Roofing – Screw it or Glue it?

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If you have been around the roofing industry over the last several years, odds are good that you have heard both sides of an ongoing debate: mechanically fastened vs. fully adhered. Every contractor has a personal preference, some swearing by mechanically fastened while others swearing by fully adhered roofing systems. Granted there are a dozens of factors to be taken into consideration when selecting a roof, such as the environment, structure of the building, slope, budget, etc. Depending on the circumstance, there are certainly some cases where one method would be more appropriate over the other.

WHY DO ROOFS FAIL?

Some contractors have one or two bad experiences with one system or the other, and chose to generalize that all fully adhered or mechanically fastened roofs consistently behave a certain way. But roofs don't always fail based on a certain system. There are a number of reasons a roof will fail. According to FacilitiesNet, some of the most common reasons roofs fail include:

- ***Blisters***
- ***Open laps***
- ***Splitting***
- ***Punctures***
- ***Penetrations***
- ***Wrinkles***
- ***Flashing***
- ***Surfacing***
- ***Fasteners***
- ***Abuse and neglect***

Some of the reasons for these failures are due to contractor error, while others can be caused by something as basic as inclement weather or lack of maintenance. Taking these factors into consideration, combined with the "mechanically fastened vs. fully adhered" debate, which system truly is the most consistent and reliable? This article will take a look at the differences between the two, and put them to the ultimate test: withstanding Hurricane Katrina.

FULLY ADHERED VS. MECHANICALLY FASTENED

First, let's take a look at the fully adhered technique. A fully adhered system, in its simplest form, means that the roof is being glued to the surface beneath it. 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 on perimeters of walls and edges. The "composite" and other intermediate components are made up of an endless combination of insulation systems, cover boards, vapor retardants, temporary roof systems and inner strata layers of adhesives.

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The bottom line is if the wind enters the roofing envelope and starts to "peel" away the component facer, 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 gust 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 the other hand, a mechanically fastened roof is attached to the structure by primarily using screws and metal plates rather than glue. Mechanically fastened systems permit a more conclusive engineering evaluation because the "fabric" is attached to the structural components of the building. That being said, the following cases from the Roofing Industry Committee on Weather Issues (RICOWI) Katrina study focus on the impact of Katrina on mechanically fastened roofs.

DEFINING THE STORM

Before traveling to the South to check out the impact of a hurricane, it is important to first understand what exactly these roofs withstood. For the purposes of this study, RICOWI defined a significant wind event as a "wind storm with a sustained wind speed of 95 mph [1 minute sustained] or greater when it makes landfall on the continental United States, in a populated area." Additionally, the National Weather Service uses the Saffir-Simpson Hurricane Wind Scale, as seen in the table below:

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.
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.
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.
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.
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.

Keep in mind that Katrina was classified as a Category 5 while still over the Gulf waters, making landfall as a Category 3 storm.

Now let's put mechanically fastened roofs to the ultimate test: withstanding a hurricane.

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VISIT OVERVIEW

Shortly after Hurricane Katrina, a group known as RICOWI (Roofing Industry Committee on Weather Issues) Research Team assembled to investigate Katrina's impact along the lower Mississippi Gulf Coast. RICOWI is comprised of all of the major roofing associations 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 impacted by variable wind speeds stretching from the eastern flank of her eye wall at Bay St. Louis east to Pascagoula, Mississippi. Inspections were focused on essential facilities, schools, hotels, and residential structures with intermediate stops to investigate a shopping center or two where an obvious blow off was visible from the road. A representative from the FiberTite Roofing Systems division of Seaman Corporation served on one of the RICOWI logistics teams during the investigation.

PASS CHRISTIAN

One of the logistics teams investigated a private school, just east of ground zero on Henderson Point, sitting on a point at the mouth of St. Louis Bay with no observable roof damage. The school was a three story, cast in place structural concrete building that more closely resembled a parking garage after the storm. 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 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, which would have allowed the team to see below the built up roof and confirm how the roof was assembled. The deck was virtually airtight and this worked in conjunction with the three-foot parapet walls to help the roofing system resist the pressures projected upon it.

BAY ST. LOUIS

The second structure investigated was a hospital in Bay St. Louis, directly across the bay, west of Henderson Point. The hospital had 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 from nearby buildings.

BAY ST. LOUIS SCHOOL AUDITORIUM

The next structure examined was the sprayed polyurethane roof on the dome of a nearby school. The auditorium, a rectangular building to the left of the dome, turned out to be a classic example of building pressurization with no back up to prevent the peeling back of the built up roof. The roof drain was located directly above the rolling freight door. Although it was unclear where the drain assembly ended up, a few of its associates were present, detached but present nonetheless.

The construction started with a steel deck, a mechanically fastened base layer of perlite using only 2 fasteners per 2' x 4' insulation board. 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. The smoke hatch lid was completely opened. 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.

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LONG BEACH

The fourth building, a "K-Mart", was located in an industrial park just outside of Long Beach. This building had a mechanically fastened 10' TPO and sustained significant winds from the storm. Flying debris left a few scars here and there, but the team was unable to find a loose fastener. Researchers found similar outcomes on this mechanically fastened vinyl roof to the one 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 less damage in general. In fact, not only did the team discover that the mechanically fastened roofs had well withstood the storm; the team did not find a mechanically fastened "single ply" membrane that had exposed the deck.

CONCLUSION

In the single-ply, low-slope roofing world, the majority of roofing failures from extreme wind events are a result of peeling failures along the edge of the roof. This was proved true in the above RICOWI cases. Peel failures occur when the membrane separates from the surface beneath it, or when the surface beneath the membrane actually separates. Many contractors are not aware of the low cost options available to prevent this from happening. A peel stop comes in several forms, including curbs and pipes. In plain terms, a peel stop is installed approximately 12 inches from the edge of the roof with the purpose of terminating any peeling that may occur. Although there are many different forms and installation techniques of peel stops, this simple addition to a roof can greatly reduce the odds of peeling from happening.

Based on the above cases of mechanically fastened roofs facing a hurricane, these examples continue to reinforce a common principle: 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 backup defensive system into loose laid and adhered roofing systems using fasteners to anchor the roof cover to the structure. The little damage the mechanically fastened roofs incurred during this study were as a result of structural failure, air borne debris or contractor error. Using this basic principle will go a long way toward ensuring any roof system's chances of survival during a very significant wind event.

Remember, if you can hold down the edges, you can hold down the roof.

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