



THE ADHESIVE AND SEALANT COUNCIL, INC.

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Office of Policy Development and Research, Room 8134  
451 Seventh Street, SW  
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SUBJECT: Progress Report – July 2007 – August 15, 2007

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

Period of Performance: 4/7/06 – 10/7/07

Contractor: The Adhesive and Sealant Council, Inc.  
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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**

##### 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**

##### 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.

We are also in ongoing discussions with several groups to monitor emerging programs related to mitigation incentives, involving the Texas Department of Insurance, the Federal Alliance for Safe Homes ([www.flash.org](http://www.flash.org)), and the Mississippi Insurance Commission. The Federal Alliance for Safe Homes (FLASH) program is heavily involved in consumer education on more hazard resistance homes (new and existing), and already has content focused on using adhesives to

increase the deck uplift resistance in existing homes. One example is an online animation tool on best practices for strong roof systems: <http://flash.org/activity.cfm?currentPeril=3&activityID=181>

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.

A new activity quite relevant to the use of adhesives in existing homes emerged in July 2007. A summary of this activity is provided below.

### **Florida Rulemaking on Wind Mitigation for Existing Homes**

In response to great property losses sustained during hurricanes in the late 1990s, Florida adopted the Standard Building Code state-wide in 1998. In 2001, Florida adopted the International Residential Code with Florida-specific amendments. Studies have shown that homes built to the standards in these codes have weathered hurricanes better than homes that predate Florida's building codes. Because a large percentage of Florida's homes were built prior to the institution of these codes, Florida's legislature recently 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 is to go into effect October 1. Based on the normal development cycle of Florida's building codes, this rule is then to be adopted into the Florida codes during the "glitch cycle" which begins in the spring of 2008. Pursuant to Florida statute 553.844, the wind mitigation measures of the rule to be developed by the FBC are to include the following:

1. Prescriptive techniques for the installation of gable-end bracing;
2. Secondary water barriers for roofs and standards relating to secondary water barriers;
3. Prescriptive techniques for improvement of roof-to-wall connections;
4. Strengthening or correcting roof-decking attachments and fasteners during reroofing; and
5. Adding or strengthening opening protection.

A draft of the wind mitigation rule was prepared through cooperation with the Institute of Building and Home Safety and was distributed by the FBC for public comment during July 2007. Public comments were received at the wind mitigation workshop held by the FBC on Wednesday, August 8, 2007. Newport staff was in attendance to speak in support of the inclusion of adhesives as a code-recognized wind mitigation measure for strengthening roof deck attachments. In the draft language, there was no mention of adhesives for this application. While at the meeting, NP made contacts with a FLASH consultant, DOW representatives, and a consulting engineer who all spoke in favor of including adhesives in the draft language.

NP's original proposal for inclusion of adhesives in the draft language called for AFG-01 adhesives to be used when the roof sheathing nailing schedule was inspected during a home

inspection conducted at resale and determined to not meet code requirements. Based on feedback from legal counsel, we learned that the Florida building code cannot tie construction requirements to real estate inspections. Also, an IBHS staff person who was involved with the original research demonstrating the effectiveness of AFG-01 adhesives for increasing roof uplift resistance, testified that the use of AFG-01 adhesives should not be mandated because of extremely difficult constructability issues associated with applying the adhesive all the way out to the eaves. Reinhold and representatives of DOW, FLASH, and other organizations related that spray foam polyurethane adhesives are a much more logical choice for increasing the uplift resistance of roof sheathing. As a result, NP adjusted its original proposal to remove the reference to a real estate transaction, remove the requirement for using adhesives, and to prescribe how AFG-01 adhesives and spray foam polyurethane adhesives should be used if they are implemented.

In preparation for the commission meeting on Tuesday, August 21, 2007, where the commission will seek to establish final rule language, NP submitted the amended proposal to FBC staff as well as to the pro-adhesive contacts made at the wind mitigation workshop. A follow-up conversation with the FLASH consultant revealed that he and IBHS have also drafted language to prescribe the selection and installation of spray foam polyurethane adhesives if they are selected to increase the wind uplift resistance of existing homes. The commission has until October 1 to finalize the wind mitigation rule, at which time it will be engrossed. Based on NP's and others' efforts, we are hopeful that adhesives will be included in the language. If they are not, the next opportunity to provide comments for their inclusion is when the language is adopted into the Florida building code in their spring "glitch cycle".

### **Task 3: Code Evaluation and Preliminary Tests**

Complete by February 1, 2008 (changed from August 1, 2007 to reflect revised testing plan)

The objectives of this task are to:

- Explore solutions to code issues for the chosen applications: including the fire protection issue and the pathway for meeting performance-based suction load requirements.
- Conduct preliminary testing (in conjunction with ASC members or other manufacturers) to evaluate system performance and assess potential solutions to constructability issues. For example, testing of mocked-up new construction roof systems might employ a pre-applied adhesive tape applied to the top surface of the truss.

Task 3 Deliverables:

- Summary of relevant code issues and strategies for compliance
- Summary of preliminary testing – including test design, findings, and recommendations

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 (complete)
2. Explore potential applications in the factory-built housing segment
  - Conduct in-house factory assessment using adhesives in roof systems
  - Assess performance enhancements (e.g. reduced damage during transport) and product implications
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)
4. National demonstration of enhanced roof systems using adhesives
  - Conduct planning and manufacturer coordination leading to demonstration of adhesive-based roof system in a national demonstration house in the Southeast US

### 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?
  - Effectiveness 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?

### Phase I – Part 2

In June 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.

We will pulse other modular builders for their views on this technology but at the current time have no further plans to initiate an actual product trial in a modular plant.

### Phase 1 – Task 3

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.

We are currently planning a small number of field trials of relatively new housing (less than 15 years old) to gain a rough estimate of how frequently nail misses do indeed occur. Builder and site locations will not be specifically identified, although the characteristics of the construction will be reported (e.g. age, style of production, roof type).

### Phase 1 – Task 4

We are in the initial stages of planning to deploy adhesives in a demonstration and field trial for a national show house in South Carolina. Our plans for this demonstration include utilizing multiple adhesive products to secure sheathing to framing, and demonstrating this application as a viable code-plus measure for high wind regions. The overall project is a showcase of innovative building systems and technologies for builders, contractors, designers, and consumers, so it will serve as an excellent platform to explore and exhibit this application to a wide audience. We will also investigate if local insurance incentives or industry mitigation programs will give the builder or homeowner special incentives for using this technology, given that the house will be in a high wind zone. This activity will provide ideal content, including photographs and an educational video segment, for the outreach and educational materials discussed below under Task 4.

#### **Task 4: Analysis and Outreach**

Complete by May 1, 2008

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:

We are currently discussing opportunities to partner and collaborate with the Federal Alliance for Safe Housing (FLASH). FLASH is focused on the application of technologies to improve the disaster resistance of new and existing housing, and is active on this issue in many different programs.

#### **SECTION III – PLANNED EFFORT**

Activity for August 2007 will focus on 1) coordinating with the FLASH organization, 2) setting up field assessments to evaluate nailing reliability, and 3) continuing to monitor developments with the Florida rulemaking process affecting wind mitigation measures for existing homes.