SOLAR GUARD COATINGS

ACRYLIC ROOF COATINGS: A VALUABLE TOOL FOR SUSTAINABLE ROOFING

A reprint of a technical paper by William Kirn,
Technical Consultant–Building Products,
Rohm and Haas Company
Presented at the Roof Consultants Institute
12th International Convention and Trade Show
March 25, 1997
Anaheim, CA

INTRODUCTION

Roofs are expensive. They are expensive to repair and maintain and they are **very** expensive to replace. Leaking roofs account for additional untold dollars of damaged internal property, inventory, lost occupancy, business interruption, increased heating and air conditioning costs, and all too often, litigation. Many of these expenses can be avoided if roofs are treated as construction assets requiring the same maintenance as elevators, heaters, air conditioners and other mechanical equipment. All of these other assets require routine maintenance. Minor repairs can be made which will prevent or greatly reduce the possibility of major or catastrophic breakdown of the equipment (roof).

Life cycle analyses have become valuable tools to the construction industry as a better method of measuring the value of a product over its service life. They have been used recently by roofing material manufacturers to position more costly but higher valued materials over lower cost analogs.[1,2,3,4] The mechanism for life cycle cost analysis is rather simple; merely compute the long term cost of several different products. The numbers include the initial cost as well as associated maintenance and routine costs for upkeep. The numbers are then normalized to their net present value (NPV or PV) to eliminate inflationary and investment effects. The Discount Rate or Factor, helps to compare different options where the costs and benefits occurring at different times can be evaluated at a common time. This number is actually the rate of interest reflecting the investor's (building owner's) time value of money. The discount rate should reflect the rate of interest that makes the investor indifferent between paying or receiving a dollar now or at some future point in time.

LIFE CYCLE COST ANALYSES COMPARING TWO ROOF MAINTENANCE SCENARIOS

The technique for conducting a life cycle cost analysis has become formalized through the use of an ASTM method E-917, *Standard Practice for Measuring Life-Cycle Costs of Buildings and Building Systems.*[5] This mathematical model enables the user to evaluate the life cycle cost of a building (roof) and compare it to alternative designs or practices that satisfy the same functional requirements. Other ASTM methods have been developed to determine the rate of return and pay back for investments and net benefits for investments in buildings.

The objective of this study is to compare two scenarios for roof maintenance and management ranging from no inspection or maintenance to a very comprehensive roof asset management program. The building is an industrial research laboratory located in Spring House, PA, a suburb of Philadelphia, at the Rohm and Haas Research Center. The roof is a 37,000 ft^2 smooth, asphalt surfaced three ply organic felt built-up roof and its size has been rounded off to 100,000 ft^2 for computational ease. The roof history is actually Scenario #2, while Scenario #1 represents a similarly roofed building located nearby whose conditions and history were monitored. However, this building is not an exact replica of the Scenario #2 building due to differences in occupancy, roof exposure and use. The study period is 20 years. The discount rate is 10% and the escalation rate is 0%. (This is the factor that will influence the increased rise in certain factors such as energy.) The two scenarios consider a number of complex factors including the use of visual and non-destructive moisture surveys, the cost of repairing leaks, interior damage to walls and ceiling tiles, wasted heating and cooling energy caused by wet roof insulation, and saved energy through the use of reflective roof coatings.

This scenario assumes no formalized roof management or maintenance program. Repairs are made only when the roof leaks. No efforts are made to maintain the roof, and the roof will be replaced at the end of 10 years. The initial cost is $3/ft^2 or $300,000 and the replacement cost is $5/ft^2 or $500,000. We assume total removal of the wet insulation and some deteriorated decking and nailers. No inspections are made of the roof and leaks are repaired by a roofing contractor at $750 each. We assume no leaks in the first two years (contractor's warranty in effect). From year 3-7 assume one leak/repair per year, two leaks in year 8, three in year 9 and four in year 10.

As the roof develops leaks, wet insulation will reduce the "R" value of the insulation. Each year 25 ft^2 of insulation becomes wet due to damage to the roof. Wet insulation costs $1.88/ ft^2 in wasted energy. A detailed economic analysis used to derive this datum is presented in the Appendix. Interior damage as wet ceiling tile and stained and damaged walls will cost $500 in repair. This will be incurred in years 5, 8, 11, 15 and 18.

This is a comprehensive roof maintenance program. A formalized roof asset management program is established costing $1,000/year. Visual inspections are made semi-annually and after severe storms. Non-destructive moisture surveys are made every five years at a cost of $500 each. In year 10, the roof is coated with a white elastomeric 100% acrylic roof coating costing $0.75/ft^2 or $75,000 as a capital cost. The white roof reduces the air conditioning load, but increases the heating load, (black roofs are warmer in the winter) but still saves the building $8,070 the first year. Dirt build up on the white coated roof reduces the savings to 80% or $6,460/year. This documentation is based on an Oak Ridge National Laboratory Report entitled "Guide to Estimating Differences in Building Heating and Cooling Energy Due to Change in Solar Reflectance of a Low Slope Roof"[6] and has also been confirmed experimentally (USM study).[7] The 20% reduction in reflectivity of white roof coatings due to dirt pickup has been observed experimentally in this study and has also been demonstrated in studies conducted by Lawrence Berkeley Laboratory.[8] No interior repairs are necessary.

CONCLUSIONS

The data clearly demonstrates the economic value of a proactive roof maintenance strategy. The last line item "Cost Savings over Scenario #1" should easily convince the building owner or facility manager of the value of regular professional roof inspections and the use of maintenance coatings as the economically preferred alternative to tearing off and reroofing every 10 years.

While the use of a reflective roof coating in the study only provided an energy savings of $0.14/ft^2/yr. the reader is reminded that this study was conducted in the Philadelphia, PA area. Actual energy studies as well as mathematical modeling have shown significant energy cost saving benefits in the "sun belt" areas of the country. It is not uncommon to amortize the cost of the coating in less than 5 years solely through reduced air conditioning energy use.[7]

With proper maintenance and coating, a low slope roof can last significantly longer than its predicted life. This will reduce the life cycle cost of the roof and reduce demand for dwindling natural raw materials, precious energy resources and shrinking landfill space. Acrylic coatings can truly make "Sustainable Roofing" a reality.