A Green Roof; Asset or Nightmare?

18 September 2017 2:00 PM - 3:00 PM





Speakers



Thomas J. Parr Jr., AIA

- Associate Principal at Ballinger
- 26+ Years of Design Experience
- Project Manager for large and varied healthcare projects.



David J. Major, P.E., CHC, CHFM

- Director of Facilities and Construction Management at Reading Health System
- Professional Engineer, Certified Healthcare Facilities Manager, and Certified Healthcare Constructor



Charles D. Miller, P.E.

- President at Roofmeadow
- 25+ Years Engineering Experience
- Specializes in the design and engineering of green roofs.



Robert P. Goss Jr., AIA

- Senior Associate at Ballinger
- 30+ Years Architecture Experience
- 22+ Years Healthcare Experience,





Learning Objectives

In this session we will....

- Illustrate the experiential impacts of a green roof
- Establish green roof design process and possibilities
- Explain green roof technical implications to building envelope design
- Identify common requirements of green roof design and documentation







46.45 ACRE CAMPUS

3,239,064 GSF CAMPUS







Campus Plan







Healing Garden









Healing Garden







Healing Garden









Experiential Impacts

"Evidence suggests that windows may reduce symptoms of ICU psychosis, and views of nature may reduce length of stay, negative comments from patients, and requests for pain medication; additionally, sunlight may reduce perceived pain and requests for analgesics." ("The Impact of Daylight and Views on ICU Patients and Staff", Shepley, Gerbi, Watson, & Imgrund, 2009) He showed, using clinical data, that patients with tree views had "shorter postoperative hospital stays, fewer negative evaluative comments from nurses, took fewer moderate-to-strong analgesic doses, and had slightly lower scores for minor postsurgical complications."

Roger Ulrich

"Humans have physiological reactions to natural beauty and diversity, to the shapes and colors of nature, especially to green, and to the motions and sounds of other animals," (taken from a quote by Frederick Law Olmstead, Dramstad, et al, 1996)

By intertwining culture and nature, we can actively design to regenerate human and ecological health (Van der Ryn and Cowan, 1996).

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Design Challenges and Solutions



CHALLENGE: Consolidating Campus Surgical Services

SOLUTION: Covering Operating Room Platform with a Green Park



CHALLENGE: Connectivity with the Rest of the Campus

SOLUTION: East/West Corridor with Public Amenities



CHALLENGE:

Humanizing the Experience of a Large, High-Tech Healthcare Environment SOLUTION:

Access to Nature and Increased Privacy

Concept Sketch









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Museum View



















Prep / Recovery









Who's Idea Was It to Put a Green Roof Above Surgery?

- Selling the Idea to Administration
- Replacement of Existing Healing Garden
- Perception vs Reality





Authorities Having Jurisdiction

- Berks County Conservation District
- Borough of West Reading
- Advocacy Groups
- Insurance Underwriter







Up Front Cost Implications and Budget Development

- Additional Roofing Requirements
- Special Materials
- Increased Structural Implications





Engineering Plan

Assess client's objectives

Develop layouts that conform with the overall facility landscape program

Maximize horizontal continuity

- Drainage
- Structural Integrity
- Design

Reduce or eliminate waterproofing penetrations Provide for worker safety Design for durability

Anticipate site constraints...







Identify Design Constraints

Dead Load Limitations (including localized concentrated loads) Wind Exposure

Vertical Constraints

- Head room for spaces below
- Thresholds
- Curtain walls

Sun Exposure

Irrigation (water supply requirements) Permitting/Insurance requirements

- Stormwater
- Drainage
- Fire and Wind



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Precedents

- Common challenges encountered in green roof design have been worked out in Europe 30 years ago
- A wide range of components and materials are available from American and European manufacturers that are specifically intended for green roof design
- Biomedical is one of the largest and most active markets for creative intensive green roofs in the United States
 - Viewscapes
 - Healing gardens
 - Gathering areas











AMBULATORY GARDEN (CHILDREN'S HOSPITAL OF PHILA.)

Biomedical Projects in the USA





WATERPROOFING SYSTEM

- Appropriate for deck type
- Track record with green roofs
- Flexibility to accommodate novel green roof design features
- Focus on transitions and flashings
- Investigate warranty terms at the beginning of the design process

Do not allow waterproofing selection to Drive the design choices for the green roof.





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GREEN ROOF MEDIA

- Lightweight (ASTM E2397)
- Dual media profiles
- Drainage
- Moisture Management
- Plant requirements









FOAM FILL

- Extruded or expanded polystyrene
- Drainage
- Slope stability derived from 'layer cake' build-up









DRAINAGE ELEMENTS

- Continuous basal horizontal drainage layer
- Vertical drainage through cover, followed by horizontal seepage toward the drains
- All drains can be inspected via access chambers









SELF-BALLASTED ELEMENTS

- Corten[®] Walls and edges
- Masonry Walls
- Tree Stays
- Fall Protection















Permitting and Insurance

Stormwater Management Ordinances

ADA

- Pavement
- Railing
- Inclines
- Egress

Underwriter's Requirements

- FM Global Process
- Wind Resistance
- Fire Resistance
- Drainage

Warranty Compliance

- Maintenance
- Reporting



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Maintenance

- Control foot traffic (during and after construction)
- Maintain irrigation
- Weeding and fertilization
- Timely response to problems
 - Wet spots
 - Weeds
 - Compressed soil
- Reporting and Documentation









Technical Implications

- Definitions and Guidelines
- Structural Considerations
- Codes, Standards and Regulations
- Details Make sure it doesn't leak









Guidelines

THE NRCA VEGETATIVE ROOF SYSTEMS MANUAL

- Technical information for "a roof system with a landscaped surface"
- Includes:
 - Design Considerations
 - Details
 - Installation guidance







Definitions

VEGETATIVE ROOF TYPES

- Extensive (Shallow) 2 6 inches
- Semi-intensive (Moderate Depth) 6 10 inches
- Intensive (Deep) > 10 inches






ROOF MEMBRANE

- Hot-fluid-applied asphalt membrane
- SBS Modified bitumen sheet membrane
- EPDM membrane
- Polyvinyl chloride (PVC) membrane
- TPO membrane









ROOF BARRIERS (IF REQUIRED)









PROTECTION FABRIC









DRAINAGE LAYER









Codes, Standards and Regulations

IBC – 1607.12.3.1 (2015 Edition) Prescribes Loads for Vegetative and Landscaped Roofs

OSHA

• "Green Job Hazards: Green Roofs - Fall Protection"

ANSI

- ANSI/SPRI RP-14 Wind Design Standard for Vegetative Roofing Systems
- ANSI/SPRI VF-1 External Fire Design Standard for Vegetative Roofs

ASTM

• E2396, E2397, E2398, E2399, E2777

FM Global Standards

• Approval Standard #4477 for Vegetative Roof Systems













Structural Considerations: What does it weigh?

IBC Requirements:

- (IBC 2015) 1607.12.3.1
 - Live Load on Unoccupied Roof: 20 psf
 - Live Load on Occupied Roof: 100 psf for roof gardens per Table 1607.1
 - Dead load per ASTM E 2397 "Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems"

Use Engineered Growth Media:

- Extensive growth media saturated weight: 70 80 lb/ft3
- Intensive growth media saturated weight: 60 70 lb/ft3

The originally proposed "solid soil/no insulation" strategy was designed for 300 psf of green roof load, plus 100 psf live load. Over 30,000 sf of meadow, that equated to 12 million pounds, or 180 concrete trucks.

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Structural Considerations

REINFORCEMENT UNDER TREES AND OTHER AREAS > 12 INCHES











EXTENSIVE VEGETATIVE ROOF SYSTEM







EXTENSIVE VEGETATIVE ROOF SYSTEM









INTENSIVE GREEN ROOF PROFILE

INTENSIVE VEGETATIVE ROOF SYSTEM







3" = 1'-0"



INTENSIVE VEGETATIVE ROOF SYSTEM







2

3" = 1'-0"













ROOF DRAIN AT PAVERS

3" = 1'-0"

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DOOR THRESHOLD









PAVERS & STAIRS / RAMPS







4

3" = 1'-0"

Flood Testing / Electric Field Vector Mapping

- Prior to installation of overburden test for leaks
- The testing agency will locate breaches requiring repair by the contractor and will retest
- Low Voltage Electronic Leak Detection requires wetting surface of the membrane, not flooding
- High Voltage Electronic Leak Detection does not require any water







Certifications and Warranty

- What's included in warranty
- Limit of Warranty Over burden depth
- Certification Provided by Green Roof System Contractor and Waterproofing Contractor







LARGE TREE INSTALLATION AND SUPPORT













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RETAINING WALLS



Scale: 1" = 1'-0"

Weathering Steel Retaining Wall - Ballast (Side Elevation) ¹) 11-C-Walls-0001-ReadingHospital





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3" = 1'-0"

HANDRAILS AND LIGHT POLES

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The ATE



Ongoing Maintenance Program

Frequency / Duration Staffing Implications Cost









Impressions

"...patient rooms will have a clear view of the roof, and this provides a little bit of tranquility with the magic of plants"

 Mark McNash, Vice President of Support Services Reading Health System

"The fact that Reading Health System has incorporated a green roof into their new building design is encouraging, and I applaud their demonstration of conservation principles"

- Kimberly Murphy, President of Berks Nature (a nonprofit that advocates for conservation of the environment)
































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