Opening Ceremony of 2010/2011 Hong Chi – Hong Kong Jockey Club Community Organic Farming Competition for Primary & Secondary Schools in Hong Kong
2010/2011匡智香港賽馬會全港中小學社區有機農耕比賽開幕禮
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Green Roof + Urban Farming
綠化屋頂 + 都市農耕

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Introduction 前言

• Problems in urban cities 城市面對的問題
  • Urban heat island 熱島效應
  • Lack of greenery space 缺乏綠化空間
  • Large ecological footprint 大型生態足跡
• Green roofs can help to mitigate the adverse effects 綠化屋頂可以幫助減輕不利影響
  • Bring the nature back 把大自然帶回來
  • Make better use of roof space 更好地利用屋頂空間
Examples of green roofs in Hong Kong 香港屋頂綠化的例子

HK Wetland Park 湿地公園

EMSD Headquarters 機電署總部

Parklane, TST 尖沙咀柏麗大道

A school in San Po Kwong 新蒲光某小學

(Photos taken by Dr Sam C M Hui)
Examples of green roofs in the world 國際屋頂綠化的例子

Solar Campus Jülich, Germany (11 Jul 2001)  
IBN-DLO Wageningen, the Netherlands (2 Jul 2001)

Putrajaya Int. Conven. Centre, Malaysia (30 Jun 2006)  
Beitou Taipei Library, Taiwan (6 Aug 2007)

(Photos taken by Dr Sam C M Hui)
Green roofs 綠化屋頂

- Major types 主要類型 (see Table 1)
  - Extensive 粗放型
  - Semi-intensive 半密集型
  - Intensive 密集型

- Roof gardens 天台花園:
  - Usually intensive greening with other features such as potted plants, pond, etc. 通常為密集型＋其他特徵
  - Sky gardens 高空花園 (e.g. > 15 storeys high)
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Extensive 粗放型</th>
<th>Semi-intensive</th>
<th>Intensive 密集型</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of material</td>
<td>150 mm or less</td>
<td>Above and below 150 mm</td>
<td>More than 150 mm</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Often inaccessible</td>
<td>May be partially accessible</td>
<td>Usually accessible</td>
</tr>
<tr>
<td>Fully saturated weight</td>
<td>Low (70-170 kg/m²)</td>
<td>Varies (170-290 kg/m²)</td>
<td>High (290-970 kg/m²)</td>
</tr>
<tr>
<td>Plant diversity</td>
<td>Low</td>
<td>Greater</td>
<td>Greatest</td>
</tr>
<tr>
<td>Plant communities</td>
<td>Moss-sedum-herbs and grasses</td>
<td>Grass-herbs and shrubs</td>
<td>Lawn or perennials, shrubs and trees</td>
</tr>
<tr>
<td>Use</td>
<td>Ecological protection layer</td>
<td>Designed green roof</td>
<td>Park like garden</td>
</tr>
<tr>
<td>Cost</td>
<td>Low</td>
<td>Varies</td>
<td>Highest</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Minimal</td>
<td>Varies</td>
<td>Highest</td>
</tr>
</tbody>
</table>
Table 2. Public and private benefits of green roof systems
表2：绿化屋頂系统的公共好處和私人好處

<table>
<thead>
<tr>
<th>Public benefits: 公共好處</th>
<th>Private benefits: 私人好處</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Aesthetic value</td>
<td>- Increase roof life span</td>
</tr>
<tr>
<td>- Mitigate urban heat island</td>
<td>- Reduce cooling loads</td>
</tr>
<tr>
<td>- Stormwater retention</td>
<td>- Contribute to green building</td>
</tr>
<tr>
<td>- Create natural habitat</td>
<td>- Contribute to green building rating credit points</td>
</tr>
<tr>
<td>- Functional open space</td>
<td>- Better use of space</td>
</tr>
<tr>
<td>- Agricultural space</td>
<td>- Reduce noise levels</td>
</tr>
<tr>
<td>- Filter dust and pollutants</td>
<td>- Reduce risk of glare for surrounding buildings</td>
</tr>
<tr>
<td>- Filter rainwater</td>
<td></td>
</tr>
</tbody>
</table>
Green roofs 綠化屋頂

• Other benefits 綠化屋頂的其他好處
  • Urban farming 都市耕種 (e.g. growing vegetables)
    • Make best use of roof space; may be organic
  • Education 教育
    • Integrated with school curriculum
  • Community and social functions 社區活動
    • Exercises & hobbies for children, adults & elderly
  • Horticultural therapy 園藝療法
    • Sensory, meditation effects; manage emotion/stress
Urban farming & education
都市耕種及教育

Horticultural therapy & social functions
園藝療法和社區活動
Urban farming 都市農耕

- Also called “Urban Agriculture” 都市農業
- Definition: 定義
  - Agricultural activities that help enhance the value and quality of life in terms of economic, socio-cultural aspects by growing plants and animals using various spaces in urban areas
  - 在城市地區利用各種空間，通過種植植物和動物，就經濟、社會和文化方面來幫助提高價值和生活質量的農業活動
Green roofs and urban farming in Osaka, Japan (Namba Parks) (2003)

日本大版南波中心的屋頂綠化及都市耕種

(Source: www.treehugger.com & www.toho-leo.co.jp)
Rooftop urban farming in the world 世界上的屋頂都市耕種

Bangkok, Thailand 泰國曼谷

Tokyo, Japan 日本東京

London, UK (with bee keeping) 英國倫敦(含養蜂)

San Francisco, USA 美國舊金山

(Source: www.time.com)
Urban farming 都市農耕

- Benefits of urban farming: 都市農耕的好處
  - Enhance urban landscape and environment 提升城市景觀和環境
  - Produce fresh local or organic food 生產新鮮或有機的本地食品
  - Reduce ecological footprint 減少生態足跡
  - Enable community & social functions 使社區及社會功能
  - Create farming & associated jobs 創造農業及相關工作
Urban farming 都市農耕

• **More people participate** in urban farming 更多的人參與都市農耕
  • They become more aware of the importance of the earth, nature, the environment, life and health and the value of working together 他們變得更加了解地球的重要性、自然、環境、生命和健康、一起工作的價值
  • This leads to healthy cities and communities for sustainable development 這導致健康城市和社區的可持續發展
Table 3. SWOT analysis of rooftop urban farming in Hong Kong

| Strengths | - Fresh food, safe & reduce transportation  
|           | - Provide many environmental & social benefits  
|           | - Better use of roof spaces (many functions possible) |
| Weaknesses | - Lack of roof spaces for farming  
|           | - Recognition of agriculture as decaying industry  
|           | - Lack of research & development for urban farming |
| Opportunities | - Growing demand for safe & organic foods  
|             | - Advantages of community & leisure farming  
|             | - Need to manage/rehab many old buildings |
| Threats   | - Lack of information and opportunity  
|           | - Lack of research data related to urban farming  
|           | - Typhoon attack & air pollution |
Design guidance 設計指導

- Key factors for planning 主要規劃因素
  - Structural loading 結構負荷
  - Accessibility 能否容易到達
  - Waterproofing 屋面防漏水
  - Drainage 排水渠務
  - Maintenance 維護保養

- Other design considerations 其他設計考慮
  - Selection of plants 選擇植物
  - Stakeholders’ involvement & support 參與支持
Typical structure of extensive green roof

綠色屋頂的典型結構

- Vegetation
- Growing medium
- Filter membrane
- Drainage layer
- Support panel
- Thermal insulation
- Vapour control layer
- Structural support
Green roof on concrete structure

(Source: www.alumasc-exteriors.co.uk)
Examples of green roof details 詳細屋頂綠化的例子

**Upstands**
- FZ-Schiene + Clamping profile EP 150
- Gutter System SR 75
- ca. 150 mm

**Roof Perimeters**
- Siraset
- ca. 100 mm

**Inspection chamber KS 8**
- ca. 300 mm

**Roof outlet with inspection chamber**

(Source: www.zinco.de)
Design guidance 設計指導

• Education functions 教育功能
  • Environmental 環保
    • Improve environmental awareness 加強環保意識
    • Learning from planting 讓學生從栽種體驗中學習
  • Scientific 科技
    • Enhance science education 加強科學教育
  • Liberal study 公民
    • Facilitate community involvement 促進社區參與
  • Horticulture 園藝
    • Allow natural functions 親近大自然活動
Green school

Environmental citizenship

Sustainable development

(Source: Education Bureau, Hong Kong SAR)
Design guidance 設計指導

• Possible learning topics 可學習的題材
  • Biodiversity 生物多樣性
  • Building & roof construction 建築及屋面施工
  • Energy conservation 節約能源
  • Gardening & horticulture 園藝
  • Natural habitat 自然棲息地
  • Thermal insulation 熱能絕緣
  • Urban heat island 城市熱島
  • Water conservation 水源節約
A green roof project with integrated systems

- Micro-wind turbines
- Rainwater recycling
- Modular system
- Built-in system
- Space for green roof research and urban farming
Urban farming on green roofs

Farming on the roof

Vegetables and herbal plants

Water melon

Green beans

(Photos taken by Dr Sam C M Hui; Acknowledgement: St. Bonaventure Catholic Primary School)
Window Farms Technique 窗口農耕技術

(Source: www.windowfarms.org)
Vertical Farm and Building Integrated Agriculture

(Source: www.verticalfarm.com)
Dragonfly Vertical Farm, New York 紐約蜻蜓垂直農場

(Source: http://vincent.callebaut.org/)
Conclusions 總結

- Green roof urban farming can provide many environmental and social benefits
  - 綠色屋頂農業可提供許多環境和社會的益處

- When applied to Hong Kong, need to consider technical issues & local conditions
  - 當應用於香港時，需要考慮技術問題及當地的條件

- More efforts are needed to develop design guidelines & practical experience
  - 需要更多的努力，制定設計準則和實際經驗
THANK YOU 謝謝 !!

(More information: www.hku.hk/bse/greenroof/)