Investigation of Adhesive Applications for Stronger and More Disaster-Resistant Roof Assemblies

Project Update for ASC & Manufacturers

January 30, 2008

Jamie Lyons, P.E.
Newport Partners

ASC

PATH
A Public-Private Partnership for Advancing Housing Technology

NP
Newport Partners L.L.C.

Roof Deck Loss

Houses with damaged or missing roof sheathing in Florida

The Impacts of Roof Deck Loss

"Roof deck attachment during a hurricane is critical to the survival of the building. Once a building loses one or more pieces of roof deck, the losses increase exponentially due to the vast amount of water that enters the building. Field observations and insurance claim folders indicate that the house quickly becomes a major loss once the roof deck begins to fail in a hurricane. In other words, even if the walls are intact and the roof trusses do not fail, loss of roof deck and a few windows typically leads to losses greater than 50% of the insured value."

"Development of Loss Relativities for Wind Resistive Features of Residential Structures" Applied Research Associates, 2002

The Adhesive and Sealants Council's Work in Adhesive-Based Roofing System Research

Project Goal:

To advance the understanding and basis for using adhesives to attach residential roof sheathing in new and retrofit applications

ASC Research Project to Address this Issue

- Cooperative Research Grant from U.S. Department of Housing & Urban Development's "PATH" Program
  - PATH = Partnership for Advancing Technology in Housing
- Adhesive and Sealant Council is prime
- Newport Partners, building technology consulting firm, is subcontractor

Project Tasks

- Task 1: Assessment of Performance Requirements
  - Canvass building code and product standards
  - Investigate related research and product testing
- Task 2: Assessment of Industry and Market Factors
  - Jobsite evaluations
  - Assess of insurance industry incentives
- Task 3: Code Evaluation and Preliminary Testing
  - Identify code issues and potential solutions
  - Identify testing needs and explore preliminary tests
- Task 4: Analysis and Outreach
  - Gap analysis for testing, codes, and constructability issues
  - Primer on using adhesives to strengthen residential roof systems

Update Topics

- State-level insurance incentive programs
  - State insurance policies & codes
- Modular industry feedback
- Review of relevant testing & research
  - Reliability of nail fastening applications
  - Aged testing of roof assemblies
  - Uplift resistance of roof assemblies with ccSPF
- Related RD&D

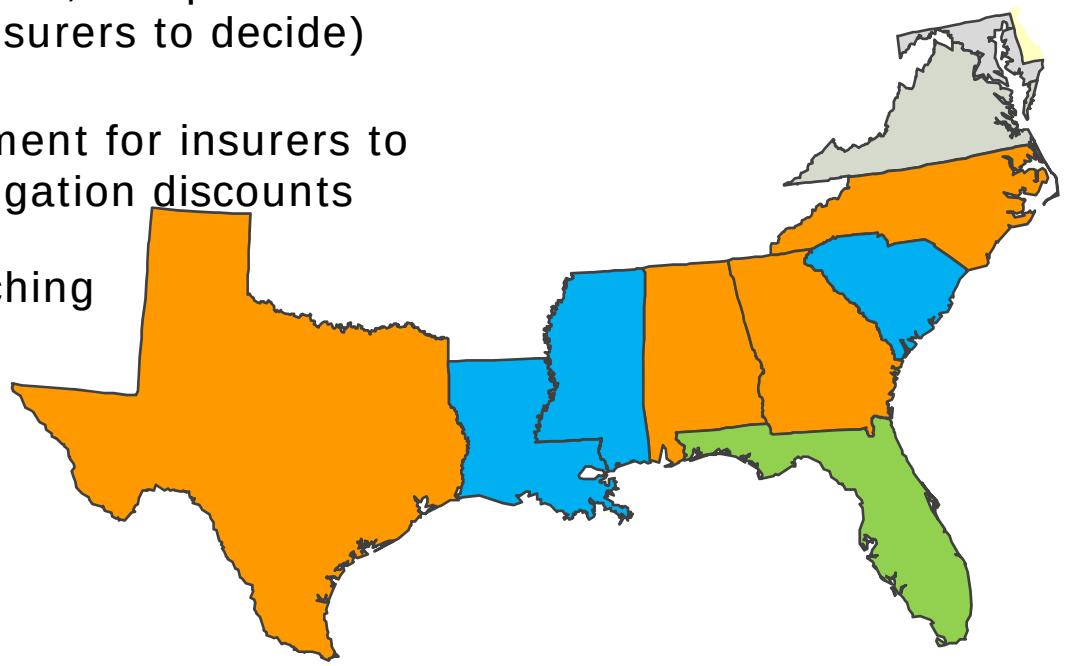
State-level Insurance Incentive Programs & Policies

State requires insurers to provide wind mitigation discounts, specific mitigation measures are defined

State requires insurers to provide wind mitigation discounts, no specific measures are defined (left to insurers to decide)

No state requirement for insurers to provide wind mitigation discounts

Currently researching status



State Wind Mitigation Incentives

- Types
  - Insurance premium discounts
    - For specific measures (e.g. gable end bracing)
    - For code-plus programs (e.g. MS recognition of Fortified Homes)
  - Matching grants for mitigation upgrades
    - Have been successful in FL and SC
- Incentives originate in state legislation
  - New homes: Building codes are typical path to legislating wind mitigation into new homes, but this can also be addressed by code^{+} wind mitigation incentives
  - Existing homes: the bulk of wind mitigation incentives are generally structured to encourage equivalent protection in existing homes

Wind Mitigation Incorporated into Codes for Existing Buildings - Florida

- Code Regulations for Existing Homes: In mid-2007 Florida's legislature passed a statute to require that the Florida Building Commission (FBC) develop language to enable older homes to be retrofitted with code-recognized wind and hurricane resistant measures.
- During drafting and review of the wind mitigation rule, applying adhesives to existing structures was proposed by NP and other groups (triggered by a property sale)
- Given the timeframe and the volume of comments received on the proposed language, the FBC decided to keep their initial language (which does not address adhesives) and adopted that as the rule that is scheduled to go into effect October 1, 2007. They are now considering some of the original comments in a current round of public meetings in early 2008

Opportunities for Adhesive Applications in State-Level Initiatives

- Widespread recognition of the need to fortify existing structures in hurricane-prone states
- The landscape of residential insurance coverage is shifting –map will look different in 1 year
- Applying codes to existing buildings (FL) could be precedent
- Supplying states with info on mitigation measures can be helpful and integrate into matching grant programs and mitigation policies

Use of Adhesives in Modular Housing Roof Assemblies

- Modular is an adhesives-ready production approach.
  - Factory setting with adhesives used for floor, wall, ceiling assemblies
- Summer 2007 conducted plant tour and review of the use of adhesives in the modular production environment
- Overall the modular builder did see value in the performance benefits offered by adhesive-based roof systems, but would not consider incorporating this technology unless it provided a significant incentive
  - first-cost savings
  - trade-off in some other code-required building detail
- In the factory setting, modular builders also feel that QA is good, so the reliability of nail-fastened roof systems is good.

Update on Related Testing and Research
- Reliability of Nail-Fastening

- Reliability of nail-fastening of residential roof systems
  - Nail misses
  - Inadequate spacing (too far apart)
  - Inadequate fastener type
  - Over- or under-driving of fasteners
- "Common [roof sheathing installation] mistakes include using the wrong size fasteners, missing the framing members when installing fasteners, overdriving nails, and using too many or too few fasteners." (FEMA Technical Fact Sheet #18 – Roof Sheathing Installation).
- Qualitative conclusions from post-disaster inspections have pointed at installation errors such as nail misses as root causes for building failures in hurricane events.
- No readily available quantitative field research of nailing reliability – confirmed with APA and National Roofing Contractors Association

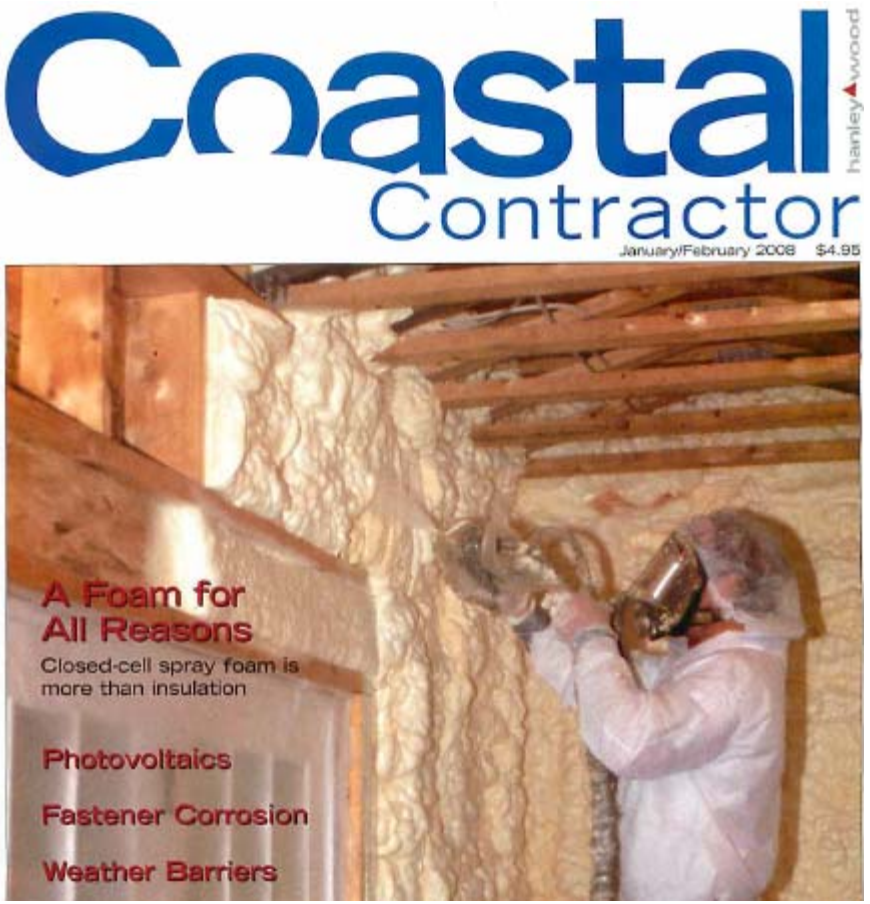
Update on Related Testing and Research
- Aged Testing of Nail Connections

- A limited body of testing data has indicated that accelerated aging of nails-only, nails + foam, and foam connections between roof decking and trusses shows drop-off in nail withdrawal strength in nails-only applications, and good performance of adhesives.
- However there is mixed debate on time effects of nail withdrawal in the wood science community, and the dynamic is influenced by many variables.
- Insights from the manufacturers?

Update on Related Testing and Research

- Uplift Resistance of Roof Assemblies with Closed-Cell SPF

- Recent testing on the structural properties of closed-cell spray foam (Honeywell, Huntsman, University of Florida)
- 3” of ccSPF increased uplift resistance of roof decking x3 compared to traditional fastening (2x4 framing @ 24” OC, ½” OSB, 6/12 fastening with 8D nails)
- Use of a 3x5 inch fillet at the deck to framing joint, resulted in x2 uplift capacity relative to baseline assembly



Next Steps

- Existing houses – using adhesives as a retrofit measure for wind mitigation
  - Continue to track state-level activities and advocate for adhesives in insurance incentive programs, matching grant programs, and codes for existing buildings
  - Develop outreach/education materials for contractors, builders, consumers, state officials
    - Awareness of mitigation measures and the discounts is lacking

Next Steps (cont.)

- New residential construction – explore cc-SPF application for conditioned (non-vented) attic assemblies
  - Prevent water intrusion thru eave vents
  - Manage ambient humidity better than a vented attic
  - Energy efficiency advantages (cooler attic temp, location for HVAC)
  - Secondary water barrier for any roof leaks that could develop
  - Effective vapor barrier
  - Recognized by 2006 IRC
- Needs:
  - If not a cathedral ceiling with drywall – how to deal with fire protection
  - Concerns about deck cupping, long-term structural benefits, and the effect of small roof leaks where water is trapped above the cc-SPF

Project Contacts

- Larry Sloan, ASC

  Larry.Sloan@ascouncil.org
  (301) 986-9700 x111
  www.ascouncil.org

- Jamie Lyons, Newport Partners
  jameslyons@newportpartnersllc.com
  (301) 889-0017
  www.newportpartnersllc.com

- Mike Moore, Newport Partners
  mmoore@newportpartnersllc.com
  (303) 279-6769