Green Engineering Symposium
"Is Hong Kong Building Green?"

18 August 2007, Hong Kong

Green Roof and Sustainable Buildings in Hong Kong

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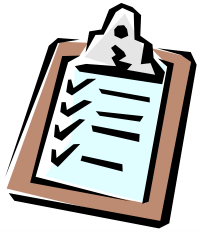
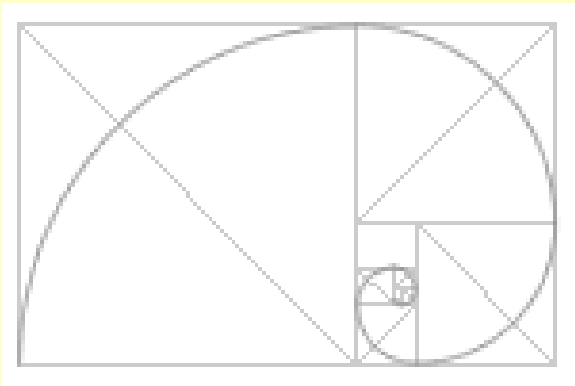
Contents



- What is Green Building?
- What is Green Roof?
- Potential Benefits
- Applications in Hong Kong
- Major Design Factors

Kyoto Face House, 1998

“What is green building?”



National Taipei University of Technology, Taipei, Taiwan

Building

+

Green

EMSD Headquarters, Kowloon Bay, Hong Kong

Green building is NOT just adding a green outlook

What is Green Building?

- A loosely defined collection of land-use, building design, and construction strategies that reduces the environmental impacts

- The term "green" is extremely wide ranging, encompassing many viewpoints and open to broad interpretation

What is Green Building?

- Green buildings are
  - Energy and resource efficient
  - Non-wasteful and non-polluting
    - Sustainable design that helps minimise broad environmental impacts (e.g. ozone depletion)
  - Highly flexible and adaptable for long-term functionality
  - Easy to operate and maintain (lower running costs)
  - Supportive of the productivity and well-being of the occupants

What is Green Roof?

- Green roofs
  - Living vegetation installed on the roofs
  - Could help mitigate urban heat island and enhance building thermal & environmental performance
  - Also known as eco-, vegetated and nature roofs
- Three major types
  - Extensive green roofs
  - Semi-intensive green roofs
  - Intensive green roofs

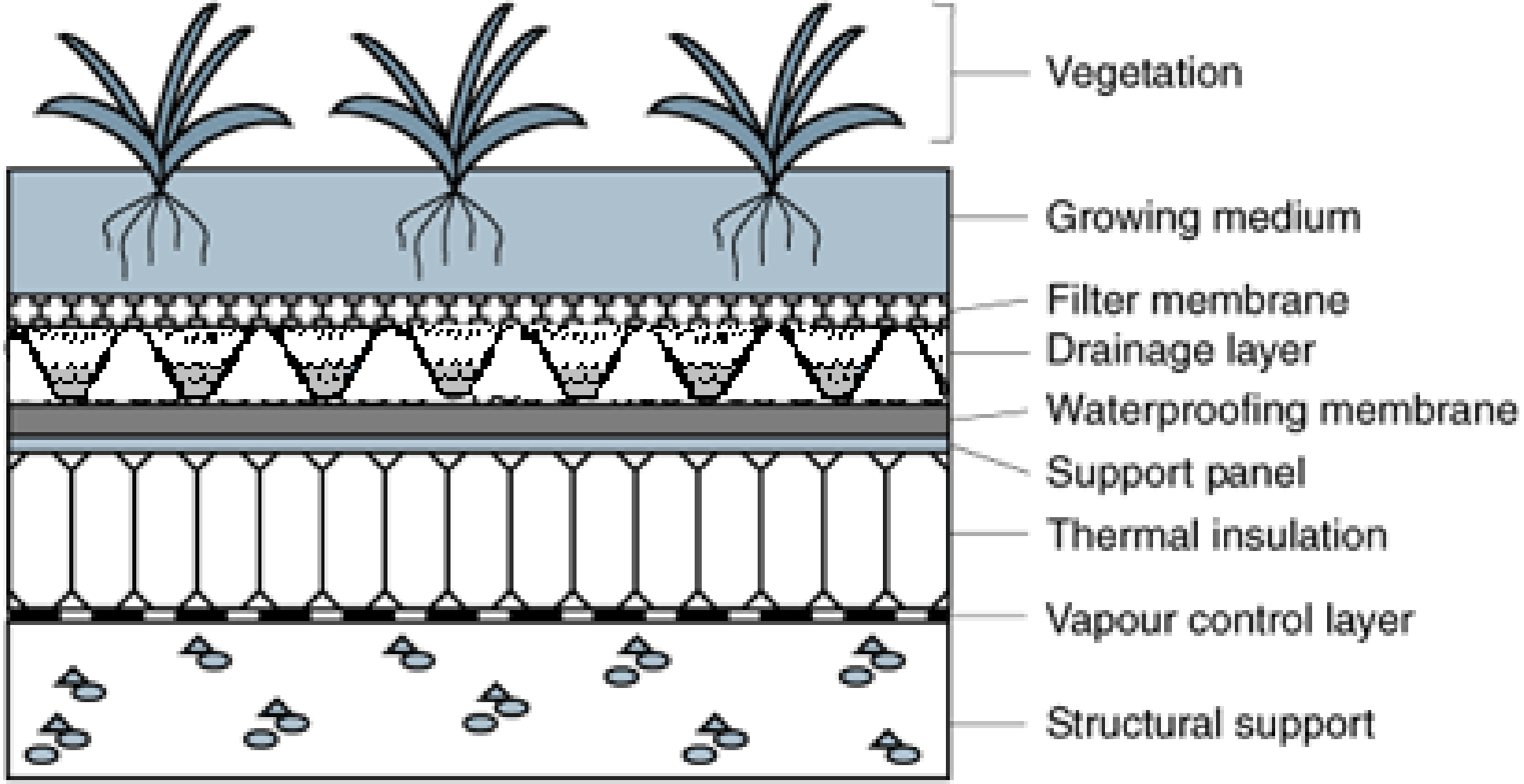
Table 1. Major types of green roofs and their characteristics

Characteristics	**Extensive**	**Semi-intensive**	**Intensive**
Depth of material	150 mm or less	Above and below 150 mm	More than 150 mm
Accessibility	Often inaccessible	May be partially accessible	Usually accessible
Fully saturated weight	Low (70-170 kg/m^2)	Varies (170-290 kg/m^2)	High (290-970 kg/m^2)
Plant diversity	Low	Greater	Greatest
Plant communities	Moss-sedum-herbs and grasses	Grass-herbs and shrubs	Lawn or perennials, shrubs and trees
Use	Ecological protection layer	Designed green roof	Park like garden
Cost	Low	Varies	Highest
Maintenance	Minimal	Varies	Highest

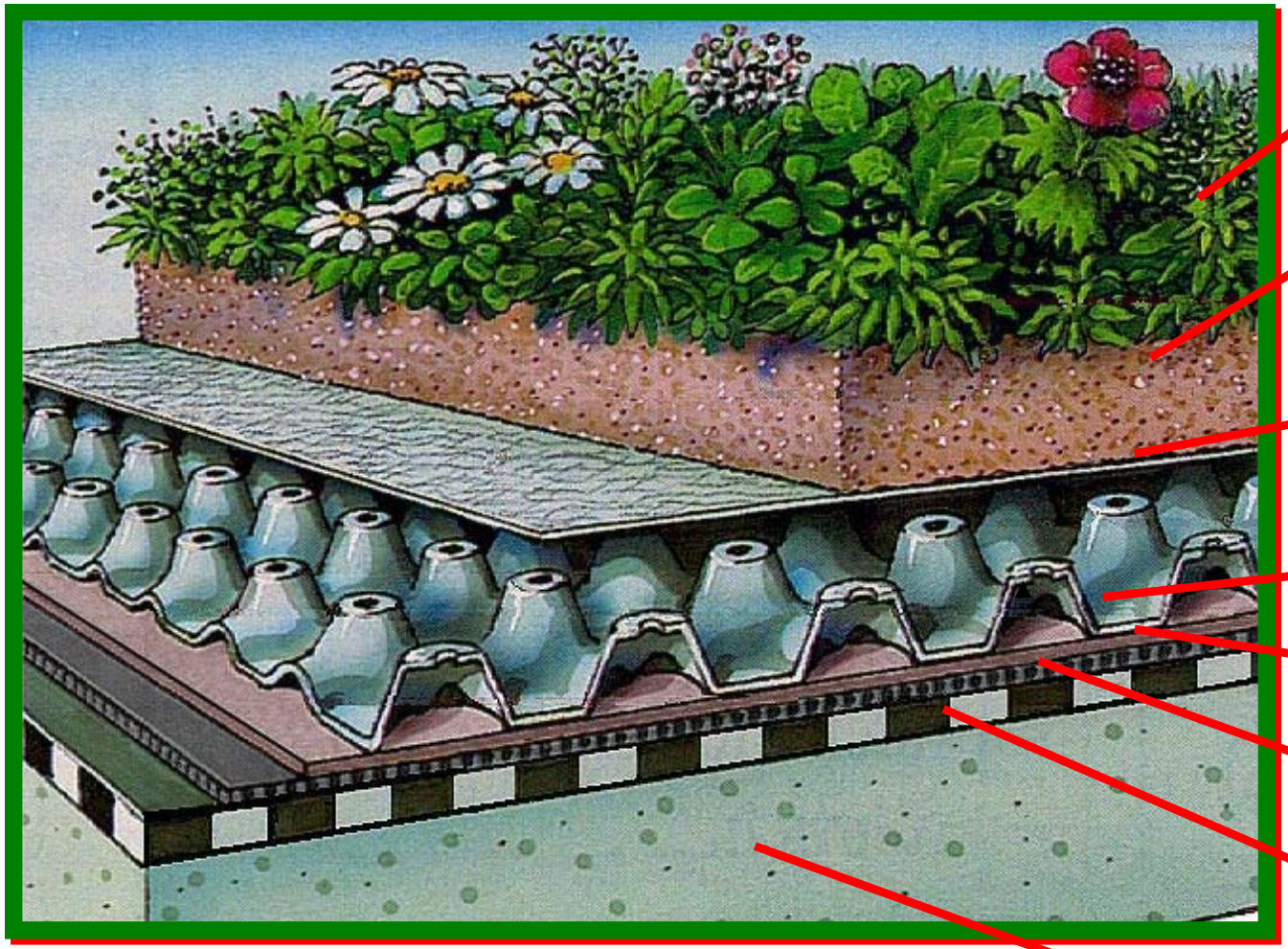
Extensive green roof
(Putrajaya International Convention Centre, Malaysia)

Intensive green roof
(Millenium Park, Chicago, USA)

Typical structure of extensive green roof



Green Roof Structure



Plant Level (植物層)

Fertilized Soil (營养土)

Filter Sheet (隔泥層)

Floradrain (儲水和排水層)

Moisture Mat (吸水層)

Root Barrier (擋根層)

Waterproofing (防水面)

Concrete Roof Top (石屎面)

[Source: Zinco (www.zinco.de) and Mr. John Yau]

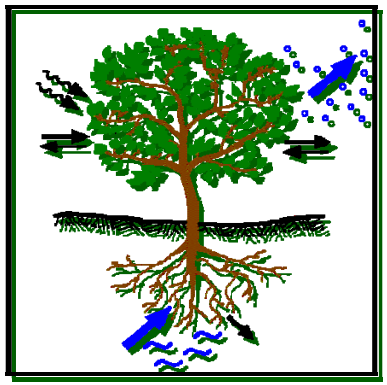
Potential Benefits

- Major aspects
  - Visual and aesthetic
  - Ecological
  - Local microclimate and thermal
  - Amenity
- Benefits for the community (public)
- Benefits for building owners & users (private)

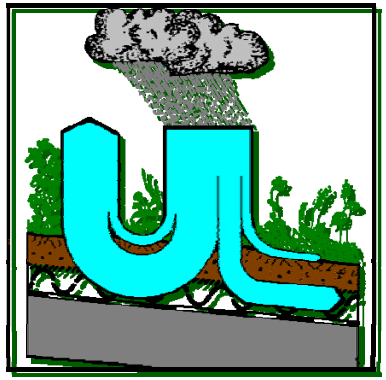
Table 2. Public and private benefits of green roof systems

Public benefits:	**Private benefits:**
- Mitigate urban heat island	- Increase roof life expectancy
- Reduce dust and pollutant levels	- Reduce noise levels
- Stormwater retention	- Enhanced thermal insulation
- Natural habitat for animals/plants	- Heat shield
- Cities and landscapes	- Better use of space
- Nature look	- Reduced risk of glare for surrounding buildings

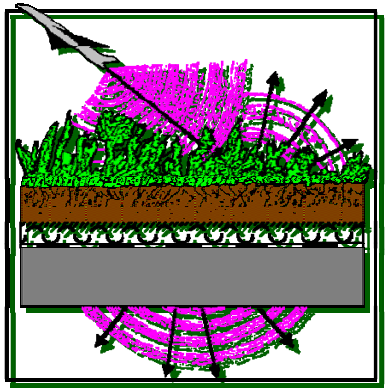
Environmental Benefits



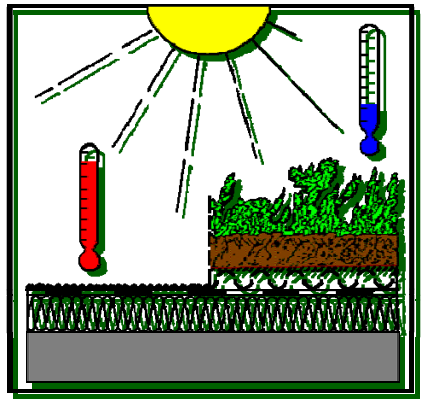
Oxygen Release



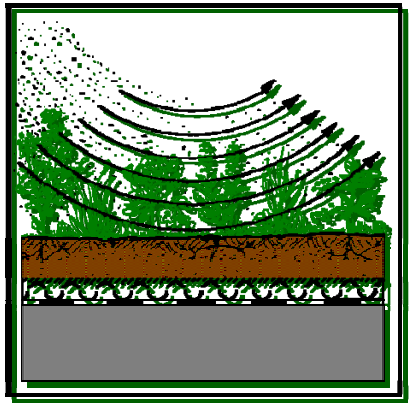
Water Retention



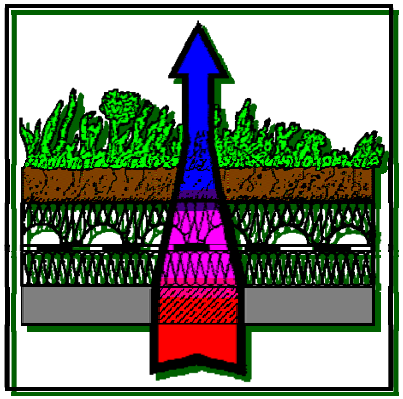
Noise Reduction



Heat Reduction

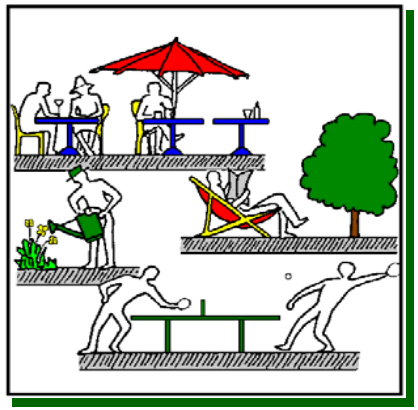


Dust Reduction



Save of Energy

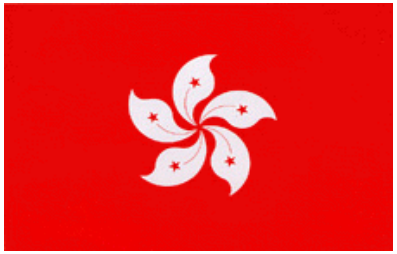
Wildlife Attraction



Use of Space

[Source: Zinco (www.zinco.de)]

Applications in Hong Kong



- Examples in public buildings
  - Hong Kong Wetland Park Phase II, Tin Shui Wai
  - Veterinary Laboratory at Tai Lung, Sheung Shui
  - Hong Kong Science Park Phase I, Shatin
  - Castle Peak Hospital extension, Tuen Mun
  - EMSD New Headquarters, Kowloon Bay
  - Canossa Primary School, San Po Kwong
- Examples in private buildings
  - • Entrance Pavilion of Kadoorie Farm, Tai Po
  - • International Finance Centre II, Central
  - • Pacific Place I and II, Admiralty

Examples of green roofs in Hong Kong

HK Wetland Park

Tai Lung Veterinary Laboratory

A school in Tsang Kwan O

EMSD New Headquarters

Green roof research at a construction site office

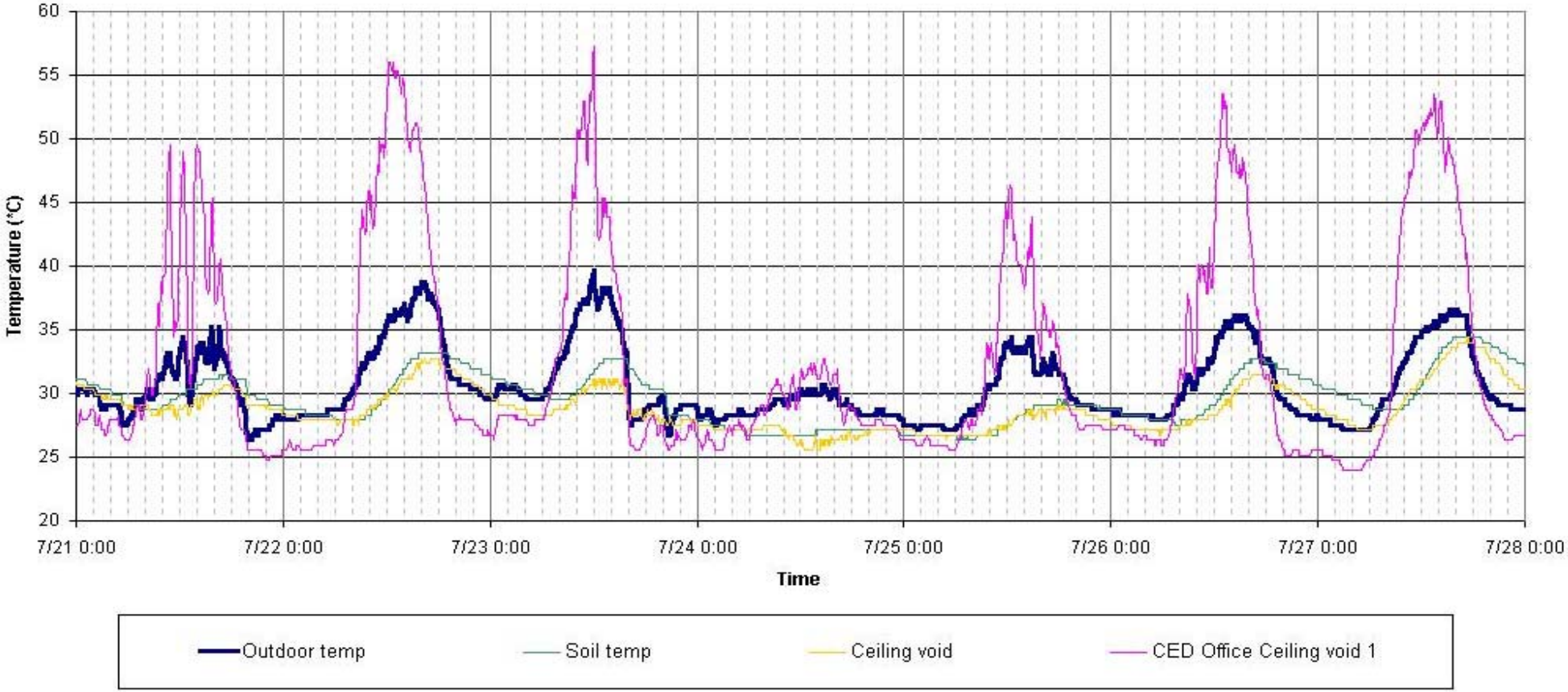
Green site office

Modular design

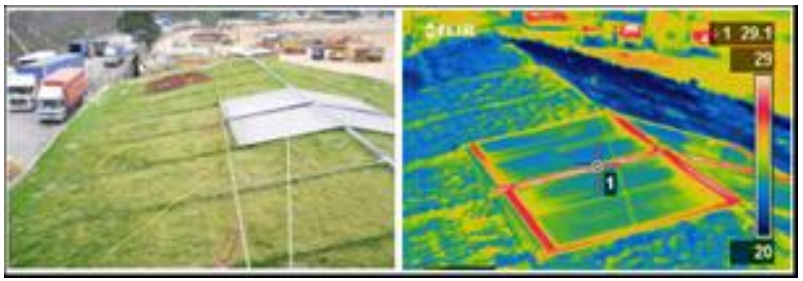
Green site office and typical site office

Water sprinkler

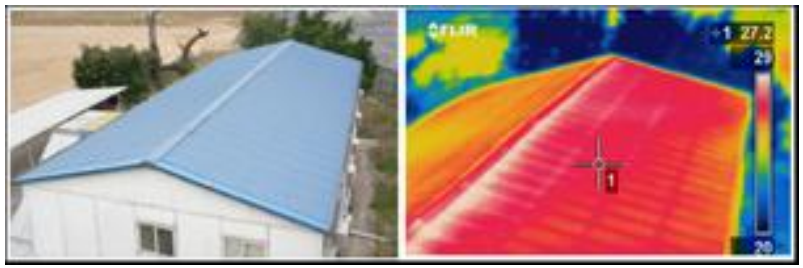
Green roof research at a construction site office (cont'd)



Infrared pictures:



Green roof



Conventional roof

Applications in Hong Kong

- Potential applications
  - New buildings
  - Existing buildings and structures
  - Carpark roofs, school buildings
  - Government & industrial buildings
- Possible forms
  - Rooftop garden, podium garden
  - Balcony planting
  - Façade greenery
- Living walls (vertical or sloped)

Potential green roof application at HKU

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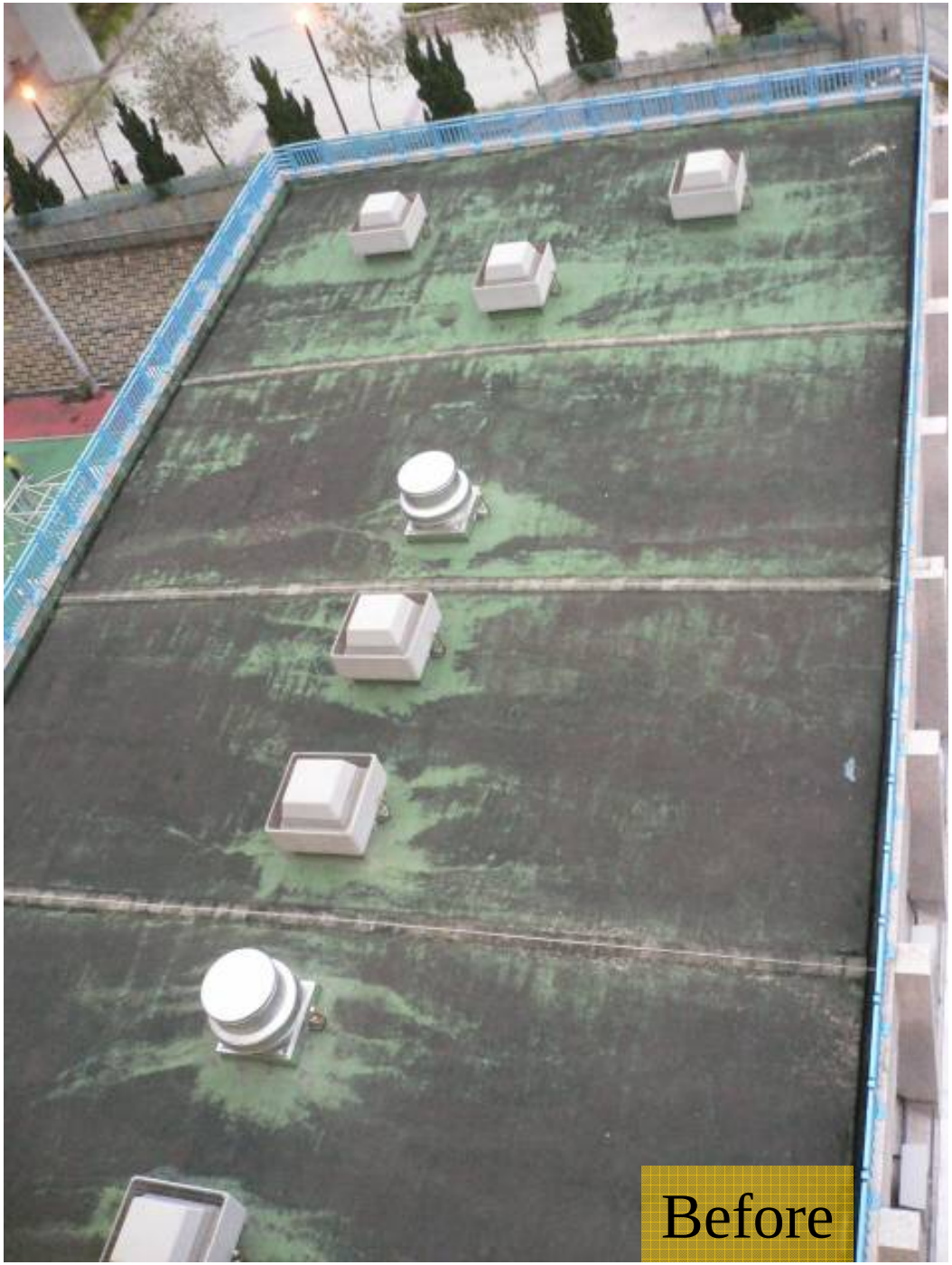
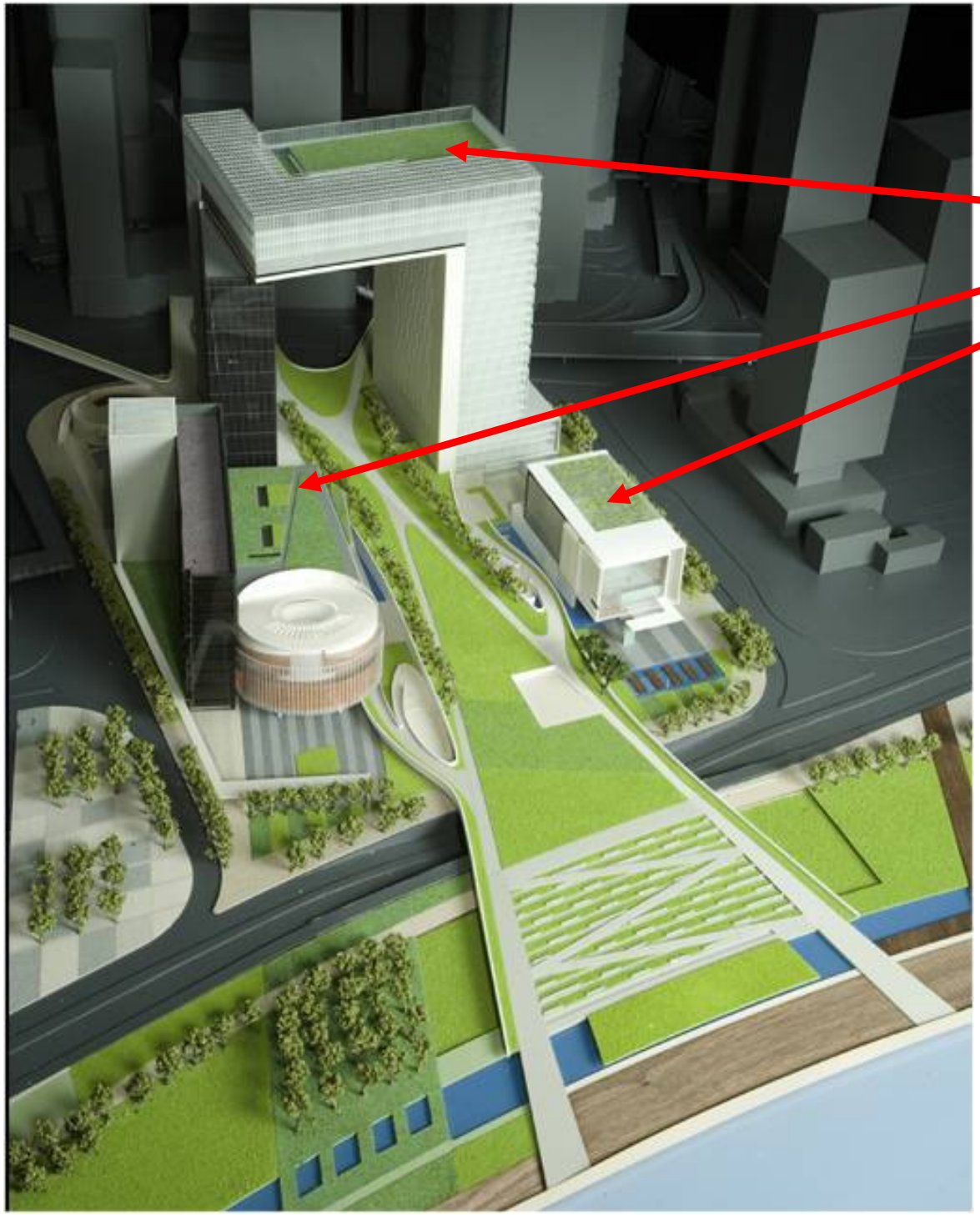
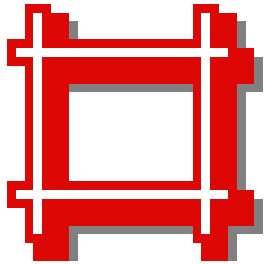
Potential green roof application at a primary school





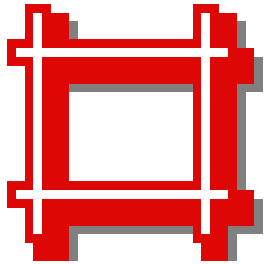
[Source: Tamar development project (www.tamar.gov.hk)]

Major Design Factors



- Green roofs design objectives:
  - Aesthetically pleasing
    - Usually “green” whole year is preferred
  - Environmentally beneficial
    - Thermal/energy performance, air quality, etc.
  - Will not compromise essential roof function
    - Such as cause water leakage and structural problems
  - Require a reasonable level of maintenance

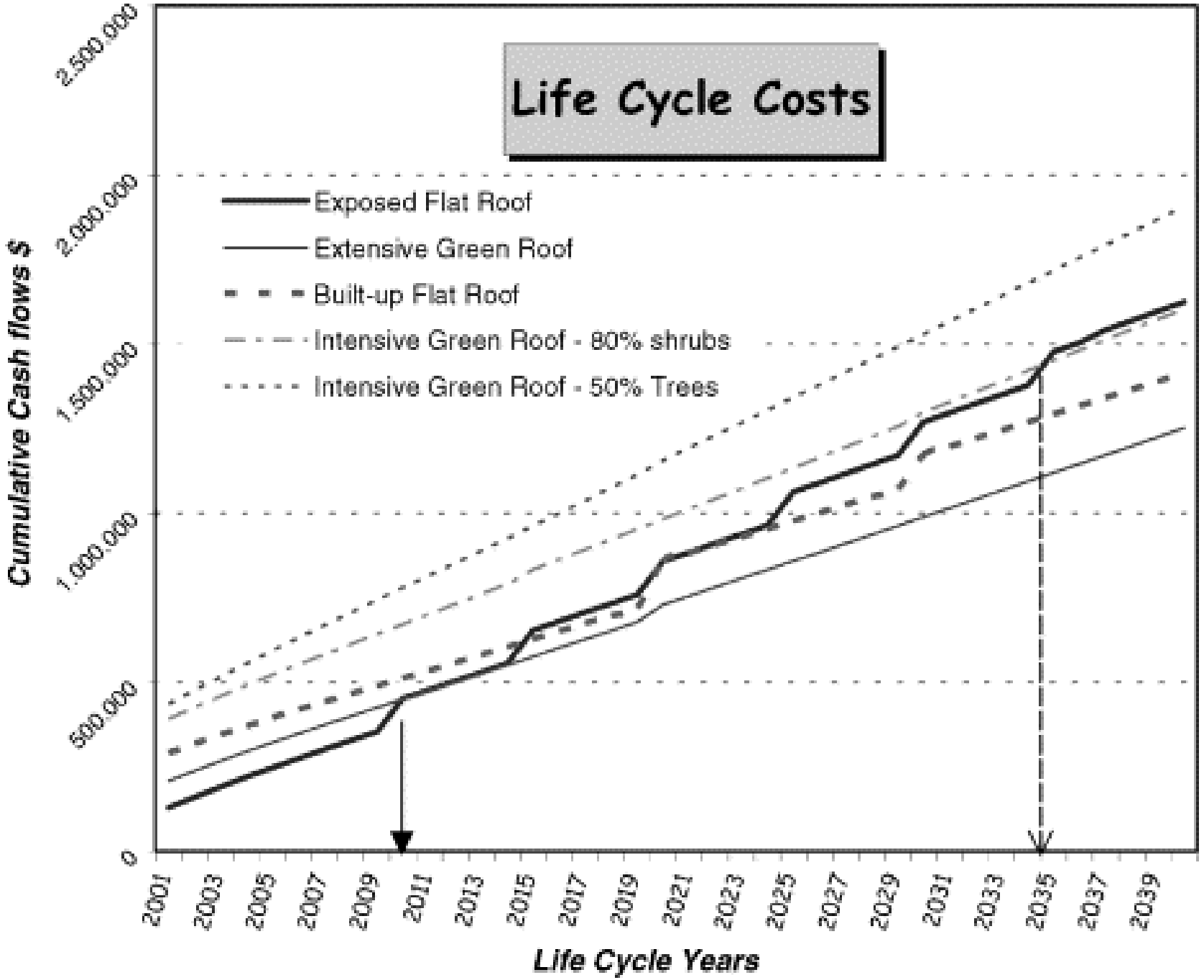
Major Design Factors



- Issues to consider:
  - Position and orientation of the roof
  - Height of the roof above ground
  - Roof pitch (flat or slopped)
  - Weight limitation of the roof
  - Preferred planting
  - Levels of maintenance
  - Possibility of rainwater recycling
  - Sustainability of components (recycled materials)

Green roof of the Tsing Yi site office (pitch roof)

Life cycle cost analysis of green roofs



Major Design Factors

- Other important factors
  - Plant species
    - Evergreen, self-generating, drought resistant
    - Such as sedum (a ground cover plant)
  - Maintenance issues
    - Watering, fertilizing, weeding, inspection of drainage
    - Usually design for low maintenance
  - Load bearing considerations
    - Dead and live loads of the roof
    - Effect of water and rainfall
  - Possibility of roof garden (accessed by all people)
  - Possibility of urban farming (e.g. for food production)

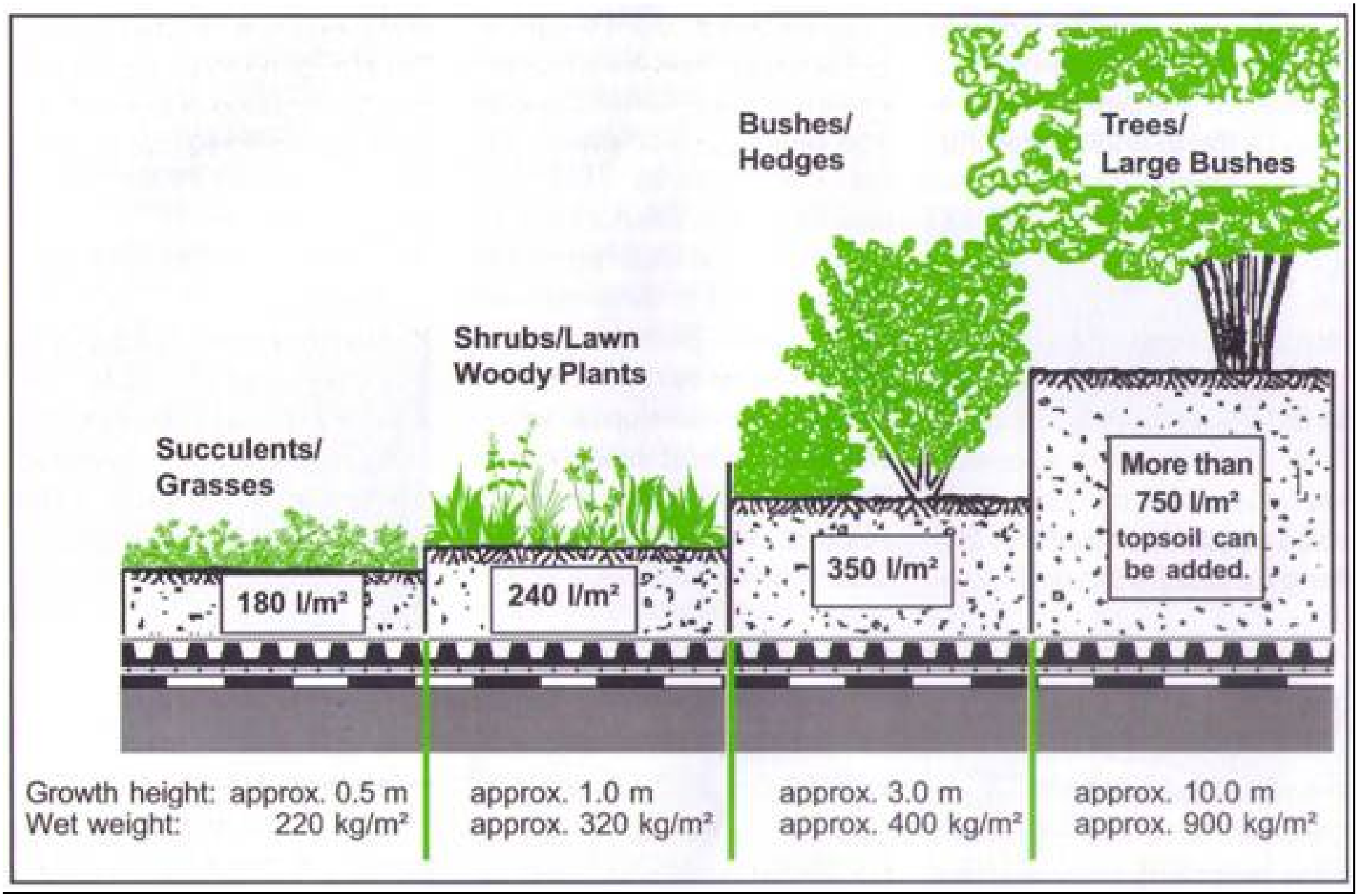
Sedum 景天科

Sedum Chinese 中國景天

Sedum mexicanum
松葉佛甲草/松葉景天

Sedum sarmentosum垂盆草

Growth height and wet weight of green roofs



[Source: Zinco (www.zinco.de)]

Roof garden example (Sino-German Centre, Beijing)

Thank You