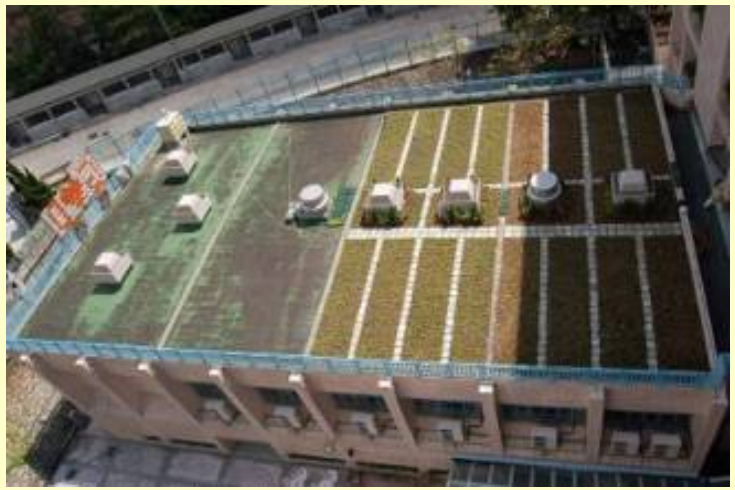
2008/2009 Roof Greening Competition for Primary & Secondary Schools in Hong Kong - Opening Ceremony & Workshop

10 October 2008, Wang Gungwu Theatre, HKU



Development of Green Roofs for School Buildings in Hong Kong

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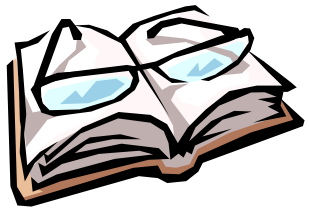
Introduction



- Problems that Hong Kong city is now facing
  - Urban heat island
  - Lack of greenery space
  - Stormwater management

- Green roofs can help to mitigate the adverse effects and provide other benefits
  - Bring the nature back to the city
  - Make better use of roof space

Examples of green roofs in Hong Kong

HK Wetland Park

EMSD Headquarters, Kowloon Bay

Parklane, Tsimshatsui

A school in San Po Kwong

(Photos taken by Dr Sam C M Hui)

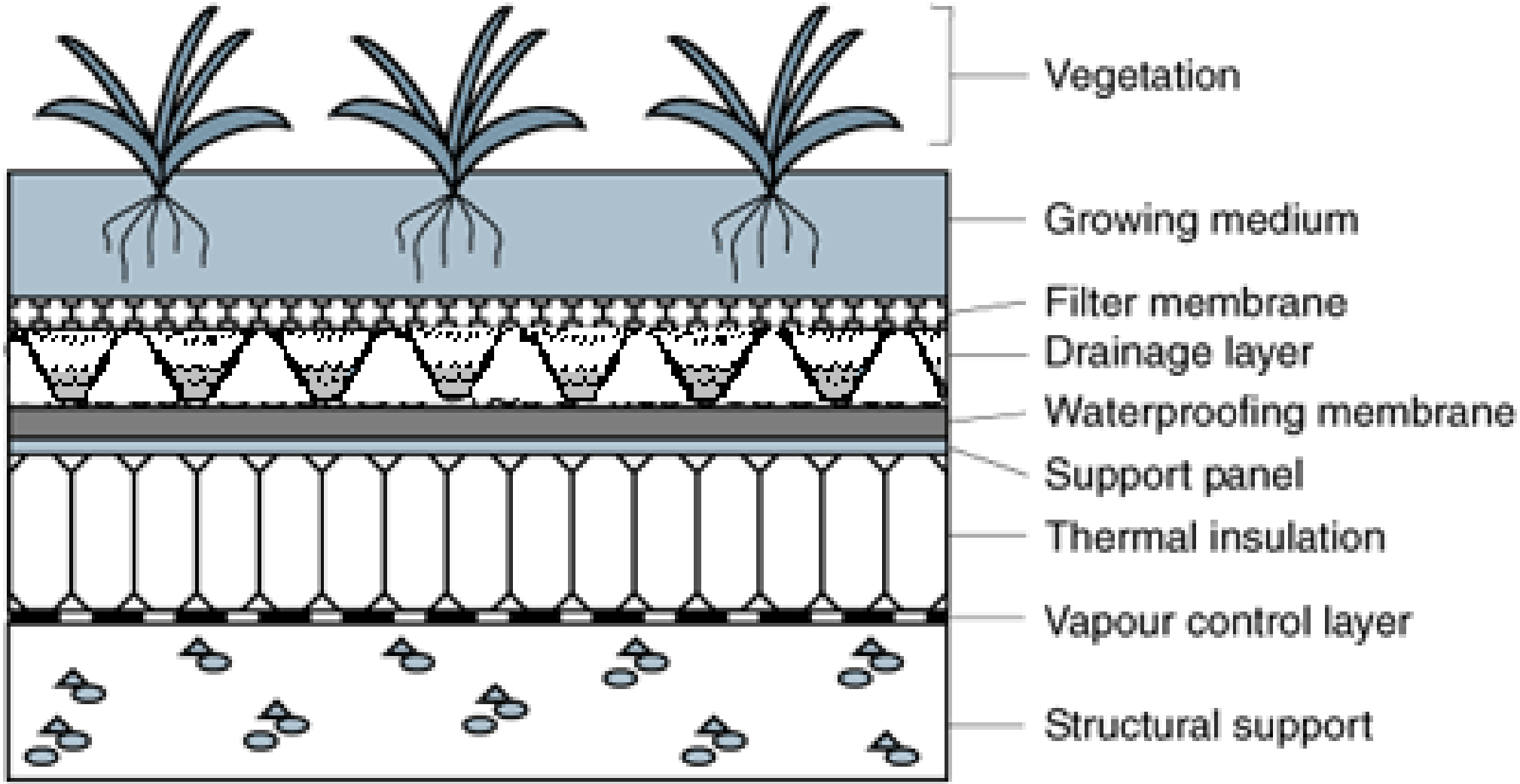
Types of green roof systems

- Major types of green roofs (see Table 1)
  - Extensive
  - Semi-intensive
  - Intensive
- Roof gardens: usually intensive greening with other features such as potted plants, pond, etc.
- Classify green roof systems by basic design:
  - Built-in green roofs
  - Modular 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

Typical structure of extensive green roof



Types of green roof systems

- Built-in green roofs
  - Installed in layers for the roof surface
  - More complex and permanent
  - Time needed for on-site installation & growing
  - Excess weight (180 to 450 kg/m^2)
  - Complexity of maintenance

- Modular green roofs
  - Prefabricated off-site, pre-grown, with modular design
  - Sub-divided into standard interchangeable parts

Types of green roof systems

- Types of modular green roofs
  - Mat system
    - Vegetated mat, pre-grown, rolled up and transported
    - Very light weight and thin (45 mm)
  - Tray system
    - Most commonly found nowadays
    - Tray containers (e.g. plastic) filled with all elements
  - Sack system
    - Sack paks easily conformed to irregular areas
    - Growing medium in fabric module ready for planting

Vegetated mat system (www.elteasygreen.com)

Tray system (www.liveroof.com)

Sack system (www.greenpaks.com)

Evaluation of their 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 (aesthetic)	- Reduced risk of glare for surrounding buildings

Evaluation of their benefits

- Other possible benefits of green roofs
  - Urban farming (e.g. growing vegetables, herbs)
    - Make best use of roof space; may be organic
  - Education (environmental, scientific, liberal study)
    - Integrated with school curriculum
  - Community and social functions
    - Exercises & hobbies for children, adults & elderly
  - Healing landscape (e.g. horticultural therapy)
    - Sensory, meditation effects; manage emotion/stress

Urban farming & education

Horticultural therapy & social functions

Planning and design

- Key factors for planning green roofs
  - Structural loading
  - Accessibility
  - Waterproofing
  - Drainage
  - Maintenance

- Other design considerations
  - Selection of plants (hardy plants, e.g. sedums)
  - Stakeholders' involvement & support

Planning and design

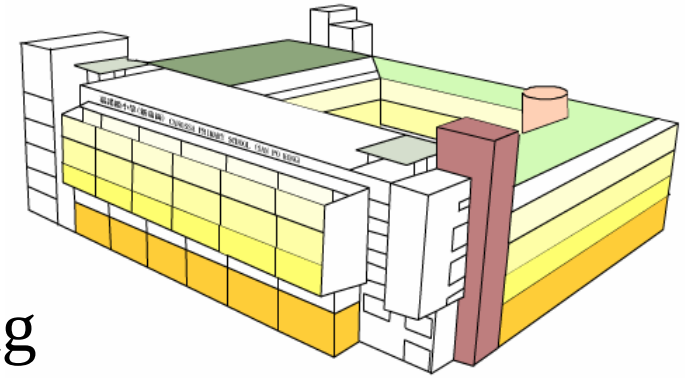
- Designing green roofs in Hong Kong
  - High-rise buildings have very limited roof area
    - More effective to apply green roof to medium- or low-rise buildings/structures
    - Occupants from surrounding can enjoy the green roof
  - Existing buildings often have constraints on roof structural loading & space
    - Select extremely light-weight green roof systems
    - Inaccessible roof: use extensive green roof
    - Accessible roof: build roof garden or hybrid systems

Planning and design

- Important climatic factors in Hong Kong
  - Typhoons
    - May blow away green roof components & vegetation. Modules & plants must be well secured and protected
  - Heavy rainfalls
    - Stormwater drainage and hygiene (mosquito) issues
  - High temperature – affect some plant species
  - Strong sunlight
    - Solar & UV effects on green roof materials & components

Applications in school buildings

- School buildings in Hong Kong
  - Different designs & ages (some new, some old)
  - Possible roofs for greening:
    - Classroom buildings
    - Assembly halls
    - Covered walkways
  - Major limitations & barriers
    - Lack of budget ($$)
    - Lack of knowledge & understanding
    - Accessibility & technical issues (e.g. water leakage fear)



Applications in school buildings

- Some primary school green roof projects (by the Architectural Services Department)

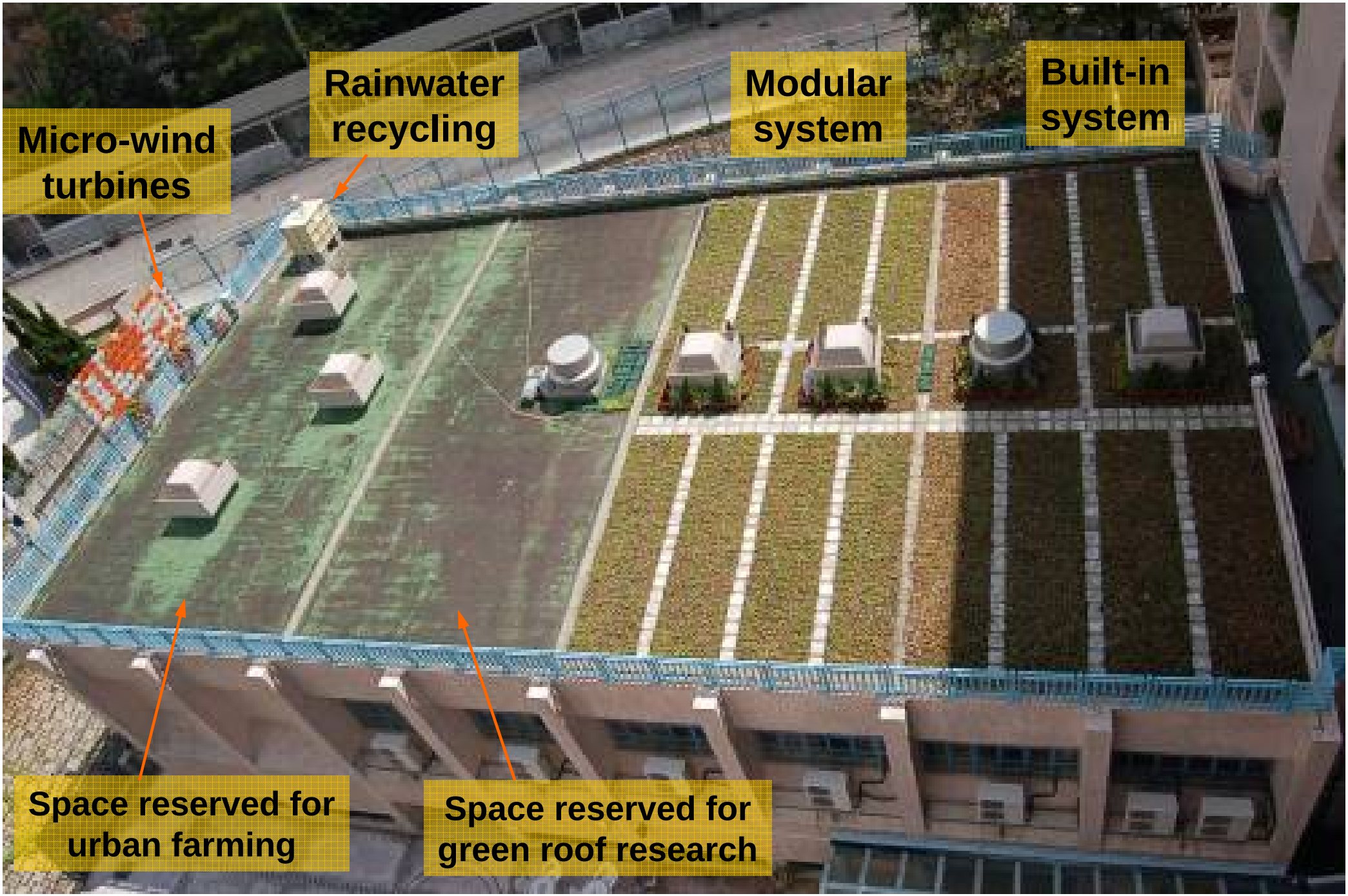
A school in San Po Kwong

A school in Tsang Kwan O

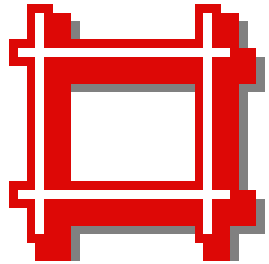
Applications in school buildings

- Our green roof research aims to develop:
  - Knowledge of green roof technology
  - Assessment and design guidelines
  - Practical information for green roof application
- Why we are interested in school buildings?
  - They have good potential for applying green roofs
  - Can demonstrate many benefits & issues
  - Can influence the local community & students
  - Can integrate/serve many education purposes

A green roof project with integrated systems in a primary school

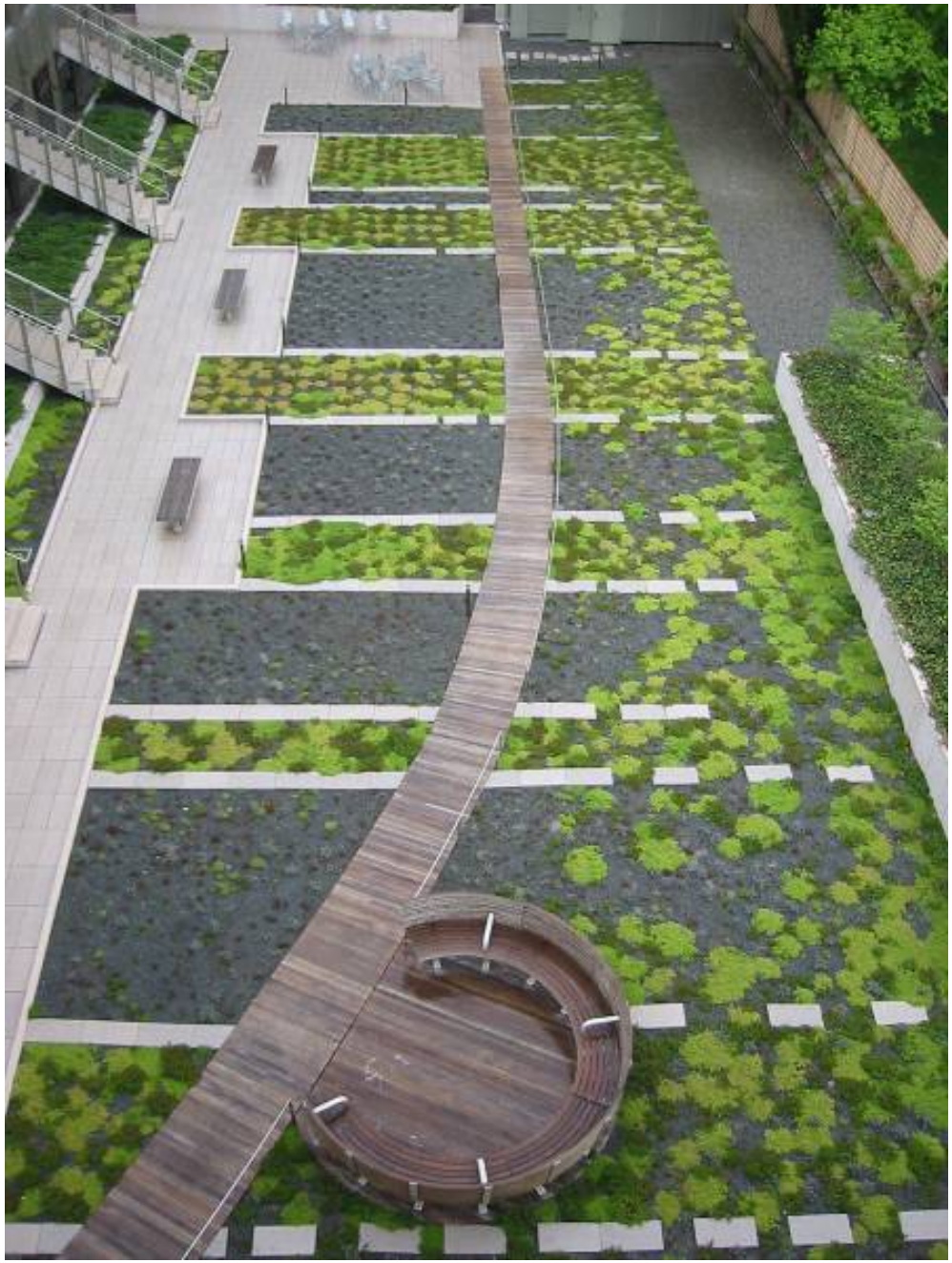


Environmental education



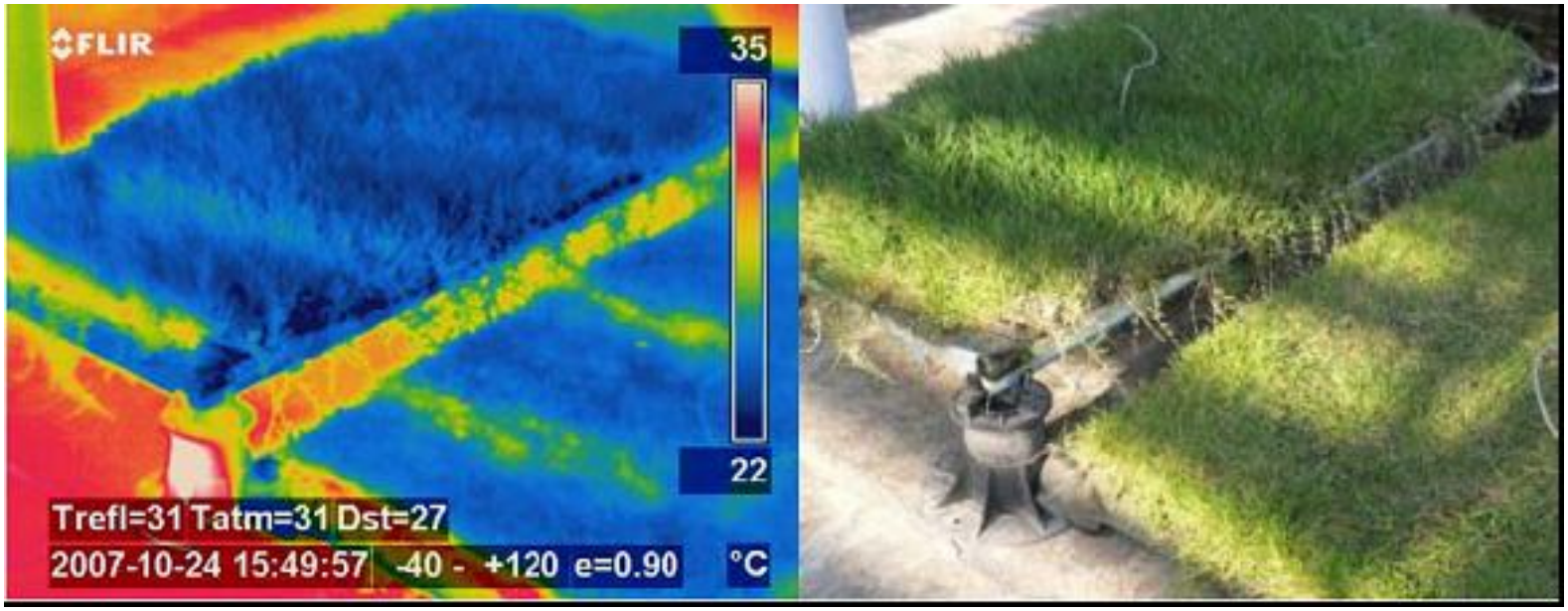
- School green roof projects
  - Allow school principal, teachers, students, parents, etc. to participate
    - They see, feel & help to maintain the green roof
  - Form part of the learning activities or school curriculum for students
    - Environmental awareness
    - Science education
    - Horticulture
  - Provide space & opportunities for other functions
    - Such as urban farming & community activities

Innovative and interesting green roof designs



Environmental education

- Possible learning topics from green roofs
  - Biodiversity
  - Building & roof construction
  - Energy conservation
  - Gardening & horticulture
  - Natural habitat
  - Thermal insulation
  - Urban heat island
  - Water conservation



Infrared photo for assessing thermal effects

Typical hardy plants (sedums) used for green roofs

Conclusions

- Green roofs can provide many benefits to mitigate environmental problems in cities
- When applied to school buildings, green roofs can achieve both environmental and educational purposes
- More efforts are needed in Hong Kong to develop design guidelines & practical experience for green roof application

THANK YOU !!

The green roof volunteers in Hong Kong

(Our green roof research information can be found at: www.hku.hk/bse/greenroof/)