



Design considerations for green roofs

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Presentation

Design considerations

- Construction
- Substrates
- Plants and plant selection
- Research efforts

AND

Reviewing CH2

Crown Casino



Chicago City Hall

1. Construction issues

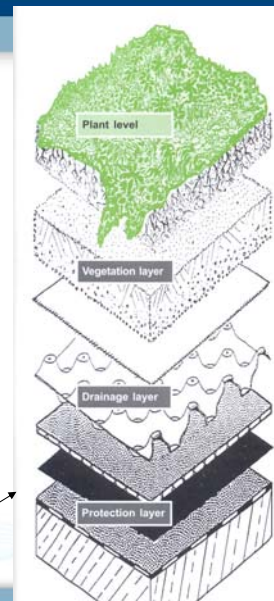
- Commercial green roof systems
- Intensive green roofs
 - 300 - 1000 kg per square metre
- Extensive green roofs
 - 70 - 200 kg per square metre
- Slope (no greater than 9.5°)



Green roof construction

Most green roofs contain:

1. Plants
2. Substrate (vegetation support layer)
3. Filter fabric (cloth layer)
4. Drainage layer (often prefabricated)
5. Protection layer (sometimes with a root barrier)
6. Roof structure



Example from the Zinco Green Roof Planning Guide, 6th edition

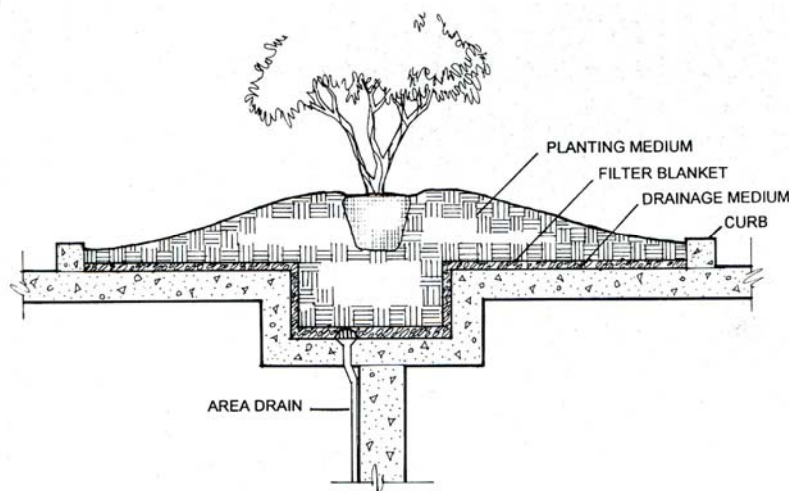
System drainage

- A crucial component of the system
- Drains excess water
- Main types include:
 - Gravels
 - Drainage cells (modular, polyethylene)
 - Some materials can assist water holding (minimal)
- Needs careful planning when retro-fitting buildings



Drainage layer from Zinco - Floradrain® FD40

Drainage from intensive green roofs



Source: Osmundson, 1999



2. Substrates

- The growing medium for plants
- Mineral, organic and synthetic (artificial) components
- Conditions are analogous to containers
- Design for function is crucial
- Key issues include:
 - Roof loading capacity?
 - Purpose/outcome?
 - Availability of components
 - Mass and depth (weight loadings)




Substrates and weight loadings

Component	Weight of a 10 cm layer* (kg per square m)
Water	100
Gravel	160 – 190
Sand	180 – 220
Topsoil	170 – 200
Scoria	100 – 170
Crushed clay brick	107 – 164
Pumice	65
Perlite	50
Recycled plastics (chips and beads)	40 – 60
Light expanded clay granules	30 – 40
Foam cell material	37
Vermiculite	10


Source: *Dunnnett and Kingsbury, 2004 (p.60) and own data. *Saturated bulk densities (container mass) values*

2. Substrates

- Balancing air and water
 - Air-filled porosity (AFP) vs. Water-holding capacity (WHC)
- Nutrient management
- Properties and stability
 - compaction
 - decomposition
 - distribution



AS 4419-2005
Australian Standard™
Soils for landscaping and garden use
Standards Australia



FLL
Guideline for the
Planning, Execution
and Upkeep of
Green-Roof Sites
Release 2002

AS 4419

- Sets performance criteria for soils and soil/organic matter blends for use in landscapes
- Defines low density soils

FLL Guidelines

- The only existing standard for Green Roofs
- Determined by German Standards Office, FLL. Used across Europe and in the USA

3. Plants and plant selection

- Intensive green roofs
 - 20 to 50 cm = herbaceous materials (perennials), low shrubs
 - 60 to 100 cm = shrubs, small trees
- Extensive green roofs
 - 4 to 6 cm = succulents
 - 6 to 10 cm = succulents, some grasses, some perennials
 - 10 - 20 cm = more perennials and grasses, turf, some sub-shrubs



Source: Osmundson, 1999; Dunnett and Kingsbury, 2004

Plant selection considerations

- Site issues
 - Wind, light, temperature, rainfall, access, construction issues, maintenance, etc.
- Design outcomes
 - Aesthetics/visual properties, ecological/habitat values, food production, etc.



Plant selection considerations

- **Plant growth and tolerances**
 - plant habit/type/growth rate
 - deficit tolerance (low-water/aridity)
 - pest and diseases
 - planting density, etc
- **Substrate properties**
 - Waterholding capacity
 - Depth, stability, weight, etc.



4. Our research efforts

- Substrate testing and analysis
- Plant evaluation
 - Plant growth assessment
 - “Droughting” experiments
 - Recycled water irrigation
- Green wall plantings
- Inventories (green roofs +walls)
- Specifications development
- Zinco project
 - Plant evaluation (esp. Australian plants)
 - Substrate performance
 - Modelling energy budgets





Zinco project - experimental green roof Planting – July 16, 2008



Our vision: Green infrastructure research and demonstration centre

- Providing innovative environmental solutions to the adverse effects of urbanisation and adapt cities to climate change
- Research to quantify the ecosystem services of urban vegetation in Australia
 - Building energy efficiency gains
 - Reduction in urban heat island effect
 - Carbon sequestration
 - Reduced air pollution
 - Improved water quality and water management
- Be a testing and demonstration site for
 - Green roof and vertical greening systems, plants and substrates
 - Climate conscious urban design
- Help to develop green infrastructure standards and life cycle costings



CH2 building (Melbourne)

- Opened August, 2006
- Three exterior landscapes
 - North Façade greening (vertical planters with climbers)
 - East Core Roof (semi-extensive modular planting)
 - Roof garden (Amenity space, beds of variable depth)

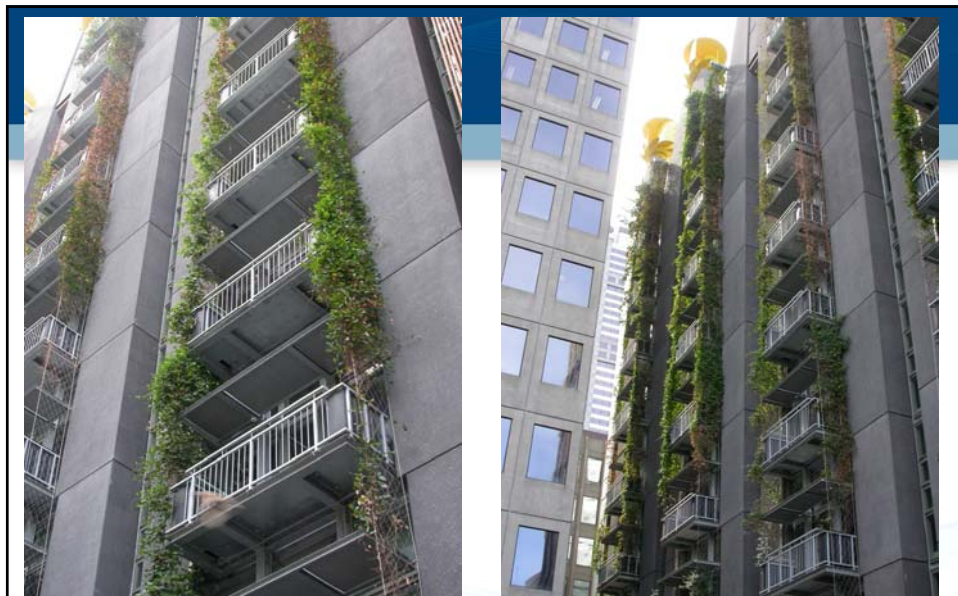


CH2 Roof garden - February 2008



Vertical plantings

- 90 external planters located on balconies
- Planters: 300 mm x 1000 mm x 1000 mm
- Frames with X-tend mesh above planter: 1000 mm x 2000 mm
- Sand-based substrate
- Capillary irrigation (hydrocell 'wick')



CH2 Vertical planters -February 2008



East Core roof

GreenTech® roof modules

- High density polyethylene
- **Dimensions**
1.2 m x 1.2 m
- **Depth**
216 mm min OR
292 mm max
(with 'sides' up)
- **Volume = 0.283 m⁻³**
- **Weight = 415 kg/sq.m (sand-based)**



Pilot study module 4 (Sand base)



April 7, 2005



May 11, 2005



June 16, 2005



August 16, 2005



September 16, 2005



January 31, 2006



CH2 East Core Roof - June, 2006



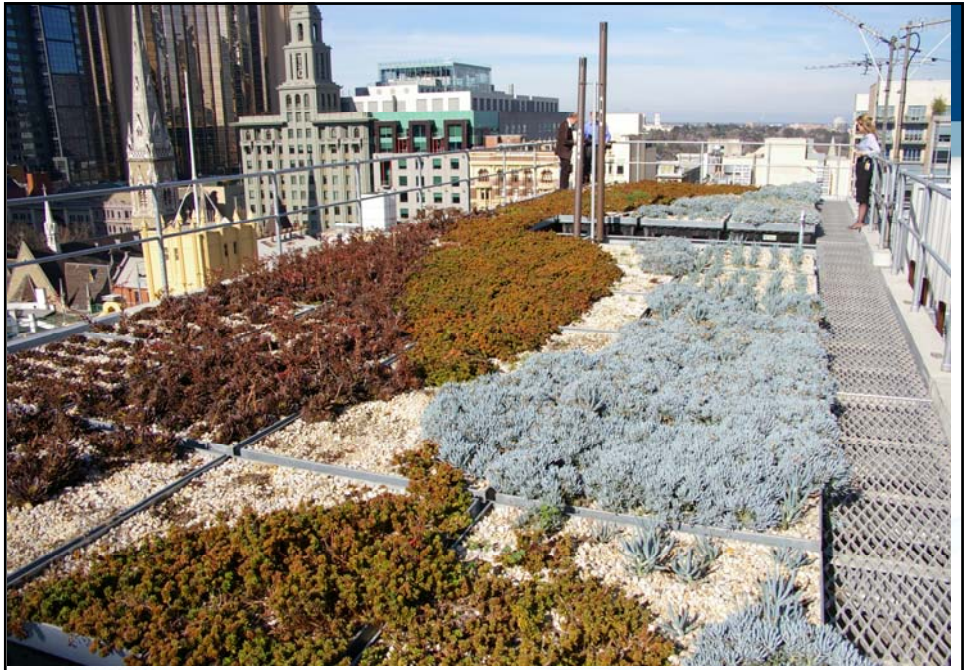
CH2 East Core Roof - July, 2006



CH2 East Core Roof - February 2007



CH2 East Core Roof - February 2008



CH2 East Core Roof - August 2008



Any questions.....

