



## Green Roof Research at Michigan State University

The **mitigation of stormwater runoff** is considered by many to be the primary benefit because of the prevalence of impervious surfaces in urban areas. The rapid runoff from roof surfaces can exacerbate flooding, increase erosion, and may result in raw sewage that is discharged directly into our rivers. The larger amount of runoff also results in a greater quantity of water that must be treated before it is potable.

A major benefit of green roofs is their ability to absorb stormwater and release it slowly over a period of several hours. Green roof systems have been shown to **retain 60-100%** of the stormwater they receive. In addition, green roofs have a **longer life-span** than standard roofs because they are protected from ultraviolet radiation and the extreme fluctuations in temperature that cause roof membranes to deteriorate.

## **Toronto, Canada:** a report by Ryerson University on the benefits of green roof technology

- Same benefits as study from MSU
- “Not all benefits of green roofs can be quantified at this time. Given the quantifiable benefits and the potential benefits that cannot easily be quantified we believe there is a case for public programs to promote green roofs.”

## **Will green roofs ever catch on in the United States like they have in Europe?**

- In Germany, it is estimated 12% of all flat-roofed buildings are covered with vegetation.
- “In the U.S. several barriers to widespread acceptance exist such as a lack of awareness regarding green roofs, potentially higher installation costs, limited quantifiable data pertaining to the benefits they provide, no technical information on how to build them, and a lack of government incentives or tax breaks.”

(Michigan State Univ)



### Green Roof Option A

*(Main roof of new addition)*

- Variety of plant materials including native grasses, plants and sedums.
- 12" engineered growth media on Geo Tex drainage core and root barrier.
- Observation deck, stair and elevator extension to roof height.
- Addition of concrete roof deck and reinforcement of building structure.

**Cost: \$487,352.00**

**Pros:**

- Easy access and observation of green roof.
- Greater diversity of plant material.
- Environmental Improvements.
- Aids in building component durability and energy efficiencies.

**Cons:**

- Increased cost to structure due to additional weight.
- Increased cost for extension of building components.



### Green Roof Option B

*(Main roof of new addition)*

- 4" engineered growth media in high density polyethylene knit fabric planted with drought resistant perennials.
- Observation deck, stair and elevation extension to roof height.
- Roof deck and building structure reinforcement.

**Cost: \$302,287.00**

**Pros:**

- Easy access and observation of green roof.
- Environmental improvements.
- Aids in building component durability and energy efficiencies.

**Cons:**

- Increased cost to structure due to additional weight.
- Increased cost for extension of building components.





### **Green Roof Option C**

*(Main roof of new addition)*

- 4” engineered growth media in high density polyethylene knit fabric planted with drought resistant perennials.
- No observation.
- Minimal structural modifications.

***Pros:***

- Environmental improvements.
- Aids in building component durability and energy efficiencies.

**Cost: \$123,489.00**

***Cons:***

- No access or observation.
- Limited plant material.
- Increased Structural Cost.



### **Green Roof Option D**

*(Low roof over lobby of Boone Building)*

- 4” engineered growth media in high density polyethylene knit fabric planted with drought resistant perennials.
- Observation from street and upper floors of Boone Building
- Minimal structural modifications.

***Pros:***

- Environmental improvements.
- Aids in building component durability and energy efficiencies.
- Daily employee and visitor observation.

**Cost: \$ 48,205.00**

***Cons.***

- Limited plant material.
- Structural modifications and cost unknown at this time.



### Solar Roof Option A

#### Roof Mounted Solar Electric (Photovoltaic) System

Using both roof areas for an 80 KW system would provide approximately 112,000 Kilowatt Hours per year, or 5% of the building's annual energy usage

**Pros:** - system should provide its rated amount of energy, with little maintenance, for a period of at least 25 years.

- an 80 KW solar array would be the largest such installation in the state of Missouri.
- panels will keep the intense sun's rays from striking the roof membrane removing a heat load from the building and extending the life of the membrane.
- system could be phased in gradually by installing mounts into the roof system with panels at a later time.
- an additional 1 or 2 LEED points

**Cons:** At a cost of \$0.32 per kWh, electricity from the solar source would be about three times more expensive than current electric rates.



**Cost: \$480,000 – \$800,000**

(\$6 - \$10 per watt )



### Solar Roof Option B

#### Solar Water Heater

This system could be installed in an area of approximately 75 square feet and would supply the building's circulating HW loop losses and the estimated daytime hot water loads presented by the building occupants.

System would produce an equivalent of 17,000 KWH per year representing 1% of the estimated energy requirement.



**Cost: \$25,000.00**

representing a simple life cycle cost of \$.06 per KWH over a 25-year life span



### White Roof Membrane



A highly reflective roofing system would save the building approximately 10,000 KWH per year in air conditioning requirements, resulting in a .5% decrease in energy usage

Many energy efficient roofing systems may be warranted for 30 years lasting nearly twice as long as the standard roofing system

**Cost: \$80,000 - \$90,000**

