UrbanNature: Propagating Green Roofs

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Landscape Professionals Training Series
City of Austin Watershed Protection Department

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A focus on **practical considerations** for building green roofs, looking at:
- environmental context
- design intent
- practice
- local examples & lessons
- opportunities
Why

Nature in cities . . .

Urban heat mitigation
Climate adaptation / carbon sequestration
Biodiversity (habitat)
Water quality (downstream health)
Air quality (atmospheric health)
Green space, amenity, biophilia

to watershed

From canopy
A green roof is a living system, married to architectural structure, that:

tempers
filters
sequesters
metabolizes
enhances
Larger (urban) context:

Green roofs are a unique, multi-functioning tool in the green infrastructure/LID (low impact development) toolbox which enables buildings to directly engage with their environment.

Specific (building) context:

As an integrated architectural-biodynamic system, a green roof enhances a building’s performance, sustainability, and enjoyment.

**why** you build them translates directly into **what** you build and **how** . . .
Vegetation

Growing medium

Filter mat prevents growing medium washing into drainage layer

Drainage layer carries water away from the plant zone.

Root protection layer protects the roof from roots and drainage layer.

Roof waterproof membrane

Underlay

Boards

GREEN ROOF

TRADITIONAL ROOF

= living sponge
what

‘green arts’ & ‘gray arts’
goals & intended uses
basis of design
architectural host
extensive or intensive
irrigation
upfront cost, life cycle cost
incentives

to support

from surface

Children’s Center, Stuttgart, Germany  LWS
‘green arts’ & ‘gray arts’

• integrated system but distinct disciplines and scopes of work
• get the roof right – well-detailed, well-draining, leak-proof
waterproofing layer (TPO, PVC, seamless elastomeric, etc.)
• what other ‘gray’ elements are needed because of the ‘green’ ones?
edging, pavers, borders, irrigation system, monitoring equip., etc.
• ‘green’ components generally start with the drainage layer, going up
• consider the gap
  roots not used to air layer at interstitial space above membrane -
can heat up and dry out
goals & intended uses
basis of design

• why is a green roof desired specifically?
• what are its purposes?
• emphasis on low inputs (organics, water, maintenance)?
• emphasis on maximizing physical performance?
• emphasis on common good (urban) or private (bldg) benefit?
• what kind and how much access? use as amenity?
• two approaches: less is more and more is more
  both (Hyundai and Cadillac) are valid options
• low input scenario: less resource use, less cost, less performance
• high input scenario: more resource use, more cost, more performance
• establish goals before moving to design
architectural host
extensive or intensive
irrigation

• new or retrofit? are there architectural drawings if the latter?
• structural limits are often at the foundation level rather than roof
• parapet roof or shed roof – both require adequate drainage at edge
• walk surface over and around green roof – protect roof membrane
• depth of green roof system determines the plant palette options
• generally, the deeper the media, the taller the species
• shallow extensive systems and porous media dry out quickly
• irrigation is generally needed for plant establishment, about a year
• relying principally on collected rainwater or HVAC condensate takes
green roof watering out of potable (municipal) demand
upfront cost, life cycle cost incentives

• green roofs are not a low budget roof choice
• not easy to calculate cumulative payback
• value arises from a matrix of interconnected benefits
• variables fluctuate since it’s a living system, makes metrics hard
• some attributes are quantifiable (stormwater retention)
  others do not lend themselves to consistent data
  (thermal insulation varies per season and moisture content)
• real estate value of green roof views from above (higher rents)
• must avoid becoming a liability; design for longevity and flexibility
• incentives in Austin, at this moment, are not explicitly financial -
  density bonus option in certain districts (greater FAR)
  part of option to discharge stored rainwater (green roof irrigation)
  green building credits like open space provision rating points
team players
proprietary system vs. assembled components
monolithic vs. modular
architectural & ancillary conditions
trifecta: growing media, vegetation, moisture
surface variegation
installation
maintenance
auxiliary systems: water, solar
local resources
team players

• team may include:
  owner, architect, landscape architect, structural engineer, green roof professional, roofing consultant, irrigation consultant, general contractor, growing media supplier, grower, various component suppliers
• project lead or architect well-suited to manage project from design to implementation since there is significant coordination
• good idea to meet early and regularly through design and planning
• draw from local providers where possible
• roofers with familiarity and experience with green roofs are preferable
proprietary system vs. assembled components

- pros and cons, each – one full package, one DIY
- how is local expertise figured in?
- how are local/regional materials included?
- access to knowledge - nuts and bolts of system components
- flexibility to customize and revise details, materials, timing
- experimentation with plant species over time
- cost, warranties
monolithic vs. modular

- **monolithic =** a blanket: one continuous entity
  
  shares moisture, microbes, fungi, nutrients, root space
  
  growing media and plants installed sequentially

- **modular systems are compartmentalized**
  
  provides pre-established vegetation in growing matrix
  
  greater control of final install look
  
  ease of tray placement and removal if necessary (in concept)

  soil biology, moisture not shared across dividers
architectural & ancillary conditions

• minimal roof slope for adequate drainage (even for “flat”)
• vents, drains, other roof penetrations need border (offset vegetation)
• roof perimeter type (parapet, shed) affects drainage, sightline
• access to and over (walk-out on level, ladder, pathways)
• deck, furnishings, shelter
• HVAC equipment can be a large presence - heavy, noisy, cast shadows, requires clearances
• irrigation system (hose bib?, pipes, controls, pumps)
• these conditions can whittle the green roof real estate down

Lovejoy Block 2   Portland, Or.
trifecta: growing media, vegetation, moisture

• characteristics are correlated – design for this (or roof will retroactively)
• baseline concern: keeping plants alive, healthy, performing
• degree of evapotranspiration sought? (more ET = more cooling)
• succession: allow plant regime to evolve over time?
• weeds are inevitable; can be seen as pioneer species in low maintenance roof
• greater initial (mature) plant coverage minimizes weed introduction
• seeding yields effective coverage if tended; economical
• low-depth growing media is typically structured and inorganic; designed to be lightweight and well-draining, doesn't hold water and nutrients long
• shallower slopes allow for longer lateral hydraulic movement
• deeper media more closely approximates at-grade conditions, can be more organic and hold water longer
• canopy plants may create rooftop microclimates or zones
surface variegation

• rockscapes and rubble roofs predicated on volunteer plant species
• nurse logs and other natural elements
• mounding of soil can create lee sides
• mulching tiles - trap moisture, seed, provide protection
• enhanced habitat, hydrologic character, biological activity
installation

(primarily for non-proprietary systems)
• coordination should begin during design
  key and secondary parties (roofer, irrigation sub, etc.)
• align schedules of gray and green
  seasonal planting is best but is tied to roof completion
growers will need to plan for readiness of plants
• insist on pre-construction meetings for optimal coordination of parties
• method for mixing media, staging media and plants, and lifting media
  and plants to roof mapped-out?
• allow time for all inspections (notably roof manufacturer, for warranty)
  seams in membrane must be fully welded, inspected, repaired
• leak detection testing or simply flooding is good practice
• many roof warranties will assume overburden waiver (owner incurs
  cost of removing overburden if needed)
maintenance

• maintenance standard high or low? influenced by:
  desired aesthetic, degree of performance (ET, property value)
• generally more needed for intensive systems than extensive
• maintenance regime may include:
  watering
  weeding
  thinning, pruning
  (re-) seeding or planting
  fertilizing
  inoculating (such as mycorrhizal)
• fertilizing and inoculating is less effective in extensive roofs (leach)
• who does it? ownership
• good practice to provide maintenance manual – include species list
• ideal to keep a log to record history, main activities
• monitoring? partnering with other organizations for data collection
• be open to succession and migration of species over time
auxiliary systems: water, solar

• water path: avoid discharge into storm sewer
  rainwater collection and distribution
  at-grade landscaping
  rain garden
  water feature
  artistic treatment of gutters, scuppers, downspouts
• rainwater system as part of closed-loop irrigation
• HVAC collection (co-mingle with rainwater?)
• photovoltaic panel array
  over vegetation: Germans lead the way
  proximity (adjacent but not over)
  synergy – panels shelter plants; plants cool panels
  armatures, structure, attachment need to be designed
local resources

Green Roof Advisory Group
• initiated by City Councilmember Riley, 2009
• looked at current state of knowledge, incentives, and credits
• 5-year implementation plan establishes framework for goals, progress
• Report to Austin City Council Oct. 2010
• Report on Extension Resolution
local resources

**Lady Bird Johnson Wildflower Center (Ecosystem Design Group)**

- trial roof research plot compared standard to cool to green roofs for surface and soil temperature data, runoff, etc.
- affiliation with University of Texas
- showcase projects on WFC campus
- consultation and design on other projects
- EDG developing growing media formula for trademark
local resources

GRoWERS  (Green Roofs: Working Expertise & Regional Solutions)
• started 2007 (not currently very active)
• nonprofit networking and advocacy group
  http://www.growersaustin.com/

Pecan Springs Bus Shelter
credit: Alejandro Moreno