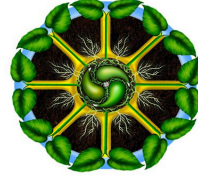


Planning and Maintaining a Living Roof

Living Web Farms

Living Web Farms



September 2018

Presented by Richard Freudenberger



Why a Living Roof?

- Reduce runoff and improve water quality
- Low to no maintenance
- Promotes energy conservation
- Moderates temperature swings
- Aesthetic appeal

- Wildlife and pollinator attractant
- Culinary herb production



- Temper the urban heat island
- Increase longevity of roofing membranes
- Reduce noise and air pollution
- Sequester carbon depending on plant choices
- Supports fire prevention with appropriate plantings

Extensive Roofs

- Designed for low- or no-maintenance use
- Not intended for regular human traffic
- Growing medium depth 2 to 6 inches
- Substrate blended to be lightweight
- Plantings are tended as a whole
- Minimal engineering is possible

Intensive Roofs

- Designed to be visible and accessible

- Planned and planted like a traditional garden
- Soil (substrate) depth 6 to 14 or more inches
- May use lightweight substrates
- Plantings are tended on an individual basis
- Suitable for container gardening
- Structural engineering necessary due to roof loading



Earthwood Building School

• Roof type	Runoff (in)	Runoff (%)
• Standard	26	81
• Standard w/2-in gravel	25	77
• Green w/2-in substrate	16	50
• Green w/4-in substrate	14.5	45
• Green w/6-in substrate	13	40

Substrates (Growing Medium)

- Ideally a mixture of components
- Designed to absorb and retain water while still allowing free drainage
- Should be lightweight for minimal roof loading
- Must provide anchorage for plantings
- High fertility is not a goal; moderate fertility encourages development of diverse meadow



- Light Expanded Clay Aggregate granules
- Biochar
- Perlite
- Vermiculite
- Pumice
- Crushed brick/clay
- Gravel
- Too much organic matter will cause shrinkage of the substrate over time
- Compost, peat, and coir should be used in moderation
- Clay or silt in moderation will help the substrate with moisture retention but can clog filter fabrics
- Soil and compost can make up the majority of the blend with other amendments up to 30 percent of total. Lightweight blends use more



Drainage Medium

- EPDM rubber membrane Ethylene Propylene Diene Terpolymer (EPDM) elastomeric homogenous roof covering .060" or .045"
- Nonwoven filter fabric needle punched 3.5 oz.
- Drainage mat Enkadrain or permanent turf mat 8 x 120 ft. rolls

Drainage System



- 2-inch threaded bulkhead conductors (scuppers)
- 3-inch to 2-inch reducer couplings
- 3-inch drain plumbing

Structural

- Different regions have varied load standards based on snowfall and wind
- Decks have live load standards of 60 lbs/square foot uniformly distributed
- Sloped Roofs less than 4:12 have live load standards of 20 lbs/square foot uniformly distributed
- Extensive systems (2 – 6 inches depth) will increase loads by 14 – 35 lbs/square foot
- Intensive systems (6 -14 inches depth) increase loads by 60 – 200 lbs/square foot

Dead Loads

- The weight of all materials of construction incorporated into the building, including but not limited to walls, floors, roofs, ceilings, stairways, built-in partitions, finishes, cladding, and other similarly incorporated architectural and structural items, and fixed service equipment

Live Loads

- Those loads produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load or dead load

Environmental Loads

- Substrate or growing medium weight can vary depending on compaction and moisture content
- Saturated weight of soil can double
- Poor drainage will increase roof load
- Snow loads can range from 5 to over 80 lbs/square foot depending upon location

Weight of Materials

Substrate materials (lbs/square foot)	Weight of 1-inch layer
• Biochar	1.6
• Brick	3.7
• Pumice	1.3
• Gravel	3.9
• Soil	4.0
• Perlite	1.0
• Vermiculite	0.2
• LECA clay granules	0.8
• Water	2.1

Roof Slope

- Sloped roofs are prone to materials slippage
- Maximum practical roof slope is 2:12 or 9.5 degrees without use of horizontal stabilizers
- With the addition of horizontal battens or lath, or grids, slope can be increased to 6:12 or 26 degrees



Plantings

- Sedum Pure Joy
- Sedum Fulda Glow
- Joe Pye
- Goldenrod
- Golden Aster
- Red Clover
- Grasses and Sedges
- Ground covers
- Virginia Wild Rye and Prairie Grasses

Resources

- Planting Green Roofs and Living Walls by Nigel Dunnett and Noel Kindsbury; Timber Press ISBN 0-88192-640-X
- North Carolina State Building Code: Residential Code 2012

https://cdn-codes-pdf.iccsafe.org/public/getpdf/9455/2012_NC_Residential_Code.pdf

- Small Green Roofs: Low-Tech Options for Greener Living by Nigel Dunnett, Dusty Gedge; Timber Press ISBN 978-1604690590
- Creating My Green Roof by Dave Hilary; CreateSpace Independent Publishing ISBN 978-1478368076

- Structural Design Loads for One- and Two-Family Dwellings

<http://www.aresconsulting.biz/publications/str%20loads.pdf>

- Residential Design loads and Construction
- http://www.dphu.org/uploads/attachements/books/books_2582_0.pdf
- Types and Features of Green Roof Substrates
- <http://vpts.edu.rs/sed17/CD%20Proceedings%202017/proceedings/6-6.pdf>
- Potential Carbon Offset Represented by a Green Roof; Ammy Marie George Univ. of Virginia 2012
- file:///C:/Users/User/Downloads/George_AmmyMarie_2012.pdf
- American Wood Council
- <https://www.awc.org/>
- Southern Pine Span Tables
- <http://www.southernpine.com/span-tables/>
- North Carolina Native Plant Society
- https://www.ncwildflower.org/native_plants/recommendations
- Lady Bird Johnson Wildflower Center
- (search by state)
- <https://www.wildflower.org/plants/>

Extensive Green Roof Construction

Cross section of basic elements

