them for our records and transfer those numbers to my RoofCAD or sketch.

After everything is marked, I begin to photograph everything in sequence. For example, I will start with the edges or parapets moving clockwise. I then move to the field of the roof ensuring my photos tell the story. I then photograph the HVAC starting with a photo a few steps back, then the number I have on the unit, then all sides of the unit and the damage (if any). I also like to place the facing direction on each side of the unit, N/S/E/W, so you know which direction the damage occurred. When documenting condenser coils, I will always use a tape measure or ruler to display the size of the area of impact.

I also use chalk to mark the dents in soft metals. If you lay your chalk on its side and rub it across the metal, it shows the image and edges of the dents. I then use a tape measure for size and depth. We often use a depth gauge to see how deep impact dents are in metal. When documenting metal roofs, common knowledge agrees damage to the coating can occur after 1/8" deep dents. I will use "F" to label a "fracture", "B" for "blister", "G" for granular loss, "AOI" for "area of interest". Any other roofing problems, even problems not associated with the storm, need to be documented.

Know Your Structure

It is vital to know how the building is constructed. The type of building is closely connected to the amount of damage that can occur. What is it made of? Is it a tilt wall? Is it masonry? Is it Exterior Insulation Finish Systems ("EIFS")? I was representing a customer on a large appraisal and our Umpire was a Judge. During my investigation of the loss, I was furnished with an Engineer Report that had the position that the roof only needed minimal repairs. In the report, he misidentified the type of building construction. He stated it was a tilt panel wall construction, which is very common in Texas. The problem was it was not a tilt wall, but a CMU block wall constructed building. At our inspection, I pointed out to the Judge the type of wall construction. Days later, during our arguments, I stated not only did the engineer misdiagnose the type of construction of the building but also the related

damages. Needless to say, I won the award.

If you are unsure, take some photos and ask someone who knows. A good practice is to request details and plans of the building you are investigating. Often the property owners can provide you with great details. I also look inside the building, above the drop ceiling or in the warehouse area to see the wall construction. I am also very interested in how the bar joists/deck are attached. I may sound like a broken record with these checklists, but this information is important because new codes may be required for additional deck securement or parapet heights, etc.

Ask these questions about the structure:

- What is it made of?
    - Is it a tilt wall?
    - Is it masonry?
    - Is it an EIFS (Exterior Insulation Finish System)?
- Is this a good installation job?
    - What are the manufacturer installation specs?
    - Were any steps skipped?
    - What is the expected life for this material?
- When was this structure built?
- Was a reputable contractor/company used?

Exteriors

EIFS or "Exterior Insulating Finish System" is often used on commercial buildings. Damage to the system is often missed because it is misdiagnosed as a hard surface, but is in fact, very easily damaged by windstorms and hail. The system is constructed of polystyrene or polyisocyanurate foam insulation, fiberglass mesh, then various types of coatings and finishes. If you tap on or knock with your fist you can usually tell as the EIFS system will sound hollow. A common knowledge of building types and construction is needed, so if you are not sure, ask someone who does know, and then research that building type and add knowledge to your experience.

More exterior items to look at:

- Identify the type of construction
- Look for evidence of foundation problems
- Look for cracks and movement
- Inspect the windows and doors
- Inspect the termination between trades (masonry to windows)
- Inspect expansion joints
- Road sign damage
- Impact marks or damage on walls, doors, or windows
- Staining on exterior from leaking
- Flashings and gutters

Mechanical Damage

Mechanical damage: mechanical damage is known in our industry as damage from normal wear and tear or non-storm related damage. This is like the damage that may have occurred because of workers working on the roof, or a truck backing into an overhang, or an HVAC that was placed down too abruptly or without proper blocking under it. Many times, this damage is easy to detect as it's a different shape, and more often than not, it is long or continuous. For instance, if you see a line of damage that looks to be older, you can summarize that this is mechanical damage due to an HVAC being moved about on the roof or something similar.

An expert should also know what mechanical damage looks like when workers are working on a new roof and create hot spots and have stepped on areas that are still hot. Some mechanical damage comes when the workers are putting on a new roof or repairing an area of the roof. Look for patterns or inconsistencies; look for scrapes and long cuts. If you are working a hurricane claim, all of these may be hard to find and hard to determine; look for the freshness of the impact marks, look for sources of flying debris, look for broken limbs and broken windows, and try to place every part of the damage of the roofing system or the building within a reasonable determination of cause and time frame of the damage.

I was called in on a loss with reported hail damage to a BUR gravel ballasted roof. I received a report from the roof consultant that determined there was mechanical damage, not hail. I went to the location and he was correct. Someone had taken an object and impacted the roof. How did we determine

this was the case and not hail? Reasonable thinking. There were only isolated areas of impact. There were no spatter marks or collateral damage, but the impacts were fresh meaning they were recent. Sometimes areas of impact (fractures or bruises) are present with no spatter marks but this is because the hail is older. Spatter marks fade away with time and other weather events like rain and dust, but for the most part they are noticeable within a year of the event.

I was working a hurricane claim where there was a lot of flying debris that impacted an EIFS exterior. Much of the exterior had been blown off from the storm and there were many other impact marks from flying debris; but on the south side of the building, we noticed an inconsistency. In fact, the objects looked to be circular, like they came from a baseball. Upon our examination, we determined that this section was mechanical damage made by children throwing a baseball against the building. In the other areas it was not the same type of damage and we concluded that most was wind-borne debris. There was also a difference when you looked very closely between the new damage and the old mechanical damage.

It is the expert's duty to see everything and to let nothing that you see go without being analyzed. It is imperative that all damage is looked at closely and other issues are also considered. If you are doing an inspection for quality control be sure to notate any possible mechanical damage that you find.

Mechanical damage is damage from normal wear and tear, non-storm related. It's easy to detect due to its different shape. Example: A long line of damage that looks older than the current damage or contains scrapes or a long cut.

Walking on a Roof

When you are on the roof you want to be able to use your feet to tell you if something is off. If you are wearing a pair of boots or clodhoppers your feet will tell you nothing. I use a soft sole, such as a sailboat shoe or a tennis shoe. Whatever shoe you choose, make sure you're able to feel under your feet when you're walking on a roof because your feet should be like an extension of your hands on that roof when looking for damage. You should be able to feel if something is soft which may indicate water damage. You should also feel if something is sticking up, like a fastener that has been pulled up by the wind or feel if there is a popping under you.

I walk every square foot of the roof. Don't just walk around, or walk the perimeters expecting to look at the roof and document the entirety in a few minutes. This process takes a lot of time. You have to walk the roof and feel the roof. You need to know what kind of insulation was used. Also, you need to know the gauge of the deck that is under your feet or whether it's structural concrete.

Many experts will come to a job, take a few photos and never spend the time really investigating the damages. Then reports fly, stating there is no damage without a thorough investigation. Many things are missed with a quick inspection, so take your time and record how long you were on a building. We represented a school district where the initial inspectors inspected 74 campus locations in eight days and reported little or no damage. We spent three months documenting the schools and logged more than six miles of inspecting a day. Needless to say, we found tons of damage.

A good friend of mine said, *"the longer you're on the roof the more it's going to talk to you."* And that's the truth. The more time you are on that building and the more you look at the roof, the more likely you will find damage if it is there to be found.

More About Inspecting Roofs

BURG INSPECTIONS

I have personally inspected millions of square feet of built up roofing. When inspecting built up roofing, I try to find out the manufacturer and the date of installation. I also want to know if there are any warranties in place, and how it was installed. What kind of deck is the built-up roof on? Is it a built-up roof with gravel? What size and kind of gravel did they use? I also like to find out how many ply's the built-up roof has. Then of course, what kind of damage inspection are you doing? Is it because of a hailstorm, windstorm, hurricane, or is this an annual inspection for roof condition and maintenance?

When inspecting a BURG, or a built-up roof with gravel, the first thing I look for is if the gravel is even and undisturbed. Are there parapets, and if so what kind of material is used on the parapet? I begin to walk the perimeter inspecting the parapets, flashings, counter flashings, lap joints between the parapets, and the condition of the roof between the flood coat and the parapet membrane. If there are gravel guards used, I walk the edge of the gravel guard and notate any gravel displacement. I also like to see if there are any stains or discoloration under the gravel guard or flashings which may indicate leaking under the flashings.

If you are inspecting after a hailstorm, notate how long it has been since the hailstorm and if there has been any rain in the area with more than an eighth of an inch accumulation since the hailstorm. If there has not been much rain and people have not been on the roof you can look for divots on and around the roof, and if the hail stones were large enough the divots marks should still be there within the first 30 days after the storm.

I once had a roofing contractor show me divots on the roof, but as I looked closer it was not a divot from hail but instead a bird nest. I have also been shown potential divots in the gravel that were from foot traffic. If the storm was recent and the hail stones are large enough, you should be able to mark the areas that were impacted by the hail stones, at least the large ones. After marking them with paint I will then begin to inspect them using a small whisk broom.

Inspect and photograph everything before you move the gravel then whisk away the gravel at the area of interest and mark it on the attached gravel so that it will not disappear quickly. Inspect the asphalt if it is visible for fractures and bruising. Use your thumb to softly push around the outside of the area of impact, and then the area of impact to see if there is movement within

the bruise. If it looks crushed and there is movement inside the bruise, more than likely it is fractured. Mark for a potential sample to be taken if needed. If you can see the areas impacted in the gravel where they can be marked, I would also mark a 10-foot by 10-foot test square around those areas and document it. Remember even if you use paint, the areas marked in the gravel are short-lived. You may want to re-mark them if needed at a later date, so remember to update your RoofCAD.

I also inspect the parapets for bruising and fractures as areas between the built-up and the parapet are susceptible to fractures. Inspect the flashing and the metal on top of the HVAC units document and look for fresh spatter. Spatter marks are marks usually caused from hail that has removed the oxidation from metal panels or metal objects. You can also see spatter marks on walls that are painted. Just about anything that has oxidation on it can show hail spatter marks.

After inspecting the parapets, I will then walk the field of the roof especially those areas that are lightly covered with gravel or where no gravel exists. Those are the areas most susceptible to hail damage. I will document any bruises or fractures if a visible fracture is apparent. I will mark it with an F. If I find an area that I'm not sure about because its soft or different than the rest of the roof I will mark it as an AOI, or "area of interest." I typically walk just about every square foot of the roof. I walk it in a systematic way looking, but also feeling with my feet for any anomalies or differences. If I feel something soft or something gives, I try investigating it more thoroughly. Depending on what type of insulation is under the BUR, if you feel a soft spot it is usually water or a deteriorated deck. Many times, fractures cause immediate leaks and the insulation becomes saturated and it feels totally different than other areas that are undamaged.

I also notate and mark any of the following areas:

- Blisters
- Faulty lap seams
- Detached flashing
- Termination bars
- Curb height
- Pitch pans
- Broken or damage skylights
- Fall protection for skylights
- Estimated size of hail
- HVAC damage
- Signs of wind damage
- Areas of repair
- Areas free from gravel
- Any damage found

Wind damage to a BUR or BURG is another type of damage that can be found after almost any type of storm. Once again, most people do not know what they're looking for when it comes to a BUR or a BURG roof. I think anyone can see the easy simple signs like hail bruising or impacts to the parapets and flashing but finding wind damage is totally different.

Wind damage is the act of wind and its forces causing damage to a roofing system. As the winds sweep over and around the building it causes a low pressure on the top of the roof. The membrane is lifted upward toward the sky, sometimes even minimally. It acts almost like an airplane wing and depending on the wind speeds, surface roughness, building type, configuration, height of the building, distance, and quantity of other buildings, winds can damage the roofing membrane quite easily. This lifting action separates membranes that have been attached or have been adhered to the insulation. They also lift the decking and the fasteners that hold the decking onto the structure.

When I am looking for wind damage on a building, I am looking for the following:

- Wind scouring
- Wrinkles in the parapet flashings
- Detached flashings
- Detached or missing vents or penetrations
- Loose insulation
- Torn or loose membrane
- Wind-born debris damage
- Collateral wind damage

I was inspecting a school along the coast, and we noticed a very long tear that was probably 15 feet long. We later did wind up-lift tests and the entire membrane had been lifted from the insulation and was torn. In December 2019, I was inspecting a BUR roof that had a gravel guard and gutter. In my inspection I noticed that the roof had been detached from the insulation about 12 inches from the edge. There was also a tear in the membrane about 6 inches long that went from the gravel guard toward the lifted area. The roofing contractor had been up there twice and had never noticed the damage. Most people believe wind damage to a roof is when wind gets under the flashing and then begins to tear away from the edge, when in fact there is lifting action on a roof, and sometimes happens further from the edge and as the roof lifts then it can be torn away. Watch a video of tornadoes and hurricanes, the roof lifts off the building.

MODIFIED BITUMEN ROOFS

When inspecting modified bitumen roofs, it is important to try to find out what type of installation and product you are dealing with. When you inspect the seams, you can usually tell what kind of material was installed. If there is little or no bleed out, it is more than likely a torch down. If there is excessive bleeding and there is asphalt on top of some of the membrane it is likely a hot mopped asphalt membrane. Core the roof and see if there is a base sheet and whether the base sheet is vented. Look to see what kind of insulation was used and what type of deck you have. When I inspect Mod-Bit it's a lot like inspecting asphalt shingles.

I am looking for a few things, including:

- Loss of granules
- Bruising
- Wrinkling
- Lifted insulation
- Torn or missing membrane
- Flying debris
- Size of hail
- Collateral damage
- Lifted fasteners (or popping)

If you find a bruise or soft spot, you should mark it. If you find a fracture in the membrane you should mark it with an "F".

Our team usually does test squares for hail assessments; approximately one test square for every 100 squares of roof. If the damage is consistent across the entire building and it is very large, you can do a smaller number of test squares (that is considered sampling). When doing a test square, measure 10'x 10' and mark brackets on all four corners. Then mark the hail damage you find and place the number in writing above the top of the test square, photograph the entire test square, then photograph each individual impact area.

When inspecting for wind damage look for multiple areas of wrinkling, especially areas of wrinkling that go across multiple seams; those are less likely to be installation issues and more likely to be wind damage. Look for severe granular loss as this is a primary type of damage to Modified roofs. In fact, the Modified Bitumen Manufacture Association states the granules are the primary water shedding component of the system. If a coating is going to be used, a third-party moisture inspection is required, and I recommend an adhesion test. Remember, a coating is not a new roof but only a maintenance action that will add a few years to an aging roof.

EPDM ROOFS

EPDM is a rubberized membrane that, when old, is easily damaged when exposed to hail. EPDM will have serious latent damage meaning you cannot see all damage immediately after the storm, but it will become clearly noticeable at a later date. Most in our industry agree that EPDM will begin to fracture many months after impacted by the hailstorm.

We were representing a school district in Nebraska years ago, and when we were inspecting the EPDM roofs, we would circle the hail impacts with paint. We made sure to walk every square foot of the roof. We later performed other inspections with engineers and other experts, and every time we would go back to the roof, especially months later, there would be more fractures. In fact, the fractures become more numerous and more visible as the negotiations continued.

TPO ROOF MEMBRANES

The old TPO's (or Thermoplastic Polyolefin) were very susceptible to hail damage when they were more than five years old. They have radically improved the polymers and reinforcement within TPO, so that they are much stronger than they used to be. Still, most TPO that is older than 10 years old is quite susceptible to hail damage. They are also susceptible for inadequate repairs in that the top scrim is worn away to a point where the welds are not as good. The weldability should be tested before major repairs on the TPO are done.

We have also found that mechanically attached systems (especially the systems that used 10-foot rolls of materials between the areas of attachment of the TPO), are highly susceptible to wind up-lift. We have found that the fasteners have been pulled upward and the areas directly around the fasteners have torn on TPO roofs that have been exposed to high winds. Many of those TPO's (especially those installed over 10 years ago), have become too brittle to attach a new membrane to the old.

Here is a small list of items we look for on a TPO inspection:

- Stressed over stretched membrane
- Cuts or tears
- Elongation of the membrane from hail impacts
- Damaged fasteners
- Anvil strike fracture
- Uplifted membrane if totally adhered
- On adhered membrane detachment in area of impact
- Insulation damage
- Mechanical damage
- Seam damage
- Seam wicking

PVC ROOFS

A PVC roof is a good roof to use if exposed to fats or oils that are coming out of vents, like a restaurant. Durolast is one manufacturer of PVC and is commonly known as a roof in a box. Their entire roof is made-to-order in the factory. The fasteners are installed with induction weld plates, and after the roof is laid out, it is welded to the plates. PVC roofs have many of the same problems and damage as a TPO. Most PVC roofs that are over 10 years old are fairly brittle and can be damaged from hail easily. The inspections and assessments are the same as those performed on TPO roofs.

METAL ROOFS

Metal roofs are very common and perform well for many years. The least expensive of the metal roofs are R-panel roofs. This roof is attached by using self-tapping screws through the metal into the decking or peelings. The screws have a small rubber washer that seals the screw from leaking. The seams are sealed with two-sided neoprene gasket and lapped over to keep watertight. The next type of metal roof is a standing seam. The panels vary in length and width but are attached together by bending and rolling the seams together on-site and are installed with clips that are unseen from the top view. They are generally very attractive and watertight.

Many years ago, the insurance companies paid for impact and hail damage to metal roofs very easily, especially when the dents were 1/8 inch deep or more. Now most policies have cosmetic damage waivers that allow for repair only when the metal has holes or where the seams are malformed and are now leaking. This leaves a very unattractive appearance after a hailstorm (Be sure to check your policy to see what your exclusions are).

What we have found is that if the hail is large enough to dent 1/8 inch it cracks the coating and the panels will begin to rust. Hail in excess of two inches usually malforms the seams. Wind can also damage metal roofs by loosening the fasteners and washers or by breaking the seams and seals loose. It can also cause heavy oil canning in the field.

More on Infrared

Infrared is one of the most interesting tools that we have as documenting experts. I would like to explain for new beginners a few things that you want to consider. Today it is very inexpensive to buy a small infrared camera to take images when you are documenting. I believe that inspectors or experts should be certified in thermography, but with just a little training I think even a beginner can use an infrared camera adequately. The first thing you need to understand is. What is the camera seeing? The camera is locating temperature differences. Most cameras are set to where cold is dark blue (or dark in color) and hot is white (or light in color); however you can change it easily to show different colors. So, the first thing you must do is set the parameters within your camera.

If you have ever been on a TPO white roof without your sunglasses, you will know it is very difficult to see anything on that roof, but if you were to put a pair of sunglasses on you can then see much clearer. This is a very basic example of what emissivity is. It is a property that you can place within the

camera so that the camera can see temperature signatures properly. Now I know it's much more difficult than that, but for a beginner, I think that it says enough for you to know how important it is. Most roofing products have a published emissivity value, but if you do not know the emissivity of a product, there is a table in most cameras. This table allows you to scroll through and see what possible color or texture that is on the building you are on. It is also very easy to search the web and find the emissivity of just about every roofing product. The blacker or darker the roofing membrane, the higher the value of emissivity. Total black will be a one (or close to a one), whereas a white roof might have an emissivity of .75.

Although all cameras are different most have these important parameters:

- Emissivity
- Temperature
- Distance
- Reflective temperature
- Relative humidity

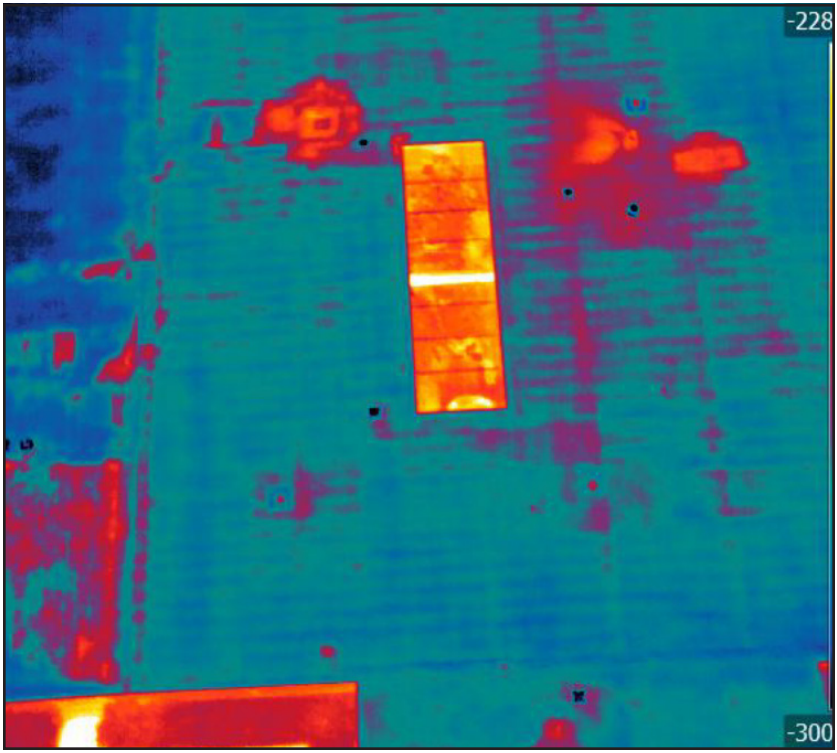
After you set the emissivity, you want to set the ambient air temperature. This can also be found by researching on your phone the closest airport near you. There you can also find the humidity. If you do not know the reflective temperature, you can set it close to the ambient air temperature. After that, set the distance in which you will be photographing the object. When photographing, move to different areas and different angles until the image becomes clearer. Then use a moisture meter to probe or cut a sample, verify moisture is present and use the sample for a Gravimetrical analysis.

Remember, when taking images of a roof, if there are areas of heavy gravel or multiple repairs, they may look like moisture, but are likely false positives. Most infrared cameras have a laser on them, and it is great if you could have someone else help you, so that you may mark the areas (especially the edges of an area), that are showing potential moisture. Then the next day, investigate to see if they are wet. After my initial cuts for a known wet and a known dry, I will then use a moisture meter probe to go inside the membrane and into the insulation to check and verify other potential areas of moisture. It is much easier to repair two small pinholes of a moisture probe than a 12"x 12"core cut. Remember that repaired areas of build up or metallic items will also all be

false positives.

If there are trees that are very close, it could be shadowing the building - that could also be shown as a false positive. Remember to do your infrared on a roof at least one hour after dark, as the images will not be accurate if you do them during the day. See ASTM Standard C1153 – 10 (2015) for more information.

I also love to use the infrared camera to document and verify moisture whenever there is flood or hurricane damage. It is also useful on leaks that have come from above as you can usually see the areas of leaking. Be sure to verify with a moisture meter or moisture probe so you do not document false positives. There are many other uses for the infrared camera. They have some cameras that detect gas leaks, other cameras that are used for finding pain in patients or other medical reasons. Many home inspectors also use infrared to find loss of cooling or loss of heat situations in attic's and within the building envelope. I have even seen where infrared has been used for vermin or termite inspections.

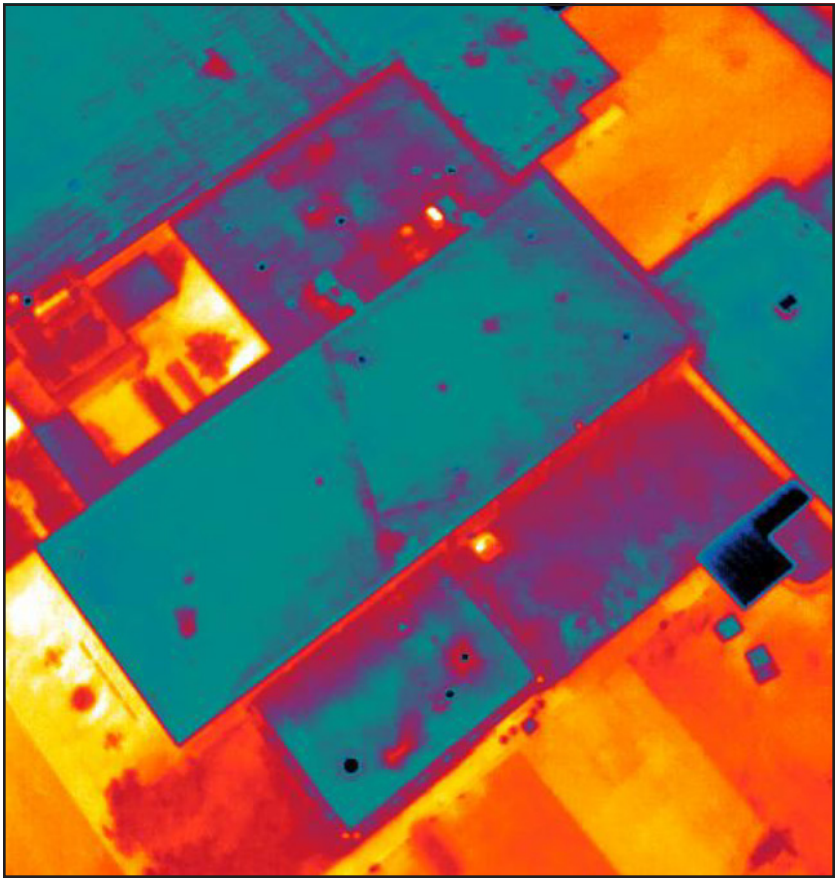


Drones

Drones are here to stay. When I first heard about the creation of drones, I was super interested. It was almost like living in the future. Once I became a drone pilot and started to fly drones, not only did I realize how easy they were to operate, but also how highly technical they were and how good their cameras are. One of my first drone projects was a commercial building in Dallas - a large commercial building that had hail damage to the modified bitumen roof. When I flew the project using video, I also used still shot photos at different angles and different elevations. Back in my office I had some questions about whether the overhead doors have been dented by hail as I forgot to inspect them on my initial walkabout. Using the still photos, I was able to detect the hail damage to the overhead doors. This is when I realize how valuable these little flying spaceships were.

I also do a lot of expert work, and I love the drone because I can fly it to an altitude of 400 feet and then start a video. It takes in most of the building while flying directly to the entrance of the building, where I then will show other photos in my presentation. I had a large appraisal I was doing where a Judge was the Umpire. I flew the drone and did a video and inserted several still shot photos. I then emailed the video to both parties explaining the damages.

It is also very important when a storm such as a tornado or hurricane has damaged an area to get initial photos and videos of the widespread damage. A pilot must be careful to make sure he doesn't break any laws because in most disaster areas or areas of catastrophe there's a no-fly zone. Be sure you get proper authorization, or you could be fined as much is $25,000.



Some of my most favorite drone work is Infrared or flights at night. In order to fly a drone at night you not only have to have a 107 drone pilots license, but you also must have a waiver through the FAA. There are many requirements that need to be met when flying at night. I was hired by City of Abilene to do infrared and daytime drone photos after a hailstorm. I applied for and received a waiver as there are large areas of airspace (Abilene Regional and Dyess AFB,) so my waiver was very limited as so many of the city buildings were within the airspace. They would only issue a waiver for a 5-mile radius. I used my bush plane, an Aviat Husky, and hanging out my window at ridiculously slow speeds we did our infrared. It was kind of cool because a lot of the buildings that the city owned were at the airport, and when you're flying an Aircraft you can request permission to fly at low levels for photography as well as in different places of the airspace. Mostly because you're in direct communication with the tower.

While I was flying and photographing the buildings, I took an aerial photo of the control tower and had it sent to the personnel in the tower. They were very appreciative as it was a very cool photo in iron bow which is a pallet used for infrared.

I also like drones for difficult inspections like high-rise buildings. After a hurricane, it is great to fly the high-rise buildings along the coast. Many times, you can attach an infrared camera and inspect the windows for an anomaly that can be seen if the seal has been broken. It usually looks like a circle of a heat signature in the middle of the glass. But even the visual inspection is great as you can fly the drone and take multiple pictures that can then be used to zoom in and inspect rather than having to use scaffolds. Also, the rules from the FAA allow for you to stay within 400 feet of that building so if that building is over 400 feet tall you can still fly it and stay within the regulations.

Please be sure to check all regulations before flying. Below is the LAANC or Low Altitude Authorization and Notification Capability. It is an app that gives you permission almost instantly. See Below.

UAS Data Exchange (LAANC)

This section can be found fully on the Federal Aviation Administration website.

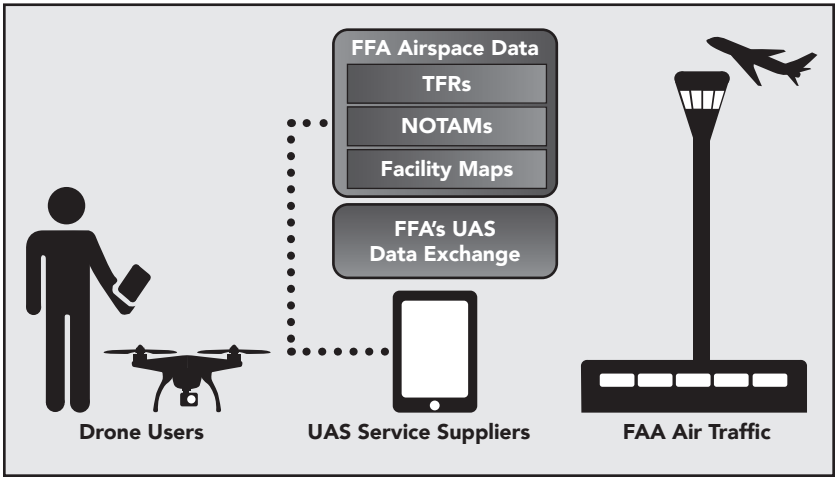
The FAA UAS Data Exchange is an innovative, collaborative approach between government and private industry facilitating the sharing of airspace data between the two parties. Under the FAA UAS Data Exchange umbrella, the agency will support multiple partnerships, the first of which is the **Low Altitude Authorization and Notification Capability (LAANC).**

What is LAANC? LAANC is the Low Altitude Authorization and Notification Capability, a collaboration between FAA and Industry. It directly supports UAS integration into the airspace.

LAANC provides:

- Drone pilots with access to controlled airspace at or below 400 feet.
- Awareness of where pilots can and cannot fly.
- Air Traffic Professionals with visibility into where and when drones are operating.

Through the UAS Data Exchange, the capability facilitates the sharing of airspace data between the FAA and companies approved by the FAA to provide LAANC services. The companies are known as UAS Service Suppliers – and the desktop applications and mobile apps to utilize the LAANC capability are provided by the UAS Service Suppliers (USS).



How does it work? LAANC automates the application and approval process for airspace authorizations. Through automated applications developed by an FAA Approved UAS Service Suppliers (USS) pilots apply for an airspace authorization.

Requests are checked against multiple airspace data sources in the FAA UAS Data Exchange such as UAS Facility Maps, Special Use Airspace data, Airports and Airspace Classes, as well as Temporary Flight Restrictions (TFRs) and Notices to Airmen (NOTAMs). If approved, pilots can receive their authorization in near-real time.

Unless specifically requested in an authorization, drone pilots do not need to notify the tower before they fly.

LAANC provides airspace authorizations only. Pilots must still check NOTAMs, weather conditions, and abide by all airspace restrictions.

How and when can drone pilots use LAANC? Drone pilots planning to fly under 400 feet in controlled airspace around airports must receive an airspace authorization from the FAA before they fly.

The LAANC capability is available to pilots operating under the Small UAS Rule Part 107, OR under the exception for Recreational Flyers.

Access to the capability is provided through one of the FAA approved UAS Service Suppliers listed **BELOW**. There are two ways to use LAANC:

- To receive a near real-time authorization for operations under 400 feet in controlled airspace around airports. (available to Part 107 Pilots and Recreational Flyers)
- To submit a "further coordination request" if you need to fly above the designated altitude ceiling in a UAS Facility Map (up to 400 feet). Applicants may apply up to 90 days in advance of a flight, and the approval is coordinated manually through the FAA (available to Part 107 pilots only).

To qualify under Part 107, you must register your drone and hold a Remote Pilot Certificate.

To qualify as a Recreational Flyer, you must register your drone and follow these steps.

Note: If you are planning an operation in controlled airspace that requires a waiver AND an airspace authorization you must apply for both through the FAA's DroneZone.

Where can I fly under LAANC? LAANC is available at approximately 400 air traffic facilities covering about 600 airports. If you want to fly in controlled airspace near airports not offering LAANC, you can use the manual process to apply for an authorization.

LAANC is in beta and seeks to test its capability nationwide; the results will inform future expansions of the capability. Updates and expansions to LAANC will be announced here.

Approved LAANC UAS Service Suppliers. The following companies have completed the technical steps required — and entered into agreement with the FAA to provide LAANC Services:

List of FAA approved companies providing LAANC Services

Approved Service Supplier	Part 107 Near Real Time Authorization	Part 107 Further Coordination	Exception for Recreational Flying/ Section 44809
Aerodyne	✔	✔	
Airbus			
AirMap	✔	✔	✔
Airspacelink	✔	✔	✔

List of FAA approved companies providing LAANC Services			
Approved Service Supplier	**Part 107 Near Real Time Authorization**	**Part 107 Further Coordination**	**Exception for Recreational Flying/ Section 44809**
AirXOS	✔	✔	
Altitude Angel			
Avision	✔	✔	
Botlink	✔	✔	✔
Collins Aerospace	✔		
Converge	✔	✔	
DJI			
Drone Up	✔		
Harris Corporation			
Kittyhawk	✔	✔	✔
Project Wing			
Simulyze	✔	✔	✔
Skygrid	✔	✔	✔
Skyward	✔	✔	
Thales Group			
UASidekick	✔	✔	✔
Unifly			
✔ = Publicly available service			

This list will be updated as additional partners are approved.

Note: Reference in this site to any specific commercial product, process, or service, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or favoring by the Federal Aviation Administration.

Flying Drones Near Airports (Controlled Airspace) – Part 107: Under part 107, drone pilots planning to fly in controlled airspace must get permission from the FAA. You can submit requests for authorization to fly in controlled airspace near airports via these two systems:

1. Low Altitude Authorization and Notification Capability (LAANC)
2. DroneZone

Using LAANC: LAANC automates the application and approval process for airspace authorizations. Through applications developed by FAA approved UAS Service Suppliers (USS) of LAANC, drone pilots can request an airspace authorization to fly in controlled airspace around airports.

When a drone pilot submits a request through an LAANC USS, the request is checked against multiple airspace data sources in the FAA UAS Data Exchange. If approved, pilots receive their authorization in near-real time. LAANC also provides FAA's Air Traffic visibility into where and when planned drone operations will take place.

LAANC is available at nearly 300 air traffic facilities covering approximately 500 airports.

A full list of Approved UAS Service Suppliers is available here. (WHERE?)

Important Limitations:

- LAANC only accepts airspace authorization requests that are fully compliant with Part 107.
- Airspace authorizations granted through LAANC are valid for 12 hours.
- LAANC authorizations cannot be combined with Part 107 waivers. For example, if you get permission to fly in Class D airspace through a LAANC application, and you already have a waiver to fly at night, you may not combine the permissions to fly in that Class D airspace at night. In order to fly in controlled airspace using your waiver, you must submit a request for an airspace authorization via the DroneZone.

Importance of Having a Protocol

Protocol is defined as a code prescribing strict adherence to correct etiquette and precedence.

In order to train yourself and your people you must do things the same way every time. Protocol teaches others the proper, proven way to take certain steps so that the outcome will be met with success each time. Discipline yourself to do things the same way. Protocol and checklists allow for everything to be documented and organized as it will be used in all aspects of the inspection.

Before an inspection, check that you have all tools necessary:

- Building access information: Ladders!
- Printed roof cad or Google aerial image
- Clipboard and notepad
- Chalk
- Tape measurer
- Camera (not cell phone) SD Cards!
- Extra batteries
- Crack gauge/metal gauge
- Soap stone or grease pencils
- Razor knife (for cutting cores)
- Core tool

Setting things up beforehand will also help you to connect the dots to damage. From photos to report writing, to sending things to the lab, everything flows when there is a system in place to ensure efficiency and accuracy. Going about things the same way every time will save you time and allow for others to be able to trust your work and results. Our company is strict on protocol., If any step is missed or overlooked, the inspector will have hell to pay. I have made my guys go back to the job on their own time before. It's that important. Below is an example of what our staff checks for prior to an inspection:

Protocols have a special place in our offices. It has taken us years to develop the perfect way for inspecting and processing our inspections and reports. It's all about finding the right steps that promote efficiency that are least likely to put you or your staff in any sort of risk. We have protocols for almost every step, from client intake to that final e-mail that we send when we have completed a job.

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CORE Forensics

Chain of Custody

Company Name _____ Submitters Name _____ Submitters Phone # _____

Laboratory ID# _____ Client E-Mail Address _____

Date Samples Taken _____ Submitters Signature _____

Sample #	Sample Address	Description of Sample and Testing Requested

For CORE Forensics Use Only: Samples Received By _____ Date Samples Received _____

Recipient Signature _____

Sample Chain of Custody form

Before the Inspection

Information I like to know prior to my initial inspection:

- Know previous conditions, previous storms, insurance company, is there an adjuster involved, ongoing claim, public adjuster? All these things are important. You can ask your client for a cheat sheet of their coverages. It will give you a lot of information so you can advise your client appropriately.
- Know the myths - what is accurate and what cannot occur when inspecting a roof.
- When documenting, be sure to include "customer reported" if the customer told you something in case it isn't accurate. If it is a big issue, have them sign an affidavit or have them send you an email recording it, etc. Be sure to use your expertise also. Make sure that your estimates are accurate and factual.
- Look for things out of place.

Especially early on, you must document the damage that is there. It's extremely beneficial to be on a loss before anyone allows tarps to be put up. That may be difficult because you are busy after a storm, but if train your people, do drone work, get your people there early, and do some scheduling early on, you will be fine. Damage that is great today may not be there tomorrow - like that huge spatter that will eventually look like something much smaller. Capture the real damage early on.

Storm Data Collection

You should know the date of the storm, the strength, the direction and have an idea about the type of damage you will find before you inspect the roof.

Some great sites to start your weather research on:

- Hail Strike: www.hailstrike.com
- Interactive-hail-maps: www.interactivehailmaps.com
- NOAA: www.noaa.gov
- Weather-underground: www.weatherunderground.com
- Weather channel: www.weather.com
- Social Media

Knowing your date of loss is paramount when it comes to storm damage assessment. (NOAA is a great resource for this). Use multiple sources so that you can ensure that it is correct. Someone must see it and document it. Just because the radar picked up a storm doesn't mean it caused damage. Date of Loss (DOL)must be accurate. There will always be an argument about the date of loss and "old damage," so searching previous storm data is paramount.

Look for things out of place. One time we identified a date of loss that was erroneous. The client said the damage had happened in the past couple of months, and after researching we found a date that made sense with high winds at a nearby airport, but this date of loss was actually not a possible date but rather an anomaly in the airports' equipment! Thankfully we always double-check our data and after researching this potential windstorm further we found that it was in fact not a storm at all. In the next chapter you will learn more about weather and meteorology from Meteorologist Rocco Calaci.

Weather and Meteorology for Storm Damage Assessment

By Rocco Calaci

When Don Lamont approached me about contributing information on how meteorology and weather affects damage assessments, I was both honored and panicked. While weather patterns can be a factor in causing damages to property, where would I even start?

Over my 50 years of operational meteorological experience, I have learned it's not always about researching the highest wind speed, or the largest hailstone or the hottest/coldest temperature, but the application of many other meteorological features that are a main factor in how weather elements generated the observed damages. For example, during a review of hail damage to a property, everyone focuses on the maximum size of the hailstones, yet most people forget to understand that the accompanying wind field plays an enormous part in how much damage that hailstone generated.

There have been numerous times when the maximum hailstone from a hail event may only be 1.5 inches in diameter, but the adjusters, engineers and roofers tell me that my hailstone size is incorrect, because the dents on the roof or siding are much larger.

When I explain that the accompanying wind was 35 miles per hour or greater, they understand that when you factor in the accompanying wind field, the kinetic energy of the hail event increases dramatically; therefore it is logical to expect and find damages equal to hailstones larger than 1.5 inches even though that was the maximum measured hailstone.

Here is another way to look at it: If I tossed a ping-pong ball at you from only a few feet away, you probably would not feel any pain or discomfort when the ping-pong ball hit you. If I threw the same ping-pong ball at you from across the room at a speed of 40 miles per hour, the ping-pong ball would definitely cause pain (probably leaving a significant bruise), and you would learn that winds accompanying a hail event are a major factor to determine when trying to assess damage to that property.

In this section of the book, I will share with the reader some of the tables and subjective or objective methods used by meteorologists to assess potential property damage. Most of these tables will provide "expected" damage levels,

based upon the current weather phenomena (i.e. wind, hail, tornadoes, etc.). I will also provide information on how meteorologists use these methods to quantify potential damage assessment, the strengths and weaknesses of each of these methods, and a bit of how each method was developed.

NOAA SED and SWDI

Before I move on, allow me to explain the National Oceanic and Atmospheric Administration (NOAA) Storm Events Database (SED) and the NOAA Severe Weather Database Inventory (SWDI). Both of these products are available on the Internet and free for public use. All you have to do is Google the appropriate product and you will be directed to the link for the requested product.

(For example, if you Google "NOAA Storm Events Database", you will receive a direct link to this product.)

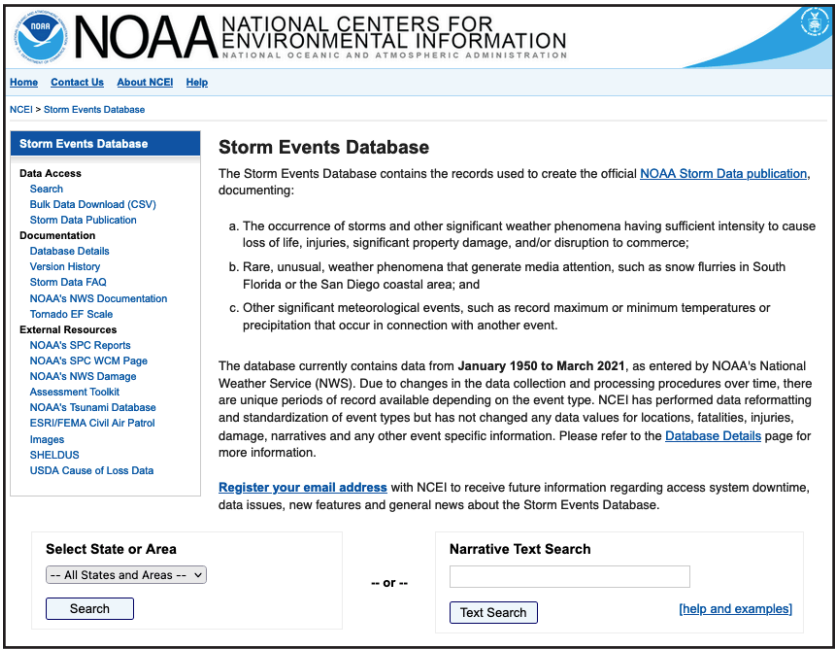


Figure 1 Landing Page for NOAA Storm Events Database
https://www.ncdc.noaa.gov/stormevents/

The SED is a compilation of "reported" weather elements for any specific date, based upon individual counties in each state. For example, if you are trying to determine if hail/wind/tornadoes/extreme heat or extreme cold affected a specific county, you would start at the SED. You will select the State on the drop-down menu, then select the date range of interest from the provided calendar. Once you have selected a range of dates, you simply choose the weather element you are researching (i.e. hail), then click on the appropriate county and you will receive a table of any and all "reported" hail events in that specific county for your selected range of dates.

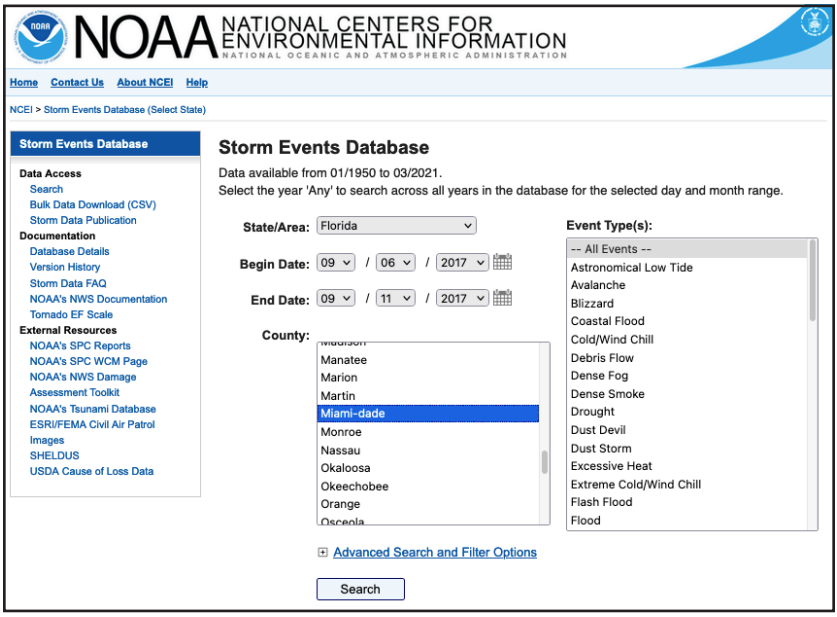


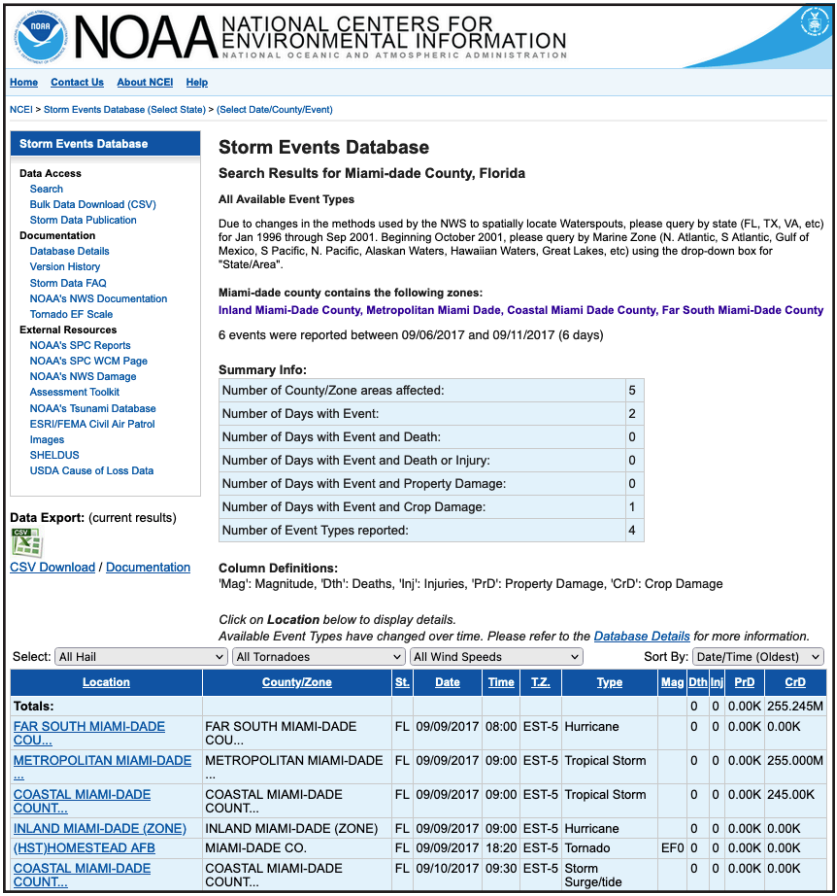
Figure 2 NOAA SED Selection Page

The SED is a great place to start any assessment of potential damage in the United States. I use the SED often to get a "first look" of what occurred on any given day or time period, for any given county in our country.

One strong point of the SED is that you can choose "All Events" and receive any reports submitted through the proper channels for the date or time period selected. This makes your search easier, faster and more comprehensive. If you choose only one weather element (i.e. hail), you will only receive information specific to that elemeent. By choosing "All Events", you

will also receive any major wind data, information on any other accompanying weather element and have a more complete idea of what occurred on the date in question.

One word of caution: the SED only provides information from "reported" events. In other words, if large hail occurred, but no one reported it through the proper channels, it won't show up on the SED summary. This doesn't mean hail didn't occur; it only means that it wasn't reported. When using the SED, remember that this product only lists "reported" weather events that were reported for that location, for that particular instance, in one particular way.



NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home Contact Us About NCEI Help

NCEI > Storm Events Database (Select State) > (Select Date/County/Event)

Storm Events Database

Data Access
Search
Bulk Data Download (CSV)
Storm Data Publication
Documentation
Database Details
Version History
Storm Data FAQ
NOAA's NWS Documentation
Tornado EF Scale
External Resources
NOAA's SPC Reports
NOAA's SPC WCM Page
NOAA's NWS Damage Assessment Toolkit
NOAA's Tsunami Database
ESRI/FEMA Civil Air Patrol Images
SHELDUS
USDA Cause of Loss Data

Data Export: (current results)
CSV Download / Documentation

Storm Events Database

Search Results for Miami-dade County, Florida

All Available Event Types

Due to changes in the methods used by the NWS to spatially locate Waterspouts, please query by state (FL, TX, VA, etc) for Jan 1996 through Sep 2001. Beginning October 2001, please query by Marine Zone (N. Atlantic, S Atlantic, Gulf of Mexico, S Pacific, N. Pacific, Alaskan Waters, Hawaiian Waters, Great Lakes, etc) using the drop-down box for "State/Area".

Miami-dade county contains the following zones:
Inland Miami-Dade County, Metropolitan Miami Dade, Coastal Miami Dade County, Far South Miami-Dade County

6 events were reported between 09/06/2017 and 09/11/2017 (6 days)

Summary Info:

Number of County/Zone areas affected:	5
Number of Days with Event:	2
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	0
Number of Days with Event and Crop Damage:	1
Number of Event Types reported:	4

Column Definitions:
'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

*Click on **Location** below to display details.*
Available Event Types have changed over time. Please refer to the Database Details for more information.

Select: All Hail | All Tornadoes | All Wind Speeds | Sort By: Date/Time (Oldest)

Location	County/Zone	St.	Date	Time	TZ.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	0.00K	255.245M
FAR SOUTH MIAMI-DADE COU...	FAR SOUTH MIAMI-DADE COU...	FL	09/09/2017	08:00	EST-5	Hurricane		0	0	0.00K	0.00K
METROPOLITAN MIAMI-DADE ...	METROPOLITAN MIAMI-DADE ...	FL	09/09/2017	09:00	EST-5	Tropical Storm		0	0	0.00K	255.000M
COASTAL MIAMI-DADE COUNT...	COASTAL MIAMI-DADE COUNT...	FL	09/09/2017	09:00	EST-5	Tropical Storm		0	0	0.00K	245.00K
INLAND MIAMI-DADE (ZONE)	INLAND MIAMI-DADE (ZONE)	FL	09/09/2017	09:00	EST-5	Hurricane		0	0	0.00K	0.00K
(HST)HOMESTEAD AFB	MIAMI-DADE CO.	FL	09/09/2017	18:20	EST-5	Tornado	EF0	0	0	0.00K	0.00K
COASTAL MIAMI-DADE COUNT...	COASTAL MIAMI-DADE COUNT...	FL	09/10/2017	09:30	EST-5	Storm Surge/tide		0	0	0.00K	0.00K

Figure 3 NOAA SED Results

You can also learn the starting and ending dates and time of the selected weather element through SED. The source of the report will also be available (i.e. public, law enforcement, social media, etc.), and there will be a brief description of the event. SED provides good information, but be cautious not to use it as the sole basis of support for any observed damages where weather phenomena may have been a factor.

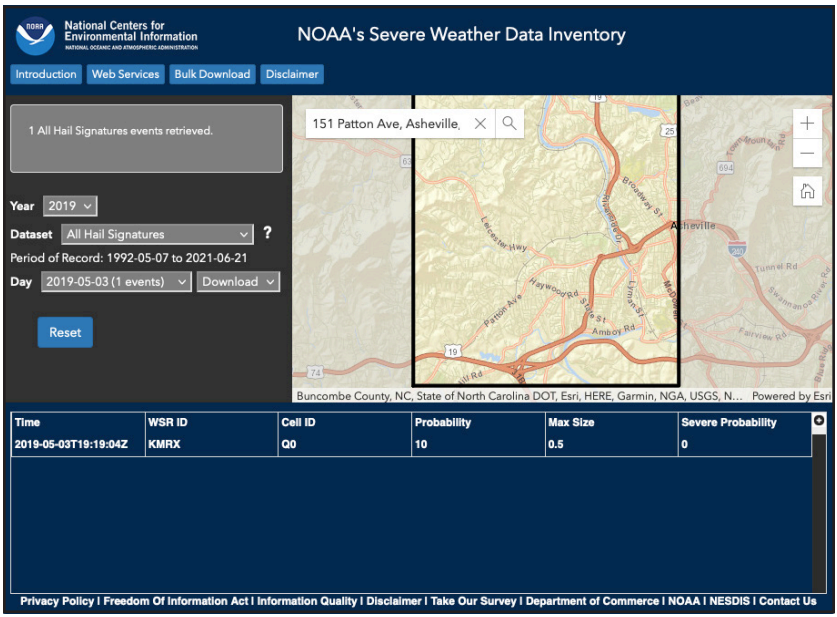


Figure 4 NOAA SWDI Starting Page
https://www.ncei.noaa.gov/maps/swdi/

SWDI is a similar resource as SED, except that it is based on radar-detected weather elements. With the SWDI, you can search for address-specific locations (i.e. 123 Main Street, Anywhere USA). Once you enter the address-specific coordinates, a small map will appear with an icon representing your site-specific address.

Then you choose the year that the weather event occurred and select a radar-detected element, such as hail. All the hail events for the selected year that occurred within a 5-mile radius of your site-specific address will be listed. All you do is click on a date of interest and you will be shown a number of push-pin icons. Each red push-pin represents the center point of the storm that was identified as producing hail in the upper atmosphere.

When you click on the red push-pin icon, you will see relevant data such as the date and time of hail detection, the location of the hail, the radar site that identified the hail, and the location in the atmosphere.

There are several weather elements that can be chosen from the drop-down menu for your selection. You can determine if severe thunderstorms occurred, mesocyclones, tornadic activity, hail events and several other potentially damage-causing weather elements.

The SWDI is another one of my favorite places to start when analyzing for weather elements that may have caused damage. The SWDI is site-specific (in contrast to the SED which is based on county boundaries). The SWDI provides information for numerous weather elements, but unlike the SED, you can only select one weather element at a time for analysis.

Another thing to note is that the SWDI only displays information detected by radar, and there are weaknesses with this set of data. For example, SWDI data is from radars scattered across the country, and at times the radar may be showing data for the upper atmosphere that did not affect the surface.

There are some locations in the United States with little to no radar coverage; meaning the SWDI may not show any weather echoes, but this doesn't mean the weather event didn't occur. It only means that the radars were unable to detect the weather phenomena.

Don't use the SWDI blindly; always have additional information to support any data from either the SED or SWDI products.

When using the SWDI for hail, you will learn the radar that detected the hail, the location of the hail and the cell identifier for tracking purposes. The SWDI will provide a maximum hail size, but remember, this hail size is what has been detected in the upper levels of the atmosphere; it does not always correlate to the hail size that impacted the ground, if it did at all.

Of course, the SED and SWDI have a lot more information to offer, but with practice (or using a qualified meteorologist), you can gather a lot of useful meteorological information from the SED and/or SWDI.

Tornadoes

Believe it or not, when trying to assess the strength or intensity of a tornado, it isn't about the maximum winds of the tornado, but rather the amount of damage it does to buildings. If you see a tornado with internal winds of 200 miles per hour moving through an empty field that causes no damage to any structure, it is rated an EF0 tornado (the weakest category for tornadoes). Conversely, if a small, compact tornado strikes a building and completely destroys the structure, it may be rated an EF5 tornado (the strongest tornado category).

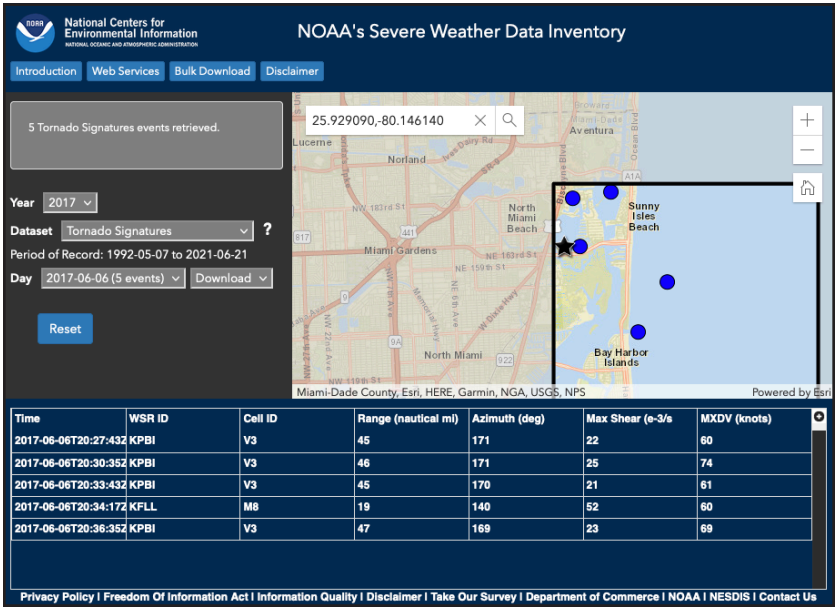


Figure 5 NOAA SWDIResults for Tornado Vortex Signatures - July 6, 2017

The EF stands for "Enhanced Fujita". The original Fujita Scale (F0 through F5), was conceived by Dr. Ted Fujita in the early 1970s, but was extremely vague and subjective. In 1998, the Enhanced Fujita Scale was developed by a team of engineers and meteorologists in an attempt to refine the differing levels of damage caused by tornadoes. The Enhanced Fujita Scale provides 27 categories of structures and breaks down the lower and upper boundaries of wind speeds and the expected level of damages based upon

wind speeds.

Figures 6a and 6b are Table 4: *One- and Two-Family Residences (FR12)* from the Enhanced Fujita Scale. This table provides a general description of construction, a table showing degrees of damage (DOD), damage description,

Table 4. One- and Two-Family Residences (FR-12)

Typical Construction

- Asphalt shingles, tile, slate and metal roof covering
- Flat, gable, hip, mansard or mono-sloped roof or combinations thereof
- Plywood/OSB or wood plank roof deck
- Prefabricated wood trusses or wood joist and rafter construction
- Brick veneer, wood panels, stucco, EIFS, vinyl or metal siding
- Wood or metal stud walls, concrete blocks or insulating-concrete panels
- Attached single or double garage

DOD*	Damage Description	EXP**	LB	UB
1	Threshold of visible damage	65	53	80
2	Loss of roof covering material (<20%), gutters and/or awning, loss of vinyl or metal siding	79	63	97
3	Broken glass in doors and windows	96	79	114
4	Uplift of roof deck and loss of significant roof covering material (>20%); collapse of chimney; garage doors collapse inward or outward; failure of porch or carport	97	81	116
5	Entire house shifts off foundation	121	103	141
6	Large sections of roof structure removed; most walls remain standing	122	104	142
7	Exterior walls collapsed	132	113	153
8	Most walls collapsed in bottom floor, except small interior rooms	152	127	178
9	All walls collapsed	170	142	198
10	Destruction of engineered and/or well constructed residence slab swept clean	200	165	220

**DOD is Degree of Damage **Wind Speed values are in mph*

Figure 6a - Table 4 - Enhanced Fujita Scale

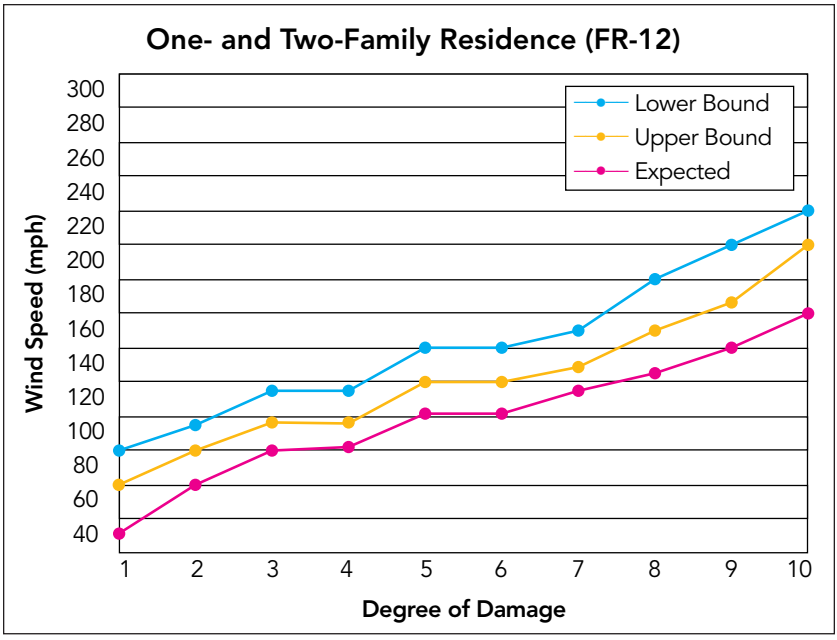


Figure 6b - Table 4 - Enhanced Fujita Scale

and the lower and upper boundaries of wind speeds that may cause this level of damage.

In my opinion, the Enhanced Fujita Scale is the most detailed of all the tools used by meteorologists for levels of potential damage. When developed, the EF Scale was a collaboration of engineers and meteorologists in an attempt to be more objective than subjective. Still, the Enhanced Fujita Scale does not cover all possible scenarios and remains highly subjective. In my experience, I have found that while general damages may seem severe, an experienced engineer and/or adjuster makes a more detailed inspection and provides a better assessment of tornadic strength.

Because the classification of tornado intensity is based solely on observed damages, the statistics for tornado activity are somewhat skewed towards weaker tornado categories. For example, if we had 5 tornadoes, and all of them had registered winds of over 200 miles per hour yet resulted in no structural damages, the record books would reflect 5 EF0 tornadoes.

As with hail and other weather elements, using an experienced meteorologist should provide detailed insight to how damages may have occurred, through the use of other meteorological data.

Sources to find tornado information are also the NOAA SED and/or SWDI tools. Again, the SED only provides data on "reported" tornadoes. The majority of tornadoes go un-reported for various reasons, and if you believe tornadic activity existed, but it is not listed on the SED and/or SWDI, you can always have a meteorologist use NEXRAD data to determine if the required radar signatures occurred at your site-specific location on certain dates.

Wind

When assessing damage due to wind speeds, there are several subjective tables and methods used by meteorologists to determine wind speeds based solely on observed damages. The first thing to know is that wind data is based upon the winds at 33 feet above the ground. This height (33 feet) is where surface friction dramatically decreases and provides better representation of what we know as "unfettered" winds. This means that winds are moving with minimal effect from surface friction.

Table 1.
Mean Hurricane Eyewall Wind Variation with Elevation

Height (ft)	Number of Stories	Wind (% surface)	Pressure Force (% surface)
33 (sfc)	3	100	100
50	5	103	106
100	10	108	117
150	15	111	123
200	20	115	132
250	25	117	137
300	30	119	142
400	40	121	146
500	50	123	151
600	60	125	156
750	75	128	164
1000	100	131	172

Figure 7 - Table 1 - Mean Hurricane Eyewall Wind Variation with Elevation

As you go higher into the atmosphere, wind speeds generally increase. When assessing damage potential from wind for a tall structure, theoretically, wind speeds should be higher at the top of a tall structure than at the bottom of the structure. Meteorologists have a "general" table from the National Hurricane Center that provides statistical data on how to compute wind speeds at various levels.

Knowing the difference in wind speeds from the ground level to the top of a tall structure allows an engineer or adjuster to determine any vertical shear experienced by the structure, resulting in damage.

At most locations we don't have wind measuring equipment to record the wind speeds throughout the day, but the National Weather Service has a table that correlates a range of sustained wind speeds to observed damages for a location (sustained winds are the average wind speed over a 2-minute time period). Figure 8 is a table that is part of the United States Federal Manual of Reporting Surface Weather Observations and is mandated by the National Weather Service, when wind measuring equipment is not available.

Table 5-1. Estimating Wind Speed

Knots	Specification	Knots	Specification
<1	Calm; smoke rises vertically	22-27	Large branches in motion; whistling heard in overhead wires; umbrellas used with difficulty
1-3	Direction of wind shown by smoke drift not by wind values	28-33	Whole trees in motion; inconvenience felt walking against wind
4-6	Wind felt on face; leaves rustle; vanes moved by wind	33-40	Breaks twigs off trees; impedes progress
7-10	Leaves and small twigs in constant motion; wind extends light flag	41-47	Slight structural damage occurs
11-16	Raises dust, loose paper; small branches moved	48-55	Trees uprooted; considerable damage occurs
17-21	Small trees in leaf begin to sway; crested wavelets form on inland waters	56-71	Widespread damage

Figure 8 - Table 5.1 - Estimating Wind Speed

The table above is also known as the Beaufort Wind Scale, which more people are familiar with as a guideline in determining wind speeds by ob-

served damages. The Beaufort Wind Scale is used for sustained winds only. There are numerous times when this table has been mis-used because someone applied wind gusts, instead of sustained winds.

Over my many years of experience, some people dismiss the Beaufort Scale because it was initially designed in 1805, but the World Meteorological Organization has continually updated the Beaufort Scale. This method is still being taught at universities and other schools around the world as an accepted method of secondary wind measurement, using observed damages as the basis of speed determination. Still (as with other methods listed in this document), the assessment of damage is extremely subjective and therefore could provide an inaccurate determination of wind speed.

For example, when trees are uprooted and considerable damage occurs, the estimated range of sustained wind speed is 48 to 55 knots (55 to 63 miles per hour). The problem lies in the definition of "considerable damage". What one person believes is "considerable damage" may not be the same as a different engineer and/or adjuster.

The National Weather Service issues a bulletin called a "High Wind Warning". The definition of High Wind is as follows:

High Wind: Sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.

This means that "high wind" occurs whenever the sustained wind speeds met and/or exceed the thresholds listed in the definition. These thresholds are the lower boundary of potential property damage as defined by the National Weather Service.

A "High Wind Warning" is defined as follows:

High Wind Warning: This warning is issued by the National Weather Service when high wind speeds may pose a hazard or is life threatening. The criteria for this warning vary from state to state.

The National Weather Service may issue a High Wind Warning by itself, or it may be part of a larger weather threat such as hurricanes and/or tornadoes. When doing a damage assessment based upon wind, please remember that the National Weather Service understands that sustained winds of 40 miles per hour and greater for a minimum of one hour may lead to property damages or loss of life.

Hurricanes

Hurricanes are one of the more destructive weather elements and also one of the most mis-understood. When hurricanes occur, everyone wants to know the maximum wind gust and the highest storm surge, yet hurricanes have several embedded features that cause significant damages. Within a hurricane, there are tornadoes, microbursts, mesocyclones and rapidly changing wind direction that can result in significant ground damage.

Another element of hurricanes is the duration that sustained wind speeds affected an area. There are plenty of engineering studies and calculations based solely on the maximum wind gusts, but there are no studies (that I'm aware of), that address the duration of time for sustained winds.

Everyone wants to know the maximum wind gust and uses this value to determine if the wind was responsible for observed damages. At the same time, no one is looking at the fact that structures experience high-level sustained winds for hours during a hurricane, which may result in structural failure.

A good example is Hurricane Irma in 2017. Though the maximum wind gusts along the eastern coastline of Florida were between 100 to 110 miles per hour, few people acknowledged that the sustained winds exceeded 60 to 70 miles per hour for 8 to 12 hours.

I use a boxing analogy to describe this philosophy: imagine a well-built house as a 6-foot-tall, 200-pound person. The house (person) is anywhere from 1 to 90 years old. According to engineering calculations, this house may require a knockout punch from a heavyweight boxer that correlates to 140 miles per hour.

If that house (person) is subjected to a continual pounding by a lesser wind (or boxer) for several hours, you won't need a heavyweight to provide the knockout punch, and it may only take a wind gust of 100 miles per hour after receiving hours of pummeling by lesser winds (punches).

With Hurricane Irma, the eastern coastline of Florida received widespread damages, yet the maximum wind gusts did not meet the results of engineering studies that would have caused this level of damage.

After in-depth analysis, I found that most locations along the eastern coastline of Florida endured up to 16 hours of tropical storm force sustained winds with several hours where the sustained winds exceeded 60 to 70 miles per hour.

On top of the numerous hours of sustained winds above tropical storm force strength, there were tornadic vortices, mesocyclones and microbursts embedded within the hurricane wind field that played a major part of damage

along this stretch of the Florida coastline.

Here is an example of radar-detected mesocyclones for a location in Boca Raton Florida on September 10, 2017 (Hurricane Irma). On that one day, there were 54 mesocyclones detected by weather radar within a 5-mile radius of this location, plus another 16 Tornado Vortex Signatures also detected by weather radar within a 5-mile radius for the same location.

- *Please note that this information was gathered using the NOAA SWDI tool.*

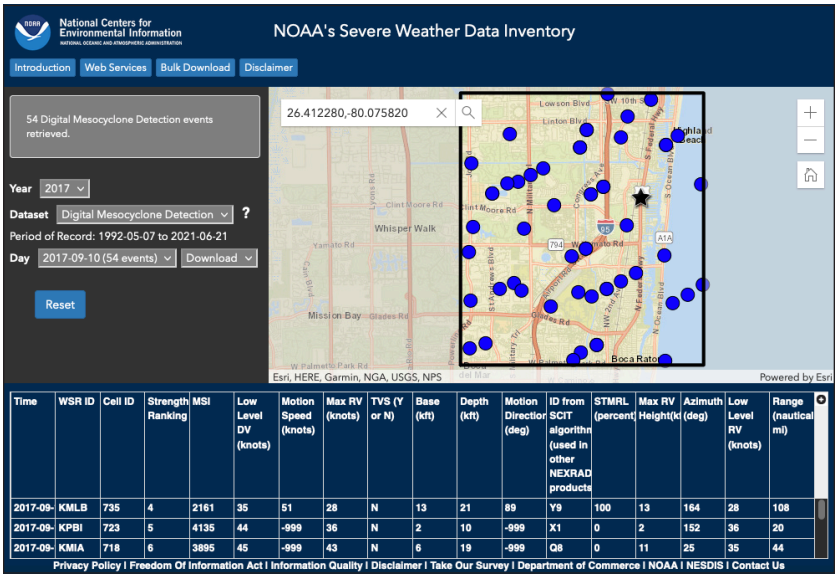


Figure 9 - SWDI Mesocyclones – September 10, 2017

When we consider hurricanes, we must look at all the potential weather elements that may cause damages, not just the maximum wind gusts and/or storm surge. Hurricanes are an event based upon duration of the storm and the embedded elements such as tornadoes, mesocyclones and microbursts.

Hurricanes have their own scale to determine intensity based on observed damages. It is called the Saffir-Simpson Scale. The Saffir-Simpson Scale was developed in 1969 in response to the destruction caused by Hurricane Camille along the Mississippi coastline that year. The scale has 5 categories (1 – 5), and they are confusing, subjective and have never been verified; yet whenever we hear about hurricane intensities, it is always based upon the Saffir-Simpson Scale.

The scale is built on the premise of a 1-minute sustained wind, though all

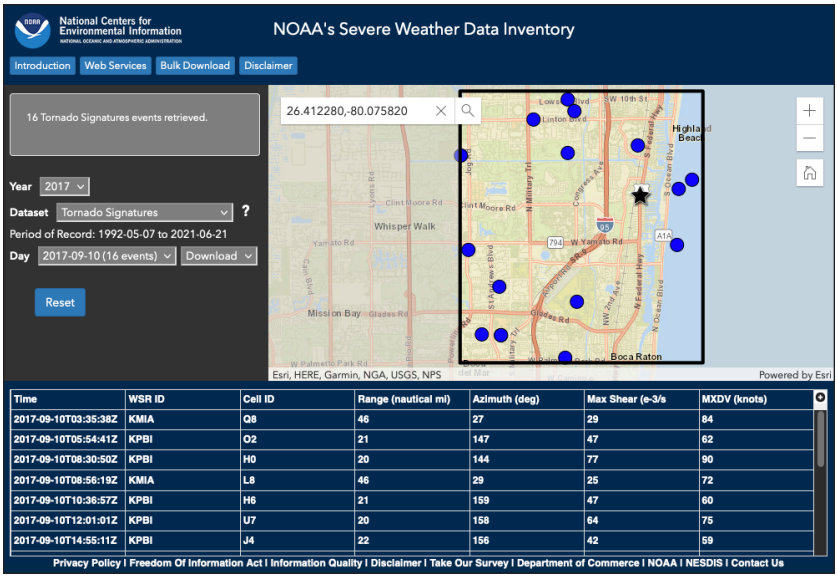


Figure 10 - SWDI – Tornado Vortex Signatures – September 10, 2017

wind measurements in the United States report a 2-minute average sustained wind. Though there are equations and methods to convert a 2-minute sustained wind speed to a 1-minute sustained wind speed, the numbers are only a "general" conversion and not site-specific or storm-specific.

When using the Saffir-Simpson Scale, it is extremely subjective on what constitutes "damage". One engineer may determine a house is destroyed if several walls are missing or if the roof is torn off. Based on this analysis, the hurricane would be classified as a Category 3, 4 or 5. Another engineer may think the same house is repairable and determine the hurricane was only a Category 1, 2 or 3.

The Saffir-Simpson Scale is a projection of maximum damage potential, based solely on expected wind speeds of a hurricane. The Saffir-Simpson Scale has been great for public consumption because it allows the public to understand the maximum strength of potential land-falling hurricanes.

At the same time, it is very misunderstood. For example, many people and commercial businesses base their responses to a hurricane on the designated category of the storm. If the hurricane is designated as a Category 2 storm, most people and commercial businesses have a protocol in place, which determines their response. The response for a Category 2 hurricane is most likely less restrictive as the preparation for a Category 3 hurricane. This makes no

sense to me because the only difference between Category 2 and Category 3 is one mile per hour (110 miles per hour is Category 2, while 111 miles per hour is Category 3).

Structures, trees, people, telephone poles and other things can't tell the difference between a 110 mile per hour wind as compared to a 111 mile per hour wind; yet we have a different expectation of damage when comparing a Category 2 hurricane to a Category 3 hurricane.

This is where a site-specific evaluation is necessary to determine what mix of weather elements may have factored into the observed damages.

The use of wind measurements in nearby areas is extremely helpful in determining the wind speed that may have affected a site-specific location, but it may not be reliable to make a conclusion on what caused the damages.

Again, I go back to the lack of studies on the effects of hours of sustained wind speeds above 50 to 80 miles per hour on any structure.

Hail

One of the most common weather elements that cause structural damages is hail. Hail comes in all sizes and shapes and can be associated with large scale storm systems, or from a single, isolated thunderstorm that drops hailstones over a small area. The development of hail is well-known, but how hail falls, is affected by the accompanying wind field and how it is reported can lead to confusion and inaccurate information.

As stated earlier, when analyzing if hail was a factor in observed damages, you must know the hailstone size and the accompanying wind field. This is when selecting "All Events" on the SED product will yield information such as hail locations, the maximum size of the hail and also any wind information that occurred with the hail event.

The use of NEXRAD products can also provide information pertinent to any hail event. There are several NEXRAD products that allow a user to make a better-informed decision about hail occurrence.

As with other weather elements, there is more to know about hail than just the maximum hailstone size. Not all hail that occurs during one event is of uniform size; meaning that if the maximum hailstone size is 2 inches, it is most likely that the majority of hailstones were smaller than 2 inches. There are no products or tables that provide the average hailstone size.

Another factor when analyzing for hail effects is the duration of the hail event. As with other weather elements, duration is a factor in assessing damage potential. A hailstorm that drops 2-inch hail on a property for less

than 30 seconds, may not cause more damage than a hailstorm that lasts 15 minutes with smaller hailstones.

Hail is frozen water and if you have hail falling on a flat rooftop for 15 to 20 minutes, the accumulated weight of the hail has more potential to result in damage than the actual hail size itself.

There are volunteer organizations across the country, where weather enthusiasts collect weather information (including hail data) and upload it into a national network for everyone to use for various reasons. Though this data is useful, there are many pitfalls if you rely on this type of data collection blindly and without supporting evidence.

Believe it or not, one of the best methods of knowing if hail occurred in the immediate vicinity of a site-specific property is social media. Whenever I have a difficult time trying to pinpoint the occurrence of hail (or any other weather element), sometimes I go to social media. Though you probably won't find a video or social media remark for the exact location you are assessing, you may find a video or social media remark from a nearby location. This can assist you in determining if hail (or any other weather event) occurred in the immediate vicinity of your location.

NEXRAD

Weather radar evolved in the early 1990s; from showing black blobs on green screens to depicting an array of colors and weather elements since the WSR-88D was deployed across the United States in 1992.

The WSR-88D is also known as NEXRAD (Next Generation Weather Radar) and is so accurate that it can provide weather information down to less than half a kilometer, every 4 to 6 minutes over areas of coverage.

Not every square mile of the United states has adequate radar coverage, but the network is supplemented using a smaller version of NEXRAD, known as the Terminal Doppler Weather Radar (TDWR).

NEXRAD has 2 ranges; 124 nautical miles and 248 nautical miles. This allows NEXRAD to see weather echoes close to the radar and also to keep a watch on storms approaching the radar from longer distances. The TDWR can only provide accurate weather information up to 50 miles.

The TDWR is deployed at major airports around the country, while NEXRAD is usually situated at locations that can provide maximum radar coverage for a specific region.

While both NEXRAD and the TDWR can provide similar base products, NEXRAD can generate certain products for hail that cannot be produced by

the TDWR. NEXRAD can also produce numerous other products to assist meteorologists that are not available with TDWR.

For example, NEXRAD produces a product called Hydrometeor Classification. This is a fancy name of saying "what type of precipitation is occurring now". For hail, this product shows the extent of the area affected by hail in red, making it easy to distinguish from other data detected by NEXRAD.

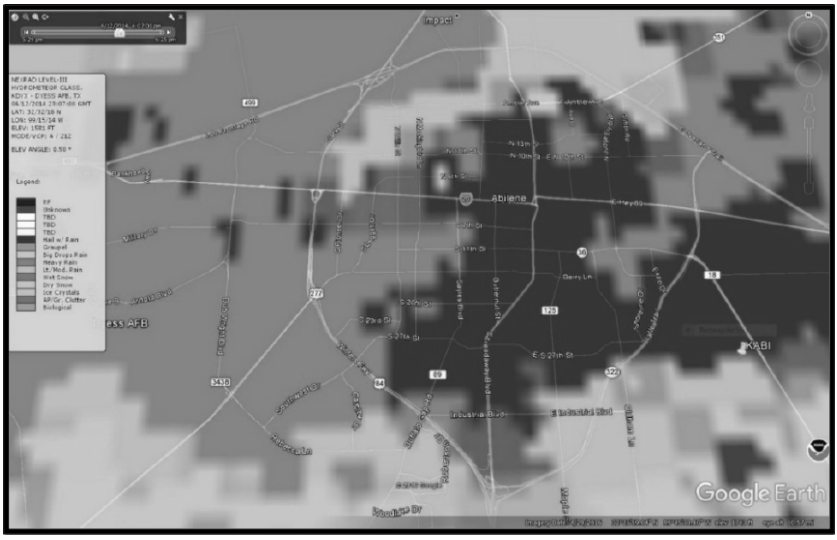


Figure 11 - Hydrometeor Classification

In figure 11, the Hydrometeor Classification shows a large area of hail (red) moving through Abilene Texas in August 2014. It is easy to determine where the hail fell using a series of similar images. For this case, NEXRAD provided data allowing meteorologists to track the hail field and issue warnings for those affected locations.

NEXRAD and TDWR provide a wealth of information and can be used for site-specific analysis. This is especially true, when there are no weather reporting sites close by. In December 2015, the Dallas – Fort Worth area was savaged by multiple tornadoes. Based on the reports from airports in Dallas and Fort Worth, there was no tornadic activity, but NEXRAD detected this tornadic outbreak, allowing the National Weather Service to issue the appropriate warnings and saving countless lives.

NEXRAD can provide instantaneous wind speeds at differing levels of the atmosphere, allow a user to track severe storms and project their movement

into the short-term future; measure details such as the tops of storm clouds, available moisture and storm strength to determine if a microburst occurred; and numerous other analyses that an engineer and/or adjuster can utilize in the damage assessment.

When looking at weather radar data, you must consider data from both NEXRAD and TDWR sites near the location of the observed damages.

Meteorologists

Though most adjusters know where to find weather statistics and information, they may not have the skills required to provide an in-depth analysis of how the different weather elements played a part in property damages. A meteorologist cannot state the type of damages caused by weather elements, but a meteorologist should be able to quantify the magnitude of individual weather elements and provide information that will assist in determining the cause of property damage (when weather is a factor).

When choosing a meteorologist, ask if they are NEXRAD-certified. This certification is granted when the meteorologist attends the official NEXRAD course from the National Weather Service or Department of Defense and is tested with a practical application of knowledge concerning NEXRAD analysis and interpretation. Though most meteorologists know about NEXRAD principles and products, very few have been awarded NEXRAD certification.

When using a meteorologist, don't just ask for one specific weather element such as hail because that is all the meteorologist will look for. Instead ask a meteorologist to analyze any and all significant weather phenomena that may have contributed to any observed ground damage. This means that the meteorologist should be analyzing other weather phenomena such as hail, microbursts, accompanying wind field and any other potentially damaging weather element.

In my 50 years of experience, it is common to find several weather phenomena involved in a weather event, not just one specific type of weather.

If possible, use an operational meteorologist. This type of meteorologist is involved in the day-to-day routine of forecasting weather elements for specific locations and to the public. For example, a meteorologist that spends time forecasting and issuing weather warnings for the public will be more likely to know what products are available and how to properly use them in an analysis, as compared to a meteorologist that deals more with theory than everyday application.

Not all observed property damage is the result of a major storm. Most

hail and tornadic events are the result of isolated and scattered storm systems, where a meteorologist must analyze lots of pertinent data, in order to provide you with an in-depth picture of what happened.

In summary, it's not always about one specific weather element, or the largest hailstone or maximum wind gust. Meteorologists have several "general" tables and graphs to provide a "general" estimate of weather phenomena, the timing, duration and intensity.

For a thorough and detailed investigation of weather elements and to determine if they were a cause of damage, you must remember that there is more to a weather events than what meets the eye.

Report Writing

It is my firm belief that everyone who is involved in documentation and/or inspections should write or contribute to some type of a report. Even when we are doing documentation as an adjuster, we always create an adjuster's report. Many years ago, as a roofing contractor, I always produced a report and estimate for my client.

Most expert report writing falls under general practices of report writing and specifications can be found through many standardizing agencies such as The American Society for Testing and Materials (ASTM), The American National Standards Institute (ANSI), and The International Organization for Standardization (ISO).

Here are some things that I think should be in a report:

- Document title
- Company name, address and contact info
- Internal report number
- Clients name and address
- Date and time of inspection
- Address of location inspected
- Type of inspection requested
- Building type and construction
- Inspection method
- Observations
- Analysis and conclusions or assessments
- Test methods and results (if any)
- Name and signature of who wrote the report
- Statement the report shall not be reproduced
- The option to change or amend report

Some of these items are obvious and are always included in reports, such as "Title" or "Company Name," while others are sometimes not included in reports that I have seen, such as "Date and Time of Inspection". This information is important to demonstrate that conditions during the inspection were both safe and that accurate observations could be made on said date and time.

A good report is concise and well organized. Step number one to writing a report from an inspection is to map out what you're planning on providing. List out the items you are planning on including and check them off one-by-one as you go. This way you won't miss any items, and you'll have a good idea about where you're going and what you have yet to look at. Having a list also helps in case you're missing information. If you understand what was requested of you and the purpose of the report, then you should have no trouble at all downloading that information into a report.

The second, more difficult part of writing, is creating sentences in a constructive manner – meaning that we stay away from the fluff. It doesn't make sense to include the same information over and over in a report, so we must stick to the facts and ensure that we aren't just rambling on about the same exact thing throughout the report. This is where your list may come in handy again; if you know you've mentioned it already, move on and inform your client of anything else they may need to know.

Another good suggestion is to draft your report right away while the information is fresh on your mind. If possible, right after you're done inspecting, sit down at your hotel or home (if you're not stranded on a beach without power), and transcribe your notes or the information you were provided on your computer. It's also really important that you keep your notes from all inspections in the past year or so. You never know when you'll have to go back and explain your report or where you got some of your information from. Transcribing right away to a computer will help you organize your thoughts cohesively, and also keep your notes organized. Once everything is transcribed you have two versions of your thoughts: one that is brief and concise and the other that is thought-out and elaborated.

It also makes sense to analyze your information after an inspection before leaving the property and ensure that your thoughts are making sense. I recall an inspection that I attended in which I gave my client some information about the roof while I was there. When writing my report later, I noticed that I had possibly made an assumption that was now proven wrong while analyzing the wind directions, so the information I had given the client was not what would later go in my report. While some clients won't think much of a small error about wind direction, this particular client noticed the change in position in the report and called to make sure I hadn't made an error on my report. It's the little things that shape who you are as an inspector. Now I try to avoid giving information unless I'm absolutely sure of it first, and I always print and bring my weather data with me!

To write a good report:

- Remember to be concise and organized: Create a list to structure your reports!
- Write while the information is fresh on your mind, or as soon as possible.
- Gather all your notes and information while writing, and always file these away for your records!
- Evaluate and analyze your information, look through your photos, and double check your own work.
- Always provide the same information from client to client if possible; a checklist and protocol while inspecting will help with this!
- Have your report peer-reviewed. Mistakes happen, but it's easier to catch them with more eyes on the final product!

Assessments

Every expert must use their experience, education and knowledge to come to a determination and assessment of the damages. It is in this arena where most experts disagree. Because my knowledge of insurance policies and insurance law, I make assessments based on these facts. If my client has replacement cost coverage, they are paying an additional premium to bring the building back to pre-loss condition; in other words, they get new for old.

For example, many engineers will recommend repair on damage to roofs - that is their assessment, based on what they know. I have been told by engineers many times, "This roof is old and at the end of its useful life, so this repair will last a year or two." But if the client has replacement cost coverage, they are paying an additional premium to bring it back to pre-loss condition or they get new for old.

This is where many arguments take place. I was on a large school and there was severe hail damage to the BUR roof. The engineer and I were arguing about the way it should be repaired. I called over the roofer who was assisting in the inspection with ladder access and core cut repairs. He had more than 40 years of roofing experience, and I asked him, "If you were to repair this parapet, how would you do it?" He then explained what he would do. I then asked him, "Would this repair make this roof as good as it was before the storm?" He said, "Hell no!" I then looked at the engineer and said, "If we can't

come up with a better option, we need to replace the roof." NRCA states a roofing repair should be looked at very closely and consideration should be taken whether the repair is a waste of money.

Most roofing assessments are in four categories. They are listed below:

- Good Condition - 15 to 20 years of life left.
- Fair Condition - 10 to 15 years of life left.
- Serious Condition - 5 to 10 years of life left.
- Critical Condition - Roof has failed, immediate action required.

Your assessment should include recommendation on repair.

Testing

Determining what kind of tests go hand in hand with what type of roof you are working with is of upmost importance. There is a special test for each type of roofing product. For example, on a BUR (built up roof) you can use a moisture survey to find out if there is moisture in a roofing system or make test cuts for laboratory testing. Whatever kind of test you perform, be sure it's the right test for that particular roofing system. Skill and experience will help you in determining a test. Reach out to others for help and seek their opinion for your specific need.

Not all testing labs are equal

Many labs in our industry have a bias or slant toward who they are working for. In order to know what labs to use, I recommend labs that are ISO accredited. Proper instructions of the testing you require need to be clear. You may want them to simply have a desaturation and the sample sent back. This is why choosing the proper lab will make a difference. Labs that are accredited under an accrediting entity such as A2LA that follow the International Standards Organization's regulations will always be more reliable than a lab that is not accredited in this manner.

You may feel confident that the report you receive is more accurate than any other when provided by an accredited entity, as their protocols are strict and detailed due to their consistent auditing and organizational structuring. For example, all labs certified under the ISO/IEC 17025:2017 (earlier version being ISO/IEC 17025:2005) have specific reporting items that are required and very specific standards that they must follow for each type of testing. If their scope of accreditation specified that they will follow a particular ASTM standard or ANSI standards or in-house protocol, that is the way that that particular test will always be performed.

A test is a test and a sample is a sample. It is easy to see damage if you just look. The problem is some labs and some technicians and engineers have subjective views and want to see a "classic fracture" or they do not call it damage even if it is in the area of interest. This is why I mention earlier that some labs are biased and that it is important to find a lab that follows certain protocols.

I had a BUR roof job in Dallas where we pulled 6 samples and sent them to a lab. The report came back that one sample had been torn in the area of interest during delamination. Another sample had a hole in the area of interest as well, but the report said it was caused during installation. I pointed out to the engineer that the area around the "torn" area was stained, signifying a leak in that area. I then asked the engineer to calculate the percentage of accuracy. What is the scientific likelihood of two samples out of six being damaged within the area of interest during installation or during the pulling of the samples? Now those are bad odds. He agreed and he paid for the roof.

Testing options include:

- Wind uplift/Bonded uplift test
- Desaturation
- Water Column
- Delamination
- Gravimetric
- Infrared Drone
- Moisture Survey
- Ring and Ball (Viscosity Testing)
- Hail ball test
- TPO tear test
- Deck pull test
- Coating adhering test
- Coating thickness test

Wind up-lift

It is very easy when the roof is on the ground or the roof is half blown off to see the wind uplift and the damage associated with wind uplift on a building. The more difficult part is to find damage on buildings that have suffered a windstorm, such as a tornado or a hurricane. After taking Richard Cannons Uplift Course, you can be a certified wind uplift expert. This is an incredible tool. Purchasing his wind uplift machine is also a great option, as I believe it is the best in the industry.

Whenever you do a wind uplift test, attention to detail is very important. You need to find the wind speeds, approximate speeds, or potential speeds that affected the roof. When you perform the test, you must bring those pres-

sures to the associated target points. All of this is explained in the FM 1-52 and in Richard Cannons certification process.

I believe that many roofs are weakened by storms. Sometimes when minor repairs are done to the roof, even though the next storm that comes might not be as strong, the roof will be laying on the ground. We had a job in Victoria, Texas after Hurricane Harvey where one roof was blown off and the other was damaged by the storm. The adjuster came out and agreed to pay for the roof that was laying on the ground but the other roof he did not agree was damaged by the windstorm. About 60 days later and during the process of our evaluations and negotiations, a smaller storm with lower winds hit the area and the roof that we were debating was laying on the materials that were stocked for the building next door - verifying our position that the roof had been damaged and needed to be replaced.

Here is a short protocol for wind uplift testing:

- Find the wind speeds associated with the damage
- Calculate your target pressures. (use roofnav.com)
- Address number of tests
- Determine where the tests are to be taken.
  - Field/Perimeter/Corner
- Run the tests/document the results
- Cut the roof to determine the mode of failure (if test fails)
- Write a report

Taking Samples

Chain of custody is necessary and can simply be a form that provides documented exchange for each sample. It contains an address, date, name and signature of the person receiving the sample, as well as the type and description of the sample. You want a minimum of 12 inches by 12 inches for these tests. Our team takes both the membrane and all the insulation to the lab. Make sure to write the address and sample number on each bag.

Sample labels that I like to use:

- "F" to label a fracture
- "B" to label blister
- "G" to label granular loss
- "AOI" to label area of interest

When you are an expert, you must remember that the details are some of the most important things in your assessment. I have said once before and I will say it again, every loss should be treated like a crime scene. The reason that I say that is because all those little details are important, and many people can overlook the small things that become big things in the claim. Remember that when you are documenting the loss, you are setting it up for litigation. The loss may never go to litigation, but these steps cannot be recreated so you must approach it as if you were to present all your data before a jury, judge or mediation.

There should be a wide spectrum of photos that should be taken of the sample, or area of interest. It must be marked and must have detailed pictures all around it. Our company policy during inspections is to photograph all damage found, and then mark it and photograph it again. A determination is made about which samples will be taken to be used as evidence or sent to a lab for further analysis. It should be marked as a sample, with the number of the sample (if multiple samples were taken), the date as well as number marked in chalk. Whatever you determine the correct thing to do, make sure that photos are taken from different angles and areas of the roof, so that full identification can be made about where that sample was taken on the roof.

Everything should be looked at and everything should be considered such as: why that damage is there and what kind of damage it is. If it is hail damage, then make sure that the damage is mostly circular in nature unless it is confirmed that the hail was jagged. Also, the direction of the storm: would there have been any obstacle that would have obstructed its ability to impact in that area? All the details should be written, and measurements should be taken. You should also, once you mark your core, measure the parameters of the building and mark this on either a satellite image or on a roof cad or something similar.

The roofing contractors and experts that are pulling the sample should all be schooled in how to treat that sample. I believe a video tape should be taken of the extraction of the sample. Once we had a young roofer who walked over to the sample with a shovel and then hit the center of the sample with the shovel and then asked, "Is this where you wanted to take the sample?" Of course, we all groaned and scolded him and could not take that sample because it was tainted with the impact of the shovel. It is very important that the roof is not hit with a hammer or beat with a pry bar, or even a spud bar. It is much better to take a little larger sample that can be cut down later.

Taking a red or yellow colored crayon (or a grease pencil), mark the area of interest as well as the area in which the impact mark was made - whether that is determined through spatter or granule loss for a modified bitumen or even gravel displacement from a BURG roof. Then make sure that whoever is cutting the sample (we typically use a Sawzall with a bi-metal blade) cuts through the membrane and through the insulation being careful not to cut through the lightweight or metal deck. If you are extracting an asphalt shingle

you must be very careful not to break the seals (if not already broken) and to remove the particular shingle that has the impact mark.

I recommend always using a licensed roofer to take your samples.

Make sure they have the proper repair materials before they ever make the cut.

I once had an engineering firm that took samples at a school. Their roofing contractor only had standard pitch and not coal tar pitch. They took samples and repaired the areas with standard pitch. This not only was improper, but these areas were sure to fail. We sent another roofing contractor behind the engineer with the proper materials and repaired the patches. Be sure to use the ASTM standard or the NRCA manual for how to repair core cuts.

I am often asked how many cores should you take? I am a firm believer of not cutting the roof any more than necessary. If you have made too many cuts on the roof and it is not being replaced, you have damaged the roof and made the system more likely to fail. Many experts want at least one sample per 100 squares or 1 sample per section of roof where there is an expansion joint or a clearly defined parapet wall between sections. However, to take samples and where there is no damage is ludicrous. I do not allow engineers to take random cores unless someone on either side believes that there is damage. Be aware of the engineers that just want to go on the roof and take random cores where no damage has been ascribed. They will, most likely, come back without fractures or imperfections.

We had a large school district in Nebraska where there were clear hail fractures in the EPDM, so all of the experts focused on other areas of interest rather than taking cores where the clear fracture was noticed. The problem was at the end of the day because the fractures were apparent visually in the EPDM roof when the report came back it showed no fractures in any of the membranes. This made it look very bad to an untrained jury. So no, we take known fractures, areas in which we believe that there is a known fracture. If the other side wants to take a sample of their own, they may choose to do so. Many experts try to do random sampling. In fact, many will take an object and throw it over their shoulder on the roof and that is where they will

choose to take the sample and often times ignore visible fractures or damage in the roof.

The best practice when you are testing a roof for damage is to find the areas of the roof where damage is visible and test it there, unless there is a protocol or ASTM standard that prohibits you from doing so. We were doing wind uplift tests on a school years ago and the wind uplift test was going to be conducted on the perimeter of this particular building. I walked about 10 feet down the parameter and found an anomaly that looks like it was damaged from the storm. I had to move the chamber down 10 feet and when very little pressure was applied, it not only lifted but it also showed a complete tear within the membrane. An expert should be looking for failure (not for something to pass) if there is potential damage.

> When an inspector inspects a bridge, he looks for the cracks, he looks for the damage that possibly happened, they also look for where the weakest points of the building or the bridge are. We need to do the same thing when documenting a building. Where is the roof the weakest, and where would it have failed had the event impacted it to a point of causing damage?

Delamination of Roofing Samples

The delamination of roofing samples is pretty basic in that the sample is taken (usually a 12 inch by 12-inch sample) and placed in a freezer, or on liquid nitrogen to freeze. Delamination tests are performed to inspect the inside of multi-ply bituminous roof membrane samples through the process of freezing and then carefully pulling plies apart. While looking in between the felt layers, we identify the presence or absence of impact distress to the inter-ply bitumen.

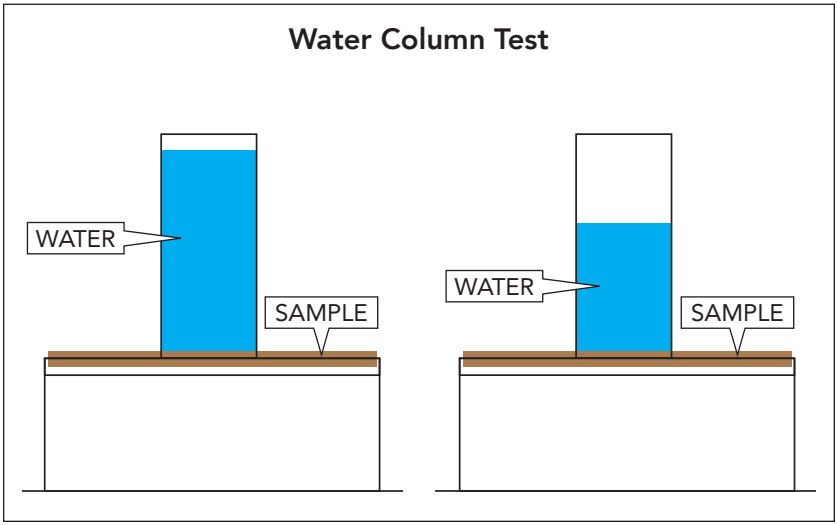
In reviewing the sample that has been successfully delaminated, experts can identify baseline anomalies, classify material types, and document sample conditions. Reports include ply configurations, anomalies found, and photos of each ply with a focus on areas of interest. Thorough documentation of the area of interest and also photographic evidence must be done no matter what. These tests are performed in general accordance of ASTM C1185-08. All of these tests should be done in a certified or accredited laboratory.

Desaturation Tests

Desaturation tests take a sample and places it in a chemical that is able to take the asphalt away from the roofing sample, leaving only the fiberglass plies or felts. Although many labs used a variety of different products, we use a non-flammable chemical that is also non-toxic. We also use a vapor degreaser that has a spray wand by which the samples can be sprayed and cleaned for inspection. Once the plies have been desaturated, they are then tactically examined for anomalies and fractures. Desaturation of samples should be performed in accordance to ASTM D3746. Reports include photographs of the samples before and after desaturation, especially in areas of interest.

Water Column Tests

This is a test in which a volume of water is placed upon a sample on a clear glass frame and colored or dyed water is placed on the sample for a period of time to see if the sample will leak. Dye is used and if no leaking is found, we will freeze the sample and then we will delaminate it. Many times, you will find ice or dye on the inner plies of the samples, proving that it leaked through the top membrane into the other samples. These tests are usually performed in accordance with ASTM D7281.



Gravimetric Testing

A Gravimetric test is used to quantify the moisture by weight, usually within the insulation of a roofing system. Drywall, and other materials can be tested using this method, but it may not be covered by an ASTM standard. This process takes a sample that is at least 72 cubic inches in volume, such as six inches by six inches by 2 inches thick sample. Time is of essence and is very crucial in the evaluation. When taking a gravimetric sample, you want to make sure that the sample and the insulation is immediately double bagged (Ziplock tight bag) otherwise it could dry out.

Great care should be taken with the sample and it should be placed in an ice chest with no ice and no sun on the sample. The samples then need to be rushed or overnighted to a lab where the bags of samples will be weighed. Next the bags and samples will be dried then put in the oven for a minimum of 2 hours and up to 24 hours (please see ASTM standard C1616-07). After they are dried, they are weighed again and recorded. Moisture is very important because of repairability. NRCA and engineer specs state that roof insulation must be dry before re-roofing.

Gravimetric Testing Steps:

- 4 samples taken
- 72 cubic inches minimum
- Double bag samples and place into controlled environment
- Measure and record weight
- Place in an air circulating oven
- Set oven to material specified temperature or no higher than 230°F
- Minimum of two hours
- Re-weigh sample, then repeat until less than 0.2 change from last weighing
- Record the weight as moisture free weight

We once had an engineer who was taking samples from a roof and bagging them and then placing the samples in the sun on the HVAC unit (the bag was sweating with moisture). He then placed the samples in his hot car all day. These samples were handled incorrectly, therefore the results were wrong. Gravimetric testing is helpful as many times engineers and experts working for opposing side will say that something is not wet when, in fact, it is very wet. They say that there is moisture in everything (which is true) but the gravimetric test explains precisely how much.

Hail Ball Gun Test Sample

A hail ball gun test is one test where you have identified the hail size, and now you are testing an undamaged part of a roofing sample to see what size hailstone damaged the roof. At this time, you want to find a strong part of the roof so that your test can reveal what the tolerances are. It is then taken to the lab (usually 16 inches by 24-36 inches long) and hail ball projectiles at different sizes will be shot at the membrane to see what size (if any) has created failure within the system. The sample is then frozen, delaminated and then desaturated.

If upon inspection it is determined that there was damage by hail that was the same size or smaller than what is documented on the roof, you now can attest to the fact that hail of that size will damage the roof. This is true engineering to me. In all my years of inspections I have only had one engineer do this test as protocol for his damage assessment.

Moisture Survey

Moisture surveys are very important in the world of an expert. The reason moisture surveys are so important is because roofing systems must be dry, especially when it comes to the insulation. There are three basic types of moisture surveys: an infrared survey, an impedance meter survey, and a nuclear moisture survey. Most experts agree the nuclear survey is the best. The problem with the nuclear survey is that it is radioactive, and shipping across state lines is very difficult. It also can cause serious side effects to different people. So, the two surveys we typically use are the infrared moisture survey and the impedance survey.

Infrared Survey

The Infrared survey is based on ASTM standard C1153 -10, standard practice for location of wet insulation and roofing systems using infrared imaging. This standard gives two ways in which to do your survey. One is classified as a walkabout method, where are you walk about the roof taking images at different angles and different areas finding moisture within the insulation.

The second type of survey is Ariel in which you can use an airplane or a drone. I have used both, and the drone and its technology with the radio metric infrared camera is absolutely the best infrared that you can perform today in my opinion. The survey also has several criteria. Number one it must be a sunny day because the radiant heat from the sun must penetrate and heat the water, if there is any in the insulation of your roofing system. Also, the winds cannot be over 15 mph because winds above that speed will literally wick away the images that you're trying to capture - similar to blowing on a spoonful of hot soup.

There are also camera settings that must be done on your infrared camera, such as distance, emissivity, temperature, etc. The survey must also be done at night or one hour after sunset. When I took my second infrared class (the level one tomography certification for drone pilots), I met a gentleman there who had a business that he was taking drone thermography for and doing it during the day. I told him he needed to change and start doing it at night, but he did not want to work during the evening hours. Needless to say, his reports would not stand up under any scrutiny.

There is also a requirement in the ASTM standard to come back and take a core of the roof to verify the moisture within the system and/or possible anomalies that we call false positives. These cores or samples should also be sent to a lab for gravimetric analysis or moisture by weight assessment. Infrared is great for someone who is well trained with the skills of infrared tomography.

Electrical Impedance Survey

The second type of moisture survey is completed using an electrical impedance scanner. The standard ASTM D7954 practice for moisture surveying of roofing and waterproofing systems uses non-destructive electrical impedance scanners. I love these tests, and I would have to say they are probably my favorite surveys. Especially for modified bitumen roof's - the electrical impedance scanner survey is the bomb. If the roof has a metallic type coating or

metal, it cannot be used as you will get false positives. The two types of scans that the ASTM standard D7954 recommends is a continual scan or a grid format scanning and recording process. This is the process I usually use.

When doing the survey, it is imperative that your unit is calibrated with a known dry area. The roof must be cut and then a known wet area found, whereby the meter can be calibrated. Many times, you can find the edges where the moisture is and create a line in different colored paint to show the areas of moisture. This can be very accurate with a skilled surveyor.

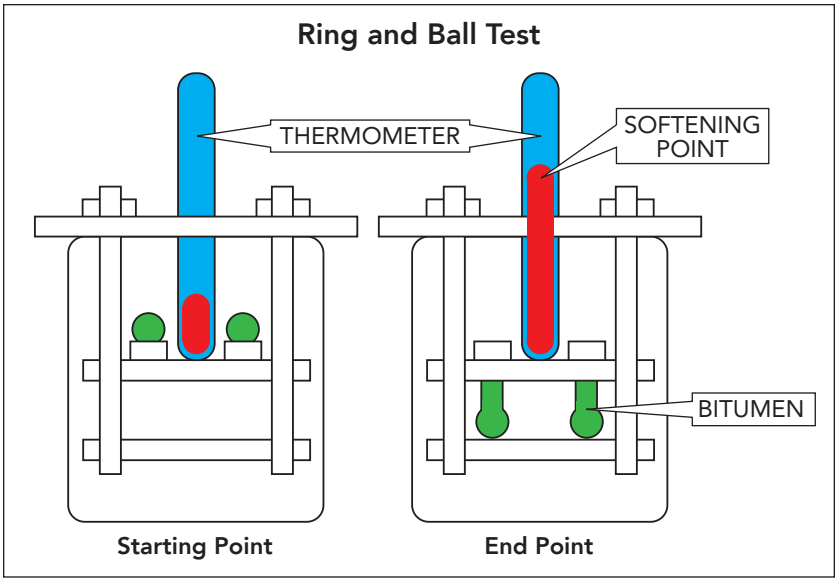
Many manufacturers require a third-party moisture survey before their product can be used. The Florida building code also has issued a testing application standard TAS 1 26–95 "Standard Procedures for Roof Moisture Surveys", as they take wet insulation very seriously. The main reason that wet insulation is not to be used is that the moisture can be trapped within the insulation and can decay or rust the deck and cause serious injuries to workers who might fall through the deck. Also, a roofing system will fail with moisture underneath.

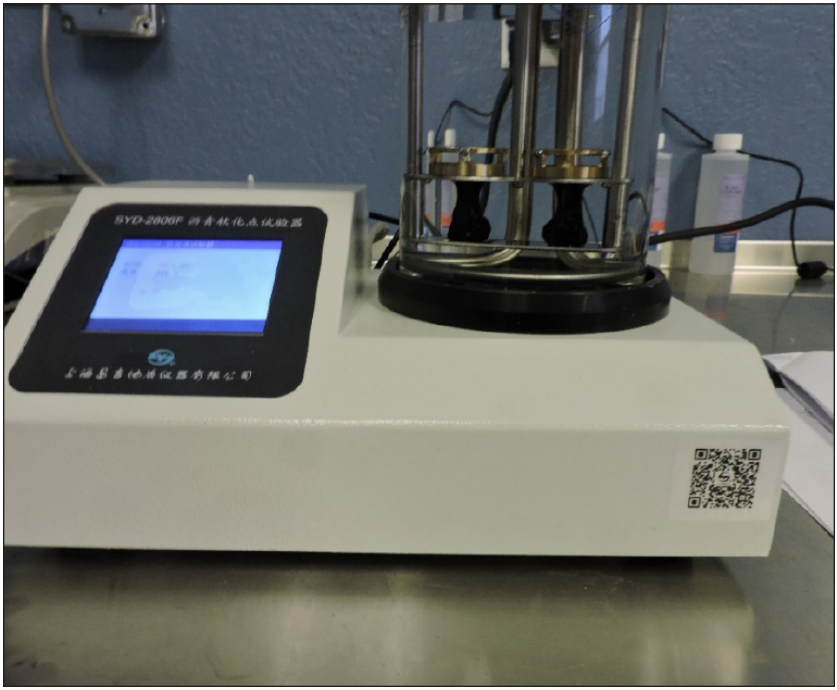
Nuclear Survey

A nuclear scanning meter emits neutrons from a radiation source within the scanning meter downward to the roof system assembly. Neutrons (which encounter hydrogen atoms), are slowed down a portion - at which time they bounce back to be counted by the detector within the scanning meter. Since water contains significant hydrogen atoms, areas of moisture within the roofing plies and/or insulation, record high levels of slowed neutrons. The nuclear scanning meter provides accurate results to a depth of 7 inches.

Ring and Ball Test

A test for determining the melting point of asphalt, waxes, and paraffins is known as a ring and ball test. In this test a small ring is fitted with a test sample upon which a small ball is then placed; the melting point is that temperature at which the sample softens sufficiently to allow the ball to fall through the ring (source: inventables.com/technologies).


Ring and Ball Test
THERMOMETER
SOFTENING POINT
BITUMEN
Starting Point
End Point



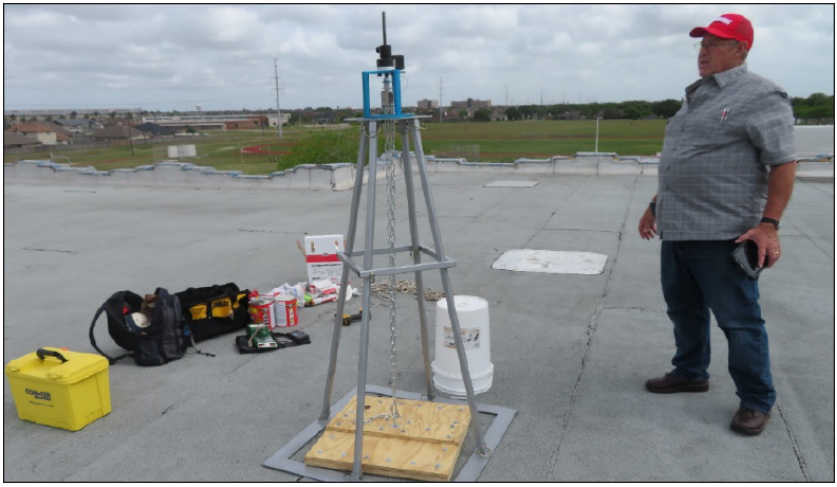
TPO Tear Test

The TPO tear test. Vulcanized rubber and thermoplastic elastomers (TPE) often fail in service due to the generation and propagation of a special type of rupture known as a tear. This test method measures the resistance to tearing action.

Tear strength may be influenced to a large degree by stress-induced anisotropy (mechanical fibering), stress distribution, strain rate, and test piece size. The results obtained in a tear strength test can only be regarded as a measure under the conditions of that particular test and may not have any direct relation to service performance. The significance of tear testing must be determined on an individual application or product performance basis (sources: ASTM D624-00).

Deck Pull Test

ANSI/SPRI Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners. This standard provides procedures used in the field to test the pullout resistance of all types of roofing fasteners. The data developed from these tests provide the roof system manufacturer, design professional, and other practitioners with pullout resistance values for the specific fastener installed into the load resisting material of the deck. (ANSI/SPRI FX-1 2016)



Coating Adhesion Test

The procedure is designed to test manufacturer product's adhesion to metal, single-ply membranes, concrete, existing silicone, EPDM and smooth surface built-up substrates. This test is a type of pull test where a cloth is adhered to the coating, then after a period of time, it is tested for resistance.

Coating Thickness Test

The thickness test is a test using a coating thickness gauge. It measures the thickness of a coating per the manufacturer specs. We perform the test in a grid to give the maximum and minimum thickness as well as an average.

Testing Options Summarized:

- **Wind uplift tests** use a wind uplift machine to find wind damage
- **Delamination test** is used to see if there is inner ply displacement or fracturing between the plies of the asphalt
- **Water column tests** check for leaking
- **Gravimetric test** is used to quantify the moisture by weight, usually within the insulation of a roofing system
- **Hail ball gun test** is to see what size hailstone damaged the roof
- **Moisture surveys** have three types: infrared survey, impedance meter survey and nuclear moisture survey
- **Ring and Ball Test** is used for determining the melting point of asphalt, waxes, and paraffins
- **TPO tear test** measures the resistance to tearing action.
- Deck Pull Test determines the withdrawal resistance of roofing fasteners
- **Coating adhesion test** designed to test manufacture product's adhesion to metal, single-ply membranes, concrete, existing silicone, EPDM, and smooth surface built- up substrates
- **Coating thickness test** measures the thickness of a coating per the manufacture specs

Dealing with Insurance

It is the duty of the policyholder to file a timely claim and know what their policy covers. The problem is, very few ever read their policy, let alone understand it. The policy is the contract between the insurance company and the insured; all conditions and exclusions apply. Today more than ever, a policy holder needs to understand what coverages they really have because policies are rapidly changing. Many policies automatically convert to ACV coverage when the roof is of a certain age; usually 10 years old. Many have cosmetic exclusions, asbestos exclusions, mold and fungus exclusions and more. Today's policies may limit or exclude code upgrade coverage, flood or water damage, earthquake or foundation damage. It is very important to know your limits of insurance, your deductible, and your exclusions.

When you file a claim, it is usually done through your agent, but most policies have directions for filing a claim.

Here are a few things you need know when filing a claim:

- Approximate time and date of the loss
- What kind of loss (hail, wind, fire)
- What have you noticed, is there leaking? (do not guess, facts only)
- Was anyone hurt?

Be very careful what you say, as it can and will be used against you. I recommend people hire experts to handle this for them, as misrepresentation is considered to be fraud. **Always tell the truth! If you have had a prior claim, tell the adjuster or your expert, do not conceal facts.**

I hear horror stories from experts and adjusters about contractors and Public Adjusters yelling at them and threating to throw them off the roof. This is insane!

Remember the adjuster is a person, and you may not like his/her opinions, but you should always treat others with respect and dignity. I love my wife more than any person on the planet, and we don't agree on a number of things, but I always respect her. (I never want to throw her off a roof.) I know

many experts in our industry and I often disagree with their findings, but I never take it personally, and I try to argue with respect.

I honestly believe that most adjusters are trying to do what is best, but they have a tough job. They are the go-between for their boss (the carrier) and the insured who pays a premium. Their hands are often tied because of desk adjusters and other requirements the insurance companies place on them. Years ago, when you found hail impacts on an asphalt shingle roof it was paid for fairly easy. Now different carriers require a certain amount of "hits per square" before the roof is totaled. Many years ago, when I was a roofing contractor, adjusters would ask me how fast I could roof the building as they did not want a re-inspector to criticize their scope of damages.

I tell experts who take my classes to "fill the file". In other words, lots of documenting and reporting. If you are a contractor or roofer and you have inspected a job and are meeting with a representative of the insurance company, have a report and an estimate ready for his review and be prepared to go over the damages you see. You will have a completely different experience when you meet the adjuster or engineer. You will also impress your client who is trusting you are an expert.

An insurance adjuster has a duty to the carrier, and it is greater than his duty to the insured, as the insurance company writes his paychecks. If you buck the system too much, you will be gone. An adjuster has inspectors that periodically re-inspect the property for which he recommends payment. If they find he was too generous or against company standards, he could lose his job. I have had many adjusters pull me aside and say they agreed with my position, but the guys at the top said no. Try to think about the insurance company as a business not a charity. They are in existence to make money and overpaying claims is a bad business plan. That is why people should hire experts to help them.

Ask your agent or public adjuster for definitions of coverages. They will usually be glad to send it to you. I tell contractors not to ask for the policy to interpret coverages, as you might be breaking some laws. Instead, have the customer request the information from the agent.

Code coverage is a big deal. A property owner told me about a tragic event that happened to him. He was a small business owner who employed about a dozen people in a welding and metal fabrication business. A large hailstorm moved through the area and caused hail damage to the metal roof on his business's building. A roofing contractor convinced him they could get him a new roof. Little did he know the problems it would cause him. After filing the claim, the roofer told the adjuster that they needed to pay for a new roof

READ YOUR POLICY!

It really is not that difficult; in fact, you can find out most of the information you need on the declaration's pages. It will tell you the following:

- Named insured
- Address
- Policy period and number
- Location of premises
- Deductible (hail and wind are often higher)
- Type of coverages; Special-Broad-Basic
- Personal property coverage
- RCV coverage
- Property covered
- Limits of insurance
- Co-Insurance
- Endorsements, or riders
- Claim reporting information
- Agent/Broker

and reframe the existing truss system because of new codes. The insurance company agreed but there was a big problem, the customer had a policy that converted the roof to ACV, and he had only $10,000.00 in code upgrade coverage. So the customer was left with the burden of his deductible, plus 50% of the cost of the roof and over $200,000 in upgrade costs. His total out of pocket was over $400,000.00. He did not have the money, but the bigger problem was the insurance company was going to cancel his policy if he did not do the work, and his bank was threatening to call his note if he could not keep insurance on his building. In this case, it would have been better not to have filed a claim.

If you are an expert on an insurance claim, you might want to ask if a claim has ever been filed for storm related damage. If there was a claim and they did not do the repairs, it could be problematic. Most insurance applications have a question asking about prior claims. If they conceal or misrepresent the facts it could void coverage. So, they could have a fire loss but misrepresented a loss on the application and the insurance company could deny coverage.

Some advice:

- Never lie/always tell the truth (even when others do not like it)
- Call it like it is
- Think before you speak
- Respect others and their opinions
- Respect and trust each other on your team
- Have an open mind
- Challenge yourself
- Seek to be unbiased
- Do not jump to conclusions
- Judge the loss not the people involved
- When black and white turn gray, trust your gut.
- Be willing to change your opinion when you find out you were wrong.
- Report illegal activities immediately
- Never over evaluate an estimate
- Listen to others and their opinion
- Never misrepresent or falsify any report or information

Expert Testimony

By Javier Delgado

An expert witness is like a detective, in that he or she must be able to answer the what, why, how, when, and where by investigating the particular issue presented; use deductive reasoning based on all the facts available and circumstances presented combined with the witnesses' skill and knowledge in the particular field; and provide credible testimony and sound opinions.

A competent expert witness is one that is better qualified than a lay person in a particular field, profession, or science because the witness studied in the field has experience in the field, or both. The witness must be able to draw inferences through his education or experience that a lay person could not have drawn because the lay person lacks such education or experience.

The credibility of the witness is decided largely by the jury, and the qualification is decided by the judge. If the judge does not believe the witness is qualified to testify, then the jury will never hear the testimony and will never have the opportunity to decide on the witness's credibility.

The court generally decides four main factors before allowing a witness to testify as an expert in a case. First, the court must determine whether the subject matter of the testimony is beyond the ordinary knowledge of the jury therefore requiring an expert's specialized knowledge to help the jury, decide on the particular issue. Second, the testimony is based on sufficient facts or data. Third, the testimony is the result of reliable principles and methods. Fourth, the expert has reliably applied the principles and methods to the facts of the case. *See Fed. R. Evid. 702, Testimony by Expert Witnesses, United States Code Annotated, 2019.*

It is very important to understand that not all experts (despite their education and professional degrees) have the same experience, knowledge, or skill. In a consumer class action case against a washing machine manufacturer, the court found the plaintiff's expert - an aerospace engineer with experience in evaluation of consumer appliances including product testing and was also the manufacturer's former director of laundry technology could not testify about tests she performed on 27 different washing machines regarding mold build up in the machines because she had a limited understanding of biofilm, had never tested biofilm prior to being hired as the expert on the case, and testified that she did not know microbiology. *See In re Whirlpool Corp. Front-Loading Washer Products Liability Litigation, 45 F. Supp.3d 724 (USDC, N.D. Ohio, Eastern Div. 2014).*

In most professions, there is no basic difference in professional standards as between different communities, so that a professional familiar with the general professional standards in the United States should normally not be required to demonstrate familiarity with the standards in a particular community.

See 24A Fla. Jur 2d Evidence and Witnesses § 1047; citing to Schwab v. Tolley, 345 So. 2d 747 (Fla. 4th DCA 1977).

Subject matter beyond ordinary knowledge of the jury

Experts may be necessary to help a jury understand the nature of what caused the damage and when the damage occurred. Sometimes it requires the use of a meteorologist in cases dealing with storm related damage, an arson specialist or an electrical engineer in cases involving fire related damage, an geotechnical engineer in sinkhole or earthquake related damage, a mechanical engineer involving mechanical breakdown of machinery, etc.

On many occasions although damage to a person or object is readily observable, experts are also necessary to determine the extent of an injury or damage. A cardiologist may testify as to the extent of permanent damage to a person's heart from a particular injury, medication, or botched medical procedure and how that injury will affect the person's health and function long term. A roofing professional or civil engineer may testify as to the extent of damage to a roof system and whether the damage can be repaired or replaced. And an art curator may testify as to the extent of damage to a valuable painting.

In many civil court cases, once the cause and extent of damage is known, the amount of money necessary to compensate the plaintiff is the next decision on a jury's verdict form. Most jurors do not know the value of repairing or replacing a roofing system nor the existing or new building code requirements resulting in a higher cost for the job. It may be necessary to hire a roofing professional to give a professional opinion on whether the roofing system can the repaired or replaced, and to determine the cost to remove and replace a particular roofing system. To decipher the building code, a building code official may be necessary to determine what will be required of a new roof that does not already exist in the old roof. An OSHA specialist may be necessary to factor in the costs of the roof project taking into consideration all of the applicable and relevant OSHA regulations for the particular roof job, which also increases the cost of the roof repair or replacement.

Testimony is based on sufficient facts or data

A well-qualified expert witness cannot apply reliable principles and methods of analysis and state his opinions in a credible fashion without first having sufficient facts or data to analyze.

Specifically, Fed. R. Evid. 703 allows an expert to rely on information from others when evaluating sufficient facts and data to form an opinion. An expert may base an opinion on facts or data in the case that he/she has been made aware of or personally observed. If experts in the particular field would reasonably rely on those kinds of facts or data in forming an opinion on the subject, they need not be admissible for the opinion to be admitted. But if the facts or data would otherwise be inadmissible, the proponent of the opinion may disclose them to the jury only if their probative value in helping the jury evaluate the opinion substantially outweighs their prejudicial effect. *Fed. R. Evid. 703, United State Code Annotated (2019).*

In any case involving damage to a building and depending on the cause of the damage, it is important to interview the occupants, owners, building managers, maintenance personnel, or vendors providing maintenance at the building. Every effort should be made to determine the condition of the damaged property prior to and immediately after the damage, as well as the extent of damage suffered. Sometimes to determine the extent of damage to a roof system, it is necessary to cut out samples from the roof and have the samples evaluated by a certified lab with experience in performing reliable test methods on roof samples. The credibility of the lab is also important and an honest opinion from an objective lab technician and engineer is necessary at all times.

Evidence about a particular property can be verbal statements; someone's mental recollections; written information such as receipts, emails, handwritten notes; and physical evidence such as photographs, roof samples or videos. All are necessary in order to provide the expert with all of the information available.

Testimony based on reliable principles and methods applied to the facts of the case

The United States Supreme Court has decided that the trial courts are gatekeepers with the obligation to determine whether explanation given by every expert witness is reliable, regardless of whether the explanation is based on scientific, technical, or specialized knowledge. *See Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993); and Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999).*

In the *Daubert* case, the Court interpreted the legislative enacted Fed. R. Evid. 702 to require reliability when dealing with scientific evidence and set forth the following question: Is the expert proposing to testify to scientific knowledge that will assist the trier of fact to understand or determine a fact in issue? The Court reasoned that the statements constituting a scientific explanation (a) must be capable of empirical tests, (b) peer review and publication is an important consideration but not a requirement, (c) the rate of error involved in the technique, and (d) general acceptance in the relevant scientific community.

In the *Kumho* case, the Court concluded that the same factors it had set forth in the earlier Daubert case dealing with scientific experts and evidence must also be applied to non-scientists that usually rely on their skill and knowledge to provide expert opinions.

In general, the expert's opinion is considered reliable if the expert's explanative theory is shown to have been derived and employed in a manner consistent with processes customarily employed by experts in the particular field; which has been stated in the alternative as (1) adheres to the same standards for intellectual rigor demanded in the experts' professional work, (2) conforms to applicable professional standards employed outside the courtroom, (3) possesses the aura of proper expert methodology, or (4) is soundly grounded in the principles and methodology of the particular field. The focus is solely upon principles and methods, not whether conclusions generated are right or wrong. *See § 702:5Reliability "gatekeeping" under Daubert/Kumho/rule 702: historical development and assessment, 5 Handbook of Fed. Evid. § 702:5 (8th ed.)*

In today's society, the court system is the only place where a person that has been wronged can seek justice. The only form of justice available in a civil case is monetary compensation; the days of eye for an eye are long gone. The reason why expert testimony is so crucial and why it is scrutinized to such a high degree is due to the Court's job of ensuring a balance of fairness and truthfulness. "We here seek only the truth" is the common pledge conspic-

uously expressed within the walls of almost every courtroom I have ever appeared. There is no place in a courtroom for unprepared experts, cavalier opinions, and lazy hap hazard opinions. If you are hired as an expert, you must approach your job in the most objective way possible and perform your job like that of a detective, considering all the information available. Combine that with your special skills and knowledge in order to provide a reliable and credible opinion that will benefit the parties, the Court, and ultimately the jury.

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Authors and Contributions

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Don Lamont is an entrepreneur and consultant with an extensive background in construction. He is president and founder of multiple companies, including an engineering lab that abides by the International Organization for Standardization's ISO 17025: 2017 and is being accredited by the A2LA. As an NRCA certified instructor he is involved in training programs specifying in storm damage assessment and writing expert reports. Don enjoys sharing his extensive experience and knowledge with others in his industry.

- Appraiser Certified – 2012 to present
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Rocco Calaci

Rocco has been involved in operational meteorology for over 50 years. His experience includes over 20 years serving in the US Air Force, and many more years as a government contractor, site-specific meteorologist, and consultant. Rocco worked for several years providing site-specific weather support to the White House, the NASA Space Shuttle program and numerous classified projects. Some of his clients are professional sports teams, oil companies, farms, Federal, state and local governments, plus school boards, law enforcement and transportation companies.

Rocco has been involved with forensic meteorology since the beginning of his career and provides after-the-fact meteorological evaluations for a variety of weather events such as hurricanes tornadoes, hail snow and extreme winds. Rocco assists clients by providing a fair and honest assessment and has the ability to clearly explain his reasoning to individuals at every level including courtroom testimony.

Javier Delgado

Javier Delgado is a former insurance adjuster and former insurance defense attorney, so he knows all sides of claims and insurance contracts. Javier is licensed in Florida, Texas, New York, and Washington, D.C. He routinely works with outside and local counsel in other states and the Caribbean representing clients with their insurance claims.

He has been featured in several publications including the Houston Chronicle, the New York Law Journal, Law 360, among others for his outstanding work on behalf of his clients. Javier speaks at various insurance industry annual events and teaches continuing education courses to insurance professionals and attorneys representing insurance carriers, as well as professionals representing policyholders. Javier was appointed Liaison Counsel by the Eastern District Federal Court in New York to assist in resolution of Hurricane Ike claims to assist the Federal Court in resolving thousands of Hurricane Sandy Claims.

Don Lamont, CEO of D.A. Lamont Public Adjusters, LLC is your guide through the complicated practice of Storm Damage Assessment. Don and his firm have successfully worked on $100,000,000's of Storm Damage Claims and Don is one of the Premier Adjusters in the United States today frequently helping on commercial and industrial property owners, municipal government agencies and homeowners with their insurance claims.

In Storm Damage Assessment, you'll learn real world secrets to the process of professionally assessing storm damage. Storm Damage Assessment in a complete work covering the subject from A to Z. The book covers the assessment of storm damage resulting from hurricanes, hailstorms and tornadoes. Don and his contributing authors Meteorologist Rocco Calaci and Attorney Javier Delgado cover the subject from Storms to Expert Testimony.

Make the practical strategies shared in Storm Damage Assessment part of your protocol for Storm Damage Assessment and watch the accuracy of your business increase.

Don Lamont has worked hundreds of damage claims from the numerous tornadoes and hailstorms common in the Midwest to tropical Hurricane damage along the US Gulf and Atlantic coast lines and the Caribbean. Sharing his knowledge and experience in Assessing Storm Damage, Don helps roofing companies, contractors, insurance companies and attorneys more accurately assess storm damage.