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EVALUATION OF ALTERNATIVE ROOFING SYSTEMS - PHASE II (FOR FLORIDA'S PUBLIC SCHOOLS)

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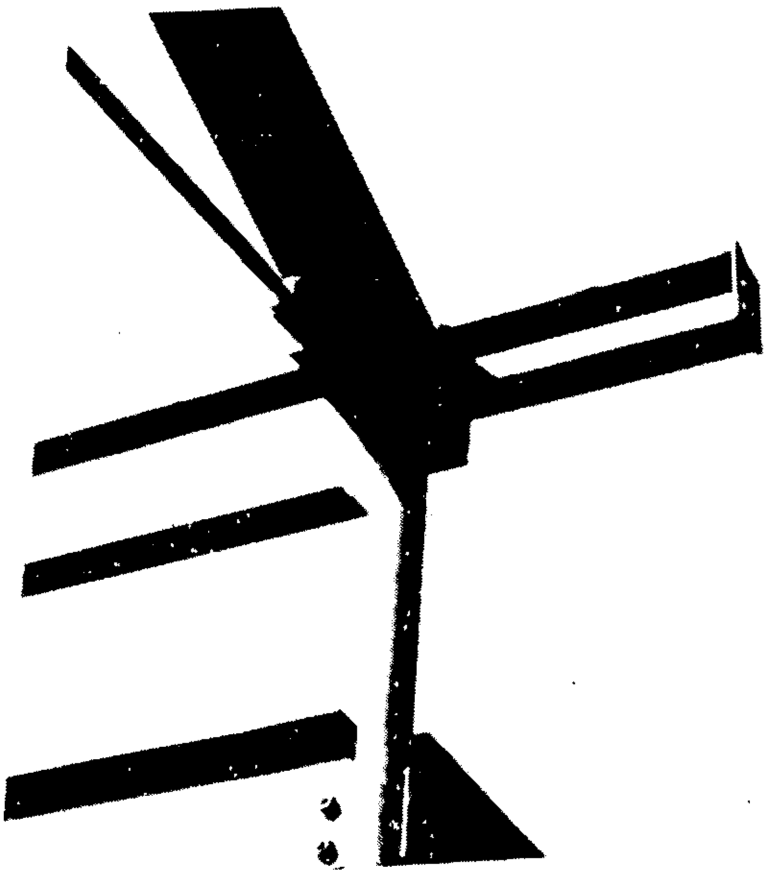

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EXECUTIVE SUMMARY

Built-up roofing has traditionally been the design of choice for the low sloped roof. In the mid 1970's, a new product was introduced from Europe to complete with the built-up roof system. This new product was classfied as a single-ply covering. It was synthetic and its main virtue was the low cost of the system. Since the product was new to the U.S. market, designers, and contractors were not fully aware of some of its characteristics. Most notably was how the material aged and where its weak points were located. As the material was installed, it began to fail causing alarm among owners as to the best means of repair or replacement and if the new material was as cost effective as originally projects. This report is an investigation into the problem. The author attempts to answer some of the more pressing questions with data collected on roof failures in the Florida public school buildings in 1986 and updated in 1991 and 1992. To validate the findings, the author gathered as much data beyond the public school survey as possible. This included a general literature search, interviews with roofing professionals in the field, roofing manufacturers, an roofing contractors to name only a few.

The author found that roofing failures could be traced back to three distinct causes. They are poor design, poor workmanship, and poor maintenance. Of these, poor ongoing maintenance appears to be one of the State's largest problem. Six recommendations are made to correct these problems. They are to establish a roofing coordinator in each county, prequalify roofing designers, prequalify roofing material manufacturers, prequalify roofing contractors, require a warranty from the roofing material manufacturers, and to annually analyze the records kept by roofing coordinators in an ongoing program to improve the longevity of Florida public school roofing systems. For further research, the author also recommends that the problem of roof failures be studied on a county by county basis to ensure that county maintenance procedures are adequate. Additionally, the author recommends that the Department of Education fund a study to develop and execute a plan to implement the

six recommendations.

A copy of this report maybe obtained by contacting: Executive Secretary, BCIAC, School of Building Construction, FAC 101, University of Florida, Gainesville, Florida 32611, PH: 904/392-5965.

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TABLE OF CONTENTS

CHAPTER **PAGE**

CHAPTER ONE
INTRODUCTION

Traditionally, roofing systems, regardless of type, have been the building owners' biggest headache in the maintenance and preservation of their facilities. The owners' problems begin almost immediately when confronted with the design decision of roof type. The owner must decide if it is more prudent to install a traditionally sloped roof that has shown to have less maintenance cost but higher design and construction costs. Or, to install a low sloped roof that has lower initial cost but somewhat higher maintenance costs over its life. The two systems differ considerably. A low sloped roof system will slope between one quarter to one half of an inch per foot of run. It normally will not have an overhang, and will drain water in one direction to a series of scuppers installed in the parapit wall. A traditionally sloped roof will normally be peaked near its geometric center and will shed water beyond the exterior wall system of the building it covers. A third type of roof, similar to the low-sloped roof, is called the no-slope roof and is designed to discharge water through roof drains located at various points in the roof itself instead of off the edges. The roof will have many peaks that gradually slope to these individual roof drains. These roof drains are all interconnected with drain pipes which are then routed outside of the building. Often times, it will be plumbed directly into the storm water drainage system. Or, it can be simply discharged as surface runoff much like a common residential guttering system.

The roofing industry has found that no roofing material is completely water-proof. Most traditional roofs are designed to shed the water quickly before it can have time to penetrate the membrane. With low and no-sloped roofs, the water drains more slowly and thus has time to cause mischief with the roofing system. Over time, the no and low-sloped roofing systems can deflect due to normal mechanical behavior of the building. Even small amounts of settlement in the building can cause low areas in the roof which allow water to pond. Once the water is allowed to stand, it eventually will find its way through the roof membrane. Thus, one can understand intuitively that no and low-sloped roofs must be better maintained over their life cycle than a traditionally sloped roofing system.

As one of the State's largest roofing owners, the Florida Public School Systems, too, have their share of roofing headaches. With millions of square feet of roofing, it has a tremendous commitment of resources dedicated to their ongoing maintenance and replacement. To help manage these resources wisely, the Building Construction Industry Advisory Committee has, in the past, investigated roofing failures and their associated causes.

A failure is defined as those occurrences in which the roof will not provide the minimum barrier against the elements for which it was designed. Most of these problems are associated with rain-water intrusion. They can also include vapor transmission, wind and other unwanted penetrations. The Committee's findings concerning these failures aided the State of Florida in understanding the cause and effect of various roofing phenomena. The authors of this report, Professor Luther Strange, et al, limited their investigation to built-up roofing because, at that time, the built-up roofing system dominated the low slope roofing market and was the system of choice for most roofing professionals. Their report was intended for the use of the administrators of the Florida State Public School System in making policy decisions concerning the design, inspection and maintenance of their built-up roofing systems.

Since that time, a host of products have been introduced to compete with the traditional built-up roof. These products are synthetic in nature and have physical properties and characteristics unique unto themselves as roofing system components. Since these products were new and untested under actual field conditions, building professionals had no data with which to make design and other life cycle costing decisions. Thus, came the need for a companion report to the original research but limited to these synthetic roofing products only.

This research is the second phase of the original study which will examine the use of these new synthetic, single-ply roofing systems in Florida's Public Schools. It is similar in its approach to the original research in its scope and methodology. The scope of work to accomplish this research, as outlined in the original proposal, is comprised seven individual tasks. These are:

1. Compile and classify manufacturers literature on alternate roofing systems.

2. Classify and quantify alternative roofing systems as a percentage of current usage throughout the state.

3. Identify problems with alternative roof systems, by type, in an effort to project life-cycle costs.

4. Develop guidelines for proper installation, inspection, maintenance and repair of alternative roofing systems.

5. Prepare addenda covering alternative roofing systems to be added to the seminars and manuals on built-up roofs.

6. Prepare a first draft final report for review and approval by the Building Construction Industry Advisory Committee.

7. Revise the final report and publish it.

In 1986, roofing failure data and manufacturers' product information were collected to comply with the intent of the research and accomplish the scope of work. This data were updated to include any new single-ply roofing material that has since come to market. The data on actual roofing failures were updated to ascertain any new or significant trends in roofing failures that has resulted since 1986. The author investigated these data on single-ply systems to determine if any correlations can be found between failures of different roof types; geographic area and roof failures; year installed; etc. In addition, the author compared the data from a similar nation-wide investigation to determine if any correlation exists between it and the data gathered on Florida Public Schools. These comparisons are an important part of the study because the data to be evaluated is drawn only from public school buildings. It will be valuable to know if the information is skewed, as a result of this, or whether any conclusions can be drawn on a broader view beyond public school assets.

The intent is to identify and isolate problem areas, their causes and suggest how these findings can best be utilized by the Florida State Public School System administrators to help guide the decision making process of their roof design and maintenance programs.

As mentioned earlier, a questionnaire was circulated in 1986 to all sixty-seven county school districts in the state of Florida. The information gathered was to be the beginning of phase two of the roofing research report. The author updated this original information. Manufacturers were queried for updated product information to establish the current state-of-the-art in roofing materials. And finally, a background search covering roofing failure in general was conducted to determine the current industry thinking on the topic and what is currently ongoing in this area. The background search began by investigating current research into roofing failures. The author interviewed other industry professionals such as architects, contractors, consultants, and end-users in an attempt to obtain their feelings on the current problems and possible solutions singly-ply roofing systems.

All of these data were studied and compared against itself on a macro level to determine if any trends or inconsistencies could be found. For instance, information from design professionals was compared against input from manufacturers and other professionals. The intent was to see if these professionals held a consistent view of roofing failures and their causes. Their input was then compared against the actual field data gathered nationally as well as in the State of Florida. Conclusions were drawn where the data did correlate well. Topics for further research are suggested where data did not correlate.

To complete the scope of work, guidelines for installation, inspection, maintenance and repair had to be developed and integrated into existing roofing seminars and manuals on the subject. These procedures and lesson plans have been developed by others and are included in chapter five, "Updating The Seminar" for completeness.

CHAPTER 2

LITERATURE SEARCH

The search into the current literature on roofing failures found that roofing problems can be the owners' worst headache. Roofing problems comprise a large percentage of the post-construction litigation in the United States. The litigants fall into one of three areas: the architect; the installer and or manufacturer; and finally the owner. A discussion of each of these, and their motivations are presented here to demonstrate to the reader how they jointly and individually contribute to the problems of roofing failures. It also explains why the cause of roofing failures can be a very complicated and an interrelated series of events. The first area that contributes to the "headache" is poor or uninformed design. The choice of roofing systems, materials, and their application initially falls to the architect. And, as a low-scope roof has very little to add to the building's appearance, most architects are reluctant to spend more than the minimal amount of time on its design. Often, architects will copy specifications and details from other successful projects to minimize design time. This is done to save time that can be spent on the design of other building components that form the character of the building. The result, however, can be plans and specifications that do not match the needs of the existing site and local conditions. This is not a criticism of the architectural profession but an observation of fact. "Frank Lloyd Wright was notorious not only for his leaking roofs but also his flippant dismissal of client complaints. "If the roof doesn't leak, then the architect hasn't been creative enough'"(Architecture 1989). In one of his most brilliant residential works, Fallingwater, Frank Lloyd Wright avoided adequate gutters and other drainage of roof and terraces saying that it interfered with what he referred to as the free-flowing lines of the house. Water ponded on the roof and terraces causing the concrete to deflect and crack. The water then ran through these cracks and caused severe damage to the interior. To a great extent, the owner must share in this particular portion of the problem. By showing more concern for cost and appearance than for good design practice, he tacitly approves of inadequate design and therefore ensures higher life-cycle costs.

The second major contributor to the roofing headache phenomenon, is the application or installation contractor. We have already noted that the selection of materials initially falls to the architect. When it becomes necessary, however, to replace the roof or make extensive repairs, the owner will normally do business directly with the roofing contractor. The roofing contractor in turn will generally make the decisions concerning materials and application technique. It would seem only natural, as the roofing contractor should be the "expert" and should know what will or will not work. The literature has shown that this is not true in every case. The roofing contractor will naturally install those products with which he is familiar and that provide the best profit. After all, he is in business to earn a living and he would not be expected to do otherwise. This can lead to a number of problems, especially if the roof has a unique or poor design to begin with.

As potentially catastrophic as poor material choices could be, it is not nearly as much of problem as poor workmanship. Our competitive bidding system, coupled with the owners' urge to save time and money, force the architect to write generic specifications that accompany standardized designs. This does not ensure poor workmanship in itself but since the roof installation is normally a competitively bid contract, the roofing contractor will not add any extras to his bid. Again, to save money, the owner will not normally require professional inspection during installation. This invites poor construction practices and minimum quality workmanship from the subcontractor who is trying to maximize his profit on a bid that was the lowest in the first place. If inspection does occur, it generally is done by the architect, whom we have already discussed as having higher priorities.

The last major cause to poor roofing is the owner himself. As stated earlier, his main concern is with cost and then appearance. Cost saving pressures give the owner a form of double jeopardy. First, as discussed, in the design/construct phase, and secondly in the ongoing maintenance of the building. As a minimum, all roofs and especially low-sloped roofs should be inspected annually. During the first year, the inspection program should be every few months beginning just after the roof is installed. It should continue annually until the roof approaches the end of its life cycle when it should be inspected more frequently also. Inspection must be done by a qualified inspector who is trained in the application, installation, maintenance and repair procedures for the particular roof in question. It is best to use the same inspector in subsequent years, and to have the inspector present at any repairs or modifications. Generally as a cost saving measure, the owner will omit or severely reduce periodic roof inspection and maintenance. This, of course, transforms any roofing maintenance program into a series of emergency repairs. Since the building occupant cannot see a leak until it rains, the scenario begins with a reported roof leak during a rain storm. The leak will be temporarily repaired, since permanent repairs cannot be made in the rain. Then, unless there is a process in place to reexamine the patch repairs, the incident will be forgotten. The owner or occupant forget until the next emergency roof leak which, again, happens in the rain. the old joke comes to pass, which is, "If it ain't rainin' it don't need fixin'. If is rainin', it's too late!"

These three main contributors to the "roofing headache" blend together to create another impediment to getting a satisfactory roofing product; that is, determining exact cause and effect. When a roof does fail, it is difficult if not impossible to determine if the failure was due to design, application or material deficiencies. Of course, one can see the area of water penetration, but only rarely why the penetration occurred. For instance, one can ask questions such as, "Did the building shift which caused low areas in the roof and subsequently water to pond?" Did the roofing contractor not ensure adequate slope while he was installing the material?" Did the material in question not adequately resist water penetration?" When talking to the major parties, the owner, the architect, the contractor, and sometimes thê manufacturer, each will as expected, shift the blame to the other. Therefore, the process does not have a way to identify the root cause of the problem. And if the problem cannot be identified, then certainly no solution can be found. This situation magnifies roofing problems and allows them to continually reoccur, to the frustration and aggravation of all concerned.

The key figures in this problem have been identified and their respective parts discussed. The roofing materials manufacturer has been mentioned only briefly. The literature search showed that he has far less input into the construction project than the other three, but still cannot be held completely harmless. The total roofing market in the United States in 1990 was $16.7 billion. Nearly 70% of this was commercial roofing. Even a small percentage of the market share means millions and millions of dollars in sales. To try to capture more of this market share, manufacturers are continually developing new products. Assuming that the materials is completely adequate for its intended purpose, these many different products tend to add to the confusion and misunderstanding of already under-informed architects, engineers, contractors, and owners. If the architect does specify the newer products, the roofing contractor must be trained on its installation. The roofing inspector must be trained on what and how to inspect the system. And finally, the maintenance crews must be trained on its repair.

The intent of this section is to give the reader a glimpse at the magnitude of the problems in identifying the causes of roofing failure. From the discussion above, it can be seen that major roofing problems are a combination of events. No single source can be isolated as the root cause of the problem. All parties involved must share in the blame for poor roofing systems. The owner must insist on, and therefore, adequately fund the design of the roof system. The architect must ensure the technical adequacy of his design and not supersede it with artistic considerations. The roofing contractor must be well versed in the installation techniques of the roofing product itself. The manufacturer must take the time to inform and educate his clientele on the best use of his product. Where it can best be used as well as not used. Finally, the owner must implement an adequate inspection and maintenance program by properly trained individuals.

CHAPTER 3
DESCRIPTIONS OF CURRENTLY AVAILABLE SINGLE-PLY MEMBRANE ROOFING SYSTEMS

The category of roofing products known as single-ply membranes can be considered one of the fastest growing categories in the roofing marketplace. Since 1980, this category has grown from less than twenty percent of the total roofing market to forty percent in 1991, while the traditional built-up roofing has declined from sixty percent to thirty percent of the total market. New products are coming onto the market almost as fast as the industry can categorize them. Certainly they are emerging faster than most roofing professionals can examine and determine their strengths and weaknesses. Currently, there are over 435 different roofing brand names from which the public can choose (Carlisle Roofing Representative, 1991). Certainly with so many individual brand name products available, it would be difficult to categorize them all. Therefore, for purposes of this report, the single-ply roofing systems will be broken down into the following areas:

1. Modified Bitumens (not truly a single-ply product).
    - A. Thermoplastic Modifiers.
        - APP (atatic Polypropylene)
        - EVA (Ethylene-Vinyl Acetate)
        - Polyethylene
    - B. Elastomeric Modifiers.
        - SBS (Sequenced Butadiene Styrene)
        - SBR (Styrene-Butadiene Rubber)
        - EPT (Ethylene-Propylene Terpolymer)

2. Single-Ply Membrane Products.
    - A. Elastomeric Membranes.

- EPDM (Ethylene Propylene Diene Monomer)
- Neoprene
- CSPE (Chlorosulfonated Polyethylene) Trade Name Hypolon
- CPE (Chlorinated Plyethylene)
- PIB (Polyisobutylene)

B. Thermoplastic Membranes.
- PVC (Polyvinyl Chloride)
- Reinforced CPA (copolymer Alloy)
- Reinforced EIP (Ethylene Interpolymer Alloy)

C. Polyurethene Foam (PUF).

Modified Bitumen Products

Modified bitumen products are a combination of materials that capitalise on the very durable and water resistent properties of bitumens and the flexibility, and elasticity of polymers. The bitumen roofing product can be made of various mineral substances of a resinous nature which are highly inflammable. They consist of mainly hydrocarbons which explain their flammability and water resistant characteristics. Polymer modified bituminous membranes are blends of polymers and bitumens that were developed in Europe in the mid-1960's. Their use spread to the United States in 1975. This product can be described as a manufactured reinforced sheet, various bituminous products and modified with different concentrations and types of polymers (Hogan 1990). The two most common types of modified bitumens are Styrene Butadiene Styrene (SDS) and Atactic Polypropylene (APL). These two products attempt to improve on the waterproofing characteristics of asphalt. They normally consist of a reinforced matting, normally fiberglass, coated with the elastomer blend. Although both systems normally use a fiberglass matting, the fiberglass can be substituted with plastic film, felt and other types of fabrics. These products are generally applied with one of three methods: 1) self-adhering; 2) torch applied or heat welded; 3) hot mopped. Hot mopping is the most popular as built-up roofing contractors can use existing crews and experience. Self-adhering, as the name applies, uses a glue backing and fixes itself directly to the underlayment of the roof structure. The torch applied brands rely on heat to soften the bitumen portion of the material until it can act as the bonding agent.

SINGLE-PLY MEMBRANE SYSTEMS

Single-ply membrane systems are divided into two distinct material compounds. These are elastomeric and thermoplastic compounds. Elastomeric compounds are rubberized products that when deformed under stress will return to their original shape after the stress is removed. There are two subgroups of elastomeric compounds. These are vulcanized and nonvulcanized. Vulcanized elastomers are cured during the manufacturing process causing their molecules to cross linked via the use of a sulfur bond (Brotherson 1986). Once the curing is complete the molecules become permanent and unchangeable. For this reason, vulcanized elastomers can only be connected to each other with the use of an adhesive. The two most common types of elastomers are EPDM and neoprene.

Nonvulcanized elastomers are not cured during the manufacturing process. The chemical make-up of these products is, therefore, not permanently fixed as in the vulcanized products and can be altered in the field during application. Applicators can use heat or solvents to melt or dissolve the nonvulcanized elastomers in order to splice one sheet to another. The nonvulcanized products will, however, begin the self-curing process once exposed to weather. Therefore, adhesives must be used to reattach the sheets together if the seam should fail. Nonvulcanized membranes can vary considerably in their chemical make-up, the manufacturing process, and installation process. Some of the more common nonvulcanized products are Chlorinated polyethylene (CPE), polyisobutylene (PIB), and Chlorosulfonated Polyethylene (CSPE).

FLUID APPLIED MEMBRANES

Fluid applied membranes chemically belong to the thermosetting category or the nonvulcanized elastomer. As the name implies these products are applied in a fluid state. They can be either single or two component systems. The single component systems cure by either evaporation of the solvent or chemical curing once exposed to the air. The two-component fluid membrane systems solidify by chemical curing as soon as the two components are mixed (Griffin 1982). These products are suitable for use with difficult roof geometries, have good adhesion and are easy to transport and apply. Some of the more common products are neoprene, silicone, polyurethane, and butyl rubber. Neoprene is actually available in both liquid applied and sheet applied form and should not be confused as two separate products.

One rather unique type of fluid membrane is polyurethane foam (PUF). It is mentioned separately because it is actually spray applied, and not rolled or troweled as are the more common fluid membranes. When it came onto the market, it showed great promise. It had three major advantages: 1) ease of application; 2) no seams to form; and finally, 3) it was a thermal insulator as well as a water barrier. PUF is produced in the field by mixing two agents at the nozzle of the spray equipment. These agents are an isocyanate and a hydroxyl compound. In addition to the foaming agents, a blowing agent, a surfactant, a catalyst, and fillers are required. The blowing agent is usually freon. The surfactant is needed to control the cell wall rigidity, and the catalyst controls the curing time of the foam. The fillers are to cut material cost in order to make the foam coating economically competitive with other roofing systems.

1. County name

2. School name or description

3. Year the roof was installed

4. Roof type

5. Number of square in the roof

6. Type of seam

7. Installation method

8. Type of problem

9. Type of area in which roof is located

Each general question above had multiple subcategories to help the respondent with completing the questionnaire. After mailing the questionnaire, other questions came to mind that the authors thought were important and needed to be included in the study. Therefore, a follow-up questionnaire was mailed out which contained the following:

1. Does the school system have an ongoing maintenance program?

2. If yes, how frequently do you inspect the roofs?

3. Do you feel your maintenance personnel are adequately trained?

4. Does the school system prequalify roofing contractors?

5. Does the school system prequalify architects?

6. Do you require full time inspection during installation of new roofs or replacement roofs?

The original data that was returned in these questionnaires were tabulated into both spreadsheet and DBase files in order to be analyzed. Concurrent with gathering the original data in 1986, manufacturers were also queried for their roofing product information, in order to compare field results with state-of-the-art roofing systems available at that time. This manufacturers' data had to be updated as well. To accomplish this, a sample of sixty manufacturers from the original list of nearly 200 manufacturers were queried as to their product line. Most of the sixty were chosen at random from the total list. There were a few major manufacturers that were included because of their size and leadership in the roofing market. These were Firestone, DuPont, Owens-Corning, and Carlisle. Fifteen of the queries came back as undeliverable. Seven of the addressees were no longer at that particular address and their forwarding order had expired, (gone beyond six months). Eight of the addressees had moved and left **no** forwarding address. However, thirty-eight manufacturers did respond with product information. As can be expected, the marketing personnel assigned to answer the questions and provide the product information were hesitant and sometimes apprehensive. After hearing the nature and intent of the research, however, they all responded quite vigorously. Some referred us to other leaders in the roofing field who had specific data that might be used.

It was these secondary and tertiary referrals that yielded unexpected dividends. One of these referrals was to Mr. Thomas Smith of the research arm of the National Roofing Contractors Association. He provided considerable background data, at the national level, on roof failures. His input will be discussed at length later in this report. In addition to these valuable sources, some of the larger manufacturers referred us to their research organizations. These research organizations were branches of Firestone Building Products and Chevron Research Corporation. One manufacturer made a special trip to deliver his company's product literature to the author personally. He was Mr. Richard Speitzer of

Carlisle SynTec Systems. Along with providing the literature and explaining it in detail, he talked at length concerning how Carlisle protected themselves from the liabilities of premature roof failure.

UPDATING THE ORIGINAL SCHOOL SURVEY

The original survey data gathered from the Florida School Districts had to be updated. It was not practical to mail out the questionnaire again because of time constraints. To ensure the data still had some validity, the author made a follow-up phone survey. In the update, the author attempted to locate the original respondents. In no case was this successful. In those cases where they could not be found, the intent was explained and a suitable substitute respondent, with the requisite knowledge, was found. The original data identified problems with roofs by school name. Therefore, it was quite easy to ask if this particular roof problem was still a problem and to discuss it at some length. Other questions included, but were not necessarily limited to:

1. Have you had any significant failures of any particular type of roof in the past five years?

2. How is your maintenance program run?
   Is there one specific individual in charge of roofing?

3. Do you prequalify bidders?
   If so, how, and to what degree?

4. Have you built any new schools in the past five years? If so, what type of roof was installed?

OTHER SOURCES OF PERTINENT ROOFING INFORMATION

Many different roofing professionals were interviewed. Their input was used to compare against other data and to guide the analysis of the Florida Public Schools roofing failure data. Some of more informative sources of information are noted here for historical considerations.

1. Mr John Pistorino, of the Miami consulting firm of Pistorino and Alam. Mr. Pistorino was chosen because of his knowledge of this project, his past contribution to this effort, and his extensive background in roof systems and their problems. His schedule was very full, but he did find time to talk to the author. He again described some of the ongoing problems with single-ply roofing problems but felt that these problems had been addressed adequately by the industry. They had provided the answers and were readily available in the current literature. As testimony to this opinion, he referred to the National Roofing Contractors Association, Roofing and Waterproofing Manual. He also produced a very thorough list of Dade County Construction Codes in whose implementation he had participated.

2. The author visited the Florida Roofing, Sheetmetal, and Air Conditioning Contractors Association (FRSA) Offices in Orlando. The point of contact was the Associate Executive Director, Mr. Jerry Dykhuisen. He was selected, as was Mr. Pistorino, for his extensive background in roofing, his knowledge of the contractors' problems and his past participation in this research effort. His schedule was very full, however, in the short time we had, he did provide us with some very useful information. He also provided the author a complimentary registration to the FRSA trade show in Fort Lauderdale, held on September 25, 1991.

3. The author attended the FRSA trade show and was able to discuss various roofing membrane problems with manufacturers and contractors. One of the most useful events was a seminar, presented by the Roofing Education Institute, for Architects entitled, "How

to Design the Perfect Roof." For six hours, state-of-the-art roofing technology was discussed with many interesting comments from the audience on their professional experience. The author was fortunate enough to have lunch with members of the Broward County School District, who were on its facilities engineering staff. They were able to provide some insight into the planning function of the district's construction program and how that contributed to their roofing failures.

CHAPTER 5
DATA ANALYSIS

Of the sixty-seven counties queried in the original survey, twenty three responded. These twenty three reported on 369 facilities with a combined total of 10,598,700 square feet of roofing. The data were entered into a spreadsheet for ease of computation. The spreadsheet files were then translated into a database format. A data base format was chosen that was compatable with the original spreadsheet software. Thus, between the two programs, spreadsheet and data base, the author had a powerful tool to segregate, sort, combine and correlate the data for analysis.

SCRUBBING THE DATA

Once the data were established in the two formats, the analysis could begin. The author scanned the data line by line looking for inconsistencies. This process of manually looking for inconsistent data is called "scrubbing the data base." Several problem areas arose and were investigated. On several records the type of roof was not reported. This problem accounted for 502,200 square feet of the total roof area included in the report, or just under five percent. Only four problems were included within these records. Therefore, the overall effect of excluding these facilities was negligible. On other records the reporting officials recorded very large numbers of problems under a specific problem type. For example, 99 seam failures were reported for one facility. It appears that the person completing the form felt they should report on number of linear feet of problem instead of saying they had three or four problems caused by seams failures. Regardless of the reasoning, this caused certain roof types and failure areas to become very disproportionate. On the original computer run to group roof problems by type of roof, the modified bitumen roof accounted for over 65 percent of all roof problems within the sample. Three roofs were reported upon in this manner and were subsequently excluded. The total square footage of roofing affected was less than 100,000 square feet. No other obvious inconsistencies were noticed in the scrubbing process.

GEOGRAPHIC DISPERSAL OF THE FLORIDA DATA

The first review was to check the data collected in the 1986 survey and its geographic dispersal over the State of Florida. Figure (1) shows the counties that reported. One county is cross hatched, signifying that even though it did report, all of its data were pertaining to traditional built up roofing and thus had no effect on the study per se. From figure (1), it is evident that the data are dispersed throughout the state. There is no geographic bias in the sample.

COMPARISON OF FLORIDA SURVEY DATA TO NATIONAL DATA

The National Roofing Contractors Association has a research arm located in Chicago, Illinois. This group has been collecting data on roofing failures for nearly ten years in a study called, "Project Pinpoint Analysis." Mr. Tom Smith, the Director of Research, provided the author with a copy of their data for the years 1983 through 1988. He also provided updates on several roofing trends through 1990. The author used this data to compare against the data collected in 1986 for the Florida School Systems. First the author compared the percentage of each type of failure in Florida, (i.e. seam, membrane, puncture, etc.) to the national data collected. It is presented in Figure (2). A strong correlation can be seen between the two samples. This tends to add validity to the locally collected data, in that both studies show similar percentages of problems. The category of "other" is the compilation of all types of failures that do not have an exact match from one study to the next. For example, the national data had a category of embrittlement. Since this was not asked in the local survey, it was categorized as other.

GEOGRAPHIC DISPERSAL OF COLLECTED DATA

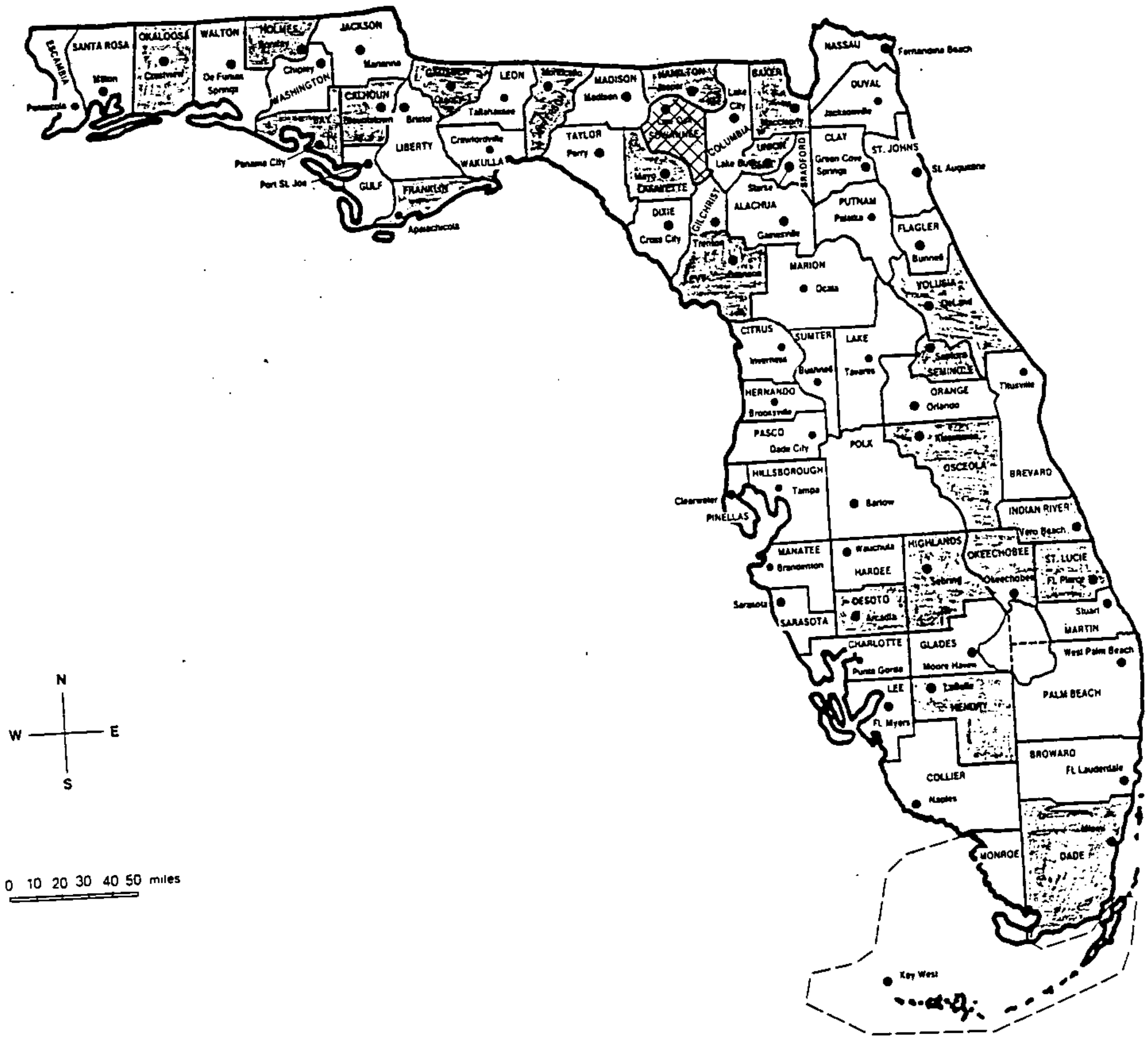

FIGURE (1)

COMPARISON OF FLORIDA ROOF FAILURES TO NATIONAL AVERAGES
(INCLUDES ALL ROOF TYPES)

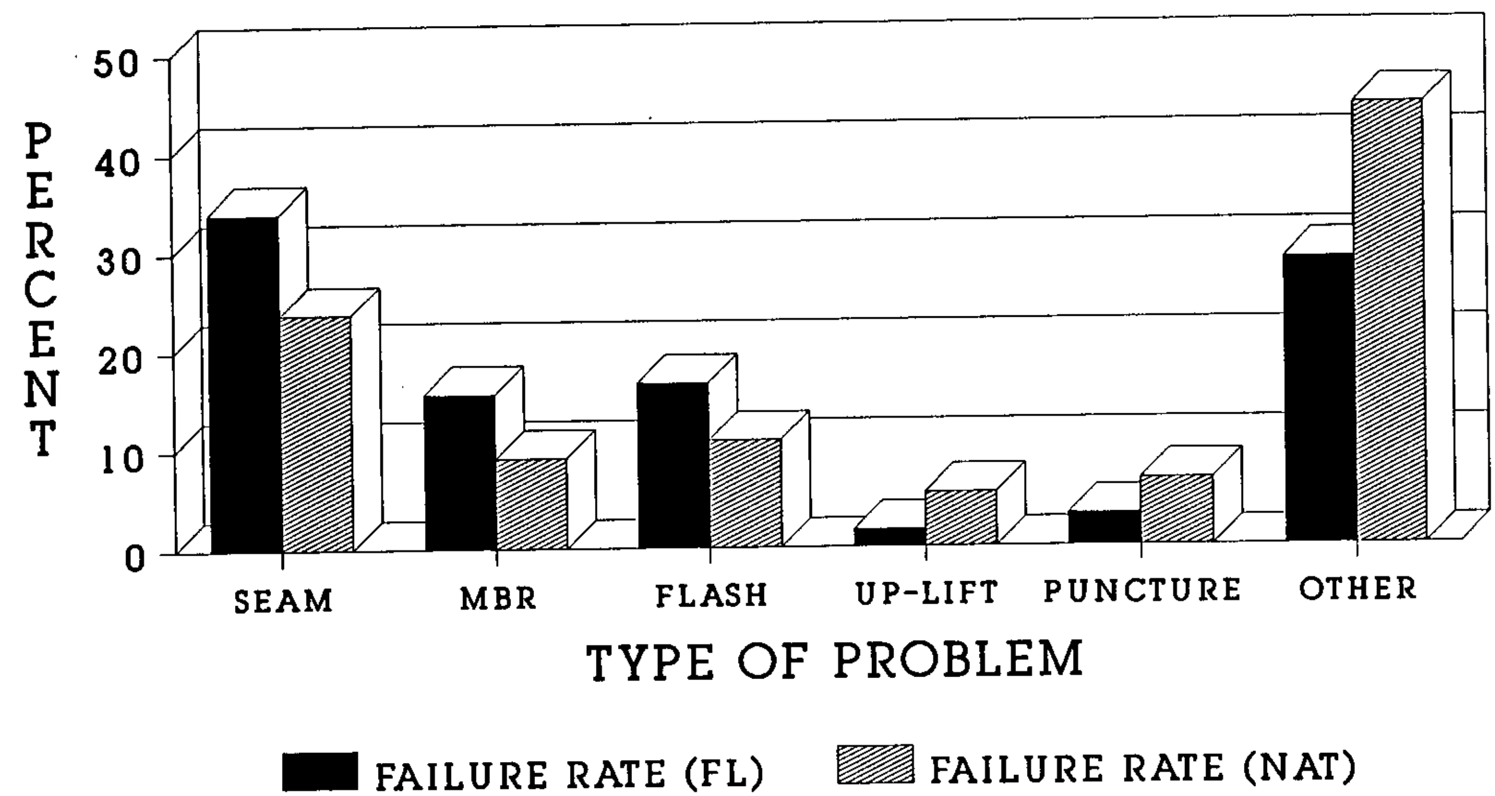

FIGURE (2)

The second comparison is between types of roofs in Florida and those in the NRCA's Southeastern Region. For example, what percentage of roofs did the NRCA data find in each category such as built-up roofing compared to the 1986 survey of Florida Schools. As can be seen in figure (3), a good correlation exists between the data in both studies. These two comparisons were made to ascertain the validity of the data collected in the 1986 Florida local survey. Since the Florida data does correlate well with data collected by the NRCA on a national level and regional level, it is felt that it is certainly valid for the Florida State School Systems and a strong argument can be made that it is representative of the commercial market in Florida as a whole.

NORMALIZING THE DATA

When looking at the data from the different counties, it was apparent that some counties had far more reported roofing problems that others. One reason for this situation was that these counties had far more roofing assets than others. In the beginning, this had the effect of one county with vast roofing assets appearing as though it had considerably more roofing problems than its neighbors who had fewer assets. In order to look at all the counties' data from an equal vantage point, the author decided to reduce all the data to "problems per one thousand squares of roofing". This type of reduction of the data to a common denominator is known as normalizing data. In this way, one county that had one thousand squares of seamed roofing and reported five seam failures, therefore had five problems per one thousand squares. And a county that had one hundred thousand squares and reported twenty-five problems then had 2.5 problems per thousand or relatively speaking, one half the problem rate as the former county with five problems per thousand. Figure (4) shows the roof type and how many problems each had per thousand.

Thermoplastic roofs had the most with modified bitumens and polyuerethene foams finishing a close second and third respectively. An interesting note is that EPDM's

COMPARISON OF FLORIDA SCHOOL ROOF TYPES TO SOUTH EASTERN REGION
(INCLUDES ALL ROOF TYPES)

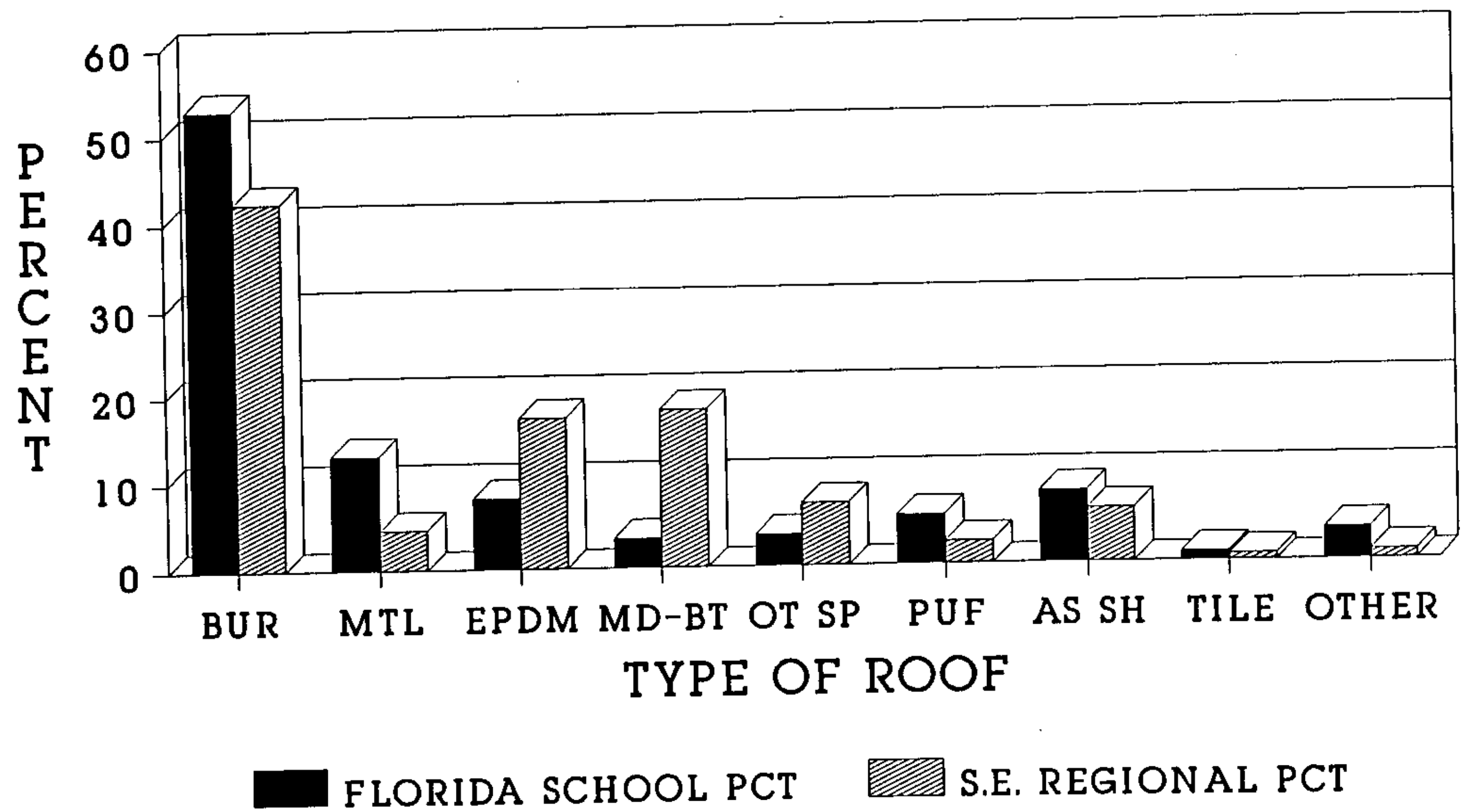

FIGURE (3)

PROBLEMS PER 1000 SQUARES SHOWN BY ROOF TYPE
(INCLUDES SINGLE-PLY ROOFS ONLY)

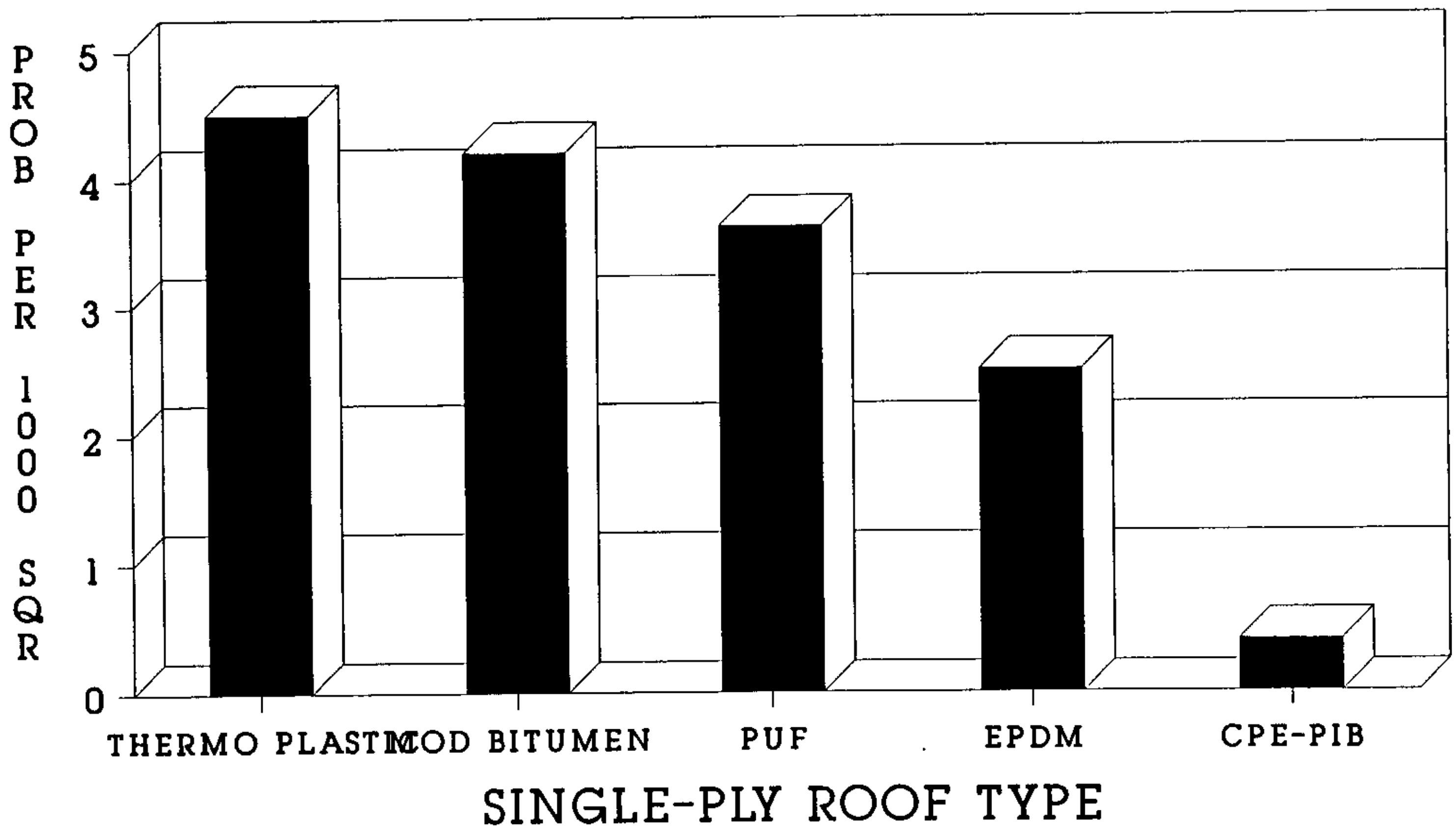

FIGURE (4)

finished fourth with 2.6 problems reported per thousand and CPE's and PIB's are last with less than one problem per thousand reported. Since these last two were the most commonly recognized roofing types, they seemed to be criticized the most for failing by the school personnel interviewed by the author. Since the data do not substantiate this, it appears that the perception comes from being widely used and thus having a highly visible failure rate. Polyurethene foam, on the other hand is rarely used in Florida due to its sensitivity to ultraviolet light. It therefore has a failure rate that is relatively unknown by the roofing professionals to whom the author spoke. Consequently, PUF appears to have a better reputation than EPDM, a situation that, according to the data, is unwarranted.

TESTING THE OPINIONS OF ROOFING PROFESSIONALS

During the interviews with the different roofing professionals, the author was interested in obtaining their opinion as to the quality, durability and suitability of the alternative roofing products both now and in the past. Of those who would give their opinion, most felt that early on, some products had problems but the industry had corrected them. Further, as more data is being made available, the industry is continuing to making minor modifications to improve their products. To test this opinion, the author grouped the problems reported by year for all alternative roof systems. Figure (5) shows the distribution. Two important correlations need to be discussed. First, the highest problem years was 1978 with nearly fifteen problems per thousand squares reported. However, the problems per thousand drop significantly in subsequent years to a low of 1.5 problems per thousand in 1982. The second significant correlation is the increase in problems reported in 1984 and 1985. Figure (6) shows how many squares of alternate roofing was installed in each of these years.

PROBLEMS PER 1000 SQUARES BY YEAR OF INSTALLATION (SINGLE-PLY ROOFS ONLY)

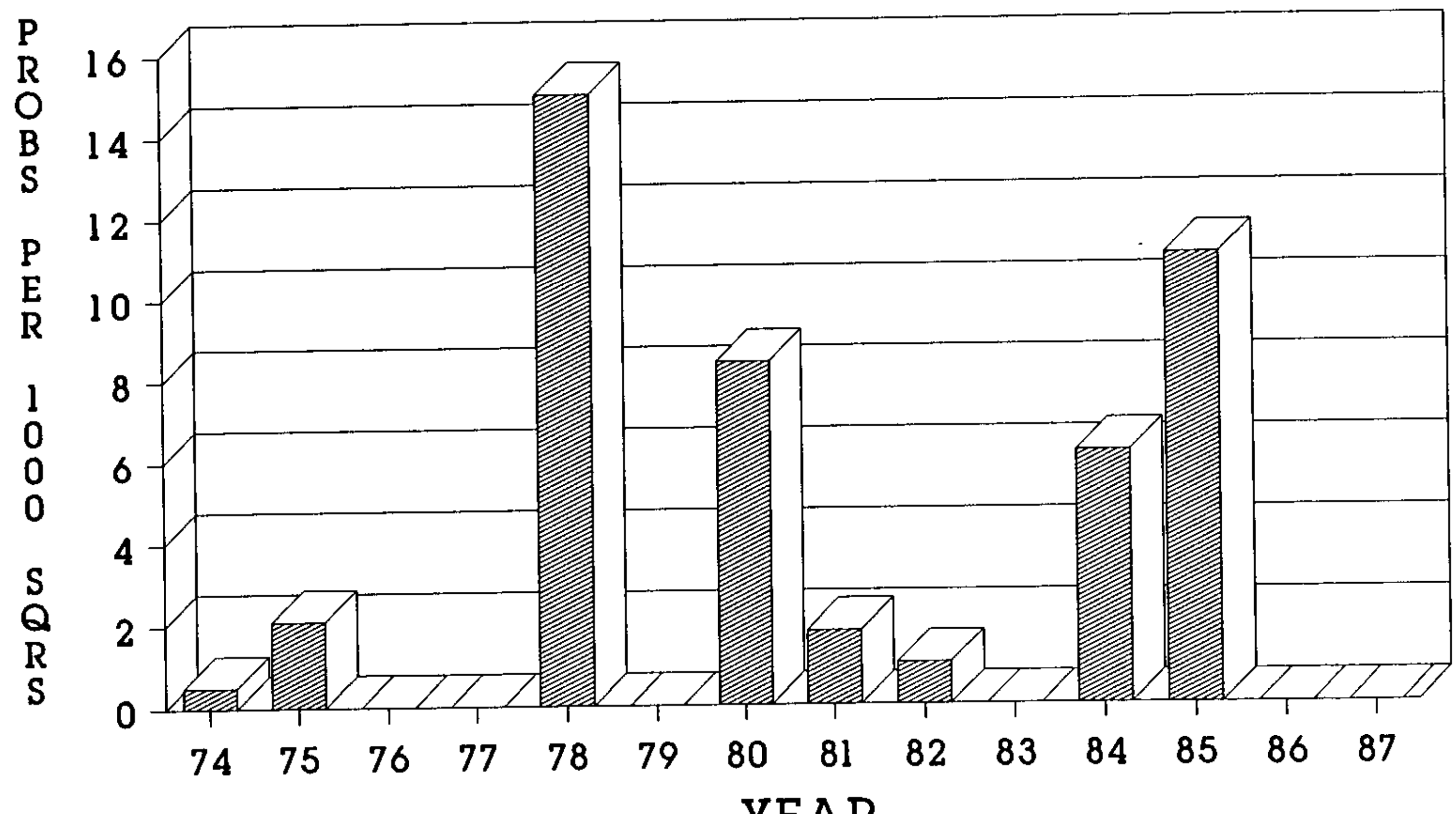

FIGURE (5)

SQUARES INSTALLED BY YEAR (SINGLE-PLY ROOFS ONLY)

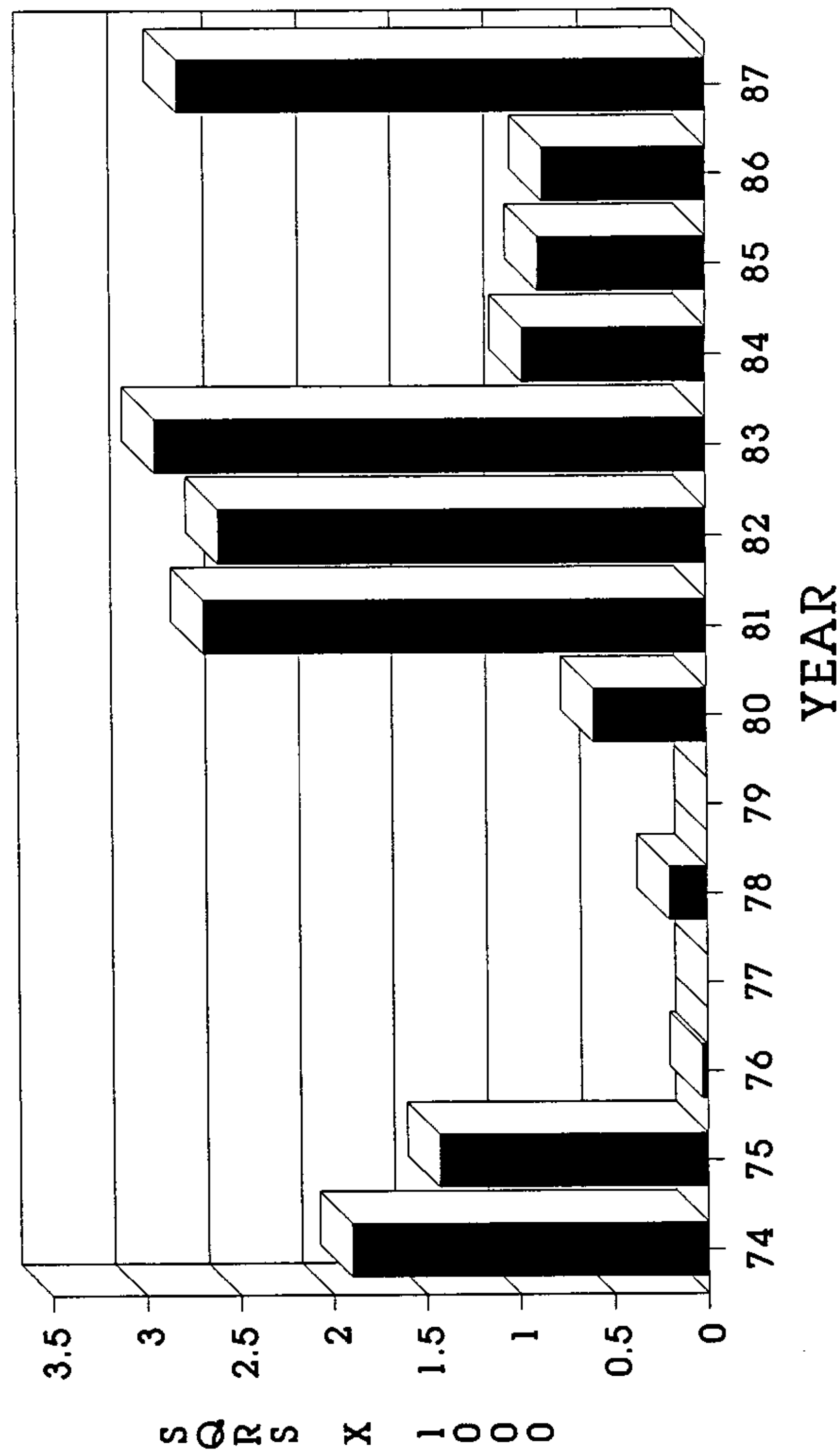

FIGURE (6)

The problem year of 1978 had less than 500 squares installed while subsequent years increased to nearly 3000 squares installed. These two figures demonstrate that even though more alternate roofing was being installed, problems were declining. This trend continues until 1984 when problems again began to rise but number of squares installed actually declined. The years of 1978 through 1982 seem to corroborate the opinion of the roofing professionals that there were problems in the early years with alternate roofing systems. As time progressed, however, these problems appear to have been corrected. The rise in problems reported but the decline of squares installed for the years of 1984 and 1985 cannot be explained from the data collected at this time. The next area of investigation was to look at the contribution of each failure type to the total. Figure (7) shows this grouping by percentage. Seam and puncture failure constitute nearly one-half of the roofing failures for alternate roofing systems. A review of the current research in these types of roofing systems indicates considerable attention to seam and puncture failure. The roofing industry is not unanimous as to the cause of these two problems. One researcher even disputes how seams fail. Still others argue as to the relative importance of seam rupture versus seam peeling failure. Regardless, the Florida roofing sample indicates that seam failure is our largest problem and this problem is reflected in the roofing industry.

PINPOINTING PROBLEM AREAS

One of the goals of this research was to compare different roofing types and correlate their most prominent failures to ascertain if one type was inferior or superior to another. One roofing type could not be found to be ultimately superior to another, however, in grouping the data it was noticed that certain counties, not roof types, seemed to have more failures than the others. A grouping of reported failures by county was compiled to test for any strong correlations. It was found that six counties reported the majority

TYPE OF FAILURE BY PERCENTAGE

(INCLUDES SINGLE-PLY ROOFS ONLY)

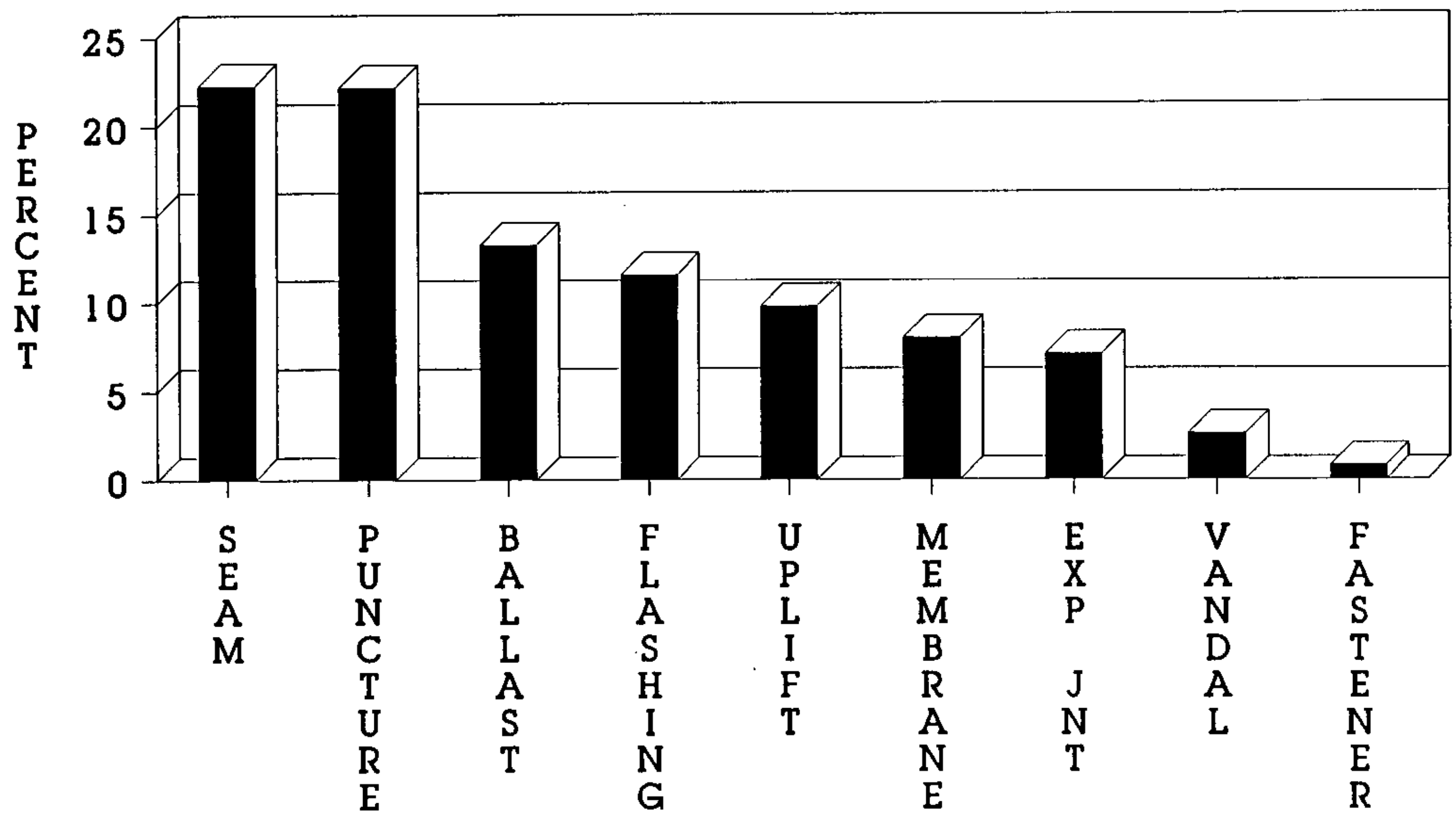

FIGURE (7)

of the roofing failures, that is, seventy eight percent of the total. These are:

1. Bay County .... 41 Problems Per 1000 Squares
2. Okeechobee County .... 14 Problems Per 1000 Squares
3. Osceola County .... 12 Problems Per 1000 Squares
4. Desoto County .... 11 Problems Per 1000 Squares
5. St. Lucie County .... 6 Problems Per 1000 Squares
6. Hendry County .... 5 Problems Per 1000 Squares

Figure (8) shows this table in graphical form.

There could be several different reasons for this high rate of roofing problems. Obviously, someone could have overstated the amount of problems much like the examples of the data that was scrubbed at the beginning of the analysis. These counties could have kept impeccable records and thus all of their problems are recorded where the other counties kept only partial data. And finally, there could have been any combination of the above that collectively lead to this bias. As a method to check against an overstating of the data, all roof types were analyzed to see if the same trend could be established. Again, a significant portion of the problems, ninety-five percent, could be accounted for within six counties.
These are:

1. Osceola County..... 40 Problems Per 1000 Squares
2. Bay County .... 38 Problems Per 1000 Squares
3. Holmes County ..... 20 Problems Per 1000 Squares
4. Okeechobee County . 11 Problems Per 1000 Squares
5. Suwanee County .... 10 Problems Per 1000 Squares
6. Hendry .... 10 Problems Per 1000 Squares

Figure (9) shows this table graphically.

PROBLEMS PER 1000 SQUARES SHOWN BY COUNTY
(INCLUDES SINGLE-PLY ROOFS ONLY)

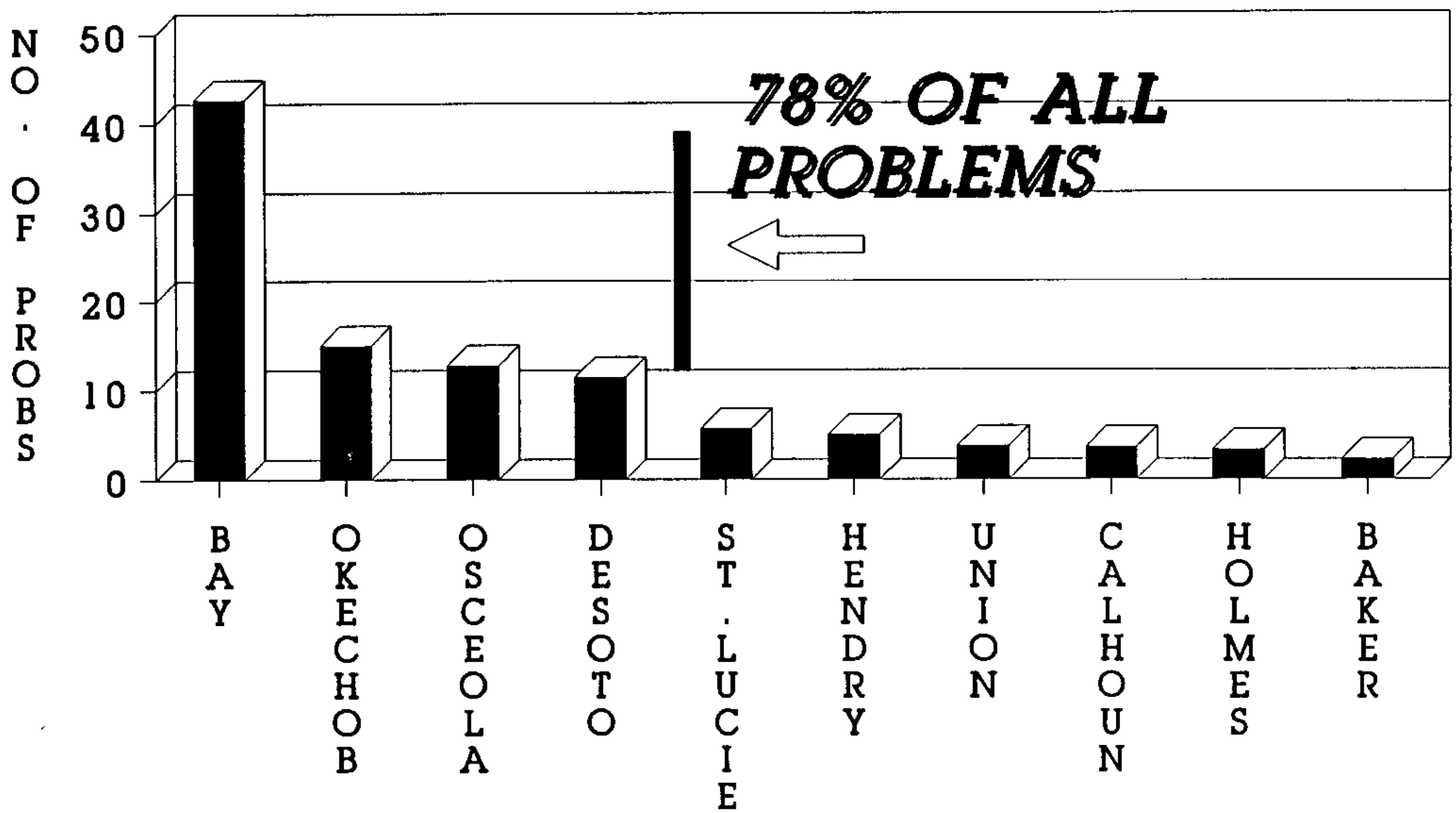

FIGURE (8)

PROBLEMS PER 1000 SQUARES SHOWN BY COUNTY
(INCLUDES ALL ROOF TYPES)

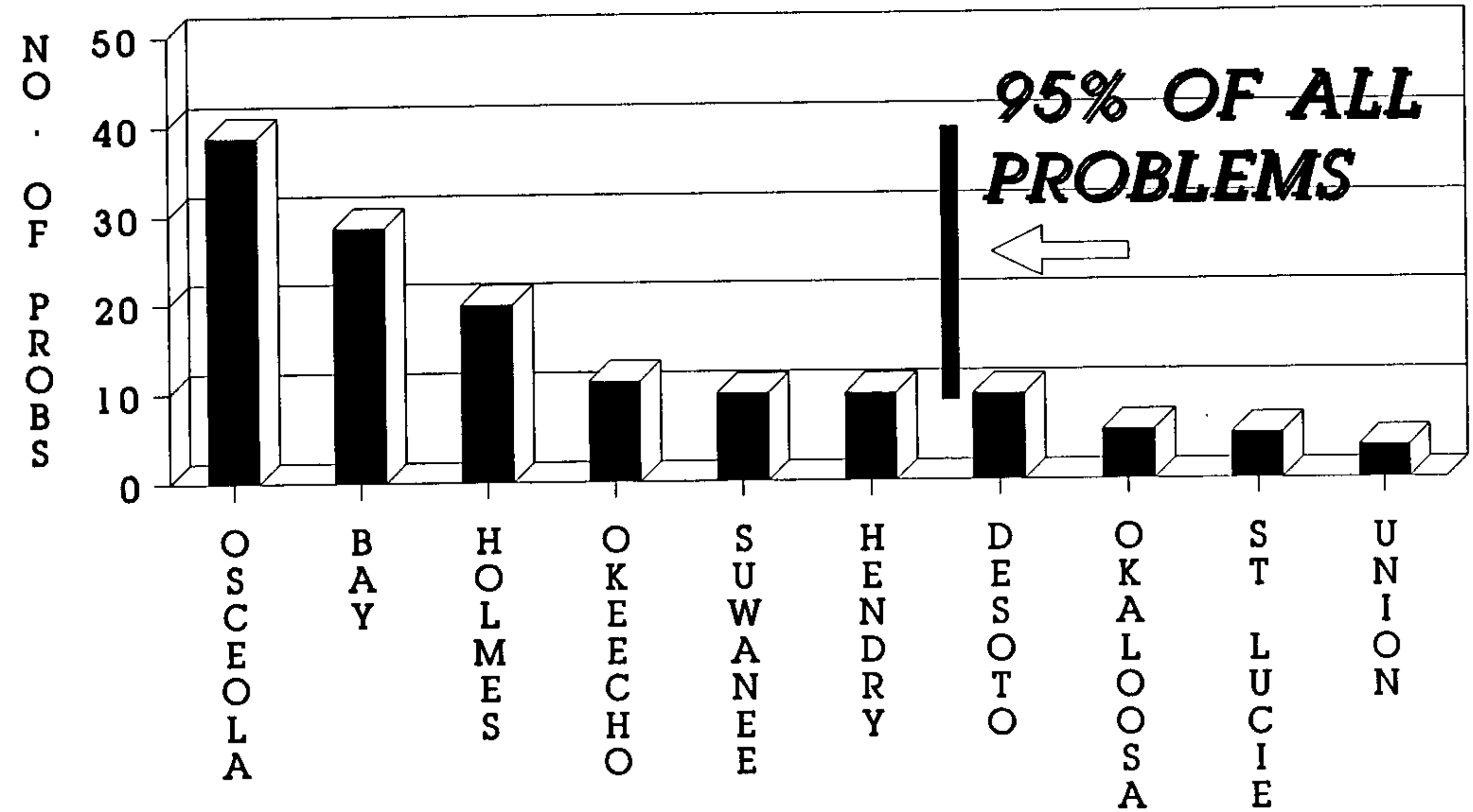

FIGURE (9)

HIGH FAILURE RATE AREAS COMPARED TO LOW FAILURE RATE AREAS

A telephone investigation into the roofing practices of these counties was conducted to see if there were some common mistakes or other problems being made. Each county however indicated that they had an ongoing roofing maintenance program, each inspected their roofing assets on a regular basis and that both architects and roofing contractors were prequalified. When asked who was actually responsible for these items, there was some hesitancy. One county indicated that it would informally assign roofing problems to the maintenance department, etc. Rather than focus on the negative aspects of an inadequate roofing program, the data was reviewed again, only this time to determine which counties had the best roofing record based on problems per 1000 squares. At the opposite end of figure (9), were two counties with very low reported problem rates. These were Dade and Volusia counties. A call to both maintenance departments indicated that each had one person in charge of roofing problems. This single point of contact was called the roofing maintenance coordinator. Further, both of these departments required that each new roof have a warranty, and that both the architect, roofing manufacturer, and roofing contractor be prequalified prior to design or installation. Differently from other counties, both Dade and Volusia had specific written procedures to qualify both architect and contractor. In the case of Volusia County, the roofing contractor was prequalified to a certain dollar limit based on past experience and size of past roofing jobs they had successfully completed. A trip to Deland Florida to meet the roofing maintenance coordinator proved to be very enlightening. A two hour discussion of his duties and responsibilities indicated that without doubt he took his job very seriously. Even though he did not supervise any maintenance personnel, he did maintain a very close liaison with them when it came to roofing problems. For example, they knew to notify him of any problems they were to repair before commencing the work. This was because each roof had a specific warranty, and some warrentors required, that to keep their warranty in force, they had to approve both the type of material and method used prior to the work being accomplished. When leaks were found, some unscrupulous warrentors would disallow the warranty because repair work had taken place without their approval, even though this work had no relation to the leak or even the area of the leak. The author also found a very organized set of files for each roof and a history of maintenance dating back to its installation. In addition, Volusia County had a very comprehensive roofing inspection plan. The plan required that roofs be inspected upon installation, six months after installation and annually thereafter until the expiration of the warranty. Upon expiration of the warranty, the roof was inspected to ensure there were no defects that could be repaired under warranty prior to the County accepting the responsibility for the maintenance of the asset.

CHAPTER 6
UPDATING THE EXISTING THREE-DAY ROOFING SEMINAR

Item four of the original scope of work required that new guidelines be developed for the installation, inspection, maintenance, and repair of alternate roofing systems. Item five required that these guidelines be included in the existing roofing seminars and manuals on built-up roofing. Professors Crosland and Strange developed these guidelines and incorporated them into the existing University of Florida Roofing Manuals and the current three-day seminar on built-up roofing.

The seminar update that they wrote included more than just a discussion on single-ply roofing systems. They also covered shingle, tile, and metal roofs. They also updated the design, inspection, quality control, and record keeping portions to include these new roof types. They obviously have gone beyond the scope of this research which focuses on single-ply systems only.

The single-ply portion of the update has been inserted as lesson five and takes two hours of the seminar, from 8:00 to 9:50 am of day two. The two-hour discussion centers on the major types of single-ply systems now in use in the United States. Sprayed in place, polyurethane foam systems are also included in this section. After a brief introduction on the history of these systems, each is described as per its individual chemical make-up, characteristics, and generalized use. The three types of application and attachment methods are discussed and which type of method each single-ply system uses. The ease or difficulty of each method as well as the their respective strengths and weaknesses are reviewed. Each system along with its application and attachment method lend themselves to specific types of roof designs. These compatibilities are also discussed, especially in the light of future inspection requirements.

The second hour of the course goes into detail on establishing a roofing inspection, maintenance, and repair program with alternate roofing systems. The meat of the discussion centers on the required inspection procedures. The need for inspections is emphasized. A check list is provided and reviewed in detail as well as inspection equipment that is needed for the program. How to establish a filing system for the roofing maintenance program is presented and includes such items as how to cross reference plans and specifications with other contract documents. How to make and keep orderly records on each roof system is discussed. And finally, the update includes a discussion on the importance of safety for all members in the roofing maintenance program. The updated course outline and the text of their update is included in the following pages for completeness.

COURSE OUTLINE

FIRST DAY

8:00 - 9:50	LESSON 1, Roof Design General Design Considerations
9:50 - 10:10	Coffee Break
10:10 - 12:00	LESSON 2, Roof Design Decks and Drainage
12:00 - 1:00	Lunch
1:00 - 2:50	Lesson 3, Roof Design Fundamentals of Membranes
2:50 - 3:10	Coffee Break
3:10 - 5:00	Lesson 4, Roof Design Penetrations and Flashings

SECOND DAY

8:00 - 9:50	LESSON 5, Roof Design Single-Ply Roof Systems	
9:50 - 10:10	Coffee Break	> > Newly Added
10:10 - 12:00	LESSON 6, Roof Design Shingles, Tile, Metals	
12:00 - 1:00	Lunch	
1:00 - 2:50	LESSON 7, Roof Inspection Quality Control	
2:50 - 3:10	Coffee Break	
3:10 - 5:00	LESSON 8, Roof Inspection Field Trip or Video	

SECOND DAY - LESSON 5

8:00 - 9:50

SINGLE-PLY ROOF SYSTEMS

INTRODUCTION

A flood of new roofing products and systems, together with a growing skepticism of conventional built-up roof systems, has made roof selection more complex than ever before. The myriad of new products available is confusing enough, but the wide variety of applications defies and simple organization into descriptive groups. To make matters worse, many of these new products have not been on the market long enough to test the warranties.

the following categories are general and generic, and are used solely as a means of presenting the materials. Each general category will then be discussed.

1. Modified Bitumens (not usually a single-ply)
    - A. APP (Atactic or Amorphous Polypropylene)
    - B. SBS (Styrene Butadiene Styrene)
2. Single-Ply Membranes
    - A. EPDM (Ethylene Propylene Diene Monomer)
    - B. CPE (Chlorinated Polyethylene)
    - C. CSPE (Chlorosulfonated Polyethylene)
    - D. PIB (Polyisobutylene)
    - E. PVC (Polyvinyl Chloride)
    - F. Reinforced CPA (Copolymer Alloy)
    - G. Reinforced EIP (Ethylene Interpolymer Alloy)
3. Sprayed-in-place Polyurethane Foam (PUF)

MODIFIED BITUMENS

Modified bitumen was developed in Europe in the mid 1960's, and introduced into the U.S. in 1975. The term "Modified Bitumen" is a generic category of roof products made up of composite sheets consisting of asphalt bitumen, polymer modifiers (APP or SBS), and reinforcement such as plastic film, polyester mats, fiberglass felt or fabrics. Usually a protective surface is provided, and may include metal, mineral granules or fiberglass. This roofing is much thicker than conventional felts, and is somewhat like combining several "plys" into one roll.

Either asphalt modifier, APP or SBS, is used to impart special properties to the asphalt. Modified asphalts have several advantages: (1) they have a higher softening point (over 200 degrees fahrenheit); (2) they are more elastic; and (3) they are more flexible. Since modified bitumens usually have their own surfacing, they often can be used in places where an aggregate-surfaced built-up roof cannot - such as steeper slopes, or curved roof surfaces.

Three methods of application are commonly used to install modified bitumens: (1) self-adhering; (2) torched; and (3) mopped. The self-adhering types have a mastic sealant on the outside of the roll, covered by a plastic film. As the film is removed, the roll is pressed onto the deck surface with the sticky side down. Torched applications uses propane torches, similar to blow-torches, to soften an asphalt bitumen coating on the outside of the roll as it is pressed onto the deck surface. Mopped applications involve mopping the hot asphalt ahead of the rolls similar to the built-up roofing system.

A forth type of application, called "heat welding", is used by some manufacturers n lieu of torching. The difference is in using a heat gun to melt the bitumen surface instead of the open flame of the torch. Torching has, on occasion, caused fires in some types of deck or insulation. Great care must be exercised to prevent fire when using the torch method. Manufacturers using the two asphalt modifiers, APP or SBS, specify the method of application, and their recommendations should be strictly followed, In general, APP systems using amorphous polypropylene modifiers have high melting points and require torching. The SBS modifieds generally use a mopped application. The type of surfacing material also influences the method of application.

Modified bitumen is seldom used as a "single-ply" roofing system. Only when it is used over a non-nailable deck which can be primed is it used in single-ply fashion. Usually manufacturers require a base sheet of fiberglass felt mopped down. On nailable decks, most manufacturers require one ply of felt nailed down, and one ply mopped down, then the modified bitumen layer. Thus, most modified bitumens are not technically "single-ply" systems, although they are usually included in that generic category.

Modified bitumens have been used successfully in Europe for over 25 years, and are gaining their share of the U.S. market. Manufacturers' warranties vary from five to twenty years, averaging around ten to twelve years. In addition to use as a roofing membrane, fabrics made of modified bitumen are frequently used as flashings for conventional built-up roofing.

SINGLE-PLY MEMBRANES

The roofing industry coined the phrase "Elasto-Plastic" in the 1960's to describe a wide variety of single-ply membranes. Today, most of these membranes are referred to by the generic material from which they are made - such as EPDM, PVC, etc. But even these generic names refer to various plastics, which are themselves somewhat confusing. The following descriptions are given to simplify the classification of membranes into two categories: elastomerics and thermoplastics. Thus the phrase "Elasto-Plastics".

First, a brief review of plastic materials. Plastics which can be reshaped, reformed or joined together by the application of heat are called "Thermoplastics". This means that they are "weldable" by using heat. Plastics whose molecular structures are cross-linked, or cured., are called "thermosetting" plastics. These have more elastic or rubber-like qualities, and are called elastomerics or elastomers. Because elastomers are "non-weldable" by applying heat, they require an adhesive to join them together. This distinction of being "weldable" or "non-weldable" by heat is very important because it basically determines the method of sealing lap seams in the membrane.

THERMOPLASTIC MEMBRANES

(These are heat weldable, and may also be joined by solvent adhesives).

PVC (Polyvinyl Chloride)

CPE (Chlorinated Polyethylene)

PIB (Polyisobutylene)

CPA (Copolymer Alloy)

EIP (Ethylene Interpolymer Alloy)

ELASTOMERIC MEMBRANES

(These are non-weldable by heat, and require solvent type adhesive bonds to bond lap seams).

EPDM (Ethylene Propylene Diene Monomer)

Neoprene

CSPE (Chlorosulfonated Polyethylene) trade name is Hypalon*

*This is manufactured as a reinforced thermoplastic membrane, which can be heat welded. After installation it cures into a thermoset plastic (Elastomeric)

Single-ply membranes (elasto-plastics) may be unreinforced sheets (rolls), or they may be reinforced with polyester mats or fiberglass. There are three methods of attaching single-ply membranes: (1) self-adhering; (2) mechanical fasteners; and (3) ballasted. The self-adhering membranes are furnished with an applied adhesive having a removable plastic film. As the film is removed, the membrane is rolled onto the deck sticky side down. Mechanical fasteners may be used to provide hold-down against wind up-lift. These fasteners usually consist of power-actuated screws with large compression washers. Various patented fastener systems are available which do not require the screw anchors to penetrate the membrane. Others require a sealing patch over the fasteners for waterproofing. The third method - ballasted membranes - are single-ply sheets laid loosely over the roof deck, with lap joints sealed, and the sheets held down by the weight of loose gravel or paving tiles. This system relies upon the weight for hold-down capacity, and the result is a much heavier roof system.

Single-ply roof membranes have long been popular for re-roofing projects because of their light weight (except for ballasted systems) and speed of coverage. These membranes have gained favor for new roofs as well - from 1986 to 1989, the gross percentage of single-ply membranes used in non-residential markets rose from 45% to 55% (Handbook of Commercial Roofing Systems, 1989, pg 22). Manufacturers' warranties vary from five to 20 years, with an average being about ten years.

SPRAYED-IN-PLACE POLYURETHANE FOAM (PUF)

Sprayed-in-place polyurethane foam (PUF) roofing systems were introduced some fifteen to twenty years ago. The early years were typified by somewhat less than spectacular success. The new product was misunderstood and often improperly applied. When it failed to r the "Cure All" for all roofing problems, many designers abandoned the product. Many improvements have been made in recent years in both the application technology and the material itself. The urethane foam contractors association (UFCA) is directing its attention to educating the industry in the proper selection and application of foam and coatings.

The basis of PUF roofing systems is the application of a sprayed-in-place polyurethane foam insulation base with a seamless elastomeric coating. This is a good concept. since both the foam and the coating applications afford little tolerance, great care is required during installation of PUF systems. The following precautions should be observed.

LIMITS FOR FOAM APPLICATION

1. Foam should only be applied to a dry surface.
2. Foam density should be 2.5 to 3.5 pounds per cubic foot, with a minimum compressive strength of forty pounds per square inch.
3. Foam lifts (layers) should be one-half to one inch thick.

4. Total thickness of foam should not be less than one inch.
5. Cell structure of foam should be small, uniform size.
6. Closed-cell content of foam should be 90% minimum by volume.
7. Surface of foam should be smooth to orange peel texture.
8. Foam should not be applied when weather conditions indicate:
    A. Rain is imminent
    B. Roof surface temperature is above 120 F or below 50 F.
    C. Roof deck temperature is within 5 degrees F of the dewpoint.
    D. Wind speed exceeds twelve MPH (without wind screen)
    E. Wind speed exceeds twenty-five MPH (with wind screen)
9. Do not apply more foam on a given day than can be basecoated the same day.

Because of its rapid degradation when exposed to sunlight, PUF must be promptly protected by a suitable elastomeric coating. These coatings may be of urethanes, silicones, acrylics, butyls, neoprenes or hypalons. Two-part urethanes, silicones and acrylics are most widely used.

LIMITS FOR COATINGS

1. Foam should be allowed to cure for at least two hours before applying the basecoat.
2. Foam must be coated within seventy-two hours after foaming (twenty-four hours recommended maximum)
3. Foam thickness not less than thirty mils.

The state of Florida is not ideal for the use of PUF roof systems for two reasons. First, the weather tolerances mentioned above make application of the foam risky. Second, the coastal areas abound with seagulls which for some reason, like to eat the PUF. Since the gulls damage the foam and then die from eating it, we have a two-way loss.

SECOND DAY - LESSON 6

10:10 - 12:00 AM

SHINGLES, TILES, AND METALS

SHINGLES

Shingles have been successfully used for roofing for centuries, and continue to provide one of the most reliable roofing systems available. The basic materials used for shingles are:

A. Wood

B. Asphalt

C. Metals

D. Slate

Wood Shingles and Shakes

Wood is used to make shingles and shakes. Shingles are sawn to produce a tapered slab that is relatively smooth and uniform. Shakes are hand split to provide a rough, rustic appearance, and are much thicker than shingles. The wood species most commonly used for shingles and shakes are red cedar, white cedar, cypress, and redwood. These woods have a natural resistance to fungus and decay, and can be worked and split easily. Wood shingles and shakes are commonly nailed to wood sheathing over a #15 felt. Shingles and shakes depend upon a good roof slope (minimum of 4" In 12") to shed water. Steeper slopes are even better.

Asphalt Shingles

Asphalt has been used to make shingles for many years. Historically, a saturated felt was given heavy coatings of asphalt, then surfaced with small mineral granules to provide color, texture and wearing surface. Today these shingles are reinforced with fiberglass. The weight of asphalt shingles varies from 220# to 325# per square (100 sq. ft.). Almost all asphalt shingles today are three tab strips, 12" high by 36" long, and come with strips of asphalt mastic which self-seals the tabs against wind uplift. Minimum slope for asphalt shingles is 3" in 12" (4" in 12" is preferred).

Metal Shingles

Various metals are used to make shingles, including galvanized steel and aluminum. Most are formed into interlocking shingles with baked enamel or porcelain color finish. These provide light weight and long lasting roofs. Minimum slope: 3" in 12".

Slate Shingles

Slate is a metamorphic rock formation which has cleavage planes that allow easy splitting into thin slabs. These slabs are used to make roof shingles about 1/4" thick. Slate is usually a dark gray color, and slate shingles are nailed with copper nails to form a long-lasting roof. Many slate shingle roofs are over 100 years old, and are still in good condition. Since slate is relatively heavy (700 lbs. per square), the roof structure must be designed accordingly. Minimum slope: 4" in 12".

Tile Roofs

Clay tile roofs have been used in Europe for centuries, and in the U.S. for many years. Clay tile are made of vitrified clay, and come in various patterns, including flat, barrel or mission tile, and spanish stile. Natural clay tile are usually red or brownish tan, but are often glazed in many colors. Clay tile are heavy (over 800 lbs. per square), and require strong roof framing. Individual tile are set in mortar over a 90# mineral surfaced felt. Minimum slope: 4" in 12". Concrete tile are available in various shapes and patterns. These are also heavy roof tile set in mortar over 90# felt. Most concrete tile require a surface coating for waterproofing. White acrylic coatings are widely used. Minimum slope: 4" in 12".

Metal Roofs

Metals have been used for roofing for many centuries. Lead sheets with flat seams were used over Byzantine Domes; copper pans with standing seams covered great cathedrals;

terne plate panels topped victorian manors. But these were very labor-intensive roof systems. More recently we have seen corrugated and v-crimp galvanized steel. Today, metal roofing is making a strong comeback. Both galvanized steel and aluminum are used in roof pans using standing seam (or batten seam) joints which can be made by motorized trolleys. These machines run themselves along the joints and fold the metal seams as they go.

Roof Maintenance and Repair of Alternative Low-Slope Roofing Systems

1. Objectives: To provide guidelines for establishing and conducting a roof maintenance program with alternate roof systems.

2. Lesson Outline:

Subject	Time Required
Introduction	5 Minutes
Historical file	10 Minutes
Inspections	10 Minutes
Roof inspection form	5 Minutes
Inspection equipment	5 Minutes
Safety	15 Minutes
Roof system components	15 Minutes
Edge flashing	10 Minutes
Coping	5 Minutes
Vent flashing	15 Minutes
Expansion joints	10 Minutes

3. Student Assignments

Review flashing details in the design lesson on alternate roofing systems.

4. Lecture

A) Introduction (5 Minutes): State the lesson purpose.

B) Historical file (10 Minutes)

1) Roof Plans & Specifications

2) Contract documents

3) Records of construction

4) Records of repairs

5) Records of inspections

C) Inspections

1) The need for inspections

2) Inspection check list

3) Inspection equipment

D) Safety

1) How to start and maintain a safety program for those who will be on the roof

E) Roof Systems Components

1) Metal roofs

2) Shingle roofs

3) Single-ply roofs

4) Liquid applied roofs

5) Foam roofs

(NOTE: Base flashing, counter flashing, vent and through-wall flashing, as well expansion joints will all be covered here.

MAINTENANCE OF ALTERNATE SYSTEMS

Introduction

As with other roofs, maintenance, inadequate or no, often leads to the death of the alternate roof systems. This is unfortunate, because the maintenance program that the owner is frequently too stingy to implement is that same owner's best chance to get his moneys worth from the roof. Maintenance programs vary slightly with the various types of alternate roofs that we are here considering, but in some respects they are much the same. All require regular inspections, an historical file, a knowledge of the type of roof being inspected (sure, you can tell metal from asphalt shingles, but can you tell EPDM from PVC?)

The best time to plan a roof maintenance program is when the roof is being installed. The maintenance should begin at that time, by making sure the job is correctly finished, cleaned up, and that there is no moisture trapped in the roof or the attendant insulation. Depending on the type of roof, repair materials for emergency repairs should be obtained, clearly marked, and stored where they can be reached in an emergency.

Historical File

The historical file should start with a copy of the original plans and specifications for the membrane. This should be followed by an "as built" set of plans and specifications showing exactly how the roof was put together, the materials used, and pointing out any potential trouble spots. From this point until the roof is replaced, this file should show everything that happens to this roof. All annual and semi-annual inspections should be logged here along with the results of those inspections and any action taken at that time. All reports of damage to the roof and copies of work orders, (with pictures where practical) as well as inspection reports of the finished work should be included in the file. There should be no equipment on the roof, but if, for some reason, there is, all maintenance to that equipment should be recorded. Many leaks start after some careless mechanic damages the membrane while tending to some equipment on the roof. Access to the roof should be limited to those people who inspect and care for the membrane. Their trips to the roof should be logged as should the trip of anyone.

Inspections

Inspections are a very important part of roof maintenance, and the need to have inspections at regular intervals is a very important part of the inspection process. After the initial "takeover" inspection by the owner's representative, that person should set up a regular schedule of semi-annual inspections. These inspections should happen in the spring and in the fall. They should be supported by supplementary inspections whenever the roof has been exposed to unusual stress. After every storm, long dry spell, long wet spell, etc. there should be an inspection of the roof. These inspections should cover more than just the membrane, although that is a very important part of every roof inspection. The inspections should also include checking drains to be certain they are open. (Many roof collapses have been caused by drains that didn't.)

Roof inspections should follow a specified format, and that is best controlled by the use of an inspection report form. A sample form for this purposes is included with this lesson.

Safety

It is impossible to say enough about safety in construction work done on top of a building. Usually the work is done at a height from which a fall is fatal. There are very rarely any railings or banisters around the edge of the roof. If work is proceeding at the time the inspector is on the roof, there is the additional danger of getting hurt by hot or corrosive materials. Any person on a roof should be dressed in sturdy, non-slip shoes, long pants and a long sleeved shirt. A hard hat or cap is also good sun protection.

When moving around on a roof, care must be made to always look before stepping. Slick spots, caused by water, algae or wet paint etc. can be very dangerous. Never step backward without looking to see what is there.

OSHA rules for working in high places have some very good safety tips and they are also the law of the land.

Roof System Components

To properly discuss this it is necessary to divide these materials into several groups.

First, let us consider shingles. Shingles imply a roof with a slope of 4/12 or better. Shingle roofs also have ridges, hips and valleys not found on the flatter roofs. Shingle material can be anything from asphalt saturated felt to tile or concrete. There are certain things they all have in common when it comes time to perform a maintenance inspection on a shingle roof.

Check the general appearance of the roof for signs of damage. Look very closely for broken or damaged shingles. Valleys, ridges and edges must be checked very closely for signs of leakage, as this will bring on rotted decking. Damaged areas should be repaired as soon as possible to prevent water damage to the structure or contents of the building. All penetrations in the roof membrane are places where water is most likely to enter the building. These places should be checked at every inspection and repaired as soon as they show signs of giving problems. the drainage system is very important on a shingle roof. Shingles are not sealed, and if water backs up on them, that water is guaranteed to get into the building.

Secondly, let us take a look at the single ply membranes. Of these, the modified bitumens are closest to the built-up roof in that they are usually mopped or torched down to the deck. They are also frequently covered with a cap sheet material or with a coating. Like most of the other single ply materials, they are self flashing.

Several of the other single ply materials come in larger sheets, and therefore have fewer joints. Their problem is that they are more difficult to fasten to the roof deck. Because of this, checking hold-down methods at each roof inspection is very important. These materials are self flashing, but even so it is always important to check at edges and penetrations. Those are still the favorite places for water to get into the building.

The sprayed on roof/insulation type of membrane is a rather special type of single ply membrane. It is actually manufactured on the roof by the installer, and as a result the installation is very critical with this material. This type of roof has been around for over thirty years, and yet is has never taken more than ten percent of the market. The roofing material is totally self flashing and it roofing a very good job in that department. The main areas to check on this type of roof are the integrity of the coating and the signs of standing water. This is a unique material in that here we have a roofing material that is not waterproof. If it is installed on a wet substrate there will be problems with bubbles and with adhesion. If the coating on top fails, this will be followed by a rapid degradation of the water-tightness and the insulating value. Part of the maintenance program for puf roofing should be recoating at a regular interval.

SEMIANNUAL ROOF INSPECTION REPORT FORM

BUILDING ____________________ DATE OF INSPECTION ______________

LOCATION ____________________ INSPECTED BY: __________________

ROOF MEMBRANE

1. GENERAL APPEARANCE:

   GOOD ____ FAIR ____ POOR ____

2. WATER-TIGHTNESS:

   NO LEAKS REPORTED ________

   LEAK REPORTED AT: (GIVE LOCATION)

   ____

3. REPORTED LEAK OCCURS:

   EVERY RAIN ______________________________

   ONLY WITH LONG CONTINUED RAIN ____________________

   ONLY WITH HIGH WINDS __________________________

   WIND DIRECTION ______________________________

   ONLY WHEN PONDING OCCURS _______________________

4. CONDITION OF MEMBRANE:

   CRACKS __________________________________

   LOOSE JOINTS ______________________________

   BUCKLING OR SAGGING __________________________

   SIGNS OF WIND DAMAGE __________________________

5. RECOMMENDED TREATMENT OF MEMBRANE:

   ____

   ____

FLASHING

1. BASE FLASHINGS:

   GOOD CONDITION ______________________________

   SURFACE DAMAGE ______________________________

   OPEN JOINTS ______________________________

SEPARATED FROM PARAPET WALL ____________________

2. COUNTERFLASHINGS:

WELL ANCHORED IN MASONRY____________________

CONDITION OF CAULKING AT MASONRY____________________

BENDS, BUCKLES OR DAMAGE TO METAL____________________

3. COPING:

GOOD CONDITION____________________

LAP JOINTS SEALED____________________

BENDS, BUCKLES OR DAMAGE TO METAL____________________

LOOSE FASTENERS____________________

4. VENT FLASHINGS:

GOOD CONDITION____________________

BASE FLANGE LOOSE____________________

BOOTS TURNED DOWN INTO VENT PIPES____________________

HOLES OR DAMAGE TO BOOTS____________________

5. CHIMNEY VENTS:

GOOD CONDITION____________________

BASE FLANGE LOOSE____________________

COLLARS SEALED____________________

RAIN CAPS SECURE____________________

6. PITCH PANS:

GOOD CONDITION ____________________

BASE FLANGE LOOSE____________________

FILLED WITH BITUMEN____________________

GALVANIZED METAL PAINTED____________________

7. DISSIMILAR METALS:

NO DISSIMILAR METALS IN CONTACT____________________

DISSIMILAR METALS ARE ISOLATED ______________

WHAT METALS ARE INVOLVED ______________

8. RECOMMENDED TREATMENT OF FLASHINGS: (CONTINUE ON BACK)

____

____

DRAINAGE SYSTEM

1. SCUPPERS:

OPEN AND IN GOOD CONDITION ______________

SEALED TO FLASHING ______________

BASE FLANGE SEALED ______________

2. ROOF DRAINS:

OPEN AND IN GOOD CONDITION ______________

SEALED TO MEMBRANE ______________

CONDITION OF STRAINER ______________

3. GUTTERS:

OPEN AND IN GOOD CONDITION ______________

SECURELY FASTENED ______________

BENT OR DAMAGED METAL ______________

4. DOWNSPOUTS:

OPEN AND IN GOOD CONDITION ______________

SECURELY FASTENED ______________

BENT OR DAMAGED METAL ______________

SPLASH BLOCKS IN PLACE ______________

5. RECOMMENDED TREATMENT OF DRAINAGE SYSTEM:

(CONTINUE ON BACK IF NEEDED)

____

____

GENERAL HOUSEKEEPING

1. CLEANLINESS:

   ROOF IS CLEAN AND FREE OF DEBRIS____________________

   FOUND LITTER. TYPE______________________________

   FOUND LOOSE OBJECTS. TYPE_________________________

2. PAINTING AND CAULKING:

   ALL FERROUS METALS WELL PROTECTED___________________

   ALL MASONRY/CONCRETE SURFACES SEALED________________

   AREAS IN NEED OF CAULKING__________________________

   AREAS IN NEED OF PAINTING__________________________

   AREAS IN NEED OF SEALING__________________________

3. REPAIR WORK RECOMMENDED:

   ____

   ____

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The author's first conclusion is that roofing failures are the building owners' most costly and biggest headache in maintaining his or her facility. There are three main problem sources that contribute to the roofing failure problem. These are poor or uninformed design, poor installation and workmanship, and poor ongoing maintenance. In a less significant sense, the manufacturer contributes to the problem by bringing new roofing products to market and not educating his clientele on their best use. Compounding these main problems are the difficulty in pinpointing exact causes of failure. Thus, no single source can be held accountable for the problem as a whole.

To see if these problems could be categorized and steps taken to identify the cause, data were collected from the Florida Public Schools for analysis. To corroborate these data and test their validity, a comparison was made against similar data gathered on a national level by the National Roofing Contractors Association. The author found two very important correlations that support the validity of the Florida data. The first was the correlation between types and percentages of roof failures in the Florida data and the National data. The second was the correlation between the percentage of different roof types derived from the Florida data and the percentage of roof types derived from the National data.

As a further cross check on the data, interviews were done in the field with many and varied roofing professionals. The information and opinions in these interviews were compared against one another and against the data taken from the field surveys. A significant correlation was found. Those who voiced an opinion remarked that single-ply roofing had some problems when it was first introduced, but the single-ply roofing manufacturers had discovered these problems and corrected them. This was confirmed by comparing the year and the amount of single-ply roofing that was installed in that year, against the associated problems that were reported in later years. It showed that in the early years, small amounts of single-ply roofing generated considerably more problems per one-thousand squares installed than other roof types. In subsequent years, more single-ply roofing was installed, but these roofing systems generated less problems per one-thousand squares. The last significant correlation that the Florida data produced was that roofing problems seemed to be grouped by county school system. The Florida data was sorted and correlated by county. By assuming Perreto's Law that eighty percent of problems are generated by twenty percent of the population a line was drawn at roughly the eighty percent level of the reported problems. It was found that four counties had accumulated seventy-eight percent of the roofing problems. This first sort and accumulation by county was done on single-ply roofing problems only. A second pass at the data was completed that included all roofing types, single-ply as well as built-up, tile, metal and other roofing. The second pass confirmed the first. The same counties that reported high failure rates on single-ply systems also reported the highest problem rates on other roofing systems as well.

A comparison of the counties with the lowest reported failure rates showed that, in general, these counties had three items in common; 1) a centralized roofing coordinator; 2) a strict prequalification procedure for roofing contractors; and 3) a requirement for all roofs to be warranted by the roofing manufacturer. The roofing coordinator was responsible for ensuring compliance with warranty and prequalification procedures. This required that he work closely with the maintenance department to monitor and record for warranty reasons that necessary ongoing corrective and preventative maintenance was completed.

RECOMMENDATIONS

1. Recommend that each county establish a roofing coordinator to implement a roofing maintenance and inspection program. His duties would include the review and coordination of all roofing construction

contract documents.

2. That the state should prequalify designers of roofs using the following criteria:

   a. Investigation of the designers background regarding specifically roofing and waterproofing expertise.

   b. Physical examination of several, possibly as many as ten, successfully completed projects of significant scope including both new construction and reroof.

   c. Proof of continuing education credits in programs specifically offered for the roofing professional such as those presented by the Roofing Industry Educational Institute (RIEI), The National Roofing Contractors Association (NRCA) and programs available through many of the university systems as well as those offered by roofing material manufacturers.

   d. Proof as an established Florida business entity since there are so many climatic characteristics unique to this state.

3. That the state should prequalify material manufacturers using the following criteria:

   a. Proof that their systems are listed by Underwriters Laboratory, Inc. and Factory Mutual for Class 1 Construction.

   b. Proof of adequate insurance coverage or reserves to cover warranty holders in the event of financial catastrophe. This necessity has been recently demonstrated by the demise of the Nuralite roof system manufacturer and The Dunlop Rubber Company.

c. Field documentation that the type of system intended for use on the design structure has performed as intended for a least 75% of the specified warranty period.

d. Mandatory annual inspection by an independent technician for the material manufacturer with monetary consequences for failure to comply.

e. Proof of a roofing contractor certification program.

4. That the state should prequalify roofing contractors using the following criteria:

   a. Must be certified as a roofing contractor by the Florida Construction Industry Licensing Board.

   b. Able to secure Performance & Payment bonds and fully covered by both Workers Compensation and pubic liability insurance.

   c. In business as a roofing contractor for a minimum of five (5) years.

   d. Proof of successful application experience of the type roof system specified for the project.

e. Proof prior to project bid that roofing contractors is certified by roofing material manufacturer for installation of specified system.

5. All roofing should be warranted by the roofing material manufacturer and not the roofing contractor.

6. The records kept by the roofing coordinators should be compiled annually into an ongoing investigation as to the durability and longevity of Florida public school roofing systems. This information should be shared and compared with the national information collected by the NRCA's project pinpoint analysis.

These six recommendations, if implemented, would have the following benefits to the State of Florida. By establishing a single point of coordination for roofing construction, maintenance, and inspection, in each county, the Public School Systems will save money by keeping maintenance problems along with life cycle costs to a minimum. By correcting potential problems early, the longevity of the roofing system can be maximized. A formal job description of the roofing coordinator should be established statewide. A sample job description is included as appendix "C". A decision needs to be made and formally incorporated into the coordinator's job description as to what level of authority he has over the design, inspection, quality control, maintenance and repair of the roofing assets under his control. Additionally, he should be responsible for the inspection program and record keeping on all roofing construction as well as monitor the condition and ongoing maintenance of the county's roofing assets. He should enforce the warranties and prequalification procedures for roofing contractors in his area.

The benefits of prequalifying the roof designers, material manufacturers and roofing contractors speak for themselves. By ensuring proper design, suitable roofing material, and that the contractor meet minimum standards will deliver a higher quality product and mean fewer long term maintenance problems for the county school systems. This recommendation interfaces well with the recommendation for the manufacturer to provide the roof warranty. To protect himself against the liability of costly repairs or replacements, the manufacturer will ensure that the roofing coordinator has the best design details and that they are incorporated into the drawings and specifications. He will also have to ensure the contractor is qualified to install the product provided. This will serve as a double check of the State pequalification procedures. And finally, as manufacturers tend to not go out of business as readily as contractors, there would be a greater chance of having the warranty work done if and when required. One of the roofing manufacturers discussed this option at some length. They were strongly in favor, as the responsibility of roofing failures tends to come back to haunt them regardless of the cause. This particular manufacturer had a contractor qualification procedure already in place. It required that a factory technician certify the contractor, and only after inspecting his installation procedures on at least three separate projects. He also had two separate roofing crews that traveled nationally resolving roof problems that were under manufacturer's warranty.

The sixth recommendation to compile and analyze the individual county records would provide hard data for comparing different roofing systems. Accurate records on construction costs, repair and maintenance costs, type and number of problems per roof type, would prove invaluable in minimizing life cycle costs.

All roofing maintenance, whether it be routine maintenance, repair, or partial or complete replacement should be based on economics. The cost of extensive repairs, even though less expensive than total replacement, are sometimes not justified on a life cycle costing basis. The decision to repair or replace can be a simple one, provided enough background data is available. Once enough historical data is compiled, decisions can be easily made that will minimize the overall life cycle cost of the roofing system. This information could also be used to spot new trends or to confirm the continuance of current trends. This would be a mirror image of the effort now ongoing in The National Roofing Contractors' Association. Should problem trends be identified, they could be easily evaluated. Earlier, it was noted that the cause of many problems were difficult to establish. This would help alleviate this identification problem. These problems could be cataloged and incorporated into the ongoing roofing seminars which are produced by the Building Construction Industry Advisory Committee and thus ensure that the body of knowledge is continually refreshed.

RECOMMENDATIONS FOR FUTURE RESEARCH

There was a definite trend between the different county school systems and their problems per 1000 squares of roofing. Some counties had much higher reported problem rates than others. The author does not imply that one county system may have a better maintenance system than another. There are several ways to explain this correlation, and the adequacy and level of ongoing maintenance is just one. The author recommends an in-depth investigation into this finding to confirm its validity and discover its cause. Obviously, each county is going to have different approaches and levels of effort toward roofing maintenance. The recommended research would investigate these differences in procedure, costs, and confirm actual numbers of problems per roof type. The best of each approach could be gleaned and incorporated into an overall roofing maintenance program. The investigation could help the counties with higher maintenance costs resolve these problems. By identifying these high maintenance cost areas, the State could concentrate its scarce resources on and solve the highest cost problems first. Thus, the most efficient use of its money and manpower.

To ensure that this future research be accomplished in the most timely and efficient manner, the author recommends that a separate grant be established to implement these recommendations. The grant should have two main thrusts. The first is to develop an implementation plan. This plan should consider the structure of the existing county school system maintenance departments and how the proposed roofing coordinator would fit into it. It should have a comprehensive time-frame in which to implement the program. A cost to implement the program needs to be estimated to show that it is truly cost effective. The plan, once developed needs to be approved and endorsed by the appropriate Department of Education (DOE) authority. This endorsement should include a mandate for its implementation of the local school systems. The second thrust is the actual implementation of the plan established in the first phase. As the plan is implemented, its progress should be monitored and reported to the appropriate DOE authority, until it is fully integrated into the local school systems.

BIBLIOGRAPHY

1. Asphalt Roofing Manual; Asphalt Roofing Manufacturers Association, 1989

2. Brotherson, Donald E.; "Investigation to Identify Performance Criteria and Test Methods for Evaluating Single-Ply Roofing Systems", USA-CERL Technical Report M-87/07, March 1987

3. Crosland, Robert E. and Strange, Luther J.; "Research and Development of Guidelines for the Reduction of Life-Cycle Cost of Roofing in Florida"; Florida Department of Education Contract DOE 084-015, July 1983

4. Crosland, Robert E. and Strange, Luther J.; "Three Day Roofing Course for the Florida School System", Developed under a grant from the Building Construction Industry Advisory Committee, 1988

5. Discussion with Carlisle Roofing Representative, September 1991

6. Donohue, Judith; "Fixing Fallingwater's Flaws", Architecture, November 1989, p 99-101

7. Elastomeric Roofing (EPDM), Department of Army, Office of the Chief of Engineers, 1988

8. Griffin, C. W.; Manual of Built-up Roofing Systems, McGraw Hill Book Company, New York, 1982

9. Handbook of Accepted Roofing Knowledge, National Roofing Contractors Association, 1989

10. Hogan, Charles T.; Masters Report: "Study to Determine Recommended Roofing Types for the University of Florida Buildings", 1990

11. Low Sloped Roofing Research Plan, U.S. Dept of Commerce, National Bureau of Standards, 1983

12. March, Francis; Flat Roofing: A Guide to Good Practice, 2nd Edition, Tarmac Building Products Limited, London, 1983

13. McCampbell, B. Harrison, Problems in Roofing Design, Butterworth-Heinemann, Stoneham, MA 1992

14. One Hundred Years of Roofing in America, National Roofing Contractors Association, 1986

15. Roofs and Roofing: New Materials, Industrial Applications, Uses and Performance; Reproduced from manuscripts by the authors, Edited by J.O. May, John Wiley & Sons, 1989

16. Single-Ply EPDM Roofing, U.S. Army Corps of Engineers, 1990

17. Watson, John A.; Roofing Systems; Reston Publishing Company; 1979

APPENDIX A

SINGLE -PLY ROOF DATA PROBLEMS BY FACILITY

COLLECTED 1986; UPDATED 1992

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
Baker County High	Baker	434.0	0	0	0	0	0	0	0
MacClenny Elem	Baker	2.8	0	0	0	0	0	0	0
Westside Elem	Baker	448.6	1	0	0	0	0	1	0
Maintenance Warehouse	Bay	161.5	0	1	0	0	0	0	0
Millville Elementary	Bay	480.0	0	0	0	0	0	0	0
Mosley High	Bay	1512.0	2	0	3	0	4	6	0
Mosley High Metal	Bay	425.0	8	1	0	6	8	0	1
Mowat Jr. High Ind. Arts	Bay	27.5	1	0	4	0	0	2	2
Mowat Jr. High Media Center	Bay	115.0	2	0	6	0	0	0	3
Rutherford Ex. Child Fac.	Bay	27.5	0	0	0	0	0	0	0
Rutherford High Phase 1	Bay	122.0	0	0	2	0	0	0	0
T.P. Haney Voc-Tech Phase 2	Bay	261.0	0	0	2	0	2	0	0
T.P. Haney Voc-Tech ph. 1	Bay	427.3	1	0	6	0	2	2	3
Blountstown Elementary	Calhoun	550.0	0	0	0	0	0	0	0
Blountstown Elementary	Calhoun	550.0	1	0	1	1	1	1	0
Banyan Elementary	Dade	783.0	0	0	0	0	0	0	0
Central Sr	Dade	2254.0	0	0	0	0	0	0	0
Coral Gables Sr	Dade	2445.0	0	0	0	0	0	0	0
Cutler Ridge El	Dade	189.0	0	0	0	0	0	0	0
Cypress El	Dade	720.0	0	0	0	0	0	0	0
Earlington H & G El	Dade	245.0	0	0	0	0	0	0	0
English Center	Dade	180.0	0	0	0	0	0	0	0
Fairchild El	Dade	210.0	0	0	0	0	0	0	0
Golden Glades Elementary	Dade	1210.0	0	0	0	0	0	0	0
Hibiscus El	Dade	289.0	0	0	0	0	0	0	0
Kelsey Phar	Dade	2395.0	0	0	0	0	0	0	0
Kenned Jr	Dade	345.0	0	0	0	0	0	0	0
Kenwood El	Dade	584.0	0	0	0	0	0	0	0
Martin L King Elementary	Dade	109.0	0	0	0	0	0	0	0
Mays	Dade	2313.3	0	0	0	0	0	0	0
Miami Beach Sr	Dade	2567.0	0	0	0	0	0	0	0
Miami Carol City Sr	Dade	524.9	0	0	0	0	0	0	0
Miami Killian Sr	Dade	2667.0	0	0	0	0	0	0	0
Miami Park El	Dade	970.0	0	0	0	0	0	0	0
Natulus Jr	Dade	2050.0	0	0	0	0	0	0	0
North Central	Dade	1250.0	0	0	0	0	0	0	0
Pine Villa	Dade	769.8	0	0	0	0	0	1	0
Pine Villa	Dade	770.0	0	0	0	0	0	1	0
Ponce de Leon Jr High	Dade	85.0	0	0	0	0	0	0	0
Royal Palm El	Dade	1860.0	0	0	0	0	0	0	0
Wheatli El	Dade	1550.0	0	0	0	0	0	0	0
14-0022-006	Desoto	30.0	0	0	0	0	0	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
14-0031-003	Desoto	165.3	3	0	0	0	0	0	0
14-0041-016	Desoto	22.0	2	1	0	0	0	0	0
14-0061-002	Desoto	32.8	1	0	2	0	0	0	0
14-0061-002 Bldg 7	Desoto	22.8	0	0	2	0	0	0	0
14-0061-002 Bldg 8	Desoto	43.7	2	1	0	0	0	0	0
14-0061-002 Bldgs:2,3,5,6,9,11,12	Desoto	343.2	0	0	4	0	0	0	0
14-0081-008 Bldgs 1-10	Desoto	966.8	2	1	0	0	0	0	0
14-0140-014	Desoto	151.1	0	1	0	0	0	0	0
14-0161-016	Desoto	762.7	0	1	0	0	0	0	0
14-0161-016 Bldg 2	Desoto	14.7	0	0	0	0	0	0	0
14-0180-018	Desoto	2.8	0	1	0	0	0	0	0
14-0181-018	Desoto	648.6	3	0	0	0	0	0	0
14-0181-018 Bldg 3	Desoto	3.6	0	1	0	0	0	0	0
14-061-006	Desoto	282.2	0	0	0	0	0	0	0
14-061-006 Bldg 2	Desoto	57.2	0	1	0	0	0	0	0
14-9001-008 Bldg 4	Desoto	47.2	0	0	0	0	0	0	0
14-9001-008 Bldgs 1&2	Desoto	181.3	0	0	0	0	0	0	0
14-9001-017 Bldg 2	Desoto	40.0	3	1	0	0	0	0	0
14-9001-017 Bldg 3	Desoto	42.1	0	1	0	0	0	0	0
14-9001-017 Bldg 4	Desoto	59.3	0	1	0	0	0	0	0
14-9001-017 Bldg 5	Desoto	52.3	2	1	0	0	0	0	0
14-9001-017 Bldg 6	Desoto	87.1	0	1	0	0	0	0	0
14-9112-911 Bldg 1	Desoto	15.0	0	1	0	0	0	0	0
Apalachicola High School Main	Franklin	2666.0	0	0	0	0	1	0	0
Apalachicola High School Old Gym	Franklin	89.0	0	0	0	0	0	0	0
Apalachicola High School Quinn	Franklin	2445.0	0	0	0	0	0	0	0
Apalachicola High School Vocational	Franklin	1050.0	0	0	0	0	0	0	0
Carrabelle High School Gym	Franklin	153.0	0	1	0	0	0	0	0
Carrabelle High School Main Build	Franklin	206.0	0	0	0	0	0	0	0
Carrabelle High School Vocational	Franklin	2313.0	0	0	0	0	0	0	0
Chapman Elementary School	Franklin	539.0	0	0	1	0	0	0	0
Carter Parramore Except. Child Voc.	Gadsen	0.0	0	0	0	0	0	0	0
Carter Parramore Jr. High	Gadsen	0.0	0	0	0	0	0	0	0
Chattachoochee Elem	Gadsen	0.0	0	0	1	0	0	0	0
Chattahoochee Elementary	Gadsen	0.0	0	0	1	0	0	0	0
Chattahoochee High Cafeteria	Gadsen	400.0	0	1	0	0	0	0	0
Chattahoochee High Gym	Gadsen	0.0	0	0	0	0	0	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
Chattahoochee High New Classroom	Gadsen	300.0	0	0	0	0	0	0	0
Gadsen Vo Tech Phase II	Gadsen	0.0	0	0	0	0	1	0	0
Gadsen Vo-Tech Phase III	Gadsen	0.0	0	0	0	0	0	0	0
Havana High	Gadsen	0.0	0	0	0	0	0	0	0
Salem Elementary Cafeteria	Gadsen	0.0	0	0	0	0	0	0	0
Walker Admin Bldg	Gadsen	0.0	0	0	0	0	0	0	0
Walker Admin Building	Gadsen	0.0	0	0	0	0	0	0	0
Central Hamilton Elementary	Hamilton	735.0	3	0	0	0	0	0	0
Hamilton County High School	Hamilton	1200.0	0	0	0	0	0	0	0
Hamilton Middle High School	Hamilton	800.0	0	0	0	0	0	0	0
Hamilton Middle School	Hamilton	90.0	0	1	0	0	0	0	0
Clewiston Elementary-Patch Work	Hendry	400.0	0	0	0	0	5	0	0
Clewiston High-Media Center	Hendry	45.0	0	0	0	0	0	0	0
Clewiston Intermediate	Hendry	25.0	0	0	0	0	0	0	0
Clewiston Intermediate	Hendry	29.0	2	0	0	0	2	0	0
Clewiston Middle	Hendry	1100.0	0	0	2	0	1	10	0
Clewiston Middle	Hendry	1100.0	0	0	2	0	1	10	0
Clewiston-Middle	Hendry	1000.0	0	0	3	0	2	8	0
LaBelle Elementary	Hendry	4000.0	0	0	0	3	0	0	0
LaBelle Elementary-Toilet Area	Hendry	100.0	0	0	3	0	0	0	0
LaBelle High	Hendry	1100.0	0	0	2	0	1	10	0
Avon Park Elementary	Highlands	736.0	0	0	0	0	1	1	0
Avon Park Elementary Portable	Highlands	748.0	1	1	0	0	0	0	0
Avon Park Elementary Trailers	Highlands	120.0	1	1	0	0	0	0	0
Avon Park High School	Highlands	105.0	0	1	0	0	0	1	0
Avon Park Middle Gym	Highlands	200.0	0	0	0	0	0	0	0
Avon Park Middle School	Highlands	583.0	0	0	0	0	1	1	0
E.O. Douglas Admin Center	Highlands	905.0	0	1	0	0	1	0	0
E.O. Douglas Aux Bldgs	Highlands	540.0	0	0	0	0	0	0	0
E.O. Douglas Gymnasium	Highlands	689.0	0	0	0	0	0	0	0
E.O. Douglas Maint,Trans, Whse	Highlands	1510.0	1	1	0	0	0	0	0
Fred Wild Elementary	Highlands	654.0	1	1	0	0	0	0	0
Fred Wild Elementary	Highlands	0.0	0	0	1	0	0	1	0
Fred Wild Elementary	Highlands	895.0	0	1	0	0	0	0	0
Lake Placid Elementary	Highlands	735.0	0	0	0	0	0	0	0
Lake Placid Elementary Portables	Highlands	551.0	0	1	0	0	0	0	0
Lake Placid Elementary Trailers	Highlands	1200.0	0	0	0	0	0	0	0
Lake Placid High School	Highlands	462.0	1	0	0	1	1	1	0
Lake Placid Middle Acad	Highlands	345.0	0	0	0	0	0	0	0
Lake Placid Middle Gym	Highlands	115.0	0	0	0	0	0	0	0
Lake Placid Middle School	Highlands	909.0	0	1	0	0	0	0	0
Sebring High School	Highlands	200.0	0	1	0	0	0	1	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
Sebring High School Portables	Highlands	300.0	0	1	0	0	0	0	0
Sebring Middle Ach Center	Highlands	0.0	0	0	0	0	0	0	0
Sebring Middle Gymnasium	Highlands	0.0	0	0	0	0	0	0	0
Sebring Middle House	Highlands	947.0	0	1	0	0	0	0	0
Sebring Middle Portables	Highlands	723.0	0	1	0	0	0	0	0
Sebring Middle School	Highlands	0.0	0	0	0	0	1	1	0
Sun'N Lake Elementary	Highlands	700.0	0	1	0	0	0	0	0
Sun'N Lake Elementary Portables	Highlands	1038.0	0	1	0	0	0	0	0
Woodlawn Elemenatry Portables	Highlands	359.0	0	1	0	0	0	0	0
Woodlawn Elementary	Highlands	0.0	0	0	0	0	1	1	0
Woodlawn Elementary Trailers	Highlands	963.0	1	1	0	0	0	0	0
Bonifay Elementary Reroofing	Holmes	618.0	0	0	0	0	0	0	0
Bonifay Elementary School	Holmes	682.0	0	0	3	0	2	0	0
Bonifay High-Excep. Child Facility	Holmes	40.0	0	0	1	0	0	0	0
Holmes County High	Holmes	30.0	0	0	0	0	0	0	0
Holmes County High-Music Suite	Holmes	85.0	0	1	0	0	0	0	0
Ponce de Leon Elementary	Holmes	200.0	1	1	2	0	0	0	0
Beachland Elementary (Reroof)	Indian River	1100.0	0	1	0	0	0	0	0
Citrus Elementary (Library)	Indian River	0.0	0	0	0	0	0	0	0
Citrus Elementary Addition	Indian River	400.0	0	1	0	0	0	0	0
Dodgertown Elementary	Indian River	645.0	0	1	0	0	0	0	0
Fellsmere Elementary	Indian River	820.0	0	0	0	0	0	0	0
Gifford Middle 6	Indian River	640.0	0	0	0	0	0	0	0
Gifford Middle 7	Indian River	240.0	0	0	0	0	0	0	0
Gifford Middle 7 (Reroof)	Indian River	0.0	0	0	0	0	0	0	0
Glendale Elementary	Indian River	1050.0	0	0	0	0	0	0	0
Highlands Elementary	Indian River	1700.0	0	1	0	0	0	0	0
Osceola Elementary (Library)	Indian River	0.0	0	0	0	0	0	0	0
Pelican Island	Indian River	400.0	0	0	0	0	0	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
Portable at Fellsmere	Indian River	1800.0	0	0	0	0	0	0	0
Portables	Indian River	1250.0	0	1	0	0	0	0	0
Rosewood Additon	Indian River	815.0	0	0	0	0	0	0	0
Rosewood Elementary (Library)	Indian River	0.0	0	0	0	0	0	0	0
Sebastian Elementary	Indian River	200.0	0	0	0	0	0	0	0
Sebastian River Middle Jr. High	Indian River	0.0	0	0	0	0	0	0	0
Thompson Elementary	Indian River	930.0	0	0	0	0	0	0	0
Vero Beach Elementary	Indian River	400.0	0	1	0	0	0	0	0
Vero Beach High	Indian River	580.0	0	0	0	0	0	0	0
Vero Beach Junior High	Indian River	0.0	0	0	0	0	0	0	0
Vero Beach Junior High (Phys Ed.)	Indian River	300.0	0	0	0	0	0	0	0
Vero Beach Sr. High(W. Wing)	Indian River	795.0	0	1	0	0	0	0	0
Howard Middle Agriculture Building	Jefferson	34.0	0	0	3	0	4	0	0
Howard Middle Gym	Jefferson	72.0	0	0	0	5	3	0	0
Howard Middle-Bldgs 1 & 5	Jefferson	263.0	0	0	0	7	4	0	0
Howard Middle-Bldgs 3 & 6	Jefferson	161.0	0	0	0	5	7	0	0
Jefferson County High School CDC	Jefferson	38.0	0	0	1	0	0	0	0
Jefferson County High School Cafe.	Jefferson	109.0	0	0	2	2	0	0	0
Jefferson Elementary Cafeteria	Jefferson	72.0	0	0	0	0	2	0	0
Vo-Tech Center High School	Jefferson	116.0	0	0	0	0	0	0	0
Lafayette Elem School	Lafayette	391.0	0	1	0	2	0	0	0
Lafayette High School Except Ed	Lafayette	30.0	0	0	0	0	0	0	0
Lafayette High School Gym	Lafayette	77.0	0	1	0	2	0	0	0
Bronson Phase I	Levy	180.0	0	1	0	0	0	0	0
Bronson School	Levy	25.0	0	0	0	0	0	0	0
Chiefland Elem	Levy	240.0	0	0	0	0	0	0	0
Chiefland Elem New Fac	Levy	240.0	0	0	0	0	0	0	0
Chiefland Elem Portables	Levy	28.0	0	1	0	0	0	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
Chiefland High	Levy	100.0	0	0	0	0	0	0	0
Joyce Bullock Elem	Levy	80.0	0	1	0	0	0	0	0
Joyce Bullock Elementary	Levy	28.0	0	1	0	0	0	0	0
Williston High	Levy	40.0	0	1	0	0	0	0	0
Williston Intermediate	Levy	14.0	0	1	0	0	0	0	0
Williston Intermediate	Levy	24.0	0	1	0	0	0	0	0
Yankeetown Elem	Levy	20.0	0	1	0	0	0	0	0
Addie R. Lewis Jr High Bldg 1	Okaloosa	714.0	0	0	0	0	0	0	0
Addie R. Lewis Jr. High Bldg 2	Okaloosa	3.0	0	0	0	0	0	0	0
Addie R. Lewis Jr. High Bldg 3	Okaloosa	4.0	0	0	0	0	0	0	0
Addie R. Lewis Jr. High Bldg 5	Okaloosa	19.0	1	0	1	0	1	1	0
Addie R. Lewis Jr. High Bldgs 4	Okaloosa	4.0	0	0	0	0	0	0	0
Bay Area Vo-Tech Bldg 23	Okaloosa	8.0	0	1	0	0	0	0	0
Bay Area Vo-Tech Bldgs 1-5,7-16	Okaloosa	769.0	0	1	0	0	0	0	0
Bay Area Vo-Tech Bldgs 17,18, & 20	Okaloosa	25.0	0	1	0	0	0	0	0
Bay Area Vo-Tech Bldgs 24 &25	Okaloosa	14.0	0	1	0	0	0	0	0
Bay Area Vo-Tech Bldgs 26 & 27	Okaloosa	51.0	0	1	0	0	0	0	0
Bob Sikes Bldgs 1-9	Okaloosa	336.0	0	0	0	0	0	0	0
Bruner Jr. High Bldg 2	Okaloosa	710.0	0	0	0	0	0	0	0
Brunner Jr High Bldg 3	Okaloosa	42.0	1	0	1	0	1	1	0
Brunner Jr. High Bldg 1	Okaloosa	1321.0	1	0	1	0	1	1	0
Brunner Jr. High Bldg 4	Okaloosa	6.0	0	0	0	0	0	0	0
Carver Hill Bldg 9 & 10	Okaloosa	53.0	0	0	0	0	0	0	1
Carver Hill Complex Bldgs 1,3,4,&7	Okaloosa	179.0	1	0	1	0	1	1	0
Carver Hill Complex Bldgs 2,5,6, &8	Okaloosa	300.0	0	0	0	0	0	0	0
Crestview High Bldgs 1,3,4,& 5	Okaloosa	1312.0	1	0	1	0	1	1	0
Crestview High Bldgs 2 & 6	Okaloosa	5.0	0	1	0	0	0	0	0
Crestview Vo-Tech	Okaloosa	10.0	0	1	0	0	0	0	0
Crestview Vo-Tech	Okaloosa	18.0	0	1	0	0	0	0	0
Crestview Vo-Tech Bldg 2	Okaloosa	85.0	0	0	1	0	0	0	0
Crestview Vo-Tech Bldgs 6-10	Okaloosa	188.0	0	0	1	0	0	0	0
Edwins Elem	Okaloosa	3.0	0	1	0	0	0	0	0
Edwins Elem Bldgs 1-10	Okaloosa	455.0	0	0	0	0	0	0	0
Florosa Elem Bldg 4	Okaloosa	3.0	0	0	0	0	0	0	0
Florosa Elem Bldgs 1 & 2	Okaloosa	466.0	1	0	1	0	1	1	0
Florosa Elem Bldgs 3	Okaloosa	4.0	1	0	1	0	1	1	0
Ft. Walton High Bldg 1	Okaloosa	1833.0	0	0	0	0	0	0	0
Ft. Walton High Bldg 2	Okaloosa	72.0	1	0	1	0	1	1	0
Ft. Walton High Bldg 3	Okaloosa	3.0	0	1	0	0	0	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
Laurel Hill Bldg 9	Okaloosa	3.0	0	0	0	0	0	0	0
Laurel Hill Bldgs 1,2,5,6,&7	Okaloosa	484.0	1	0	1	0	1	1	0
Laurel Hill Bldgs 3 & 10	Okaloosa	67.0	0	0	0	0	0	0	0
Longwood Ele	Okaloosa	2.0	0	1	0	0	0	0	0
Longwood Elem Bldg 3	Okaloosa	2.0	0	1	0	0	0	0	0
Longwood Elem Bldgs 2 & 3	Okaloosa	4.0	0	0	0	0	0	0	0
Longwood Elementary Bldg 1	Okaloosa	565.0	0	0	0	0	0	0	1
Longwood Elementary Bldg 1	Okaloosa	565.0	0	0	0	0	0	0	0
Mary Esther Elem Bldg 01	Okaloosa	464.0	0	1	0	1	0	0	0
Mary Esther Elem Bldgs 2 & 3	Okaloosa	18.0	0	1	0	0	0	0	0
Northwood Elem Bldg 1	Okaloosa	134.0	0	1	0	0	0	0	0
Northwood Elem Bldg 2	Okaloosa	33.0	0	1	0	0	0	0	0
Northwood Elem Bldg 6	Okaloosa	36.0	0	1	0	0	0	0	0
Northwood Elem Bldg 7 & 8	Okaloosa	76.0	0	0	0	0	0	0	0
Northwood Elem Bldgs 3-5	Okaloosa	222.0	0	0	0	0	0	0	0
Oak Hill Exc. Child Bldg 3	Okaloosa	14.0	1	0	1	0	1	1	0
Portable	Okaloosa	14.0	0	0	0	0	0	0	0
Pryor Jr. High Bldg 17	Okaloosa	51.0	1	0	1	0	1	1	0
Richbourg Jr. High Addition	Okaloosa	26.0	0	0	0	0	0	0	0
Richbourg Jr. High Bldg 12	Okaloosa	59.0	0	0	0	0	0	0	0
Richbourg Jr. High Bldg 14	Okaloosa	58.0	0	0	0	0	0	0	0
Richbourg Jr. High Bldg 9	Okaloosa	41.0	0	0	1	0	0	0	0
Richbourg Jr. High Bldgs 1-8,10,13	Okaloosa	772.0	0	0	0	0	0	0	0
Richbourg Jr. High Burn Repair	Okaloosa	50.0	0	0	0	0	0	0	0
Ruckel Jr. High Bldg 13	Okaloosa	5.0	0	1	0	0	0	0	0
Ruckel Jr. High Bldg 16	Okaloosa	3.0	0	1	0	0	0	0	0
Ruckel Jr. High Bldg 9	Okaloosa	216.0	1	0	1	0	1	1	0
Ruckel Jr. High Bldg. 11	Okaloosa	25.0	0	1	0	0	0	0	0
Ruckel Jr. High Bldgs 1-8, & 11	Okaloosa	635.0	0	0	0	0	0	0	0
Valparaiso Elem Bldg 11	Okaloosa	3.0	0	1	0	0	0	0	0
Valparaiso Elem Bldg 12	Okaloosa	84.0	0	0	0	0	0	0	0
Valparaiso Elem Bldg 9	Okaloosa	63.0	0	1	0	0	0	0	0
Valparaiso Elem Bldgs 1-8, 10, & 11	Okaloosa	404.0	0	0	0	0	0	0	0
Central Elementary	Okeechobee	600.0	0	0	0	0	1	0	0
Multipurpose building	Okeechobee	156.0	0	1	0	3	3	0	0
North Elementary	Okeechobee	650.0	0	1	0	0	0	0	0
Okeechobee High School	Okeechobee	1520.0	3	1	0	0	3	0	0
Portables (Total of 11)	Okeechobee	99.0	0	1	0	2	0	0	0
Portables (Total of 7)	Okeechobee	63.0	0	1	3	0	2	0	0
South Elementary 0111	Okeechobee	500.0	0	0	3	0	4	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
South Elementary 0111	Okeechobee	500.0	4	0	0	0	0	0	0
Beaumont Middle	Osceola	49.0	8	1	0	0	0	0	0
Boggy Cree Elementary	Osceola	732.0	0	1	0	0	0	4	0
Denn John Middle	Osceola	850.0	4	0	0	0	3	25	5
Portables (Total of Five)	Osceola	50.0	0	1	0	0	1	0	0
Reedy Creek Elementary	Osceola	648.4	2	0	0	0	0	0	0
St. Cloud Middle	Osceola	893.5	4	0	0	0	3	25	5
Altamonte Elementary	Seminole	700.0	0	0	0	0	0	0	0
Bear Lake Elementary	Seminole	0.0	0	0	0	0	0	0	0
Crooms High	Seminole	800.0	0	0	0	0	0	0	0
Eastbrook Elementary	Seminole	600.0	0	0	0	0	0	0	0
English Estates	Seminole	600.0	0	0	0	0	0	0	0
Exceptional Education	Seminole	0.0	0	0	0	0	0	0	0
Forest City Elementary	Seminole	500.0	0	0	0	0	0	0	0
Idyllwilde Elementary	Seminole	600.0	0	0	0	0	0	0	0
Jackson Heights Middle	Seminole	1000.0	0	0	0	0	0	0	0
Lake Brantley High	Seminole	1900.0	1	0	0	0	1	0	0
Lake Howell High	Seminole	1900.0	1	0	0	0	0	0	0
Lake Orienta Elementary	Seminole	500.0	1	0	0	0	1	0	0
Lake Rock Middle	Seminole	0.0	0	0	0	0	0	0	0
Lakeview Middle	Seminole	1300.0	0	0	0	0	0	0	0
Lawton Elementary	Seminole	900.0	0	0	0	0	0	0	0
Lyman High	Seminole	2755.0	0	0	0	0	0	0	0
Lyman High Gym	Seminole	400.0	0	0	0	0	0	0	0
Oviedo High	Seminole	2600.0	0	0	0	0	0	0	0
Red Bug Elementary	Seminole	500.0	0	0	0	0	0	0	0
Sabal Point Elementary	Seminole	500.0	0	0	0	0	0	0	0
Sanford Grammer	Seminole	0.0	0	0	0	0	0	0	0
Sanford Middle	Seminole	1900.0	0	0	0	0	0	0	0
Seminole High	Seminole	2700.0	0	0	0	0	0	0	0
Spring Lake Elementary	Seminole	600.0	0	0	0	0	0	0	0
Sterling Park Elementary	Seminole	600.0	0	0	0	0	0	0	0
Teague Middle School	Seminole	1000.0	0	0	0	0	0	0	0
Transportation Facility	Seminole	400.0	0	0	0	0	0	0	0
Tuskawilla Middle	Seminole	900.0	1	0	0	0	0	0	0
Wekiva Elementary	Seminole	500.0	0	0	0	1	0	0	0
Winter Springs Elementary	Seminole	500.0	0	0	0	0	0	0	0
Administration Bldg	St. Lucie	122.0	0	0	0	0	1	1	0
Anglewood Center Phase 1	St. Lucie	41.0	0	0	0	0	0	0	0
Anglewood Center Phase II	St. Lucie	41.0	0	0	0	0	0	0	0
C.A. Moore Elem Bldgs Cafe & B Wing	St. Lucie	50.0	0	0	0	0	0	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
County Office Complex Compt. Bldg	St. Lucie	30.0	0	0	0	0	0	0	0
F.K. Sweet Elem-Office Build	St. Lucie	7.0	0	0	0	0	1	0	0
Floresta Elem	St. Lucie	666.0	0	0	0	0	0	1	0
Ft. Pierce Central High	St. Lucie	300.0	0	0	0	0	1	1	0
Ft. Pierce Central High Bldg "C"	St. Lucie	245.0	0	0	0	0	0	0	0
Ft. Pierce Central High Bldg G	St. Lucie	190.0	0	0	0	0	1	0	0
Ft. Pierce Elem Caftr	St. Lucie	51.0	0	0	0	0	0	0	0
Ft. Pierce Westwood High	St. Lucie	1500.0	0	0	1	0	1	1	0
Ft.Pierce Westwood High Voc Bld	St. Lucie	312.0	0	0	0	0	0	1	0
Garden City Elem	St. Lucie	100.0	0	0	0	0	1	0	0
Garden City Elem 74 Addition	St. Lucie	170.0	0	0	0	0	1	0	0
Lakewood Park Elem	St. Lucie	666.0	0	0	0	0	0	1	0
Lawnwood Stadium	St. Lucie	80.0	0	0	0	0	0	0	0
Lincoln Park Middle-Gym	St. Lucie	132.0	0	0	0	0	1	0	0
Lincoln Park Office	St. Lucie	28.0	0	0	0	0	1	0	0
Morningside Elem	St. Lucie	666.0	0	0	0	0	1	1	0
Port St. Lucie Elem	St. Lucie	425.0	0	1	1	0	0	0	0
Service Facility	St. Lucie	240.0	0	1	0	0	0	0	0
St. Lucie Elem "A" Wing	St. Lucie	100.0	0	0	0	0	0	0	0
White City Elem-Cafe	St. Lucie	32.0	0	1	0	1	1	0	0
Branford Elementary	Suwannee	83.0	0	1	0	0	0	0	0
Branford High	Suwannee	568.0	0	0	0	0	0	0	0
Suwannee Elementary East	Suwannee	1045.0	0	1	0	0	4	4	0
Suwannee Elementary West Phase 1	Suwannee	433.0	9	1	2	0	6	4	0
Suwannee Elementary West Phase 2	Suwannee	80.0	0	1	0	0	0	0	0
Suwannee Elementary West Phase 3	Suwannee	80.0	0	0	0	0	0	0	0
Suwannee High	Suwannee	318.0	0	1	0	0	4	0	0
Suwannee High	Suwannee	1114.0	0	1	0	0	0	0	0
Suwannee Middle	Suwannee	516.0	0	1	0	0	0	0	0
Suwannee Middle School	Suwannee	121.0	0	1	0	0	0	0	0
Suwannee-Hamilton Vo Tech	Suwannee	53.0	0	1	0	0	0	0	0
Suwannee-Hamilton Vo Tech	Suwannee	330.0	0	1	0	0	0	0	0
Lake Butler Elem	Union	800.0	0	0	1	0	1	0	0
Lake Butler Elem	Union	984.0	0	0	1	0	1	0	0
Lake Butler Middle	Union	535.0	0	1	0	1	1	0	0
Union Co High	Union	459.0	0	0	1	0	1	0	0
Union County High	Union	618.0	1	0	1	0	1	1	0
Union County High	Union	775.0	1	0	1	0	1	0	0
Union County High	Union	524.0	0	0	0	0	0	0	0
Blue Lake Elementary	Volusia	800.0	0	1	0	0	0	0	0
Bonner Elementary	Volusia	429.0	0	0	2	0	0	0	0

SINGLE PLY ROOF DATA
PROBLEMS BY FACILITY
COLLECTED 1986
UPDATED 1992

FACILITY NAME OR ID	COUNTY NAME	NUMBER OF SQUARES	SEAM PROBS	MECHANICAL PROBLEMS	MEMBRANE PROBLEMS	FASTENER PROBLEMS	FLASHING PROBLEMS	EXPANSION JOINT PROBLEMS	VANDALISM PROBLEMS
Boston Avenue	Volusia	120.0	0	0	2	0	0	0	0
Bus Garage	Volusia	72.0	0	1	0	0	0	0	0
Central Warehouse	Volusia	257.0	6	1	0	0	0	0	0
Chisholm Center	Volusia	130.0	0	1	0	0	0	0	0
Data Processing Center	Volusia	1026.0	0	1	0	0	0	0	0
Deland Junior High (DD)	Volusia	1700.0	0	1	0	0	0	0	0
Deland Senior High	Volusia	55.0	0	1	0	0	0	0	0
Deland Senior High	Volusia	666.0	0	1	0	0	0	0	0
Deland Senior High "D" Wing	Volusia	240.0	0	0	0	0	0	0	0
Deland Senior High School	Volusia	240.0	0	0	2	0	0	0	0
Deland Senior High School	Volusia	240.0	0	0	2	0	0	0	0
Deltona Lakes Elementary (C)	Volusia	800.0	0	1	0	0	0	0	0
Holly Hill Elementary	Volusia	800.0	0	1	0	0	0	0	0
Holly Hill Junior High	Volusia	1700.0	0	0	0	0	0	0	0
New Smyrna Beach High	Volusia	45.0	0	1	0	0	0	0	0
New Smyrna Beach Junior	Volusia	1700.0	0	0	0	0	0	0	0
Orange City Elementary	Volusia	60.0	0	0	0	0	0	0	0
Ormond Beach Elementary	Volusia	119.0	0	1	0	0	4	0	0
Ormond Beach Junior High	Volusia	720.0	0	1	0	0	0	0	0
Osteen Elementary School	Volusia	1700.0	0	1	0	0	0	0	0
Pine Trail Elementary	Volusia	800.0	0	1	0	0	0	0	0
Port Orange Elementary	Volusia	140.0	0	1	0	0	0	0	0
Silver Sands Junior High	Volusia	1700.0	0	1	0	0	0	0	0
Southwestern 7th Grade Center	Volusia	433.0	0	0	0	0	0	0	0
Spruce Creek Elementary	Volusia	800.0	0	1	0	0	0	0	0
Spruce Creek Senior High	Volusia	2636.0	0	0	0	0	0	0	0
Spruce Creek Senior High	Volusia	2636.0	0	0	0	0	0	0	0
Sugar Mill Elementary	Volusia	800.0	0	1	0	0	0	0	0
T.D. Taylor Jr. Sr. High	Volusia	266.0	0	1	0	0	1	0	0
T.D. Taylor Jr. Sr. High	Volusia	325.0	0	0	2	0	0	0	0

APPENDIX B

COMPOSITE LISTING OF ROOFING MANUFACTURERS

COMPOSITE LISTING OF
ROOFING MANUFACTURERS

COMPANY NAME	ADDRESS	CITY	STATE	ZIP
A&S BUILDING SYSTEMS, INC	P.O. BOX 40099	HOUSTON	TX	77240
AGR CO.	BOX 7488	CHARLOTTE	NC	28217
ALCOA BUILDING PRODUCTS	P.O. BOX 716	SIDNEY	OH	45365
ALKOR DIV., HEDWIN CO	1 BLUE HILL PLAZA	PEARL RIVER	NY	10965
ALTUSA CLAY CORPORATION	12070 NW SOUTH RIVER DRIVE	MEDLEY	FL	33178
ALUMAX	227 TOWN E	MESQUITE	TX	75149
ALUMAX, BUILDING SPECIALTIES DIV	P.O. BOX 163	MESQUITE	TX	75149
AMERICAN BUILDING COMPONETS	1727 EASTERN AVENUE	CINCINNATI	OH	45202
AMERICAN DURA-TILE, INC	2013-A WEST COMMONWEALTH AVE	FULLERTON	CA	92633
AMERICAN HYDROTECH INC.	303 E. OHIO SUITE 2120	CHICAGO	IL	60611
AMERICAN LUBRICANTS CO., THE	1227 DEEDS AVENUE	DAYTON	OH	45401
AMERICAN PROTECTIVE COATINGS	11350 BROOKPARK ROAD	CLEVLAND	OH	44130
AMERICAN ROOFING CORPORATION	3100 S. CALIFORNIA	CHICAGO	IL	60608
ANDEK CHEMICAL CORP.	P.O. BOX 392	MOORESTOWN	NJ	08057
APACHE	100 APACHE ROAD	JACKSON	MS	39212
ARCHITECTURAL ENGINEERING PROD. CO	1901 MAIN STREET	SAN DIEGO	CA	92113
ARCHITECTURAL METAL FABRICATORS INC	P.O. BOX 83851	SAN DIEGO	CA	92138
ARMCO BUILDING SYSTEMS	110 BOGGS LANE	CINCINNATI	OH	45246
ASC PACIFIC	P.O. BOX 2075	TACOMA	WA	98401
ASTRALINE CORP	117 INDUSTRIAL AVENUE	TETERBORO	NJ	07608
AT-LAST ROOFING, INC	7044 N STATE ROAD 39	LAPORTE	IN	46350
ATAS ALUMINUM CORP	540 SNOWDRIFT RD	ALLENTOWN	PA	18106
ATLANTIC BUILDING SYSTEMS	P.O. BOX 82000	ATLANTA	GA	30366
ATLANTIC PACIFIC ROOF TILE	24550 PRODUCTION CR SE	BONITA SPRINGS	FL	33923
ATLAS INTERNATIONAL BUILDING PROD.	5600 HOCHELAGA STREET	MONTREAL	QB	H1N 1W1
B.T.L. WEATHERPROOFING SYSTEM	284 WATLINE AVENUE	MISSISSAUGA	ONTAR	0
BARRA CORP. OF AMERICA	190 FAIRFIELD AVENUE	W.CALDWELL	NJ	07006
BARRET COMPANY, THE	1001 JEFFERSON PLAZA	WILLMINGTON	DE	19801
BEH STEV CORPORATION	188 SOUTH TEILMAN	FRESNO	CA	93706
BEHLEN MFG COMPANY	P.O. BOX 569	COLUMBUS	NE	68601
BERRIDGE MFG CO	1720 MAURY ST	HOUSTON	TX	77026
BERRIDGE MFG. COMPANY	1720 MAURY STREET	HOUSTON	TX	77026
BIRD ROOFING DIV	PLEASANT STREET	NORWOOD	MA	02062
BITUMAT CO LTD	P.O. BOX 58698	RIYADH-11515	SAUDI	0
BOND COTE	P.O. BOX 71	WEST POINT	GA	31833
BUCKINGHAM-VIRGINA SLATE CORP	4110 FITZHUGH AVENUE	RICHMOND	VA	23230
BUILDING PROTECTIVE IND	P.O. BOX 392	MOORESTOWN	NJ	08057
BURKE RUBBER COMPANY	2250 SOUTH 10TH STREET	SAN JOSE	CA	95122
BUTLER MFG COMPANY	P.O. BOX 419917	KANAS CITY	MO	64141
C.M.P.R. AMERICA INC.	18924 SOUTH LAUREL PARK ROAD	COMPTON	CA	90220
CAL-SHAKE	5355 NORTH VINCENT AVENUE	IRWINDALE	CA	91706
CARDINAL METAL PRODUCTS INC	2013 1RST AVENUE N	IRONDALE	AL	35210
CARLISLE SYNTEC SYSTEMS	P.O. BOX 7000	CARLISLE	PA	17013
CARROLL S BUILDING MAT, INC	P.O. BOX 2090	PINELLAS PARK	FL	34290

COMPOSITE LISTING OF
ROOFING MANUFACTURERS

COMPANY NAME	ADDRESS	CITY	STATE	ZIP
CECO BUILDINGS DIVISION	P.O. BOX 6500	COLUMBUS	MS	39701
CELOTEX CORP	1500 N DALE MABRY HWY	TAMPA	FL	33607
CELOTEX CORPORATION, THE	1500 N. DALE MABRY	TAMPA	FL	33067
CENTRAL STATES ASSOC CORP	P.O. BOX 65504	WEST DES MOINES	IA	50265
CENTURY BLDG SYSTEMS	3546 N RIVERSIDE	RIALTO	CA	92376
CERTAINTEED	P.O. BOX 860	VALLEY FORGE	PA	19482
CHEVERON U.S.A. INC./ASPHALT DIV	P.O. BOX 7006	SAN FRANCISCO	CA	94120
CHICAGO METALLIC CORP	4849 SOUTH AUSTIN AVENUE	CHICAGO	IL	60638
CIRO ROOFING PRODUCTS OF CANADA	555 WEST HASTINGS ST	VANCOUVER	BC	0
CLASSIC PROD, INC	P.O. BOX 701	PIQUA	OH	45356
CLASSIC PRODUCTS, INC.	P.O. BOX 701	PIQUA	OH	45356
COLUMBIA CONCRETE PROD LTD	8704 120TH ST	SURREY	BC	V3W 3N7
CONKLIN CO	4660 W. 77TH STREET	MINNEAPOLIS	MN	55435
CONSOLIDATED PROTECTIVE COAT. CP	1801 E. 9TH STREET	CLEVELAND	OH	44114
CONTINENTAL RUBBER CO	415 BLAKE ROAD	MINNEAPOLIS	MN	55343
COOLEY ROOFING SYSTEMS INC	50 ESTEN AVENUE	PAWTUCKET	RI	02860
COPPER SALES, INC	1405 N COUNTY RD 18	PLYMOUTH	MN	53441
CRAWFORD MANUFACTURING CO. INC	P.O. BOX 458	BRENHAM	TX	77833
CRAYCROFT BRICK COMPANY	2301 WEST BELMONT AVENUE	FRESNO	CA	93728
DALY INDUSTRIAL COATINGS	124 137TH STREET	HAMMOND	IN	46327
DANOSA CARIBBEAN INC	BOX 13757	SAN JUAN	PURTE	00908
DELCO CLAY TILE CO, INC	600 CHANEY ST	LAKE ELSINORE	CA	92330
DIBTEN USA	4301 E. FIRESTONE BLVD	SOUTH GATE	CA	90280
DINATRA/TROELSTRA & DE VRIES	P.O. BOX 1626	MAARSSEN NL-3600-	HOLLA	0
DIVERSITECH GEN. BLDG SYST. DIV	P.O. BOX 875	TOLEDO	OH	43696
DOW CORNING CORPORATION	5755 PEACHTREE-DUNWOODY	ATLANTA	GA	30342
DUNLOP CONSTRUCTION PRODUCTS INC.	2055 FLAVELLE BLVD.	MISSISSAUGA	ONTAR	0
DURATREND INC	2870 W HIGHLAND AVENUE	FONTANA	CA	92336
DURATREND INDUSTRIES	2870 W HIGHLAND AVENUE	FONTANA	CA	92336
DUROLAST ROOFING INC.	525 MORLEY DRIVE	SAGINAW	MI	48601
DYNAMIT NOBEL OF AMERICA INC.	10 LINK DRIVE	ROCKLEIGH	NJ	07647
ECI BUILDING COMPONENTS, INC	P.O. DRAWER C	STAFFORD	TX	77477
EDIL DIST, INC	6504 21ST STREET E	SARASOTA	FL	34243
EDIL USA, INC	P.O. BOX 610905	NORTH MIAMI	FL	33161
ELCOR COMPANY	6750 HILLCREST PLAZA DRIVE	DALLAS	TX	75230
ELK CORP OF AMERICA	6750 HILLCREST PLAZA DR	DALLAS	TX	75230
ENTERPRISE COMPANIES	1191 SOUTH WHEELING RD.	WHEELING	IL	60090
ERACORP	15001 MINNETONKA IND. RD	MINNEAPOLIS	MN	55435
ETERNA ROOF TILE CORP	1201 NORTHWEST 18TH ST	POMPANO BEACH	FL	33060
ETERNIT, INC	VILLAGE CENTER DR	READING	PA	19607
EVANITE PERMAGLAS INC.	P.O. BOX E	CORVALLIS	OR	97339
EVERGREEN SLATE CO. INC.	68 POTTER AVENUE	GRANVILLE	NY	12832
EXTERIOR BUILDING PRODUCTS	P.O. BOX 800	EUFAULA	AL	36027
FABRAL	3449 HEMPLAND RD	LANCASTER	PA	17601

COMPOSITE LISTING OF
ROOFING MANUFACTURERS

COMPANY NAME	ADDRESS	CITY	STATE	ZIP
FASHION, INC	15450 W 108TH STREET	LENEXA	KS	66219
FIRESTONE BUILDING PRODUCTS	3500 W. DEPAUW BLVD.	INDIANAPOLIS	IN	46268
FLEX-SHIELD CORP.	636 W. COMMERCE	GILBERT	AZ	85234
FOLLANSBEE STEEL CORP	STATE STREET	FOLLAMSBEE	WV	26037
FOLLANSBEE STEEL CORP	STATE STREET	FOLLANSBEE	WV	26037
FOREMOST MFG COMPANY	21000 W 8 MILE ROAD	SOUTHFIELD	MI	48075
FUTURA COATINGS INC.	9200 LATTY AVENUE	HAZELWOOD	MO	63042
GACO WESTERN, INC.	P.O. BOX 88698	SEATTLE	WA	98188
GAF CORPORATION	1361 ALPS ROAD	WAYNE	NJ	07470
GAF CORPORATION	1361 ALPS ROAD	WAYNE	NJ	07470
GARLAND CO. INC., THE	3800 E. 91ST STREET	CLEVELAND	OH	44105
GATES ENGINEERING CO INC.	100 SOUTH WEST STREET	WILMINGTON	DE	19801
GEDACO S.P.A.	VIA BUSSE 23	ROVERCHIARA (VERO	ITALY	37050
GENERAL ELECTRIC CO	3156 LEON ROAD	JACKSONVILLE	FL	32216
GENSTAR ROFFING PRODUCTS CO	5525 MAC ARTHUR BLVD	IRVING	TX	75038
GENSTAR ROOFING PROD CO	5525 MACARTHUR BLVD	IRVING	TX	75038
GEOCEL COATING SYSTEMS, INC	P.O. BOX 398	ELKHART	IN	46515
GEORGIA-PACIFIC	133 PEACHTREE STREET N.E.	ATLANTA	GA	30303
GERARD TILE CO. USA INC.	190 NORTH CYPRESS STREET	ORANGE	CA	92666
GERARD TILE SUPEROOFING	955 COLUMBIA ST	BRAY	CA	92621
GLADDING, MCBEAN & CO.	P.O. BOX 97	LINCOLN	CA	95648
GLODBE IND	2638E 126TH STREET	CHICAGO	IL	60633
GOODYEAR TIRE AND RUBBER CO, THE	1144 E. MARKET STREET	AKRON	OH	44316
GORY ASSOC IND, INC	1100 PARK CENTRAL BLVD S	POMPANO BEACH	FL	33064
GRACE AND COMPANY, W. R.	62 WHITMORE AVENUE	CAMBRIDGE	MA	02140
GUAINA CORP OF AMERICA	121 RAILROAD AVE	HACKENSACK	NJ	07602
GUAINA CORP OF AMERICA	P.O. BOX 1205	HACKENSACK	NJ	07602
HAMRE ASSOCIATES	P.O. BOX 489	WHITE ROCK	SC	29177
HH ROBERTSON COMPANY	P.O. BOX 2793	PITTSBURG	PA	15230
HICKMAN ROOFING SYSTEMS	29100 HALL STREET	SOLON	OH	44139
HILLTOP SLATE, INC	P.O. BOX 201, ROUTE 22A	MIDDLE GRANVILLE	NY	12849
HITCHINS AMERICA INC	P.O. BOX 3449	LONGWOOD	FL	32779
HUGHES MANUFACTURING, INC	11910 62ND STREET N	LARGO	FL	33543
HUMES ROOFING TILE, INC	10650 S POPLAR AVE	FONTANA	CA	92335
HYLOAD INC.	1006 MC KNIGHT PARK DR.	PITTSBURG	PA	15237
IDAHO QUARTERZITE/CHINA SLATE	P.O. BOX 1657	BOISE	ID	83701
IKO MFG, INC	HAY RD-EDGEMOOR	WILMINGTON	DE	19809
IMPERITALIA S P A	STRADA LANZO 131	TORINO	ITALY	10148
INLAND BUILDINGS	175 N PATRICK BLVD	BROOKFIELD	WI	53005
INRYCO, INC	P.O. BOX 1168	CULLMAN	AL	35055
INTERN. EPDM RUBBER ROOF SYS. INC	5110 ANGOLA ROAD	TOLEDO	OH	43615
INTERNATIONAL PERMALITE, INC	300 N HAVEN AVENUE	ONTARIO	CA	91761
INTERNATIONAL ROOFING PRODS, INC	4929 WILSHIRE BLVD #750	LOS ANGELES	CA	90010

COMPOSITE LISTING OF
ROOFING MANUFACTURERS

COMPANY NAME	ADDRESS	CITY	STATE	ZIP
J&P PETROLEUM PRODUCTS	P.O. BOX 4206	DALLAS	TX	75208
KELLY ENERGY SYSTEMS INC	P.O. BOX 2583	WATERBURY	CT	06723
KENDALL COMPANY	1 FEDERAL STREET	BOSTON	MA	02101
LEAD INDUSTRIES ASSOCIATION, INC	292 MADISON AVENUE	NEW YORK	NY	10017
LIFETILE CORPORATION	45111 INDUSTRIAL DRIVE	FREMONT	CA	94538
LUCOWICI CELADON COMPANY	4757 TILE PLANT ROAD	NEW LEXINGTON	OH	43764
M.C.A.	1985 SAMPSON AVENUE	CORONA	CA	91720
MALARKEY ROOFING CO	3131 N. COLUMBIA BLVD.	PORTLAND	OR	97217
MANVILLE CORP	7670 OPPORTUNITY RD	SAN DIEGO	CA	92111
MANVILLE ROOFING SYSTEMS DIVISION	P.O. BOX 5108	DENVER	CO	80217
MARLEY ROOF TILES INC	1990 E RIVERVIEW DR	SAN BERNADINO	CA	92408
MASONITE CORP	1 S WACKER DR	CHICAGO	IL	60606
MAXI-TILE INC	15000 STAFF CT	GARDENIA	CA	90247
MCELROY METAL, INC	555 DIVIDEND DRIVE	PEACHTREE CITY	GA	30269
MERCHANT & EVANS CO	100 CONNECTICUT DR	BURLINGTON	NJ	08011
MET-TILE INC.	P.O. BOX 11677	SPOKANE	WA	99211
MET-TILE, INC	P.O. BOX 4268	ONTARIO	CA	91761
METAL BUILDING COMPONENTS, INC	P.O. BOX 38217	HOUSTON	TX	77238
METAL SALES MANUFACTURING CORP	10300 LINN STATION ROAD	LOUISVILLE	KY	40233
METAL SALES MFG CORP	10300 LINN STATION RD	LOUISVILLE	KY	40223
MINERAL FIBER MFG. CORP	P.O. BOX 356	COSHOCTON	OH	43812
MM SYSTEMS	4520 ELMDALE DR	TUCKER	GA	30084
MONIER	P.O. BOX 5567	ORANGE	CA	92666
NORD BITUMI U.S. INC.	966 S. SPRINGFIELD AVE.	SPRINGFIELD	NJ	07081
NORMAN CORP, THE W.F.	P.O. BOX 323	NEVADA	MO	64772
NOVAGLASS USA, LTD	333 N AVENUE	WAKEFIELD	MA	01880
NUCOR BUILDING PRODUCTS	P.O. BOX 1000	ST. JOE	IN	46785
O'BRIEN BROS SLATE CO, INC	57 NORTH STREET	GRANVILLE	NY	12832
OLYMPIC RUBBER ROOFING SYSTEMS	2845A WEST STARK STREET	MILWAUKEE	WI	53209
ORA B HOOPER & SON	102 S. 30 TH STREET	PHOENIX	AZ	85034
ORBITS ROOFING OF FLORIDA, INC	1735 MYRTLE ST	SARASOTA	FL	33580
OVERLY MANUFACTURING CO	574 W OTTERMAN	GREENSBURG	PA	15601
OWENS-CORNING FIBERGLAS CORP	FIBERGLAS TOWER	TOLEDO	OH	43659
OWENS/CORNING FIBERGLAS CORP	FIBERGLAS TOWER	TOLEDO	OH	43659
PALM BEACH CLAY TILE CO	P.O. BOX 10282	RIVERIRA BEACH	FL	33404
PENN BIG BED SLATE CO, INC	P.O. BOX 184	SLATINGTON	PA	18080
PENTAGON PLASTICS, INC	905 NORTH RAILROAD AVE.	WEST PALM BEACH	FL	33401
PERMA-CLAD	4400 AMWILER ROAD	DORAVILLE	GA	30362
PETERSEN ALUMINUM CORP	955 ESTES AVENUE	ELK GROVE	IL	60007
PHILLIPS FIBERS CORP	P.O. BOX 66	GREENVILLE	SC	29602
PLANNJA INTERNATIONAL	1450 ENERGY PARK DR-63	ST PAUL	MN	55108
POLYMER PLASTICS CORP.	65 DAVIDS DRIVE	HAUPPAUGE	NY	11788
POLYSEAL	9411 WALLISVILLE ROAD	HOUSTON	TX	77013
PROOF TILE INC	4125 GOLDEN STATE BLVD	FRESNO	CA	93725
PROTECTIVE COATINGS INC	1602 BIRCHWOOD AVENUE	FORT WAYNE	IN	46803

COMPOSITE LISTING OF
ROOFING MANUFACTURERS

COMPANY NAME	ADDRESS	CITY	STATE	ZIP
REAL SLATE CO	P.O. BOX 1359	LA JOLLA	CA	92038
REPUBLIC POWDERED METALS	2628 PEARL ROAD	MEDINA	OH	44256
REYNOLDS ALUMINUM	ARCHITECTURAL PRODUCTS	ATLANTA	GA	30080
REYNOLDS METALS CO	REYNOLDS RD	ASHEVILLE	OH	43103
RHOFLEX ROOF. SYSTEM, TELTEX INC	COMMERCE DRIVE	N. BRANFORD	CT	06471
RIB-ROOF INDUSTRIES	5775 LOCUST AVENUE	RIALTO	CA	92376
RISING & NELSON SLATE CO	ROUTE 153	WEST PAWLET	VT	05775
RO-TILE MFG CO	310 N CLUFF AVE	LODI	CA	95240
ROBERTSON	400 HOLIDAY DRIVE	PITTSBURGH	PA	15220
ROOF SYSTEMS, INC	10551 SATELLITE BLVD	ORLANDO	FL	32809
ROOFING PRODUCTS INTERNATIONAL	R.R. NO. 1 HIGHWAY 6	WAWAKA	IN	46794
ROYAL OIL CO	P.O. BOX 646	FORT WORTH	TX	76101
RTS COMPANY	7670 OPPORTUNITY ROAD	SAN DIEGO	CA	92111
RUBBER & PLASTICS COMPOUND INC	3615 23RD STREET	LONG ISLAND CITY	NY	11106
SAM BUILDING PRODUCTS, INC	P.O. BOX 94	LIBERTY CORNER	NJ	07938
SAN VALLE TILE KILNS, INC	1849 SAWTELLE BLVD #610	LOS ANGELES	CA	90025
SARNAFIL INC	P.O. BOX 380	CANTON	MA	02021
SEAL-DRY/USA INC	486 S. OPDYKE RD	PONTIAC	MI	48507
SEAMAN CORPORATION	2170 WHITFIELD AVENUE	SARASOTA	FL	34243
SHAKERTOWN CORP	1200 KERRON ST	WINLOCK	WA	98596
SHELTERED PROPERTIES, INC	6504 21ST STREET EAST	SARASOTA	FL	34243
SHELTERED PROPERTIES, INC	6504 21ST STREET EAST	SARASOTA	FL	34243
SIPLAST INC	HWY. 67 SOUTH	ARKADELPHIA	AR	71923
SOPREMA ROOF. & WATERPROOFING INC	487 ARMOUR CIRCLE N.E.	ATLANTA	GA	30324
SOUTHWESTERN PETROLEUM CO	534 NORTH MAIN STREET	FT. WORTH	TX	76101
SPECTILE	2990 PORTLAND RD NE	SALEM	OR	97303
STACO ROOF TILE	3530 EAST ELWOOD	PHOENIX	AZ	85040
STAR MFG COMPANY	P.O. BOX 94910	OKLAHOMA CITY	OK	73143
STEELITE, INC	1010 OHIO RIVER BLVD	PITTSBURGH	PA	15202
STEVENS & CO INC, J.P.	395 PLEASANT STREET	NORTHAMPTON	MA	01061
SUMMIT BUILDINGS	19775 SOMMER DR	WAUKESHA	WI	53186
SUNCRETE ROOFTILE	P.O. BOX 518	THOUSAND PALMS	CA	92276
SUPRADUR MANUFACTURING CORP	P.O. BOX 908	RYE	NY	10580
SYENERGY METHODS INC	1367 ELMWOOD AVENUE	CRANSTON	RI	02910
TAMKO	220 WEST 4TH STREET	JOPLIN	MO	64802
TAMKO ASPHALT PROD	220 W 4TH	JOPLIN	MO	64801
TARMAC ROOFING SYSTEMS, INC	1401 SILVERSIDE ROAD	WILMINGTON	DE	19810
TECHNICAL COATINGS, INC	P.O. BOX 296	CANTON	MA	02021
TECHNICOTE CORP	P.O. BOX 7262	MEMPHIS	TN	38107
TELTEX, INC	COMMERCE DRIVE	NORTH BRANDFORD	CT	06471
TEXAS REFINERY CORP	1 REFINERY PLACE	FT. WORTH	TX	76101
THREE "E" CORPORATION	525 PLUM AVENUE	MEMPHIS	TN	38107
THREE E CORPORATION	850 GLEN AVENUE	MOORESTOWN	NJ	08051
TREMCO INC	10701 SHAKER BLVD	CLEVELAND	OH	44104

COMPOSITE LISTING OF
ROOFING MANUFACTURERS

COMPANY NAME	ADDRESS	CITY	STATE	ZIP
TRI-PLY INC	1401 E. LINCOLN	MADISON HEIGHTS	MI	48071
TROPICAL INDUSTRIAL COATINGS INC	P.O. BOX 444	BRUNSWICK	OH	44212
TRU-FAB MANUFACTURING	5819 CHIPPEWA	HOUSTON	TX	77086
TUFF-CON PHOENIX	3837 EAST MIAMI AVENUE	PHOENIX	AZ	85040
U.S. INTEC INC/BRAI	P.O. BOX 2845	PORT ARTHUR	TX	77643
UNITED STATES TILE CO	215 E COMMONWEALTH	FULLERTON	CA	92632
UNITED STEEL DECK, INC	14 HARMICH ROAD	S. PLAINFIELD	NJ	07081
VANDE HEY-RALEIGH MFG, INC	1665 BOHM DR	LITTLE CHUTE	WI	54140
VARCO-PRUDEN BUILDINGS	6000 POPLAR	MEMPHIS	TN	38119
VERMONT STRUCTURAL SLATE CO, INC	3 PROSPECT ST	FAIR HAVEN	VT	05743
VILLAS ROOFING SYSTEMS INC	FRONT & LLOYD STREET	CHESTER	PA	19013
VIN-LOX CORPORATION	930 N.W. 13TH AVENUE	FT. LAUDERDALE	FL	33311
VINCENT METALS	P.O. BOX 360	MINNEAPOLIS	MN	55440
WAT-PRO INC	P.O. BOX 400	KIMBERTON	PA	19442
WEATHERGARD ROOFING SYSTEMS INC	P.O. BOX 11187	MEMPHIS	TN	38111
WESCO CEDAR INC.	P.O. BOX 2566	EUGENE	OR	97402
WESTILE, INC	8311 W CARDER CT	LITTLETON	CO	80125
WHIRLWIND BLDG SYSTEMS	8234 HANSEN ROAD	HOUSTON	TX	77075
WP HICKMAN CONST PRODUCTS	P.O. BOX 15005	ASHEVILLE	NC	28739
ZAPPONE MANUFACTURING	N 2928 PITTSBURG	SPOKANE	WA	99207
ZAPPONE MFG	2928 N PITTSBURG	SPOKANE	WA	92207
ZIP-RIB INC.	P.O. BOX F	BURLINGTON	NJ	08011

APPENDIX C

PROPOSED DUTIES AND RESPONSIBILITIES OF THE COUNTY SCHOOLS ROOFING COORDINATOR

PROPOSED DUTIES
AND
RESPONSIBILITIES OF THE COUNTY
SCHOOLS ROOFING COORDINATOR

A roofing coordinator is responsible for the entire roof system on public school buildings from new construction to overseeing roof repair/replacement past the warranty period.

Primary duties include conducting scheduled visual roof inspections to determine existing conditions of the roof systems and overall performance. Results are recorded and records are maintained throughout the life of each building's roof. The coordinator managesand coordinates roof investigations conducted by roof consultants which usually result from the inspection process.

This position is also responsible for developing an annual reroofing budget based on the roof inspections and current market replacement value. The employee then administers any reroofing projects from the design through construction phase. Once the roof is accepted, all roof warranty repairs will be administered to ensure adequate compliance by the manufacturer/contractor. If buildings require additions to the initial structure, the roofing coordinator will also be responsible for reviewing the new construction plans and specifications. Once the construction is completed, he will conduct the initial roof inspection and subsequent scheduled inspections.

Once the warranty period expires, the roofing technician is expected to conduct training seminars on roof systems involving the Maintenance Department personnel who will perform the actual roof repairs.

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MIAMI DADE COMMUNITY COLLEGE
Building Construction Technology
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