INSULATION REUSE IN LOW-SLOPE ROOFING IN THE USA: AN INDUSTRY SURVEY

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In early 1995, the Insulation Subcommittee of SPRI, in concert with Oak Ridge National Laboratory, circulated a survey to the membership of SPRI, the Roof Consultants Institute (RCI), and the technical committees of the National Roofing Contractors Association (NRCA) seeking their input on the issue of insulation reuse. The subcommittee was attempting to determine what guidelines are currently used by the manufacturing, consulting, and contracting segments of the roofing industry to decide whether existing roof insulation can remain when a roof system is reroofed. The purpose of the survey was to determine if there was any consensus and if it was worthwhile to pursue the development of a guide that would assist roofing professionals in this decision making process. The survey inquired into the assessment parameters, the means used to gather the necessary data, and the pass/fail criteria employed. A second survey was sent to the respondents of the first survey summarizing the authors' finding and requesting further insight and more quantitative information on the pass/fail criteria.

This paper summarizes the results of these two surveys. A listing of assessment parameters and pass/fail criteria is presented, along with conclusions and recommendations that can be employed to determine if existing insulation can be reused.

KEYWORDS

Conservation, dimensional stability, energy, insulation, low-slope roof, moisture, re-cover, reroofing, structural integrity.

INTRODUCTION

Roof re-cover, the practice of installing a new roof system over an existing failed roof, has become a commonplace occurrence. The 1995 NRCA Annual Market Survey[1] indicates that approximately 33 percent of current reroofing activity is re-cover.

When re-cover is the selected reroofing option, the roofing designer is making the decision that the insulation material in the existing roof system can remain in place and is a satisfactory substrate for the new roof system that is being installed. Most often, the existing roof system has failed, and moisture has entered the roof system and has been absorbed into the insulation material. Moisture absorption degrades the thermal performance of insulations,[2] can reduce their physical properties and can create an environment that can corrode the metal components of the roof, producing life/safety concerns.

Given the serious impact that moisture can have on insulation materials, the SPRI Insulation Subcommittee recognized that guidelines for reusing insulations or leaving them in place during reroofing would be of significant value to the roofing industry. To develop these guidelines, the committee decided to produce and circulate a survey to generate the necessary data. This paper summarizes the activities of the SPRI Insulation Subcommittee in developing the surveys and analyzing the subsequent survey responses. A series of issues that need to be addressed when considering reusing insulation, along with pass/fail criteria, is proposed.

THE SURVEYS

Survey Number One (Appendix 1)

The original survey was developed and circulated in the summer of 1995. This survey was circulated to the entire memberships of SPRI and the Roof Consultants Institute (RCI) and the technical committees of NRCA. Eighty responses were received, representing a 9 percent return. The return percentages for SPRI, RCI, and NRCA were 26 percent, 5 percent, and 25 percent, respectively.

The survey asked if criteria were in place in their company/firm to assess if insulation could be reused. Of the 80 responses, 84 percent indicated that their company had some criteria. When asked what factors were included in their criteria, the most frequently stated factors were:

- moisture content (80 percent)
- structural integrity of the insulation (39 percent)
- roof system issues, such as age, history, attachment methods, etc. (19 percent)
- insulation type (13 percent)
- compressive strength (10 percent)
- R-value (9 percent)
- dimensional stability (9 percent)

Other factors included codes (4 percent), manufacturer requirements (3 percent), facer condition (4 percent), deck type (3 percent), insulation thickness (3 percent), and the existence of a vapor retarder (3 percent).

The survey inquired about how information was gathered to determine whether the insulation should be reused. Of the 73 responses to this question:

- 23 percent indicated that visual inspections were used;
- 8 percent used testing methods;
- 69 percent used a combination of visual and testing techniques.

The most frequently performed tests were nondestructive moisture testing (67 percent). The types of tests used included:

- moisture content using gravimetric measurement (57 percent)
- core cuts (28 percent)
- compressive strength (12 percent)
- R-value (7 percent)

In addition, dimensional stability (2 percent), insulation thickness (2 percent), faster pull-out (3 percent), and facer adherence (2 percent) were noted.

The survey asked what was employed as the pass/fail criteria. This question yielded a wide variety of responses. Of the 62 responses received to this question:

- Fifty-five percent stated moisture as the criteria. Answers ranged from "the insulation must be dry" to "the insulation can contain more than 150 percent by weight moisture content."
- Eighteen percent of the responses indicated the criterion was based on the amount of roof area that was wet, suggesting if the wet area was between 20 percent to 40 percent wet, the insulation should be replaced.
- Compressive properties were identified by 10 percent of the responses as a pass/fail criteria.
- Seventy-five to 85 percent of the original compressive strength was mentioned on several responses.

Codes and manufacturers' requirements were cited on 10 percent of the responses as being a limiting factor. R-value reduction ranged from 10 to 20 percent, and dimensional stability appeared on 8 percent of the responses.

The survey asked the opinion of what factors should be considered in the decision making process and received 76 responses to this question. Moisture, R-value, and compressive strength were listed on 96 percent, 70 percent and 57 percent of the responses, respectively. Other factors that were identified included structural integrity of the insulation (15 percent) and dimensional stability (5 percent). The final question that the survey asked was the usefulness of this survey. Of the 76 responses received, 87 percent of the responders indicated that pursuing this subject was of interest, 3 percent responded that it may be of interest, and 10 percent indicated that this information was not found to be useful.

Conclusions from Survey Number One

- There is an interest and a need to provide guidance on the issues of insulation reuse. Almost 90 percent of the responses received in the first survey suggest that this is an important issue.
- The factor cited most often is moisture; 80 percent of the responses received indicated that moisture must be taken into account when considering insulation reuse.
- Clearly, there are numerous opinions regarding what is acceptable. There is a tremendous educational opportunity in that many of the suggested moisture limits are below equilibrium moisture levels at ambient conditions. This indicates the need to understand the moisture dynamics of a low-slope roof.
- The majority of responders used testing in concert with visual observations as a means for determining the suitability of insulation for reuse.

Survey Number Two (Appendix 2)

Almost every response indicated agreement that the effort to obtain information was useful. Based on this affirmation that additional information would be useful and recognizing the problem individuals had in responding quantitatively because different insulations required different responses, a second survey was developed and sent to those who answered the first survey. A respectable response of 24 percent was received in the second survey.

To assist in being able to respond more definitively, the first survey was summarized and returned with the second survey. Also, Table 1, which was developed based on the commentary received in the first survey, was included. This table listed 10 factors to assess, the methods of assessment, and the recommended requirements for insulation reusability. Part 1 of this survey requested an evaluation of these recommendations. Part 2 was based on questions directed towards three categories of insulation and five quantifiable questions associated with each insulation type:

- What quantitative value(s) should be assigned for the maximum percent of wetted roof area?
- What quantitative value(s) should be assigned for the maximum moisture content?
- What quantitative value(s) should be assigned for the maximum loss in compressive properties?
- What quantitative value(s) should be assigned for the maximum loss in R-value?
- What quantitative value(s) should be assigned for the maximum variation in dimensional stability?

The factors in the table were accepted almost unanimously. All of the limitations and Factor Number 10 of the table formed the basis for Part 2. The results of the request to quantify the five questions for each of three types of insulation are:

- The suggested limits for the maximum area of wetted insulation permitted remained unchanged between 20 and 40 percent. Additionally, some responders required the wet insulation be removed.
- The moisture content limits (percent dry weight) for all of the insulations ranged from a low of equilibrium moisture content to:
  - No limit for type A, porous and water insensitive insulation
  - 100 percent for type B, porous and water sensitive insulation
  - 500 percent for type C, closed cell foam insulation
- The reduction of compressive strength considered acceptable varied the least with a range between 5 and 25 percent loss and averaged 16 percemt.
- The loss of thermal value ranged from none or not an issue to 50 percent, but averaged around 25 percent.

- The loss of dimensional stability held to a close tolerance between 0 and 20 percent with most recommending 10 percent.

Conclusions from Survey Number Two

- The responses varied greatly.
- With the exception of moisture content, the values were independent of the type of insulation.
- There was no agreement on the limit of moisture content of the insulation regardless of the type of insulation.
- The decision to leave insulation in place when reroofing appears to be a highly individual approach.

SUMMARY/RECOMMENDATIONS

The information gained points out that there is no singular defined methodology to determine when an insulation can remain in place when reroofing. It also shows that there are a large number of individual approaches in making the decision. There were many items that received little consideration in making this decision. Examples are:

- Minimal response was received regarding the consequences of changes in properties of the insulation upon subsequent drying.
- Testing for minimal values for fastener holding capability was not mentioned.
- The fact that the recommended percent moisture limits of the different types of insulation translated into different quantities of water remaining in the roofing cross section had no impact.
- The compressive strength limits require higher values for some wetted insulations than some insulations in the dry state when used in new construction.
- Potential for the roof to dry and the amount of time that this will take.
- Consequences/risk of structural failure caused by deck deterioration and blow-off caused by fastener corrosion.
- Increased energy costs.

It becomes obvious that more information is needed and desired to be able to make a proper decision to leave insulation in place when reroofing. Such information can be acquired by:

- applying engineer logic;
- developing and utilizing testing procedures;
- initiating demonstration projects;
- evaluation of roofs as they age where the original insulation has been left in place.

REFERENCES

1. NRCA, *Annual Market Survey*, National Roofing Contractors Association, 1995.
2. Tobiasson, W., A. Greatorex, and D. Van Pelt, "New Wetting Curves for Common Insulations," *Proceedings of the Third International Symposium on Roofing Technology*, National Roofing Contractors Association, 1991.

	FACTORS	ASSESSMENT		METHODS*		RECOMMENDED REQUIREMENTS FOR INSULATION REUSE
		VISUAL	CORE CUTS	TEST	LIT/ ENGR†	
1	Determine why roof is distressed	✔	✔	A,B,C,D	✔	Original problem is eliminated
2	Drainage	✔			✔	Water will drain from surface of new system
3	Elevation of new system and flashings	✔			✔	New roof will not divert water into building
4	Fastener type and condition	✔	✔	D	✔	Fasteners can take loading and not protrude into membrane
5	Type and condition of deck	✔	✔	D		Will carry load and allow for timely drying to not degrade new or existing systems
6	Type of existing system and components (including vapor retarder)	✔	✔	D	✔	Will not compromise new system
7	Hazardous materials		✔	E	✔	Not present or will not disperse
8	Building interior temperature and RH			F	✔	Can be maintained to reasonable tolerance to achieve drying
9	Climate				✔	Will provide adequate drying potential for existing system
10	Type and condition of existing insulation		✔	A,B,C	✔	Stable, will carry load, and will dry

* Test Method Listing: A. Nondestructive testing (infrared, nuclear densometer, electrical capacitance, flood testing);
B. Core cuts to determine moisture content;
C. Core cut for physical properties (density, R-value, compressive strength, and dimensional stability;
D. Cuts into roof system to identify components and their condition (deck, vapor retarder, fasteners);
E. Cuts to identify contaminants in, on, or under the roof system; and
F. Measure inside temperature and relative humidity over a period of time.

† Appropriate industry literature and engineering logic.

Table 1. Proposed requirements for insulation reuse.

APPENDIX I: ORIGINAL SURVEY

INSULATION REUSE/RECOVER SURVEY

1. Does your company have any criteria to determine the reusability of thermal insulation?
   Yes _____ No _____

2. On what factors are the criteria based? _____

   _____

3. What assessment methods are used?

   ☐ Visual _____ What are your pass/fail criteria _____
   ☐ Other (please describe) _____

   What are your pass/fail criteria? _____

   _____

4. What, if any, testing do you perform or require to be performed? _____

   _____

   What properties are measured? _____

   _____

   What are the pass/fail criteria? _____

   _____

5. If you have no specific requirements, what would you recommend if asked? _____

   _____

   _____

6. Do you think the decision-making process should be based on (check all that apply):
   ☐ moisture content ☐ R-value
   ☐ compressive strength ☐ other

7. Are you aware of any requirements or recommendations from other organizations? Please describe. _____

   _____

   _____

8. In your view, is the information the subcommittee is attempting to obtain something that would be useful to your company? Yes _____ No _____

Name _____ COMPANY _____

APPENDIX 2: Second Survey
INSULATION REUSE/RE-COVER SURVEY FOLLOW-UP QUESTIONNAIRE

PART 1: REQUIREMENTS FOR INSULATION REUSE

1. Do you agree or disagree (check appropriate column) that nine of the ten recommendations listed on Table 1 are valid guides to follow when considering the issue of insulation reuse (Recommendation #10 is considered in Part 2 of this survey).

FACTOR	YOUR OPINION		YOUR COMMENTS
	AGREE	DISAGREE	
1			
2			
3			
4			
5			
6			
7			
8			
9			

2. Are there other recommendations that should be added to this listing? _____

_____

_____

PART 2: LIMITS OF ACCEPTABILITY FOR INSULATION

For the following questions, assume that you are considering a re-cover system that uses mechanical fasteners and the original insulation is one of the following three generic types:

a) porous and water insensitive (for example, fibrous glass);
b) porous and water sensitive (for example, perlite board); or
c) closed cell foam (for example, polyisocyanurate foam).

1. What quantitative value(s) should be assigned for the maximum percent of wetted roof area allowed for insulation reuse and re-cover? _____

_____

_____

2. What quantitative value(s) should be assigned for the maximum moisture content for insulation reuse and re-cover?

_____

_____

3. What quantitative value(s) should be assigned for the maximum loss in compressive properties for insulation reuse and re-cover? _____

_____

4. What quantitative value(s) should be assigned for the maximum loss in R-value for insulation reuse and re-cover?

_____

5. What quantitative value(s) should be assigned for the maximum variation in dimensional stability for insulation reuse and re-cover? _____

_____

NAME _____ COMPANY _____

I am a ☐ (Roof Consultant ☐ (Roofing Contractor ☐ (Material Supplier

PLEASE RETURN THIS SURVEY BY __ SEPTEMBER 1996 TO SPRI
BY MAIL: 175 Highland Avenue, Needham, MA 02194
OR BY FAX: (617) 444-6111