UrbanNature:
Propagating Green Roofs

Jan. 15, 2016

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

from canopy

nature in cities . . .

why

urban heat mitigation
climate adaptation / carbon sequestration
biodiversity (habitat)
water quality (downstream health)
air quality (atmospheric health)
green space, amenity, biophilia

to watershed

California Academy of Arts and Sciences

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

- tempers
- filters
- sequesters
- metabolizes
- enhances

Chicago City Hall

Larger (urban) context:

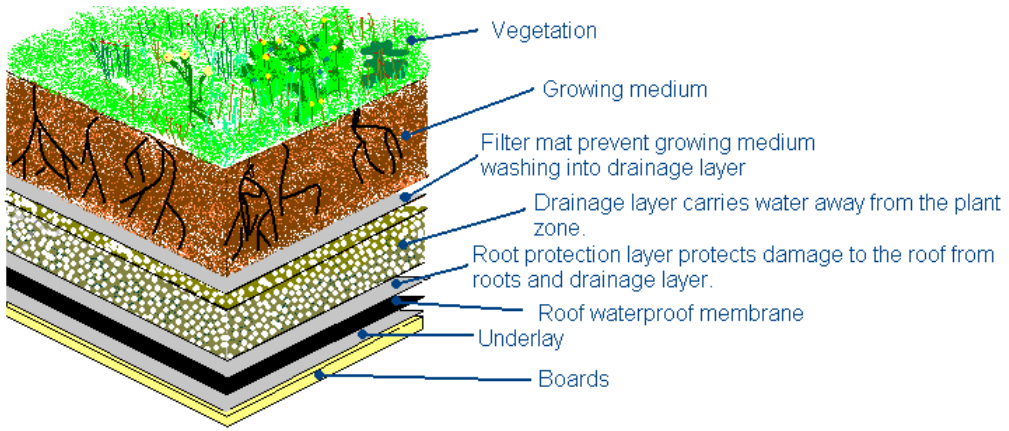
Green roofs are a unique, multi-functioning tool in the green infrastructure/LID (low impact development) toolbox which enables buildings to directly engage with their environment.

Donovan residence Seattle, Wa. LWS

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** . . .



GREEN ROOF

TRADITIONAL ROOF

= living sponge

from surface

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

Children’s Center, Stuttgart, Germany LWS

LBJ Wildflower Center Green Roof trial roof credit: Brian Gardner

‘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.)

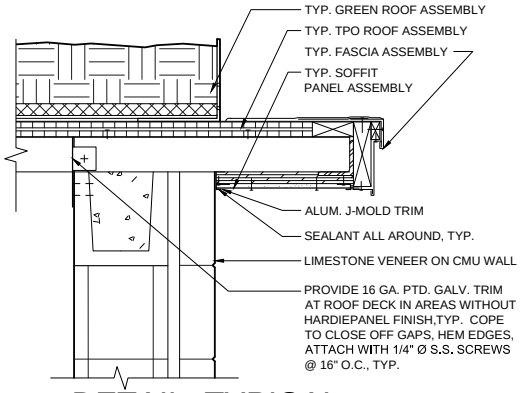
•what other ‘gray’ elements are needed because of the ‘green’ ones?

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



DETAIL: TYPICAL GREEN ROOF RAKE

4 SCALE: 1 1/2" = 1'-0"

credit: :Stanley Studio

Denver Botanical Garden

Stanley Studio photo credit Marsha Miller

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

Brooklyn Grange Urban Farm

berm roof credit: LBJWFC website

architectural host
extensive or intensive
irrigation

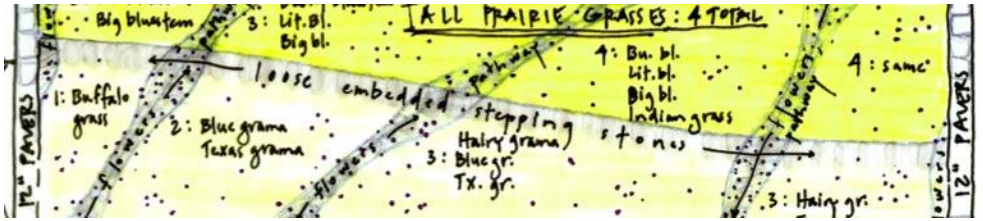
•new or retrofit? are there architectural drawings if the latter?
•structural limits are often at the foundation level rather than roof
•parapet roof or shed roof – both require adequate drainage at edge
•walk surface over and around green roof – protect roof membrane
•depth of green roof system determines 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

Dell Childrens Hospital TBG Partners

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

how



from plan

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

to construction

Stanley Studio

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

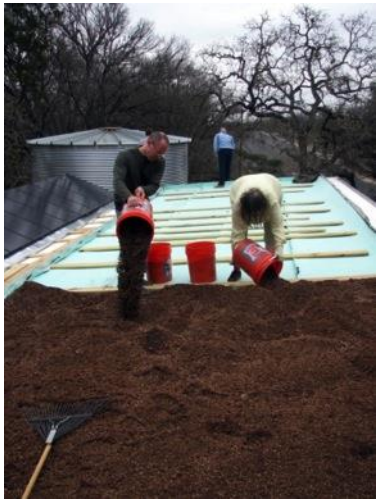
•draw from local providers where possible

•roofers with familiarity and experience with green roofs are preferable

Ballard Library Seattle, Wa.

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



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Chicago City Hall

modular trays photo credit: LiveRoof

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

Lovejoy Block 2 Portland, Or.

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

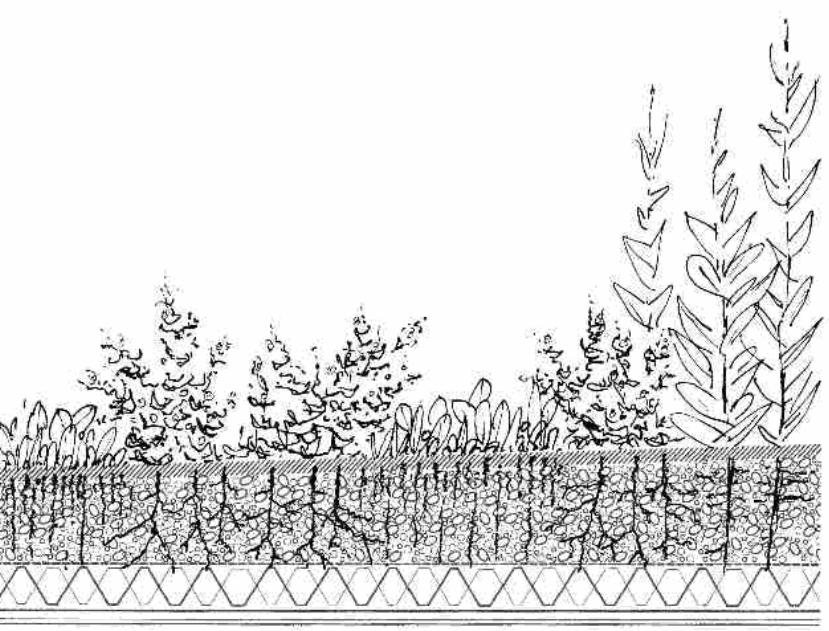


image credit: Roofscapes Inc.

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

Rubble roof Hackney, UK

mulching tiles – Prairie Design Stanley Studio

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

John Gaines Park (Mueller SE Swim Center) Stanley Studio

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)

Butterfly weed, Stanley Studio credit: Marsha Miller, UT

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

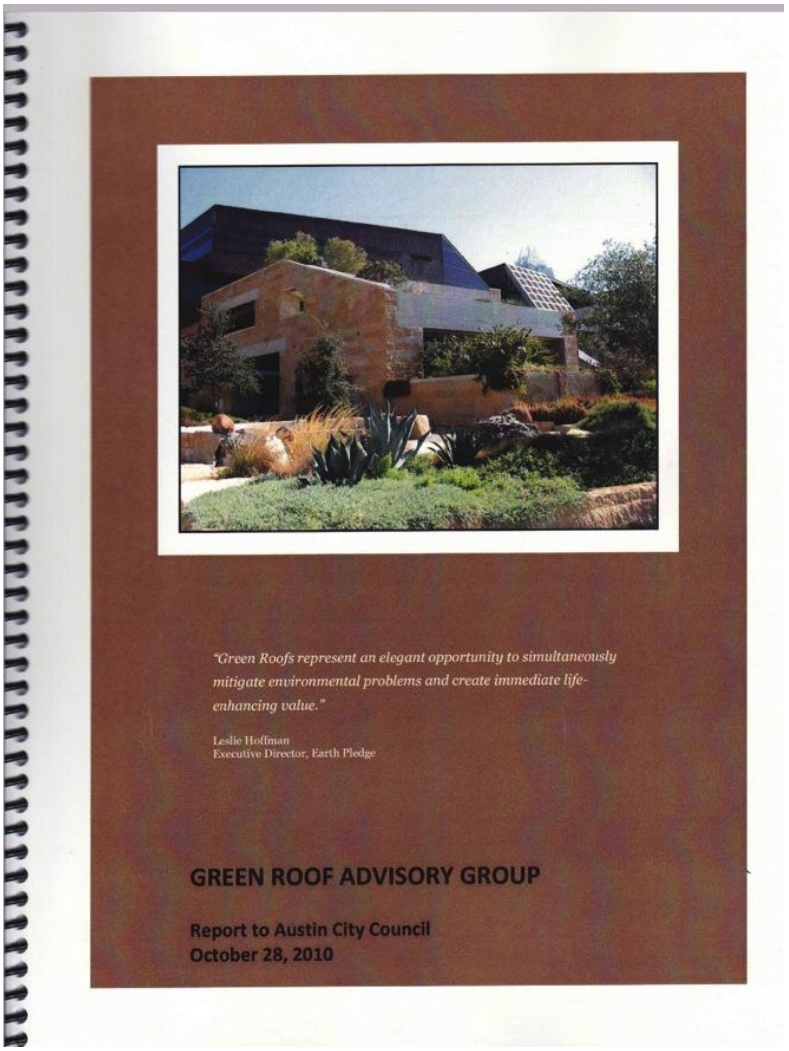
John Gaines park (Mueller SE Swim Center) Stanley Studio

Stanley Studio

Duke Univ. Environment Hall Payette

- 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

MTZ Munich, Germany credit: ZinCo



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

  https://www.austintexas.gov/department/green-roof (2010 Report link)
- Report on Extension Resolution

  https://www.austintexas.gov/department/green-roof (2011 Report link)

roof trial LBJWFC

kiosk LBJWFC

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