



THE ADHESIVE AND SEALANT COUNCIL, INC.

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Office of Policy Development and Research, Room 8134
451 Seventh Street, SW
Washington, DC 20410

SUBJECT: Progress Report for April 2008

Contract No. H-21521CA, Investigation of Adhesive Applications for Strong and More Disaster-Resistant Roof Assemblies – Phase 1

Period of Performance: 4/7/06 – 11/7/08

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Email Attachments which Accompany this Report:

- None

SECTION I – INTRODUCTION

The HUD Office of Policy Development and Research has been extensively involved in supporting research and development on building technology innovations, construction systems, products, standards, regulations, and code issues which affect the affordability, safety and livability of the nation's housing. As the interrelationships of these topics become more complex, the continued need to conduct research and demonstrations becomes even more critical.

In addition to the research and demonstration efforts administered directly by the Office of Policy Development and Research, HUD administers the Partnership for Advancing Technology in Housing (PATH) program. PATH provides private and public sectors for the U.S. housing industry an unprecedented opportunity to advance state of the art practices in the design and construction of affordable housing for the public by accelerating the process of developing and introducing new and innovative technologies and new materials through demonstrations and pilot projects throughout the nation.

This cooperative agreement with the PATH program will investigate and characterize the use of adhesives to fasten roof sheathing materials to underlying roof structures in residential buildings.

This application of adhesives holds the potential for improvements in roof system durability and disaster resistance, and applies to both new and existing construction.

SECTION II – PROGRESS AND SCHEDULE

Phase 1 of this project consists of 4 tasks. The status of each task is presented below.

Task 1. Assess Performance Requirements and Develop Criteria for Adhesive Consideration

Complete - no new activity in April 08

Summary:

Task 1 called for ASC and its subcontractor Newport Partners (NP) to better understand the performance requirements needed from adhesives used in roof assemblies by a) canvassing building code and product standards, and b) investigating related research and product testing.

Together ASC and NP have completed this task by engaging dozens of industry stakeholders, including ASC members and non-member adhesive manufacturers, researchers from academia and private firms, industry associations, building code bodies, and international groups involved in research and testing. Findings can be grouped into the following categories:

- Similar research and product development efforts
- Findings on the most suitable applications for similar systems (e.g. retrofit of existing roofs)
- Relevant building code issues that affect the application (e.g. issues with fire blocking for foam plastics)
- Relevant building performance and installation issues which have been raised (e.g. restricting ability of sheathing panels to expand/contract with ambient humidity changes)

The results of these research efforts are presented in the Task 1 summary report submitted to HUD in August 2006.

Task 2: Assessment of Industry and Market Factors

Complete – no new activity in April 08

Summary:

In March 2007 we submitted the summary report “Insurance Incentives for Wind Mitigation Measures.” While the summary report on insurance incentives is now complete, we will continue work under this area as the project moves forward and we continue to work with stakeholder groups. In January 2008 – we renewed our research of state-level programs which involve insurance incentives for building owners to “harden” their buildings against wind damage. Such efforts at the state level are becoming more common as insurance coverage for homeowners becomes increasingly expensive and/or difficult to obtain in hurricane-prone regions.

The table below summarizes our current findings in this area:

State	Programs & Policies
Florida	<ul style="list-style-type: none"> • Insurance Incentives: Statute 627.0629 requires residential property insurance providers in FL to provide “discounts, credits, or other rate differentials, or other appropriate reductions in deductibles” for residential properties where construction methods that have been shown to reduce loss caused by windstorms are employed. Adhesives are recognized as a wind mitigation measure affecting roof deck attachment in retrofit construction, but not construction in or after 2002. See this site: http://www.floridadisaster.org/mitdb/ • 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. The rule was to go into effect October 1, 2007 and be adopted into the Florida codes during the spring of 2008. In order to represent adhesives applications in this effort, Newport become involved with the drafting and review of the wind mitigation rule and participated in a public meeting in August 2007. IBHS, DOW, and FLASH were also represented. However, given the timeframe and the volume of comments received on the proposed language, FBC decided to keep their initial language (which does not address adhesives), unchanged except for editorial changes, and adopted that as the rule that is scheduled to go into effect October 1, 2007. However they are now considering some of the original comments in a current round of public meetings. There is a meeting in March 2008 on this topic, where we will either participate or submit comments related to the benefits of adhesives in roof systems.
Texas	<ul style="list-style-type: none"> • Texas Department of Insurance (TDI) regulates the insurance industry within the state. TDI cannot require private insurers to offer wind damage mitigation incentives. However, due to recent losses in the state, insurers in Texas are generally becoming more proactive. • We are currently re-connecting with TDI to see what policy developments have occurred over the last 6-9 months. When we last spoke with them, they were very interested in mitigation techniques which proved effective on existing homes, potentially for application in the highest risk areas of Texas (insured by the Texas Windstorm Insurance Association) or for use in voluntary incentive programs
South Carolina	<ul style="list-style-type: none"> • SC insurers are required by law (The Omnibus Coastal Property Insurance Reform Act of 2007 amended S.C. Code Ann. Section 38-73-1095(c)) to provide homeowners discounts for mitigation efforts. Insurers are also required to inform consumers of the discounts they offer for mitigation efforts undertaken by the homeowner. This policy came into affect Jan 1, 2008 and has a two-year phase in period. <ul style="list-style-type: none"> • Currently, this statute only extends to property coverage in <i>seacoast and coastal areas</i>. It is anticipated that legislation will be introduced in 2008 to extend mitigation discounts to the entire state. • SC does not dictate measures for which discounts must be provided, or the amount of the discount, but does require the insurer to demonstrate a correlation between reduction in premium and reduction in risk. • Sheathing attachment, to receive a discount, must comply with the current edition of the IRC as adopted by SC, or an engineered design for the wind speed for the site on which the home is located which meets current code requirements • Retrofits are included in the legislation, although specific measures for existing homes are not identified and instead left up to the insurer to identify and evaluate for risk-mitigation effectiveness • NP is in contact with DOI staff involved in administering the incentives program and will provide them with technical info showing the merits of using adhesives in roofing retrofits • South Carolina’s Safe Home program provides matching grants to home owners who pursue wind mitigation measures for their existing homes. The program was created through the SC Omnibus Coastal Property Insurance Act of 2007, engrossed June 2007, and is administered by the SC Department of Insurance (DOI). All grants for projects to help make homes less vulnerable to hurricane damage may be matched on a dollar-for-dollar basis, with the state’s contribution not to exceed \$5,000. Use of adhesives in the attachment of roof sheathing to roof framing is one of the mitigation measures eligible for the funding match. https://online.doi.sc.gov/Eng/Public/safehomes/index.html • Insurers in the state are also starting to recognize “code plus” programs for new residential construction – specifically the Institute for Business and Home Safety’s (IBHS) “Fortified for Safer Living” program. The

	<p>program specifications are "code plus" requirements for all types of perils including hurricanes and flooding, and require a secondary water resistant barrier but do not recognize adhesives used to bolster uplift resistance in new homes. One SC insurer, South Carolina Farm Bureau Mutual Insurance Company, currently recognizes and offers an insurance discount for homes meeting the program.</p>
Maryland	<ul style="list-style-type: none"> • Maryland recently established a task force to examine options for helping low income homeowners in coastal regions to obtain hazard insurance. Initial hearings were heard in October-November 2007. We are currently contacting the state to determine their next steps.
North Carolina	<ul style="list-style-type: none"> • The North Carolina Department of Insurance doesn't require any insurer to offer discounts for wind mitigation efforts. Insurers that do offer discounts, of any kind, have to offer them to all customers, not just one or on a case-by-case basis. The Dept. of Insurance would have to approve any discounts offered by insurers.
Georgia	<ul style="list-style-type: none"> • The Georgia Department of Insurance doesn't require home insurance providers to offer discounts for wind mitigation efforts. The state will consider rate filings for insurers who chose to offer mitigation discount, but insurers are not required to do so.
Alabama	<ul style="list-style-type: none"> • The state of Alabama's home insurance industry is regulated by the state's Department of Insurance. Individual insurance providers can offer discounts to policy holders for wind mitigation measures. However, the state does not require nor urge insurance providers to offer discounts for wind mitigation efforts. • The Department of Insurance would need a legislative mandate or significant commissioner involvement before the agency begins to recommend that insurance companies lower rates on homes with wind mitigation efforts. Legislation has never been proposed to this effect.
Mississippi	<p>2007: HB 753 - Engrossed 4/17/07</p> <ul style="list-style-type: none"> • Perform cost-benefit study on wind mitigation (WM) measures • Mandate INSURANCE incentives for WM • Establish WM program within MS Dept of Insurance • STATE ASSISTANCE: Provide inspections, retrofit grants, and certifications; recommend affordable WM retrofits <p>MS WUA: up to 25% reduction for IBHS Fortified Homes Status: program development in progress</p>
Louisiana	<ul style="list-style-type: none"> • Insurers shall provide wind deductible credits and wind exclusion credits in their rating plans. Insurers can use past and prospective loss experience, in and outside the state, to determine the credits given. • Regulation 94 - Premium Adjustments for Compliance with Building Codes and Damage Mitigation with section 12721. Appendix A. details the information homeowners have to provide to insurers. Homeowners would need to contact insurance providers to learn what mitigation efforts carry discounts. <ul style="list-style-type: none"> • Retrofits are included in the legislation. • Supplemental coverage is provided through the Citizens Property Insurance Corporation.

A progress briefing on this project to industry stakeholders, given during an online conference on January 30, 2008 – summarizes this information and also includes a map graphic.

In addition to the state policy issues, we tracked code proposals relevant to this application at the February ICC hearings. Code proposals related to the use of adhesives in residential roof systems mostly dealt with proposed requirements for secondary water barrier systems in hurricane-prone regions. A major issue with such provisions is defining what materials and systems should qualify as a secondary water barrier system.

As a second part of this task, we have assessed jobsite factors which need to be considered for the successful use of adhesives in both new and retrofit applications. These items are considerations for this application which may affect the installation of adhesive or related materials, as well as long-term performance and maintenance. A summary of jobsite factors was submitted in the monthly report dated April 19, 2007.

Task 3: Code Evaluation and Preliminary Tests

Complete by July 1, 2008

The objectives of this task are to:

- Conduct preliminary testing (in conjunction with ASC members or other manufacturers) to evaluate system performance and assess potential solutions to constructability issues.
- Explore solutions to code issues for the chosen applications: including the fire protection issue and the pathway for meeting performance-based suction load requirements.

Task 3 Deliverables:

- Summary of preliminary testing
- Summary of relevant code issues and strategies for compliance

Testing activities are laid out in Phase I and Phase II activities below. Phase I activities allow us to better understand the application and potential market segments where it would provide the most value for housing durability. Phase II testing needs, which are subject to additional project funding by HUD, will provide more complete technical performance data, which will enhance the likelihood of integrating this application into regulatory and insurance programs.

Phase I Testing & Evaluation

1. Field Trial of Applying Adhesives in Site Built Single-Family Housing (completed in August 2006)
 - Summary of field trial for new construction submitted to HUD in 2006.
 - As a new addition to this subtask, we will conduct a case study on the use of adhesives in retrofit projects to assess their effectiveness, cost-effectiveness, and the applicability of any available matching grant programs.
 - In April of 2008, Newport Partners conducted a case-study in Florida with a commercial provider of a spray-applied spray foam system. The spray foam is applied to the underside of the roof decking in existing homes to enhance deck uplift strength and also provide a secondary water barrier for the roof system. The case study assessed the pre- and post-condition of the roof system, costs and benefits (installation cost, any applicable insurance premium discounts), and application issues. Interviews were conducted with

the home owners to determine motivation behind the retrofit, as well. A draft case study report is being submitted to HUD in May 2008.

2. Explore potential applications in the factory-built housing segment
 - Conduct in-house factory assessment using adhesives in roof systems, and assess performance enhancements (e.g. reduced damage during transport) and product implications.

In 2007 we met with a modular home builder at their production facility in Pennsylvania. The meeting summary was provided in the monthly progress report dated July 18, 2007. 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 (e.g. first-cost savings, a trade-off in some other code-required building detail). The builder, as well as the adhesive supplier to the builder, are both interested in the progress of this research and will be kept informed as we move forward.

3. Research of traditional construction techniques
 - Conduct background research and preliminary field testing as deemed necessary on the reliability of typical roof deck installations (e.g. nail misses, adherence to spacing requirements)

Following a literature review of research into the reliability of nailing decking to roof framing, we have found:

- “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).
- Pneumatic nail guns are more likely to “miss” than hand nailing, because the installer cannot sense the miss as easily with the powered nail gun
- The impact from nail misses (or other fastener mistakes like overdriving) really depends on the location of the nail. If the missed nail is on the edge, gable or ridge then the roof’s overall uplift performance is decreased more than if the nail was in the middle of the roof.
- Qualitative conclusions from post-disaster inspections have pointed at installation errors such as nail misses as root causes for building failures in hurricane events.

Despite this awareness of the critical importance of accurate nailing of roof sheathing to framing, there is no readily available field research that focuses quantitatively on the frequency of nail misses, nail overdriving, inaccurate spacing, or improper fastener selection. This conclusion was confirmed with groups such as APA and the National Roofing Contractors Association.

4. Demonstration of enhanced roof systems using adhesives

- Due to timing and coordination issues, this demonstration project has been put on hold. If the demonstration house project in South Carolina does not get underway in a timely manner we will look for an alternative way to test the constructability of tape adhesive systems in new residential construction.

Manufacturer Collaboration

In addition to the activities established above, we have also had preliminary discussions with an adhesives manufacturer which is interested in performing in-house testing to evaluate performance benefits of adhesives used in residential roofing applications. More information on this potential collaboration will be provided if it moves forward.

Phase II Testing (Subject to Additional HUD Funding)

5. Conduct technology demonstration from Item #4
 - Conduct time & motion studies of the application of multiple types of adhesive systems (e.g. tapes, caulk gun applied adhesives)
 - Capture field installation on video for education/outreach
6. Examine one or more of the following technical performance issues. Funding levels and manufacturer input will help form final priorities:
 - Long-term performance of adhesives in an attic environment. What are the impacts on uplift resistance from temperature and humidity cycling?
 - Long-term performance of mechanical (nail) fasteners in an attic environment. What are the long-term issues with connection strength and nail withdrawal?
 - Effectiveness of adhesives as a redundant system to make up for inconsistent fastener application. How effective are adhesives, used in either new or existing construction, in mitigating the reduction in uplift strength caused by nail misses or other shortcomings of standard installations?
 - Improved tooling for retrofit installations. Explore tooling solutions that allow installation of adhesives all the way out to the edges of the roof?
 - Investigation of adhesives applied at roof deck seams for waterproofing as well as improved uplift. Is there a minimum deck thickness required to prevent warping of deck panels as moisture content of framing and panels equilibrates? What happens to seam-applied adhesives when the adjacent wood becomes saturated?

Task 4: Analysis and Outreach

Complete by November 1, 2008 (per project extension)

The objectives of this task are to:

- Summarize, based on results of Task 3, current “gaps” in adhesive-based roof sheathing attachment systems in three core areas: 1) performance testing, 2) codes, and 3) solutions to constructability issues.
- Develop a primer on using adhesives to strengthen roof systems. Guidance document would be aimed at the appropriate audience, e.g. if the application is new construction the audience

would be builders and contractors; for retrofit applications the audience would be contractors, roofers, and DIY homeowners. The short (~ 2 page) primer will explain the benefits of using an adhesive-based system, the intended application, and recommendations for materials.

Deliverables:

- Report on findings and remaining information gaps
- Primer on using adhesives to strengthen roof systems

Task 4 Progress:

In April 2008, we presented our research findings and future projects at the World Adhesives Conference in Florida. The attendees, comprised of adhesive industry manufacturers and others, were interested in our work and we made some good connections with manufacturers. The presentation was attended by roughly 50 individuals.

We are also conducting preliminary background research on the long-term performance of roof deck-to-roof framing connections in attic environments, to determine what data exists on nails-only or adhesive connections.

Another outreach effort is our review of FLASH's contractor training curriculum for its "Blueprint for Safety" program. This training program teaches contractors how to harden houses to withstand natural hazards including high wind events. The training explains the application of adhesives to strengthen residential roof systems (particularly for retrofits). In April we reviewed this technical manual to determine if there might be additions or improvements, and found that the information is well presented in its current form. We will follow-up with FLASH to determine if there are any additional ways we can help them disseminate this information to building industry professionals.

SECTION III – PLANNED EFFORT

Activity for May 2008 includes; coordinating with an interested manufacturer on potential lab testing and researching the existing research on nail connection strength as a function of aging.