



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 – June 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

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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.

This monthly report reflects a period of performance of 18 months as noted in the previous monthly report. Dates for several task deliverables now reflect this period of performance.

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

Complete

Deliverable & Due Date: Summary of adhesive-based roofing attachment systems, relevant building code, relevant product standards, and related research programs. Submitted to GTR 8/22/06.

Progress and Deliverables:

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

The objectives of this task are to:

- Conduct assessment of jobsite factors which are involved when using adhesive-based systems (especially in new construction). More information is needed on these issues to understand the magnitude of potential barriers.

- Investigate and characterize insurance industry programs focused on encouraging improved water resistance and uplift resistance for roof systems (new and existing) to mitigate future damages. This will improve our understanding of industry interest in applications involving adhesives.
- Determine the most feasible application(s) moving forward based on performance, building code, “constructability”, and market factors. This effort involved a roundtable discussion of adhesive manufacturers at the ASC Fall Convention to get their input.

Task 2 Deliverables:

- Summary report of jobsite factors, including assessments of different application strategies
- Summary report on insurance industry initiatives which could impact adoption of adhesive-based systems

Task 2 Progress:

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), 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>

In July we have a meeting scheduled with the FLASH group to discuss our research, their current programs to educate homeowners and others on damage mitigation practices, and opportunities for collaboration.

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 August 1, 2007 (changed from June 1, 2007)

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 trial 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?

Under **Phase 1 – Task 2**, in June 2007 we met with a modular home builder at their production facility in Pennsylvania. The modular home industry already uses adhesives in ceiling, wall, and floor systems so adhesive application is part of their production process. This particular builder uses adhesives to bond OSB decking to floor joists, drywall to wall studs, and ceiling drywall to the underside of roof trusses. In this ceiling drywall-to-truss application, no additional fasteners are used, which helps prevent nail pops during transport of the modules.

The purpose of the meeting was to discuss the modular builder’s use of adhesives and the values and disadvantages that they see in incorporating adhesives into their roof systems. Overall, this well established builder saw the use of adhesives in roof systems as a good idea and recognized the performance benefits in terms of uplift resistance. They also felt it was ironic that adhesive is commonly used in other building assemblies (floors, walls) but not roofs where it could have a major durability benefit. And while adhesives’ ability to reduce drywall pops during transport are a major benefit of using adhesives in ceilings and walls for them, they did not see similar transport benefits to using adhesives in the roof assembly.

Relative to their standard practice and the current building code, for them to add adhesives to their production process simply “adds a step”. It would likely not be a difficult step for them to add, especially since their operation already incorporates adhesives into several production stations. And in fact they would strongly consider using adhesives in their roof systems IF there was some type of trade off, e.g. use adhesives and then you can use thinner decking. Their builders out in the field simply want to meet code requirements and have no interest or tangible incentive to go beyond code minimums. It is interesting to note that this group ships some units to high wind coastal areas in the mid-Atlantic region, but in general their customers are not nearly as sensitive to high wind damages compared to homeowners in the southeast US.

The builder also felt that in the factory setting, the quality of roof fastening is fairly good. Floor labor constructs and fastens the roof on a table in controlled conditions. It is easy to access the areas to be fastened, and workers are not high in the air as they can be in site-built housing. Additionally, the modular builder has in-house QA staff which inspects the building process. So overall, the builder did not feel like the “belt and suspenders” approach of using mechanical fasteners along with adhesives as an added assurance measure to account for nail misses was a significant benefit.

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.

Under **Phase 1 – Task 3**, we are currently conducting a literature review of research into the reliability of nailing decking to roof framing. The intent of this activity is to assess what prior research has concluded regarding the application of nails to fasten roof decking. That is, has prior research examined adherence to nail spacing and fastener specifications, and if so has field nailing been found to be a reliable method of meeting code requirements for roof uplift.

Our findings thus far indicate:

- “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. Therefore we will conduct a small number of field trials of relatively new housing (less than 15) 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).

Under **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 October 30, 2007

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 June we initiated discussions with the Federal Alliance for Safe Housing (FLASH), and in July we will discuss partnering opportunities with this group. This collaboration could yield additional opportunities for outreach.

SECTION III – PLANNED EFFORT

Activity for July 2007 will focus on 1) coordinating with the FLASH organization, 2) setting up field assessments to evaluate nailing reliability, and 3) preliminary planning for the South Carolina demonstration.