Cool Roof Restoration

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ABSTRACT

Everyone involved in roofing has witnessed the advent and explosive growth of "Cool Roofing " The importance of reflectivity has been emphasized and highlighted by the ENERGY STAR® program for roof products Reflectivity and emissivity have been hailed as the cornerstones of the Cool Roof Rating Council (CRRC) Numerous government bodies -- both states and cities -- and even public utilities are offering rebates and incentives for roofing projects utilizing "Cool Products "

As the cost to generate and distribute electricity has risen, the demand for heating oil has exceeded availability, and both the general public and the roofing industry have become educated on the heat island effect, the benefits of the cool roof and saving energy have received widespread and growing support

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Brief Cool Roof Summary

Roofs with high reflectivity and emissivity have been labeled cool roofs Reflectivity is a measure of the ability of a surface to reflect the visible and infrared portions of the UV spectrum and emissivity is the ability of the material to radiate heat The combination of these two properties creates the cool roof The general effect of a cool roof product on roof surface temperature can be seen in *Figure 1* The Figure shows that the temperature of the black EPDM was reduced by 60 degrees F with the application of the white coating

The benefits of a cool roof include reduced energy consumption, increased comfort in non-conditioned buildings, prolonged life of the roof, and improved air quality (reduction of the heat island effect)

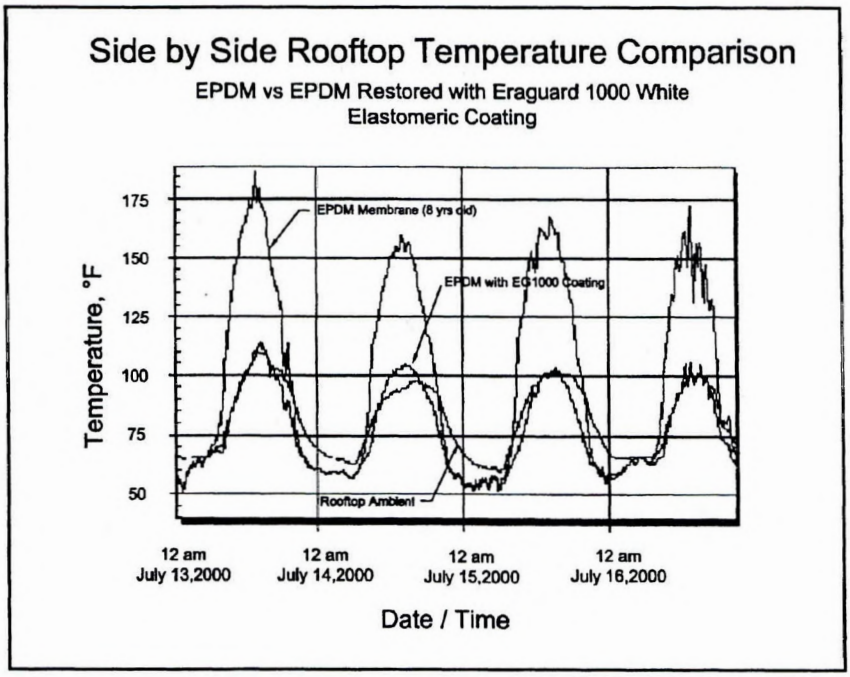

Figure 1

Cool Roofing and Restoration

Cool roofing can be incorporated into most roof system restorations The process of restoration, as defined by Webster, is to bring back to an original state To achieve the original state, a roof restoration must address several variables, each controlled by the type and the condition of the roof system being restored Some examples of the variables would be condition of seams on a single ply membrane or cap sheet, type of existing coating on a foam roof, amount of rust on a metal roof, and so on Current technology in primers and preparation allow most existing roof systems to be restored Technology has also allowed the combination of different systems used in restoration The best properties of several systems can be combined, thereby compensating for the limitations of each individually [1]

Energy Bill Analysis / Energy Audits

Energy audits can be combined with energy bill analysis to provide insight into the potential savings of a cool roof The basic energy calculators common in the industry have been criticized as being too conservative If the analysis predicts a lower savings than actual, it is labeled as "wrong " It is important to note that any analysis that relies on average temperatures and mother nature cannot be exact The basic energy calculators, however, do an excellent job of demonstrating the savings trend that can be expected through cool roofing One of the best uses of energy calculators is to compare the energy savings of different roof systems This may be as simple as comparing a white versus a black coating, or a more involved analysis evaluating the diminishing rate of return for additional insulation (increased R Value – See *Figure 2*) In either case, analysis is an invaluable tool for demonstrating the potential energy savings through cool roofing

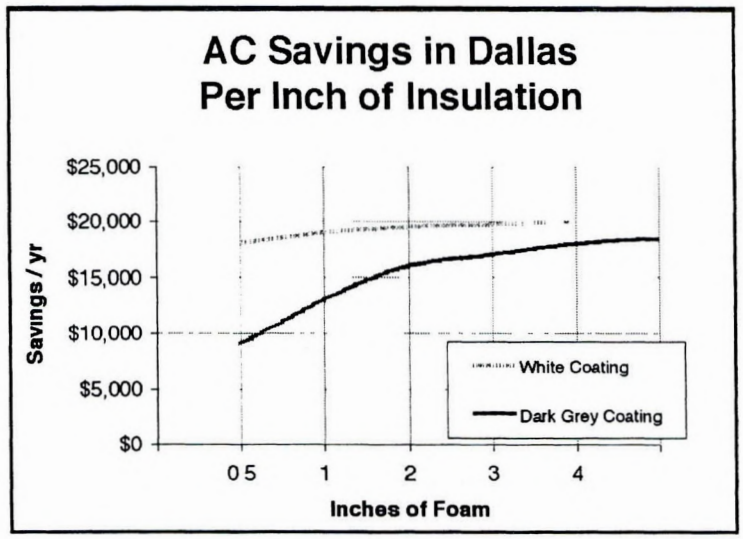

Figure 2

Most commercial/industrial energy bills are broken into several charges, they are distribution, transmission, and generation charges These charges depend on the rate schedule that is chosen, the amount of power used, and when the power is used The charges will also be split into usage and demand portions Usage is the kWh consumed and demand is the instantaneous kW required[2], usually measured over a 15 or 30 minute period Each utility has a number of rate schedules available for a customer to choose from A cool roof can lower both the amount of power used (kWh) and the demand peaks (kW) A detailed energy bill example can be found in Reference 3

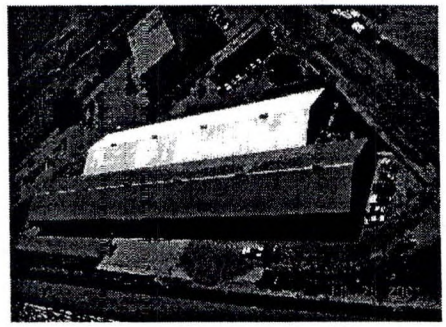

Figure 3

Cool Roofing Results

The first example addresses the benefit to the occupant through increased comfort Most manufacturing companies have large areas of unconditioned space Inexpensive methods (fans, etc) are used to improve employee comfort Lowering interior building temperature has been shown to increase worker productivity and job satisfaction [4] In very hot climates, a 5 degrees F reduction in interior temperature may allow a manufacturer to remain open during the hottest period of the day In an average manufacturing facility, energy costs are typically $1 50 to $2 50 per square foot per year and people costs (labor) are $200 per square foot annually [4] Often, a productivity gain of 1 or 2 percent can decrease the return on investment period by half

The following example is a metal roof restoration system in Colorado *(Figure 3)* The roof was power -washed, primed, all seams and fasteners sealed, and a white elastomeric acrylic coating was applied as the finish coat Temperature data was recorded during the restoration process with remote temperature sensors As shown in *Figures 4* and *5,* the temperature inside the building was decreased by 10 degrees F and the surface temperature was decreased by over 30 degrees F The occupants could feel the difference in interior temperature as the roof was restored

A second example combines both polyurethane foam and coating to increase emissivity, reflectivity, and R Value The project was a fully-conditioned dome located in Louisiana *(Figure 6)* The roof system was composed of metal panels with low emissivity and the profiled construction increased the surface area of the dome by 17% The foam and coating restoration system was a perfect fit for the project

After reviewing the energy bills, it was obvious that there was a very high cost tied to the peak demand of the facility Several energy analyses were performed to attempt to quantify energy savings for the unique structure AC savings resulted in all three analyses with yearly savings between $9,200 and $16,500 Average costs per kWh were

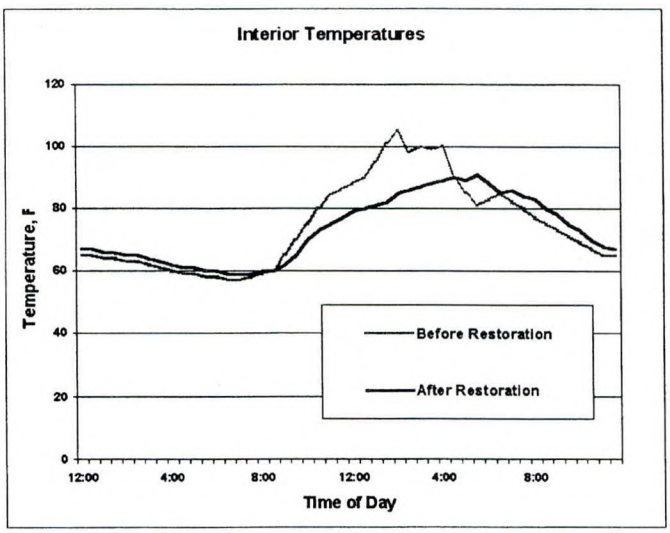

Figure 4

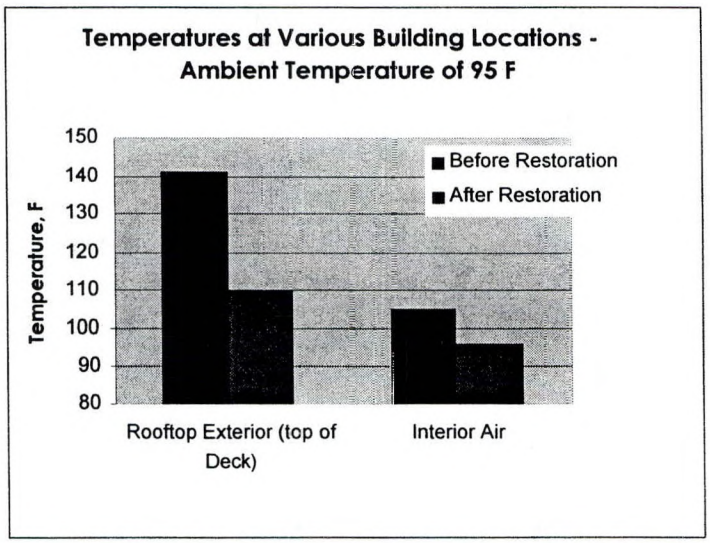

Figure 5

used to estimate both the demand and usage costs

Figures 7 and *8* show the savings for both usage and demand as supplied by SWEPCO (Southwestern Electric Power Company) The month of February was unusually warm in 2001 (as shown in *Figure 7*), which is why the electrical usage was especially high that month

The large drop in demand shown in *Figure 8* came mainly through the reduced usage of one of the two cooling units used for the building Only one unit operated the first five months of 2001 The second unit was first used in June 2001 Savings through the first six months of the year were approximately $7,200 and should be around $15,000 for the year

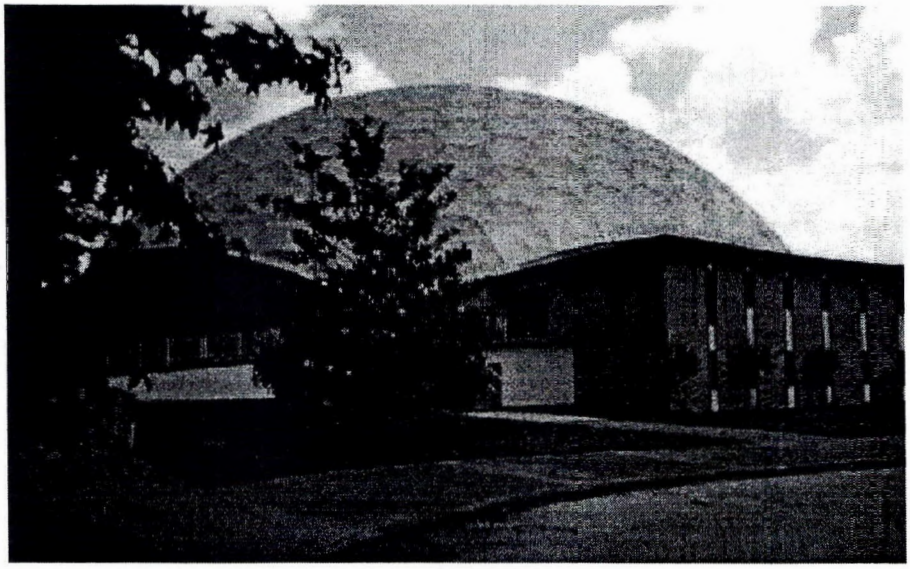

Figure 6

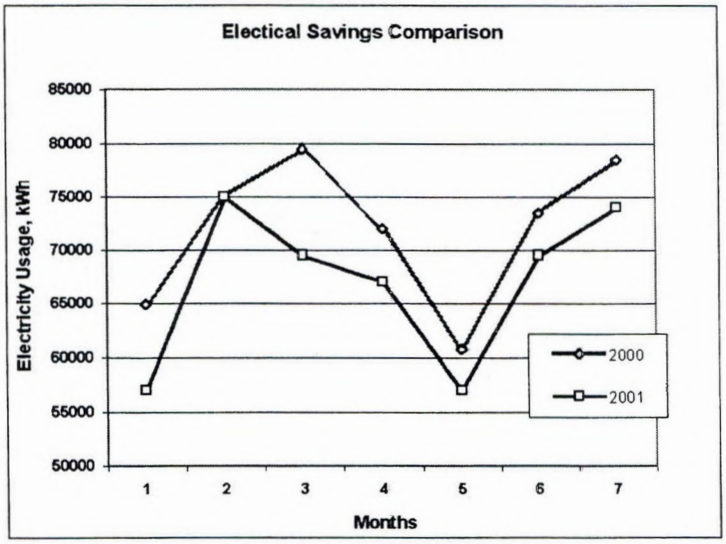

Figure 7

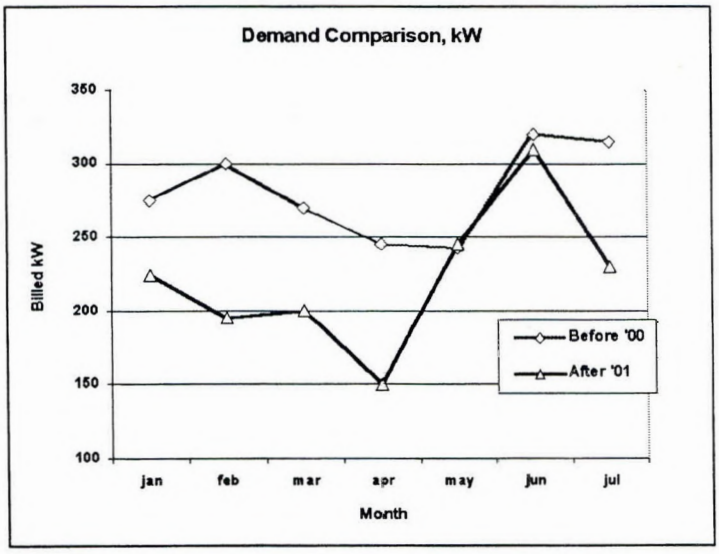

Figure 8

Cool Roofing Incentives

A growing number of utilities, states, and cities are providing incentives for cool roofing The benefits may include dollar rebates or tax incentives Many are calculated on a square foot basis but others are on a case-by-case basis The range can be $0 05 or less, up to $0 40 per square foot A number of programs and contacts are listed below Note that many programs are under development as this paper is being written and this list cannot be complete

- SMUD (Sacramento Municipal Utility District) – rebate program
- California Assembly Bill 970 – rebate program
- LAPWD – rebate program
- Xcel Energy – rebate program
- Florida Power and Light – rebate program
- New Jersey – tax incentive program
- Portland - incentives

There are communities not offering an incentive, but they are requiring cool roofing As the public awareness of heat islands increases, this will become the rule rather than the exception A community list is compiled below

- Chicago
- Sacramento
- Salt Lake City
- Atlanta

Conclusion

Cool roofing is a proven technology where both the environment and the building owner benefit The building owner benefits with lower utility costs, more comfortable and productive employees, and extended longevity of roof systems The environment will benefit with fewer peak generation plants, cleaner air, and more effective use of roofing material resources PLUS – the building owner may qualify for cool roof incentives to make these good roofing decisions Cool roof restoration will continue to grow as legislative and building code bodies recognize its potential and require its application Cool roof restoration will be recognized as the next major energy saving opportunity, along with lighting, windows, and HVAC and it provides the added benefit of reducing the urban heat island

References

1 Leonard, Jim "Integrating Polyurethane Foam with Other Roofing Systems," *Interface,* January 2001, p 5

2 Capehart, Barney, Turner, Wayne, and Kennedy, William, *Guide to Energy Management,* 2000, The Association of Energy Engineers, Atlanta, GA

3 Smith, Thomas, and Gagliano, Drew "Energy and Environmental Conservation," *Interface*, September 2000, p 15

4 Romm, Joseph J , *Cool Companies - How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions*, 1999, Island Press, Washington, DC