Sustainable Green Roof and Future Trends

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20 July 2011
Presentation

• Who is ZinCo?
• World’s greenroof industry today

PART 1: SUSTAINABILITY
• What is Sustainable Greenroof
• Addressing “Affordability”

PART 2: GREENROOFS AND PV
• Integrating greenroofs and photovoltaic

PART 3: ADDRESSING URBAN FLOODING
• Reduce urban flooding through greenroofs

PART 4: FUTURE CHALLENGE
• World’s greenroof
Who is ZinCo?

- Australia
- Austria
- Belgium
- Canada
- Chile
- Cyprus
- Denmark
- Germany (HQ)
- United Kingdom
- Greece
- India
- Iran
- Italy
- Luxemburg
- Macedonia
- Netherlands
- Norway
- Poland
- Russia
- South Korea
- Spain
- Switzerland
- Turkey
- UAE
- Ukraine
- USA

ASEAN
Greenroof Specialist

Expertise begins with Design considerations

- Type of greenroof – Intensive or extensive; vegetation
- **Earth-friendly** Roof & Greenroof construction
- Load capacity
- Fire & personal safety
- Waterproofing
- Drainage, slope and fall
- Premise – Accessibility, shape, location, height, surroundings, full sun, shaded area, etc
- Irrigation - Use of water
- Wind effects
- Detailing – Architectural, M&E, etc
Traditional roof gardening practices

The shortcomings:

• Consolidation
• Settlement of fine particles
• Drainage impediment
• Ponding
• Filter layer deteriorates
• Root penetration
• 20% Thicker & 40% heavier
• Use of natural soil – not ecological

When is aeration going to take place?

Then there are pests!

Within 12 - 18 months upon installation

After 2 yrs

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Green Roof Industry 2008: World’s perspective

- **Infant**
  - S’pore
  - HK
  - Manila

- **Growth**
  - Central & W Europe incl Germany
  - USA
  - E Europe

- **Maturing**
  - China

- **Decline**
  - Germany
    - Started early 1970s
  - Started mid 1980s

Uptake of Green Roofs in sqm:
- Started early 2000s
- Started mid 2000s
- Started early 1970s
Green Roof Industry 2010: World’s perspective

Stages of Product Life Cycle

Infant

- China (Started mid 2000s, $45 per sqm)
- S’pore (Started early 2000s, $130 per sqm)

Growth

- USA
- E Europe
- Central & W Europe incl Germany (Started early 1970s, $40 per sqm)
- Germany (Started mid 1980s, $180 per sqm)
- S’pore (Started early 2000s, $130 per sqm)

Maturing

- Germany
- S’pore

Decline

- Germany

Uptake of Green Roofs in sqm

- Started early 1970s
- Started mid 1980s
- Started early 2000s

Note: Price refers to Extensive-type roof greening
PART 1:

SUSTAINABILITY
What is Sustainability?

WHAT -
• Practices & processes
• Environmentally responsible
• Resource efficient
• Throughout the life cycle of the building

HOW -
• Efficient use of energy, water & other resources
• Protecting health and improving productivity
• Reducing waste, pollution and environmental degradation
Sustainable Greenroofs

Low carbon footprint & Recycled Materials

• Conscientious - Right from the source (i.e. Soil, mines, ores, etc) to the point of application,

Q: “Is there a need to deplete mother earth of that asset?”

Q: “Is there a need to burn fossil fuel?”

• There are enough man-made products that can be recycled, re-used and re-engineered to be used in Greenroofs.
Sustainable Greenroofs

QUALITIES

• Safety

• Effectively reduce Urban Heat Island Effect

• Low carbon footprint eg through high recycled content

• Consistent performance over long term (life cycle)

• Requires lesser attention

• Consumes less treated-water and manages stormwater

• Accessible
Affordability

COST EFFICIENCY

Cost incurred:
• Structural
• Initial supply & installation
• Maintenance (recurrent)

Cost savings (recurrent):
• Cooling cost
• Stormwater infrastructure
• Re-waterproofing
PART 2:
GREENROOFS
AND
PHOTOVOLTAIC
Integrating Greenroofs and Photovoltaic

How does PV work?

• **Test Standard** - The electrical performance of photovoltaic modules are tested under "**Standard Test Conditions**" (STC) with different parameters.

• **Module Operating Temperature** – The optimal temperature at which the photovoltaic modules operate. *(Usually 25 – 28 °C)*

• For crystalline silicon solar panels, **every 1 °C increase** above the module operating temperature **reduces** the power supply of the PV module **by 0.5%**.
Integrating Greenroofs and Photovoltaic

Temperature

• There is a big difference in surface temperature of bare concrete roofs and green roofs.

• Surface temperature affects ambience temperature.
Integrating Greenroofs and Photovoltaic

Critical Success Factors

• Planning and Design – Layout, orientation, degree of pitch, etc
• Wind uplift
• Space - Distance between PV modules or panels; between PV modules and vegetation
• Closed vegetation
• Work coordination – Architect, main builder, PV module supplier, landscape contractor, solar cell installer
PART 3:

ADDRESSING URBAN FLOODING
Reducing Floods through Greenroofs

Rain and Surface Runoff

Article in The Straits Times, 18 Oct 2010:

1. Annual rainfall is about **2,350 mm**.
   - Wet months – November, December and January; more than 240 mm per month.
   - 195.6 mm of rain on 17 July 2010 alone.

2. One of “The problem” – “Increasing urbanisation leads to more storm-water above ground.”

3. Drainage infrastructure – 7000 km of scupper drains, drains and canals.

4. Flood prone area – 62 ha as of July 2010

5. Freak condition - “The drainage system was overwhelmed, leading to flooding.”
Reducing Floods through Greenroofs

Rain and Surface Runoff

Stormwater management infrastructure

- Reduced Volume
- Time lapse
- Usable quality
Reducing Floods through Greenroofs

Stormwater management

- **Extensive** Greenroofs reduce run-offs by about 30%
- **Intensive** Greenroofs reduce run-offs by about 50%

<table>
<thead>
<tr>
<th>Time lapse</th>
<th>Rain stops</th>
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<tbody>
<tr>
<td>Surge in rainfall is later</td>
<td></td>
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Cumulative runoff

- Runoff from bare roof
- Runoff from greenroof

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Situation in Paris, France

The situation of the Seine:

Project with town hall of Paris

Flood-prone area
Which rainfall is critical?

- **Maximum run-off:**
  - 80% $(\Psi = 0.8)$
  - 25% $(\Psi = 0.25)$

- **After 1 hour:**
  - > 95%

**Duration (minutes):**
- 15
- 60

**Intensity of precipitation:**
- Gravel roof
- Average green roof

Measuring: Dr. Walter Kolb, LWG-Veitshoechheim

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PART 4:

FUTURE CHALLENGE
Future Challenge for Greenroofs

What if buildings go DOWNWARDS?

What would be the character of greenery?
Future Challenge for Greenroofs

Cavern Landscape in an urban setting

... where greenery thrive on a glimmer of light.
Future Challenge for Greenroofs

Next yardstick? Water footprint

• The water footprint is an indicator of water use that looks at both direct and indirect water use of a consumer or producer of greenroofs.

• The water footprint of a greenroof is defined as the total volume of freshwater that is used to produce, used by and maintain the greenroof.
CLOSING:

GREENROOFS AROUND THE WORLD
Skyrise Greenery in SINGAPORE

Commercial buildings

- Subaru Showroom, Toa Payoh
- Fusionopolis (Ph 1), Buona Vista
- Tampines Grande, Tampines
- Tampines Concourse, Tampines
Skyrise Greenery in SINGAPORE

Public housing estates

Compassvale, Sengkang

Tah Ching Road, Jurong

Tampines Ave 6, Tampines

Edgedale Plains, Punggol
Skyrise Greenery in SINGAPORE

Private residential developments

- Parc Emily Condo, Mt Emily
- Botania Condo, West Coast
- Bungalow, Belmont Road
- Clementiwoods Condo, Clementi
Skyrise Greenery in SINGAPORE

Institutions

NJC Boarding Hse, Bt Timah

Moral Home for the Disabled, Eunos

French Int’l School, Ang Mo Kio

Bukit Panjang Sports Hall, Bukit Panjang
Skyrise Greenery throughout the World

Institute of Environmental Medicine, Freiburg, Germany
Skyrise Greenery
throughout the World

Clara Grunwald School, Freiburg, Germany
Skyrise Greenery throughout the World

Solar Info Centre, Freiburg, Germany
Skyrise Greenery throughout the World

1815 building – Lunette 42, Germany
Skyrise Greenery throughout the World

Meydan Centre, Istanbul, Turkey
Skyrise Greenery throughout the World

Airport Kloten, Zurich, Switzerland
Skyrise Greenery throughout the World

The Jungle, Palma de Mallorca, Spain
Skyrise Greenery throughout the World

Gallie Craig coffee shop, Drummore, Scotland
Skyrise Greenery throughout the World

Villa Marina Estate, Warsaw, Poland
Skyrise Greenery throughout the World

SM City North Edsa, Quezon, Philippines
We make life at the top ... beautiful!

Thank you.