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But first... a Quiz

• Where was the first reference to “Cool Roofing” recorded?
Answer

• In the Old Testament:
• “Ahud went to his “Cool Roof Chamber”.”
ASTM E917

• “Standard Practice for Measuring Life-Cycle Costs of Buildings and Building Systems”
• Compares the long term performance of a system over its service life
• All future expenditures are recalculated at present time = Net Present Value
ASTM E917 (con’t)

• 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 also been developed to determine the rate of return and pay back for investments and net benefits for investments in buildings.
The Specific Project

• Three Scenarios
  – 37,000 ft² smooth, three ply glass felt granule surfaced capsheets roof and its size has been rounded off to 100,000 ft² for computational ease.
Scenario #1

- No Formal Roof Management Program
- Initial Cost = $500,000
- Repairs are made only when the roof leaks
- Replacement Cost =$700,000.
- Wet insulation and deteriorated deck are replaced as needed
- No inspection of the roof is made
- Leaks are repaired by the contractor for $750 each
- No leaks in the first 2 years as contractor’s warranty is in place
- One leak in year 3
- Two leaks in Year 8
- Three leaks in year 9 and 4 leaks in year 10
Scenario #1 (con’t)

• As the roof develops leaks, wet insulation will reduce the “R” value of the insulation.
• Typically each year 25 ft² of insulation became wet due to damage to the roof. Wet insulation costs ~$2.88 /ft² in wasted energy.
• The detailed economic analysis used to derive this datum is attached in the appendix. Interior damage as wet ceiling tile and stained and damaged walls has typically cost $1,000 to repair. This was incurred in years 5, 8, 11, 15 and 18 during the study.
Scenario #2

• Modest Maintenance Approach
• Visual Survey made each year
• A non-destructive moisture survey is made after year 15, prior to recovering and damaged areas are repaired rather than just “patched”.
• Initial cost is the same as Scenario #1 =$500,000
• After year 15 the roof is recovered without tear off at $3.25/ft2 or $325,000.
• Formal inspection program is implemented, costing $3,000/year
• Moisture survey at year 15 costs $7,000
• Repairs are made each year from 3-15 and 17-20 costing $750 each
• Interior damage is repaired at years 7 and 16 for $1,000 each.
• Wet insulation causes increases in energy costs of $2.88/ft2/year with a 5’ by 5’ area noted in years 3, 5, 7, 9, 11, 13, 15, 18 and 20.
Scenario #2 (con’t)

• Moisture survey at year 15 costs $7,000
• Repairs are made each year from 3-15 and 17-20 costing $750 each
• Cost is lower here than in Scenerio #1 as the leaks are identified earlier, within the year of their development
• Interior damage is repaired at years 7 and 16 for $1,000 each.
• Wet insulation causes increases in energy costs of $2.88/ft2/year with a 5’ by 5’ area noted in years 3, 5, 7, 9, 11, 13, 15, 18 and 20.
Scenario #3

• Formalized Roof Asset Program $3,000/yr.
• Visual inspection made semi-annually.
• Small problems and “suspect areas” repaired immediately.
• Non-Destructive moisture survey made every 5 years costing $6,000
• Year 10, roof is coated with a white elastomeric 100% acrylic roof coating costing $1.25/ft² or $125,000 as a capital cost.
• White colored roof reduces the air conditioning load
Scenario #3 (con’t)

• Increases heating load as black roofs are warmer in the winter
• Saves the building $8,070 in electricity in year 10
• Dirt buildup on the roof reduces the savings to 80% or $6,460 in years 11-20.
• This documentation is based on an Oak Ridge National Laboratory Report titled, “Guide for Estimating Differences in Heating and Cooling Energy Due to Changes in Solar Reflectance of a Low Slope Roof”
Results

The summary results are derived from the spread sheets attached in the Appendix. Present value (PV) numbers are listed, and are different than actual costs. The summary statistics are listed in the table below:

### Life Cycle Cost Summary

<table>
<thead>
<tr>
<th></th>
<th>Approach #1</th>
<th>Approach #2</th>
<th>Approach #3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Costs (PV)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial Investment</td>
<td>$500,000</td>
<td>$500,000</td>
<td>$500,000</td>
</tr>
<tr>
<td>Roof Replacement</td>
<td>$700,000</td>
<td>$325,000</td>
<td>$0</td>
</tr>
<tr>
<td>Roof Coating</td>
<td>$0</td>
<td>$125,000</td>
<td>$125,000</td>
</tr>
<tr>
<td><strong>Maintenance Costs (PV)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program</td>
<td>$0</td>
<td>$8,505</td>
<td>$8,505</td>
</tr>
<tr>
<td>Visual Survey</td>
<td>$0</td>
<td>$8,505</td>
<td>$17,010</td>
</tr>
<tr>
<td>Moisture Survey</td>
<td>$0</td>
<td>$1,195</td>
<td>$6,970</td>
</tr>
<tr>
<td>RepairingLeaks</td>
<td>$7,142</td>
<td>$7,142</td>
<td>$1,638</td>
</tr>
<tr>
<td>InteriorDamage</td>
<td>$928</td>
<td>$365</td>
<td>$0</td>
</tr>
<tr>
<td>Wasted Energy</td>
<td>$1,486</td>
<td>$891</td>
<td>$0</td>
</tr>
<tr>
<td>Saved Energy</td>
<td>$0</td>
<td>$0</td>
<td>($18,393)</td>
</tr>
<tr>
<td><strong>PV of 20 Year Expenditure</strong></td>
<td>$1,200,000</td>
<td>$825,000</td>
<td>$625,000</td>
</tr>
<tr>
<td><strong>Equivalent Annual Value</strong></td>
<td>$61,426</td>
<td>$46,016</td>
<td>$40,506</td>
</tr>
<tr>
<td>(Cost) UCR</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>i = 10% 20 Years (.1175)</td>
<td></td>
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</tr>
<tr>
<td><strong>Depreciated Annual Value (Cost)</strong></td>
<td>$56,317</td>
<td>$47,212</td>
<td>$35,646</td>
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<tr>
<td><strong>Straight Line 39 Years 40%</strong></td>
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<tr>
<td><strong>Cost Savings over Approach #1</strong></td>
<td>$0.09 $/ft2/year</td>
<td>$0.14 $/ft2/year</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- The data above demonstrates the economic value of a proactive roof maintenance strategy. The last line item “Cost Savings over Approach #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 tear off and reroofing every 10 years.

- While the use of a reflective roof coating in this study only increased the savings by $0.05/ft\(^2\), the reader is reminded that this study was conducted in the Pennsylvania 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 return the cost of the coating in less than 5 years through reduced air conditioning energy use.
Conclusions (con’t)

• Scenario #2 enables the building owner to sustain his original roof for 15 years before requiring reroofing.
• However, after the “recover roof” was no longer serviceable, he would be faced with a costly tear-off of both roofs.
• In Scenario #3, the use of a white reflective roof coating in conjunction with a professionally managed roof asset program would allow the roof to be recoated numerous times before reroofing would be required.
• With proper maintenance and periodic recoating, a low slope roof can last considerably longer than its predicted life. This will reduce the life cycle cost of the roof, reduce demand for dwindling natural resources, precious energy resources and shrinking landfill space. Roof coating manufacturers and consultants working together can truly make “Sustainable Roofing” a reality.
Questions