Katrina - Revisited

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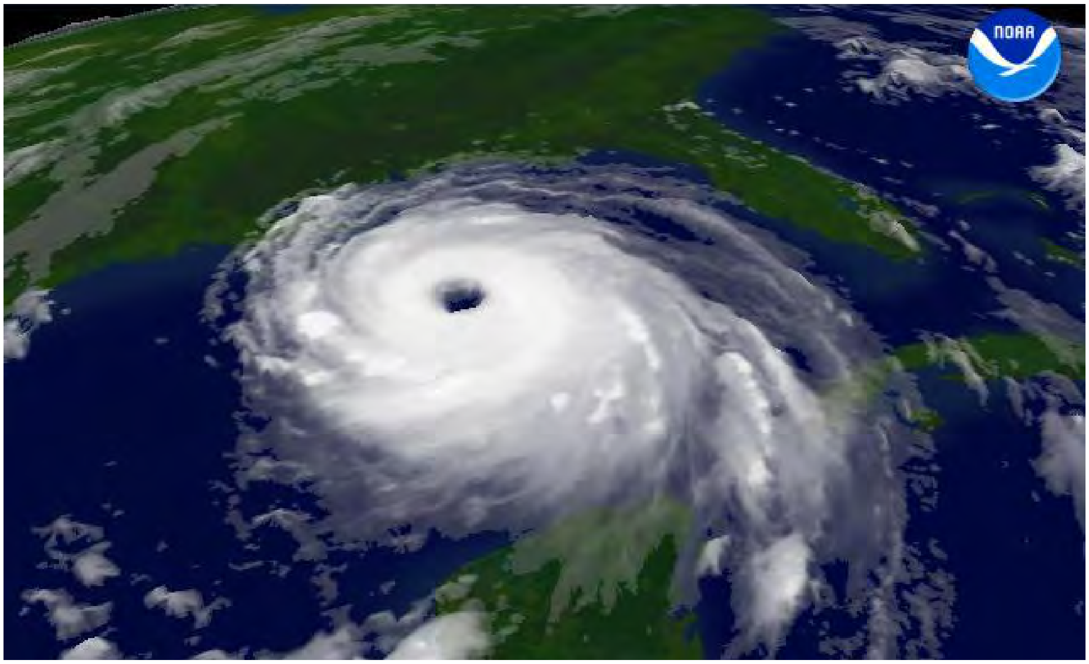
When a hurricane slams into one of our coastal communities it is considered a significant wind event. There have been quite a few significant wind events in the past that I've evaluated from afar. I was dependant upon others to visit the sites, photograph and collect data and send it to me for review. Most significant among our internal investigations were Hugo, Andrew, Charley and Ivan. Principally, my evaluations centered on the performance of our FiberTite Roofing Systems. Imagine that! Of the major and minor storms that have made landfall over the last 15 years or so, I did not find one instance or circumstance where the "membrane" failed to perform. In fact, each storm builds further confidence in the material I've represented and promoted over the past 30-years. Now I'm not about to profess that every building that had a FiberTite roof escaped every storm unscathed but I can tell you that either structural failure, an engineering oversight, air borne debris or contractor misfortune accounted for what damage we did encounter.



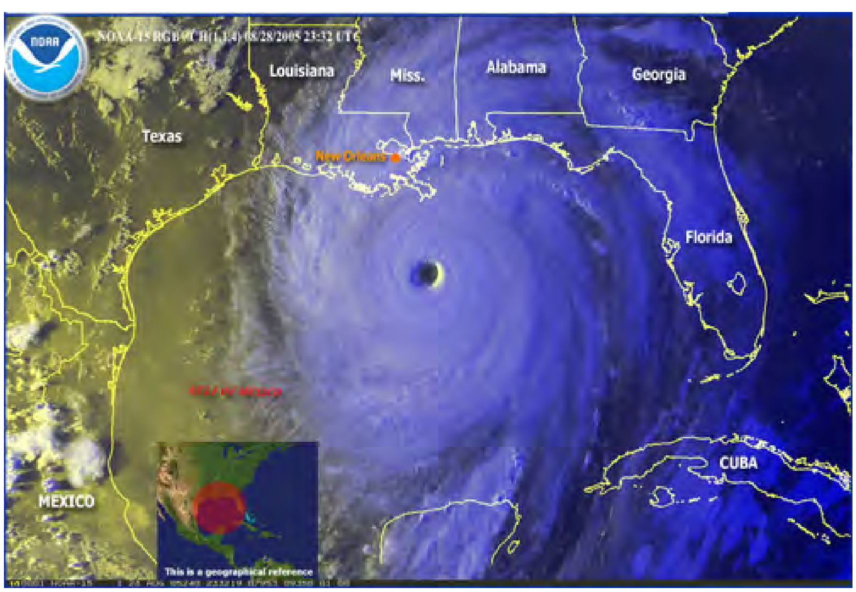
Hugo was the first really significant wind event in my tenure with the company to really test our roofing systems and receive a full follow up investigation to his aftermath. Since his Category 4 rampage against Charleston SC in September of 1989, I've been responsible for overseeing a significant portfolio of our Roofing Systems that have been subjected to and "weathered" catastrophic winds propagated by these unruly offspring born of Mother Nature's fury. The lessons I've learned were little more than common sense. As a highly respected consultant & good friend recently reminded me, "it ain't higher math". Keep the edge or perimeter on and your odds are significantly improved that your roof stays on. This is typically true regardless of the membrane. Sometimes that's a little easier said than done. Structural failures, inadequate design, failure to follow guide specifications and general short cuts can all contribute to a roof systems performance or lack there of. Keeping it in place has been rule #1 and the foundation for my approach to engineering FiberTite Roofing Systems since my introduction to Seaman Corporation in 1984.

Mechanically fastened roofing systems were our principle offering for the first fifteen years of our marketing effort. We did not introduce an adhered roofing system until 1994. Since their introduction, adhered roofing systems have actually increased our customer's exposure to damage during a significant wind event if there were oversights during the "attachment" of the perimeter. Unlike our mechanically fastened systems that permit a more concise engineering evaluation because the "fabric" is attached to the structural components of the building. An adhered membrane system is totally reliant upon the performance of an array of intermediate components that separate the transfer of stress on the fabric from the structure.

These intermediate components are made up of an endless combination of insulation systems, cover boards. vapor retarders, temporary roof systems and inner strata layers of adhesives. For typical board stock insulation systems, the roofing membrane is often adhered to layers of fiberglass, paper or treated facing materials that are laminated to the board products. The overall performance of an adhered roof is dependent upon the multiple layers of adhesive that hold the "composite" together with the fabric sidelined except for its attachment around penetrations and perimeter walls and edges. If the wind enters the roofing envelope and initiates a peeling force on the component facer or the adhesive layer, there's little or no back up to prevent its continued propagation. The peel effect that accompanies perimeter displacement due to the force of a significant wind upon adhered systems can exasperate the damage that could have been mitigated if the adhered system had incorporated a mechanically fastened back up system into the design.

On August 29th, 2005 Mother Nature incarnate, paid a visit to the northern Gulf of Mexico. Katrina, a category 4 bitch with a bad attitude, created far more than a significant wind event. And on September 6th I had the fortune to participate on a RICOWI (Roofing Industry Committee on Weather Issues) Research Team that assembled in Mobile AL to investigate Katrina's impact along the lower Mississippi Gulf Coast. RICOWI is supported by all of the major roofing associations, manufacturers and includes members of academia, educational and testing facilities and others involved in the science of roofing.

Under the auspices of the Department of Energy (DOE) and Oak Ridge National Laboratory (ORNL), RICOWI investigators consisting of wind engineers, roofing material specialists, insurance analysts, structural engineers and roofing consultants conducted extensive investigation into the impact of Katrina's winds on a variety of roofing systems subjected to variable wind speeds stretching from the eastern flank of her eye wall at Bay St. Louis east to Pascagoula, Mississippi.



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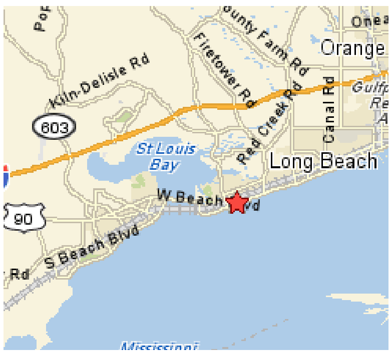
Inspections were focused on essential facilities, schools, hotels, and residential structures with intermediate stops due to my 'cow boy" nature to investigate a shopping center or other site where an obvious blow off was visible from the road.

A RICOWI logistics team was deployed to the area on September 1st and they initiated ground contacts, did an aerial flyover and mapped out specific buildings targeted for investigation. There were upwards of 26 members that divided into 6 teams headquarters was set up in Mobile, AL. None of teams ventured into the New Orleans storm surge area.

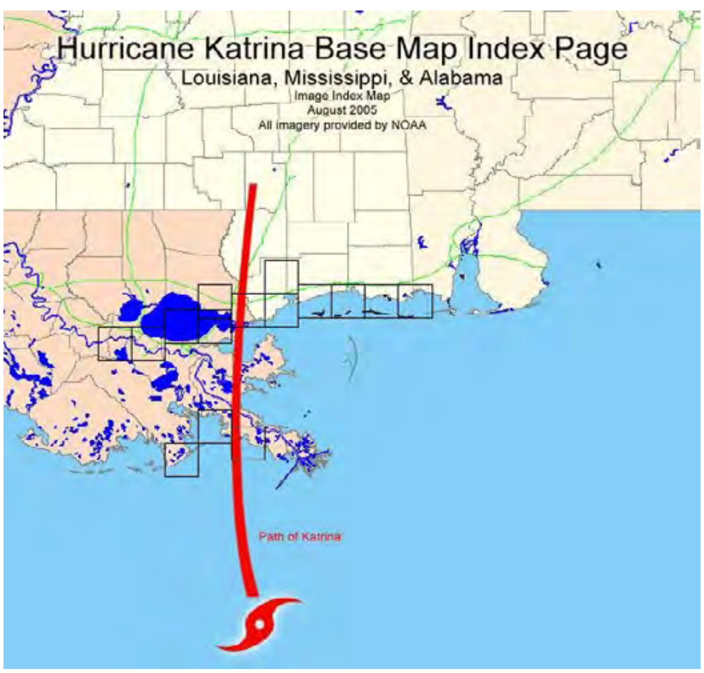
Before I give a general overview of my teams efforts, I have to say that after watching Katrina's impact unfold with 24/7 news coverage, I expected to witness the utter despair taking center stage on the television. Instead, we all came away with great respect and admiration for our Cajun brothers and sisters. Yes, there was despair but in the midst of complete destruction, we found that the majority of the people maintained there sense of southern hospitality, were gracious, appreciative, optimistic and above all, united and determined.

Each team consisted of at least four members with a captain, data recorder, photographer and sample collector. I was assigned to a "low slope" team captained by David Roodvoets, Director of SPRI. In addition to being designated as our sample collector, I choose to pilot the Ford Expedition that would be our home from sunrise to sun set for three solid days of running.



Our first day's target would take us to Pass Christian. The logistics team had pinpointed a most interesting structure, just east of ground zero, sitting on a point at the mouth of St. Louis Bay but with no observable roof damage.

Getting from Mobile to Henderson Point was no simple task. Traffic jams crammed with vehicles traveling west into the damage areas in the morning, (and back to lodging in Alabama at night) were crippled with the loss of a lane on the I-10 bridge that crosses the river and marsh that separates Pascagoula from Ocean Springs. Once we finally arrived in Pass Christian, letters secured from EMA officials for the state of Mississippi and the local counties allowed us to enter the security zones set up and cordoned off by the National Guard around the hardest hit areas.



Take it from me, seeing the devastation on television did little to prepare me for the immensity and totality of the destruction. You can't imagine what obliterated smells like.

The previous picture is what was left from a house built on stilts. I can't tell you the exactly where this is because street signs and roads for that matter were few and far between. I knew where I was but all my senses disagreed.

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Our first target turned out to be a private school, located right on the point at Henderson Point.

The school was a three story, cast in place, structural concrete building that unfortunately resembled a parking garage when we got there. The lower two floors were cleaned out by the storm surge. Members of a US Geological Society survey team put the surge (28' 2 inches) just over the second story ceiling. The bedrooms on the third floor were basically intact, windows and all. But the bedrooms appeared to be isolated in time amidst the destruction they were clean and neat with bath towels laid out and beds with sheets and covers thrown back.

The roofing system was an aggregate surfaced built up roof. Apart from some general wind scour, and displacement of some of the roof top HVAC, there was no evidence that the 140 mph winds even knew the roof was there. The roof system lacked even the smallest hole that would allow us to see below the built up roof and confirm how the roof was assembled. And we weren't about to cut one into a perfectly good roof. We did know that the deck was virtually air tight and this worked in conjunction with the three foot parapet walls to help the roofing system resist the pressures that had to have been projected upon it.

In Pass Christian we also looked at two other schools, both having built up roofs that were partially damaged. However, in both cases, poor perimeter blocking attachment initiated the lifting of the roof system and it was subsequently peeled open or off. It seemed that the damage always began in the south east corner of the structure where the building took it on the chin from the right hook delivered by Katrina's counter clock wise winds.

The next day put us in Bay St. Louis, directly across the bay, west of Henderson Point.

Here we investigated a hospital with a 20 year old mechanically fastened EPDM roofing system and some newer areas that used a mechanically fastened vinyl membrane. The deck was steel with lightweight insulating concrete creating a monolithic substrate. The membrane was attached with metal battens, secured through the membrane with fasteners spaced 12 inches on center at 5 foot intervals. The battens were sealed with a cover strip. There was some damage to the blue standing seam metal roof on one of the cupolas at the south east corner of the hospital but the EPDM roof and the smaller vinyl roof areas were intact with almost no damage except for some built up roofing debris that came from a small shopping center across the way.

Hospital; Mechanically Fastened EPDM.

Hospital; Mechanically fastened vinyl roof system.

Debris from a built up roof system with no apparent source.

Small Strip Center off to the south east that was the source of the debris on the hospital roof.

Another private school also on the bay...

located to the south west of the one at Harrison Point.

Poured concrete deck, smooth surface multiply BUR mopped direct, recovered with perlite mopped to the existing and multi ply aggregate surface BUR mopped to the perlite.

Wood blocking, associated with the recover, was 'nailed" at approximately 2 feet on center. When the blocking lifted, the recover system peeled. Crews were on site installing temporary EPDM repairs.

Damage along the eastern side at out cropped areas.

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Here too the school suffered complete destruction of the lower level from the storm surge with apparent flooding on the second floor.

The storm surge showed no mercy to anyone or anything caught in its wake.

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The sprayed polyurethane roof on the dome led us to this school. The auditorium, rectangular building to the left of the dome, turned out to be a classic example of building pressurization and no back up to prevent the peeling back of the built up roof.

Our collabsable ladder was not going to help us here. We also noticed that the rolling freight door at the southeast corner of the building had been blown in. Directly above at the parapet line we could see missing metal.

We decided to go inside and search for a way up toward a roof hatch. It was painfully obvious that the building had played a role as a shelter. After searching the stage, and the four interior corners, the only thing we found was the foul stench coming from the rest rooms and the evidence of the distress and fear that had to have over taken those seeking shelter when the door blew in and the explosion of in coming air displaced the roofing assembly.

The National Guard was outside working diligently to clear downed trees and other hazards in the area. Our Captain was successful in enlisting their assistance by providing a cherry picker to lift all four of us to the roof.

This was the roof drain. It was located directly above the rolling freight door. Note the "fasteners" in the base layer of perlite.

We really weren't sure where the drain assembly ended up.

But a few of its associates were present, detached but present none the less.

The construction started with a steel deck, a mechanically fastened base layer of perlite using only 2 fasteners per 2' x 4' insulation board. Yet the mechanically fastened insulation was barely disturbed. An additional layer of perlite was adhered to the first layer with a ribbon applied, asphaltic adhesive. The roof cover was a smooth surface, multi-ply bur.

I almost forgot about the smoke hatch. It looks like the lid was opened by King Kong so he could peek inside.

With this type of dramatic pressurization, the entire roof cover can blow off but in this case it created its own peel stop, although a bit too late. The membrane eventually tore apart as the weight of the air borne portion increased.

I need to note that we did not investigate the PUF on the dome but it looked pretty sound.

One additional site.
This was a grocery store that we noticed had a large of section of EPDM hanging along one of its exterior walls. The cornering effect of the winds is easily discernable in this satellite photograph.

The landscape fashioned by the wind in the gravel was surrealistic.

Here, the weight of the ballast created a "peel stop" but not until a significant portion of the deck had been exposed.

Crop circles in the ballast.

The store front windows were blown out. Pressurization along with the probability that scour was already present in the corner initiated the blow back.

This store also had a mansard that wrapped its south east corner. This is where it landed when it came loose.

And so it went for our three days. RICOWI has [finished and published the report of its findings.] I'm not sure how any report can distill al the data obtained. Our team photographers captured well over 500 photos. There were 5 other teams covering metal, shingles and additional low slope targets.

We came across this building in an industrial park just outside of Long Beach.

This was definitely a case of significant wind.

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This building “K-Mart” was also in the Long Beach area.
It is a mechanically fastened 10’ TPO.

Flying debris left a few scars here and there but we couldn’t find a loose fastener. It was a similar finding on this mechanically fastened vinyl roof in Bay St. Louis.

Systems that utilized mechanical fasteners to tie the roof cover to the structure, including metal roof systems, seemed to exhibit far lees damage in general. In fact, our team did not investigate a mechanically fastened “single ply” membrane that had allowed significant exposure to the building it was installed on.

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I went to lower Mississippi hoping to verify, validate or a least reinforce the lessons I'd learned by observing FiberTite's performance over the past 30 years. I felt my learning would be enhanced by obtaining a different perspective during this investigation since there was only one FiberTite roof on record within the high wind areas of Katrina's path.

The lessons learned were not new and continue to speak to common sense. Keep the edge and/or perimeter solid and intact and restrict air infiltration into the roof envelope by sealing deck and wall interfaces. If not using a mechanically fastened roof system at least incorporate a back up defensive system into loose laid and adhered roofing systems using fasteners to anchor the roof cover to the structure. If we can just promote and follow the basics we'll go a long way toward ensuring any roof system's chances of survival during a "very" significant wind event.

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Jerry Beall's career in the roofing industry spans more than 40 years, stemming from a 10-year chapter as a journeyman with Roofers' Local #88, and then developing into work in technical service, commercial roofing sales, estimating, and project and technical management. Jerry joined Seaman Corporation in 1984 and spent 5 years as FiberTite's Senior Technical Service Representative. During a three absence from Seaman, Jerry took up a role with a Florida roofing contractor involving commercial roofing sales, estimating, and project management. In 1992 Jerry returned to Seaman as the FiberTite Technical Manager. Then in June of 2000, Jerry assumed the role as National Sales and Technical Manager for FiberTite® Roofing Systems. After four years leading the Sales and Tech departments, Jerry opted for his current role as FiberTite Product & Technical Specialist. Jerry uses his field experience, studies and interest in leadership, product development, marketing and strategic visioning to support a nationwide team of sales, technical and manufacturing representatives. Jerry is an expert in roofing design, engineering, building codes and testing. He enjoys engaging the industry in discussions related to the design, engineering, application and sales of different roofing systems by teaching and providing presentations to audiences that include members of AIA and RCI, as well as roofing contractors and building owners. He has been published in RCI Interface twice, as recently as July 2015 for High Profile Roofing. Jerry is President of the Chemical Fabrics and Film Association (CFFA), Chair of the ASTM KEE Task Group, and an active member of RCI. He holds three patents for his work in color extruded rib profile, an apparatus for welding a synthetic strip to a roofing membrane (rib), and WrapidFlash™ Molded Pipe Flashing.