Appendix 2

TREMCO: New Life Cycle Calculator Compares the Cost of Green Vegetative Roofs with Conventional Roof Systems

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Life Cycle Cost Calculator-Phase 1 published by Green Roofs for Healthy Cities from the 2007 Proceedings from the Greening Rooftops for Sustainable Communities Conference, Awards and Trade Show

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New Life Cycle Calculator Compares the Cost of Green Vegetative Roofs With Conventional Roof Systems

BEACHWOOD, Ohio (April 30, 2007) — A major obstacle to the proliferation of green vegetative roofs has been that organizations have no effective way to compare the life cycle cost of green roofs with conventional roofs. Professionals concerned with or responsible for sustainability, such as architects, designers and facility managers, will soon be able to use the Life Cycle Costing (LCC) Calculator. The first phase of the LCC Calculator was unveiled today at the Fifth Annual International Greening Rooftops for Sustainable Cities Conference, held at the Hyatt Regency Minneapolis Hotel.

Many varied benefits can be factored into the investment of a green roof, such as lowering energy costs and having an employee-accessible green roof. As many benefits as possible will be incorporated into the LCC Calculator, with additional benefits to be calculated in future versions. The intent is for the LCC Calculator to expand as specific projects are uploaded into the case study memory.

The LCC Calculator is used to compute roofing alternatives having the same purpose (functional utility) over the same time frame, then compare them to determine which has the lowest life cycle cost for the selected study period. Calculating a roof's life cycle cost is particularly useful in determining whether the higher initial cost of an investment is justified by reductions in future costs such as operating, maintenance, repair or replacement costs. The LCC Calculator also takes into consideration whether some roofs have lower initial costs but higher future costs.

"The LCC Calculator determines the lowest cost investment for satisfying a specific roofing requirement over a specific time frame," said Ralph Velasquez, Sustainable Technologies Manager for Tremco Roofing and Building Maintenance, which is one of the country's largest providers of roofing and building envelope systems and a leader in sustainable roofing technology.

In a combined effort, Green Roofs for Healthy Cities (GRHC), a network consisting of public and private organizations, with funding from Tremco, hired the Athena Institute to build the first phase of the LCC Calculator. Velasquez chairs the GRHC's Life Cycle Costing Subcommittee.

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The Athena Institute undertakes and directs various research and development activities that make it possible to factor environmental considerations into the building design process from the conceptual stage onward.

"The value of the LCC Calculator is that it will allow users to explore both the hard and soft costs associated with green roofs versus conventional roofing systems," said Jamie Meil, co-founder and director of the Athena Institute, "thus enabling organizations to better understand the benefits of green roofs from a more robust life cycle cost perspective.

On April 30 and May 1, 2007, at the Sustainable Communities Conference, which GRHC sponsors, attendees will be able to "play" with the calculator and then provide feedback about their experiences. This feedback will be assessed for potential integration into the calculator's functionality prior to its launch later this spring.

The final Web-based version will be designed to allow the end user to consider the study period, discount rate, general inflation rate, energy price inflation, investment cost data, financing data, residual or resale value, recurring operating and maintenance costs, and replacement costs. It is also capable of capturing other possible roof benefits such as storm water and heat island mitigation, extended roof durability, related energy costs and savings, development fee savings, marketing benefits, increased rentability and tenant health and productivity improvements that can be ascribed to a roofing system.

During the first year of its availability, the LCC Calculator will be accessible exclusively from Tremco at www.tremcoroofing.com and from GRHC at www.greenroofs.net.

"The LCC Calculator is truly groundbreaking in that it is a third-party, unbiased tool that can be used to make fully informed decisions about green roof technology as it applies to specific projects and organizations," said Velasquez.

About Ralph Velasquez and Jaime Meil

Ralph Velasquez has been in the roofing industry since 1978. He has been deeply involved in the green vegetative roofing industry since 2000. He has worked on millions of square feet of roofing and re-roofing projects, as well as a large number of building envelope restoration projects for corporations, educational and institutional entities and governmental agencies across the country. Velasquez is a member of ASTM's Sustainable subcommittees, Green Roofs for Healthy Cities, the U.S. Green Building Council (serving his local chapter as board member and Advocacy Co-Chair) and numerous other related organizations.

Jaime Meil is the prime developer of the Athena Institute's Environmental Impact Estimator software – the only commercially available decision-support tool in North America that facilitates life cycle-based whole building environmental assessment.

About Tremco Incorporated

Headquartered in Beachwood, Ohio, Tremco Incorporated helps manage building life cycles while providing roofing and weatherproofing peace of mind to customers in education, healthcare, government, manufacturing and more. In business since 1928, Tremco and its service organization are ISO 9001:2000 certified. To learn more about Tremco North American Roofing and Building Maintenance, visit the Web site at www.tremcoroofing.com, or call toll-free at 800/562-2728.

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Session 2.2: Stormwater Management and Life Cycle Calculation

LIFE CYCLE COST CALCULATOR – PHASE ONE

Ralph P. Velasquez

Tremco Inc.

Abstract

While many of us have expressed the benefits of green roofs to any and all that would listen over the last several years, the reality is the question often or always, refers back to cost. More fundamentally, the question is why should I spend my money on this course of action, as compared to another course of action? Another way to express this same question is: Can you make the "Business Case" for the utilization of a green roof versus a more conventional roofing approach? Undoubtedly, many of you have either posed the question yourselves or been asked the question by someone else. With this being the proverbial "$64,000" question, the idea of the Life Cycle Cost (LCC) calculator was formulated, a sub-committee formed and the endeavor undertaken.

Sub-committee members and others that were intimately involved included: Steven Peck, Alex Johnston and Flavia Bertram – GRHC, Jamie Meil – Athena Institute, (**www.athenainstitute.com**), Chris Goemans – GreenPath Environmental Design Shop, (**www.gpath.com**), Linda Fischer – Tremco IT Dept., Allen Lee – Quantec LLC, Monica Kuhn – Architect, Glenn MacMillan and Lisa Rocha – Toronto Regional Conservation Authority, Keith Adron – Elevated Landscape Technologies, Leslie Hoffman and Greg Loosvelt – Earth Pledge and myself.

First, what is an LCC calculator? One definition would be " an economic method for evaluating project investment alternatives over a designated study period". It entails computing the LCC for all alternative projects having the same purpose (functional utility) over the same time frame and then comparing them to determine which has the lowest LCC for the selected study period. LCC as a method is particularly suited to determining whether the higher initial cost of an investment is justified by reductions in future costs (e.g., operating, maintenance, repair or replacement expenditures) when compared to an alternative with a lower initial cost but higher future costs. If one alternative has a lower initial *and* lower future costs, an LCC is not needed to determine it is the least capital expense and preferred investment. LCC is about determining the least cost investment for satisfying a specific requirement over a specific time frame.

In a combined effort, GRHC in conjunction with the Athena Institute, with the first phase funded by Tremco Inc., undertook to build this model. The prevailing thought at the outset is to build this

model in two or more phases. The initial "beta version" will be designed to be web-based, have a user guide and tutorial available for the end user. A focus group interface at this conference will provide additional input that will help shape the tool, specifically with the web-based interface. Additional feed back from the marketplace once the tool has been made available to the general public will enable the LCC sub-committee to incorporate specific needs of the market into the next phase of the tool that will be developed over the next 1-2 years.

The initial beta version will be designed to allow the end user to consider the study period, discount rate, general inflation rate, energy price inflation, investment cost data, financing data, residual or resale value, recurring operating and maintenance costs, and replacement costs. In addition, numerous other costs, benefits and "soft" values will be calculated, with some having a "slot" or placeholder for future incorporation into the model. As many slots as can be incorporated into the beta version will be included, given time schedules, data availability and financing constraints. The beta tool will be based on case studies from various regions in the U.S. and Canada. Input for the tool was derived from information already collected by GRHC, the Athena Institute in their other LCC development work, and from other various members of the GRHC association. Members were asked to provide data and their experience with the construction of green roofs, in order to more fully support the underlying basis for the calculator.

This tool will be groundbreaking in it's ability to give owners and their representatives, a third party, unbiased tool, to make more fully informed decisions regarding green roof technology, as it applies to their project and organization. As the first attempt to create such a tool, it is understood the tool is not in its desired final creation but it will serve as the first step in the process of making the selection of a vegetative roof a more financially driven exercise. It is the hope of the sub-committee and GRHC that the tool will continue to grow and be enhanced by the experiences of the market place, thereby creating a more finely tuned tool. This in turn will help grow the market for vegetative roofs, demonstrate the business case for the selection of this approach on this most crucial element of the building envelope and in effect positively impact our cities' environments in an economic, environmental and socially prudent manner.

LCC Project Development Historical Context

The first determination in preparing the calculator was to identify the various private and public benefits that potentially could be included in the tool. Our understanding was that the state of the industry would likely require it being broken into two or more phases. Phase one would identify the existing data that was most easily quantifiable, as well as obtainable, constrained by our time element, in the market place, and incorporate this information into the calculator. We anticipated there would be information that was either not readily available or would need further research in order to provide more detail for the end user of the tool. Therefore, a phase two is envisioned that would take one to two years or longer, to fund, conduct research, obtain results and infuse this data into the calculator. With this in mind we determined it would be critical for "slots" to be built into the calculator that might initially be empty or have minimal usability for the end user in phase one but that could be filled out in the future, as the work was completed. Further, we wanted data infusion from the market that would help the sub-committee in refining the calculator.

The components of the LCC tool are the web-based calculator, workbook/spreadsheets to make the calculations to be entered into the tool, a user guide and a tutorial. This phase one tool is available free of charge, only on the GRHC and Tremco Websites and through the 2007 Green Roofs Conference. The worksheets will be able to be downloaded on the user's computer to be worked on, as they desire. Once the worksheets have been completed, then the data will be uploaded to the calculator, which will be housed online. The executive summary sheet will display the results, comparing the defined three scenarios.

To begin the process, the Athena Institute provided an initial base model for discussion and input from the sub-committee members. A weekly conference call was established so that ongoing dialog could provide the necessary interchange of ideas to refine the calculator in a very short time frame. The first official conference call occurred on Monday, February 12, 2007, to discuss the benefits to be included in the calculator. The initial identified benefits were expanded to include all benefits that would extend both to the end user and the broader community. For phase one, the calculator will only tabulate some of the end user benefits and none of the broader community benefits, even if they in turn provided a benefit back to the end user. The sub-committee felt that while these benefits were real and should be added, time did not allow us to include this in phase one.

The original categories were listed as:

Storm Water Management

Quantity
Quality
Down stream erosion control
reduced municipal infrastructure requirements
reduced water treatment
reduced overflow into water bodies

Energy Savings

Heating load
Cooling load
Peak demand reductions
reduced air emissions
Equip't downsizing
Building integration (e.g., PV oper. temp.

Heat Island Effect Mitigation

energy savings
peak demand reduction

Improved Air Quality

pollution abatement
population health effects

Improved Aesthetics / Livability

Improved building marketability
Increased commercial space rentability
reduced fire insurance
reduced EM fields
Improved health
Improved worker productivity

Waste Diversion

less waste going to landfill

Job Creation

increased demand for labor

After some discussion, the second draft appeared as:

1. Storm Water Management

Quantity reduction	society/owner
Offsetting potable water use through irrigation reuse	owner
Quality of run-off, e.g., reduced downstream treatment	society
Down stream erosion control	society
reduced municipal infrastructure requirements	society
reduced combined sewer overflow into water bodies	society
roof storage vs. other sw storage or mngt methods	owner

2. Energy Savings

Heating load	owner
Cooling load	owner
Peak demand reductions	society/owner
HVAC Equip't downsizing	owner
Building integration e.g., PV oper. temp.	owner

3. Roof Durability / Maintenance

extended roof life	owner
reduced annual maintenance	owner
less waste going to landfill	society

4. Heat Island Effect Mitigation

energy savings	society
peak demand reduction	society

5. Improved Air Quality

pollution abatement	society
population health effects	society

6. Improved Aesthetics / Livability

Improved building marketability	owner
Increased commercial space salability/rentability	owner
public relations benefit	owner
other income sources	owner
noise abatement	owner
reduced EM fields	society

7. Development fees

land purchase cost avoidance	owner
density bonus	owner
Improved site acquisition capability of sensitive sites	owner
permitting savings	owner

8. Improved worker productivity / health

Improved worker health, less absenteeism/ admin costs	owner
Improved worker productivity	owner

The final form at the time of printing is:

Impact Category	Impact Sub-Category	Applicable to society or owner
1. Storm Water Management		
	Quantity reduction	society/owner
	Offsetting potable water use through irrigation reuse	owner
	Quality of run-off, e.g., reduced downstream treatment	society
	Down stream erosion control	society
	reduced municpal infrastructure requirements	society
	reduced combined sewer overflow into waterbodies	society
	roof storage vs. other onsite sw storage or mngt methods	owner
2. Energy Savings		
	Heating load	owner
	Cooling load	owner
	Peak demand reductions	owner/society
	HVAC Equip't downsizing	owner
	Building integration e.g., PV oper. temp.	owner
3. Roof Durability / Maintenance		
	extended roof life	owner
	reduced annual maintenance	owner
	less waste going to landfill	owner/society
4. Heat Island Effect Mitigation		
	energy savings	society
	peak demand reductions	society
5. Improved Air Quality		
	pollution abatement	society
	population health effects	society
6. Improved Aesthetics / Livability		
	Improved building marketability	owner
	Increased commercial space salability/rentability	owner
	public relations benefit	owner
	other income sources	owner
	noise abatement	owner
	reduced EM fields	society
7. Development fees		
	land purchase cost avoidance	owner
	density bonus	owner
	Improved site acquisition capability of senstive sites	owner
	permitting savings due to fast-tracking	owner
8. Improved worker productivity / health		
	Improved worker health, less absenteeism/ admin costs	owner
	Improved worker productivity	owner

A second decision had to be made as to what; we were comparing our vegetative roof to. Since the decision is usually made versus a conventional roof assembly, the committee chose two roof systems; a BUR/MB configuration and a single ply assembly, as the basis of comparison, as these are the most common types of conventional roof assemblies installed in the marketplace today. The executive summary sheet will compare these two scenarios against the green roof.

Once the benefits were identified and the comparisons established, then two key components were on the docket next, the designing of the web tool interface and the case study information. The web interface proved to be far more difficult than first imagined for a bunch of roofing and plant people. We quickly had to bring in the IT people from Tremco and the Athena Institute partner, GreenPath Environmental Design Shop to assist the process. Over the next month, numerous phone calls, emails and our weekly conference calls were dominated by the volume of technical and interface issues related to how the tool would function not only now during the "beta" phase, but also into the future. User and business requirements, data management and security issues, as well as overall workability had to be considered. GRHC even had to change some of their internal mechanisms in order to facilitate the future growth of the tool. Roughly some 80 separate web related questions had to be answered to get the first phase built. Some 45 days before conference the first web skeleton was built. A final face-to-face meeting at the Tremco Toronto headquarters finalized the web issues and the IT team went to work to build the web tool, which you will see shortly.

As previously mentioned, the case studies and other data used to build the scenarios have numerous sources, however, the true strength of this tool is the living and growing nature of the calculator, based on the submitted worksheets and future research. As the end user completes the worksheets and re-loads them into the calculator, they will have the option to input the data into the content storage brain of the model. That data will be mined quarterly to update the calculator's current categories, infuse more case study examples and build out the slots that may not be functional at the time of this first release. The intent is to make the calculator as user friendly as possible, backed by the most comprehensive data available in North America on a continual live basis.