MEBS6020 Sustainable Building Design

http://www.hku.hk/bse/MEBS6020/

# Sustainable Masterplanning (I)

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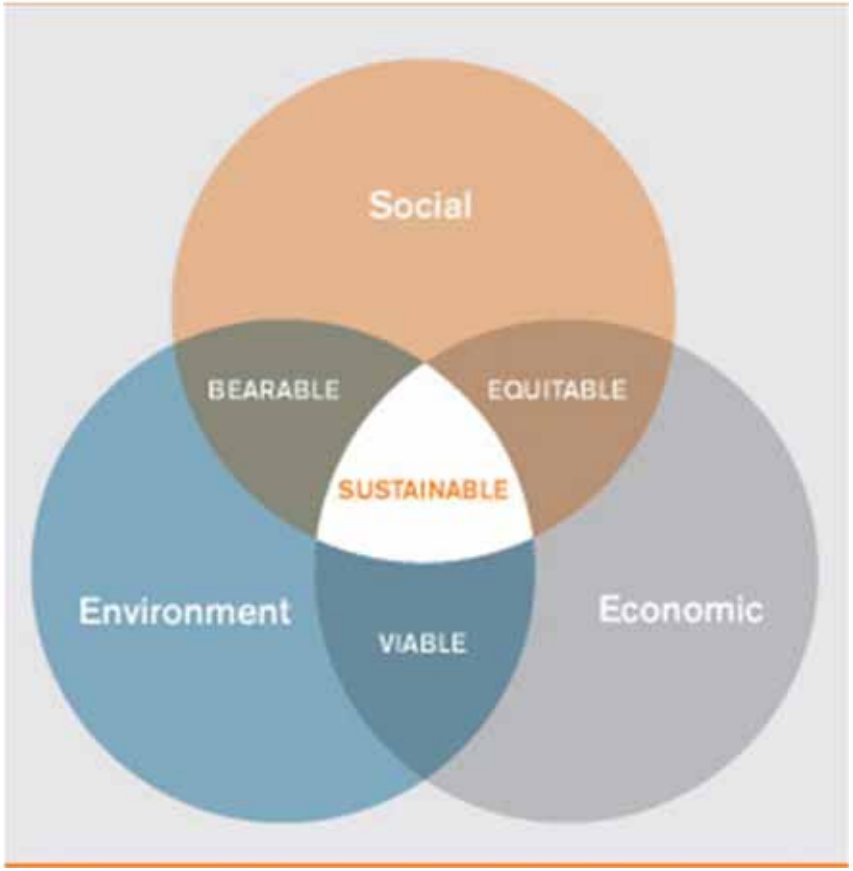


# Masterplanning

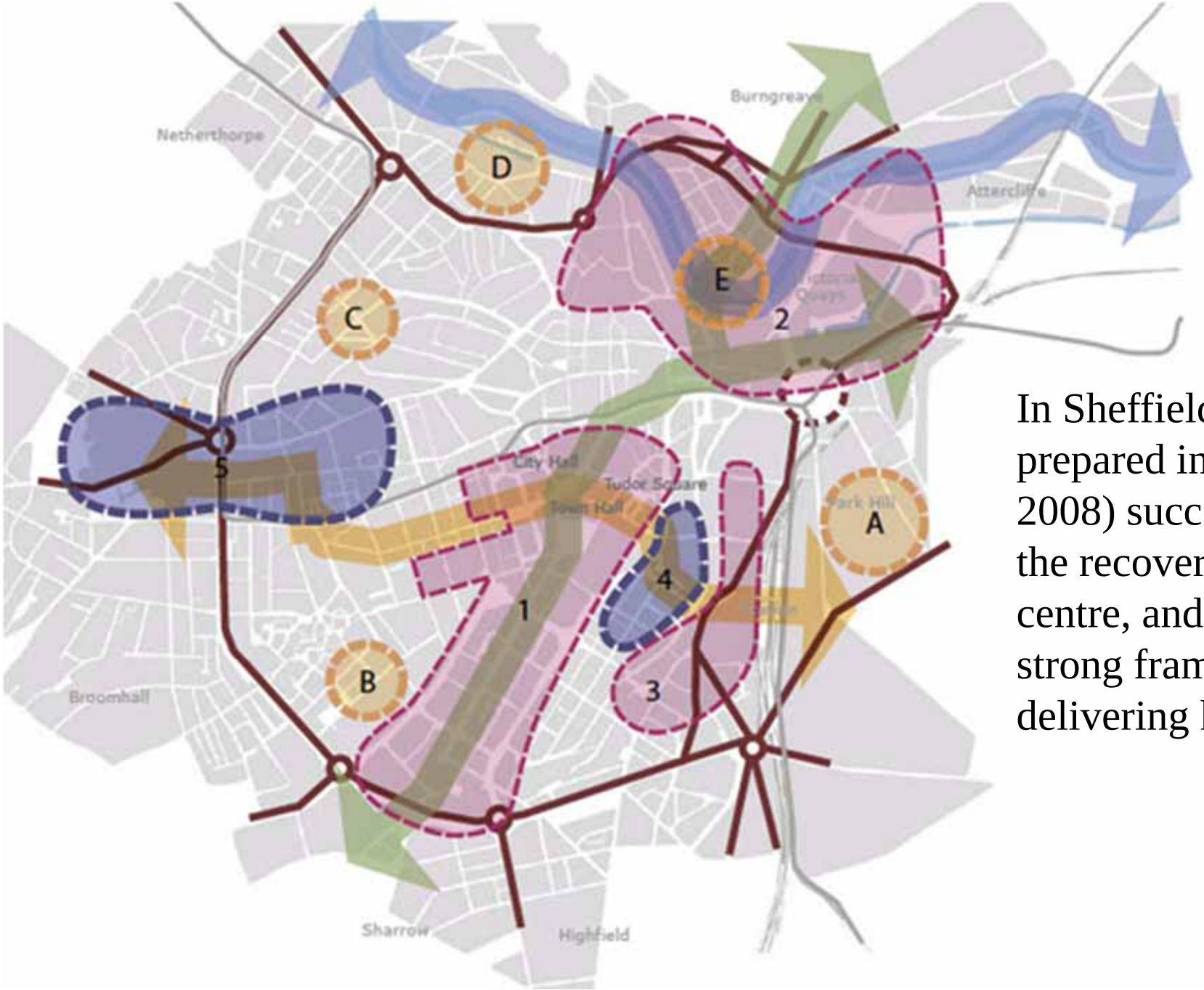
- Masterplanning
  - Strategic planning (i.e. vision), for a large-scale, long-term development project
  - Set down the fundamental principles for a place
  - Help produce different spatial plans and strategies – for example, design codes, design guides, development briefs and strategic frameworks
  - Useful in a range of scenarios in different places, from schemes for entire towns and cities, down to small-scale rural developments

# Masterplanning

- Spatial masterplans
  - They set out proposals (design patterns) for buildings, spaces, movement strategy and land use in three dimensions and match these proposals to a delivery strategy
  - This means a drawn plan, supported by financial, economic and social policy documents and detail about how the plan will be delivered
  - Cover a wide range of spatial scales and timescales (from city scale to groups of buildings)

# Sheffield city centre masterplan (UK)

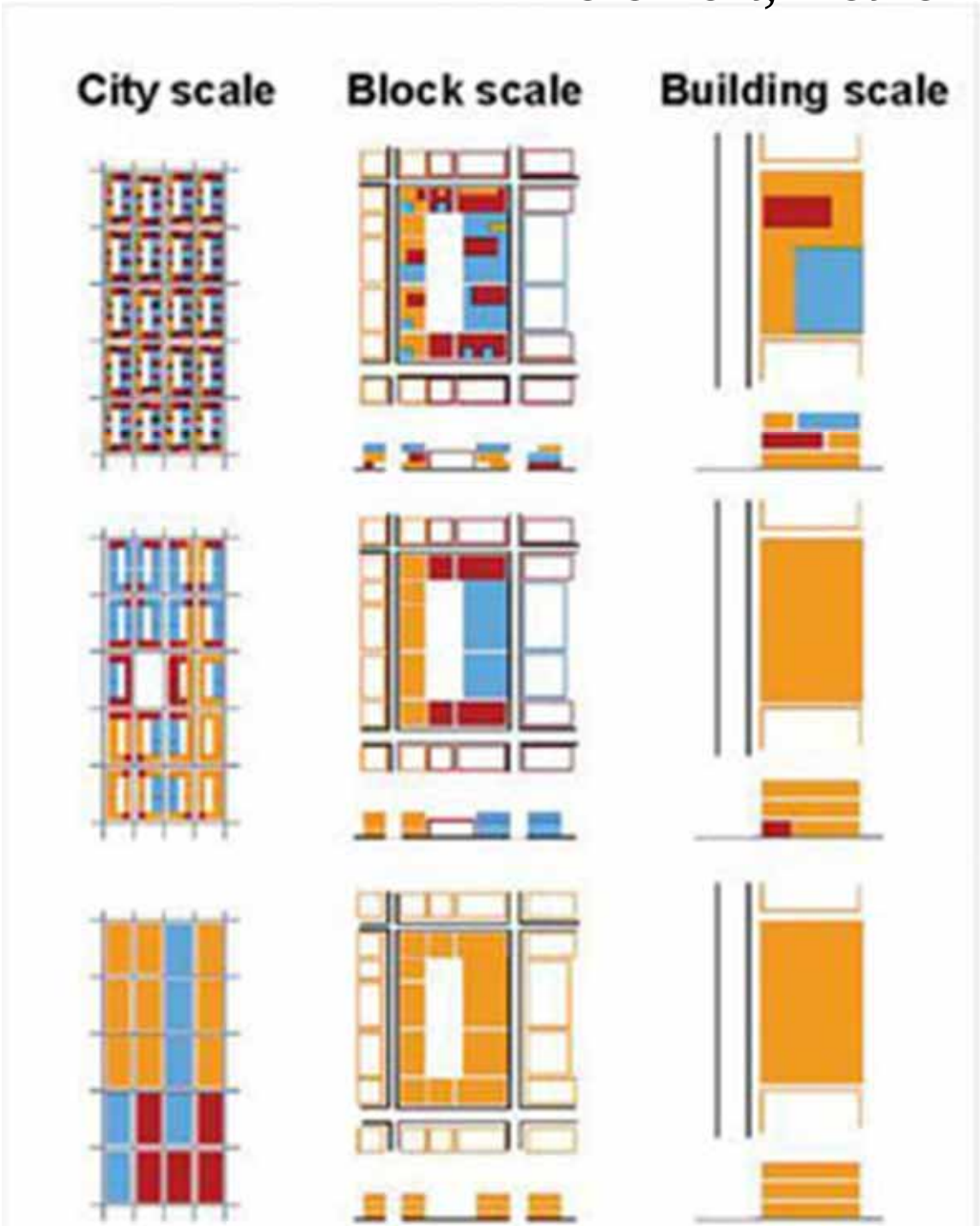
(www.creativesheffield.co.uk/DevelopInSheffield/CityCentreMasterplan/)




In Sheffield, a masterplan prepared in 2000 (revised in 2008) successfully guided the recovery of the city centre, and provided a strong framework for delivering key projects.

(Source: www.cabe.org.uk/masterplans)

# Almere Port, Netherlands




These diagrams show the use of generic modelling to illustrate the impact of a mix of uses at the scale of the building, block and the city area. Such analysis can help to consider the impact of different development options on city character, building design and development economics. Investigations of this sort are needed to test the viability of proposals and ensure that they are fully understood.

(Source: www.cabe.org.uk/masterplans)

# Masterplanning

- Masterplanning animation (4:00)
  - http://vimeo.com/11104400
  - Designing sustainable cities, three aspects - three plans. An animation shot by rods & cones film, depicting planning strategies in recent masterplans by vandkunsten in collaboration with hausenberg (from Denmark)
    - 1. Using the local potential
    - 2. Make it liveable
    - 3. Initializing a strategy

# Masterplanning

- Examples of masterplans in Hong Kong
  - West Kowloon Cultural District (WKCD) conceptual plan options
    - Options unveiled (2:10), http://youtu.be/Hn5aIOy98o8
    - www.wkcda.hk/pe2/en/conceptual/
    - Foster + Partners
    - Rocco Design Architects Ltd.
    - Office for Metropolitan Architecture (OMA)

# Masterplanning

- Examples of masterplans in HK (cont'd)
  - Hong Kong International Airport Master Plan 2030, www.hkairport2030.com

  - HKU centennial campus masterplan
    - www3.hku.hk/cecampus/
    - www3.hku.hk/cecampus/eng/planning/masterplan_8.php
  - CUHK campus master plan
    - www.cuhk.edu.hk/cmp/en/
  - HKBU campus master plan
    - www.hkbu.edu.hk/~cep/


(Image source: www.hku.hk)

# HKU Campus Masterplan (in 2006)

(Image source: www.hku.hk)

# Masterplanning

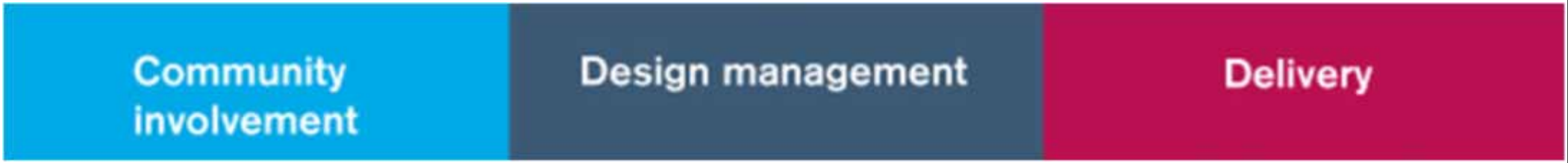
- Related professionals:
  - Developers
  - Planners
  - Urban designers
  - Architects
  - Engineers
  - Government/Local authorities (planning)

- Other stakeholders: local community, proposed end-users, facility managers

# Masterplanning

- The Masterplanning process
  - A useful step-by-step guide:
    - Creating successful masterplans: A guide for clients [Commission for Architecture and the Built Environment, CABE], www.cabe.org.uk/masterplans
  - Key issues:
    - Community involvement
    - Design management
    - Delivery (implementation)

# The masterplaning process at a glance




| | |
|---|---|
| **1. Prepare for the masterplanning process**<br>- Clarifying aims and objectives<br>- Planning community involvement<br>- Developing the vision<br>- Assembling the client team<br>- Preparing an outline business case | **2. Define the project brief**<br>- Preparing a project brief<br>- Understanding the place<br>- Maintaining a focus on quality<br>- Preparing a strategic framework<br>- Planning how to deliver the project<br>- Selecting partners |
| **3. Design the final masterplan**<br>- Managing the design process<br>- Generating and testing detailed options<br>- Finalising the masterplan<br>- Adopting or approving a masterplan | **4. Implement your masterplan**<br>- Managing implementation<br>- Developing mechanisms to deliver quality<br>- Preparing a design code |

(Source: www.cabe.org.uk/masterplans)

# Masterplanning

- How to be more sustainable: (a useful website)
  - Sustainable places [Commission for Architecture and the Built Environment, CABE], www.cabe.org.uk/sustainable-places
    - Give expert advice on planning, designing and managing a sustainable place
    - Priorities and common themes: energy, waste, water, transport, green infrastructure and public space
    - Spatial scales: subregions, cities and towns, neighbourhoods or buildings and spaces

The Sustainable Places priorities and common themes

| | |
|---|---|
| **1. Energy**<br>- Develop a low carbon and renewable energy portfolio<br>- Reduce energy demand | **4. Transport**<br>- Encourage public transport, walking and cycling<br>- Reduce car use and improve the carbon efficiency of vehicles |
| **2. Waste**<br>- Plan for sustainable waste management<br>- Turn waste into energy | **5. Green infrastructure**<br>- Integrate green infrastructure into urban areas<br>- Help wildlife adapt to climate change |
| **3. Water**<br>- Manage surface water and flood risk<br>- Encourage sustainable water use | **6. Public space**<br>- Adapt public space to climate change<br>- Maximise the potential of public space |

(Source: www.cabe.org.uk/sustainable-places)

# Sustainable communities

- Definitions of sustainable communities:
  - “those that are capable of maintaining their present levels of growth without damaging effects” – US National Resources Defense Council (NRDC)
  - “places where people want to live and work, now and in the future” – UK Department of Communities and Local Government (CLG)
    - Meet the diverse needs of existing & future residents; sensitive to their environment; contribute to a high quality of life; safe & inclusive; well planned, built & run; equality of opportunity & good services for all

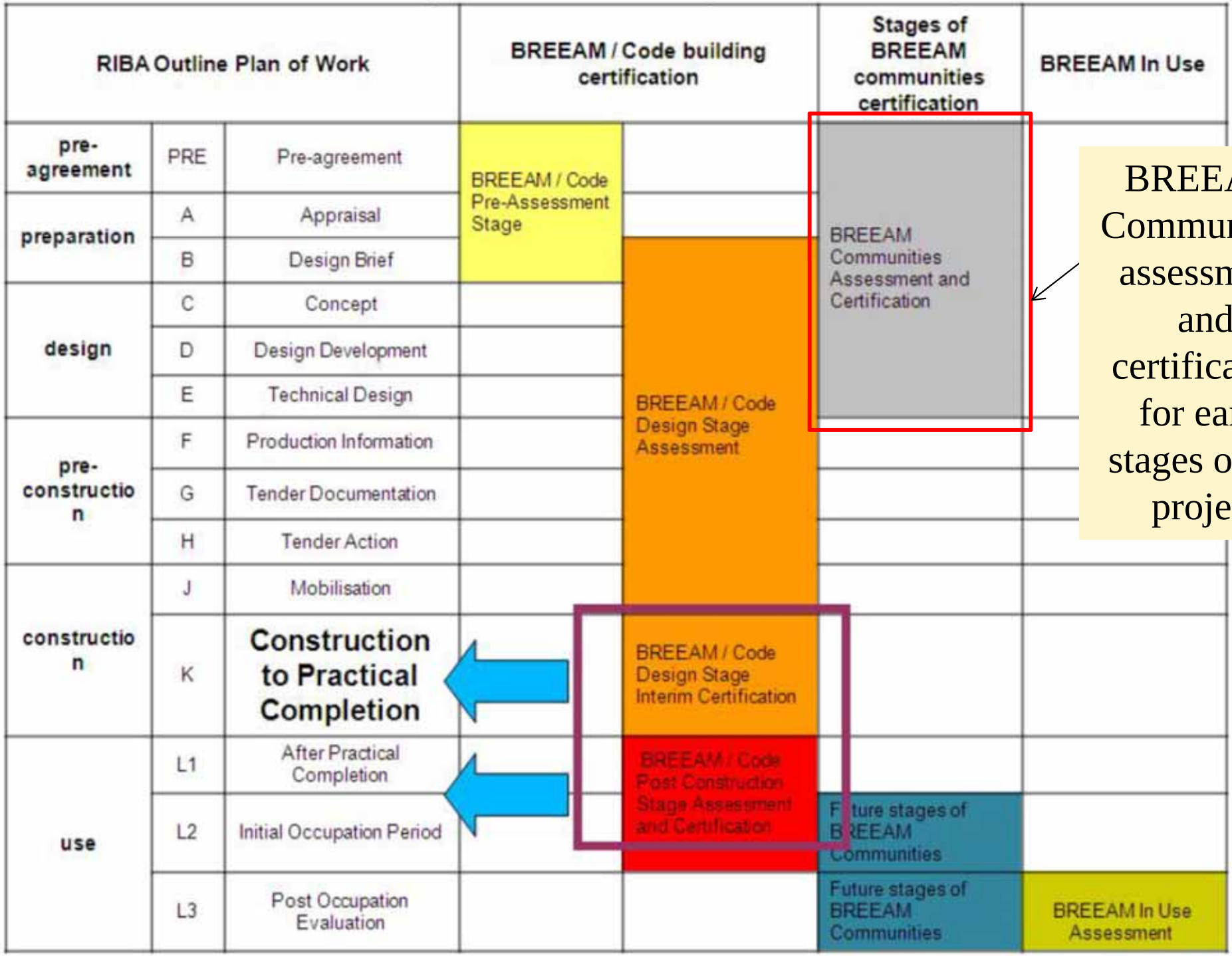
# Sustainable communities

- Other related terms: smart growth, sustainable neighbourhood development
- Decisions that impact on the sustainability of a community:
  - Development of government policy
  - Regional spatial strategies
  - Local development frameworks
  - Masterplanning
  - Detailed design of individual developments

# Sustainable communities

- Evaluation tools:
  - BREEAM Communities
    - BREEAM = Building Research Establishment Environmental Assessment Method
    - By UK Building Research Establishment (BRE)
    - www.breeam.org/communities
  - LEED for Neighborhood Development
    - LEED = Leadership in Energy and Environmental Design
    - By US Green Building Council
    - www.usgbc.org/leed/nd/

# BREEAM systems and stages of development




(Source: www.breeam.org/communities) RIBA = Royal Institute of British Architects

# The eight categories of BREEAM Communities

| | |
|---|---|
| **1. Climate Change and Energy**<br>flooding, heat island, water efficiency, sustainable energy, site infrastructure | **5. Transport and Movement**<br>general policy, public transport, parking, pedestrians and cyclists, proximity of local amenities, traffic management, car clubs |
| **2. Community**<br>promote community networks and interaction, involvement in decision making, support public services, social economy and community structure, and community management of the development | **6. Ecology**<br>conservation, enhancement of ecology, planting |
| **3. Place Shaping**<br>efficient use of land, design process, form of development, open space, adaptability, inclusive communities, crime, street lighting/light pollution security lighting | **7. Resources**<br>appropriate use of land resources, environmental impact, locally reclaimed materials. water resource planning, refuse composting, noise pollution, construction waste |
| **4. Buildings**<br>EcoHomes / BREEAM or Code for Sustainable Homes | **8. Business**<br>competitive business, business opportunities, employment, business types |

(Source: www.breeam.org/communities)

# LEED for Neighborhood Development (LEED-ND): credit categories

## 1. Smart Location & Linkage (where to build)

- encourages communities to consider location, transportation alternatives, and preservation of sensitive lands while also discouraging sprawl

## 2. Neighborhood Pattern & Design (what to build)

- emphasizes vibrant, equitable communities that are healthy, walkable, and mixed-use

## 3. Green Infrastructure & Buildings (how to manage env. impacts)

- promotes the design and construction of buildings and infrastructure that reduce energy and water use, while promoting more sustainable use of materials, reuse of existing and historic structures, and other sustainable best practices

## 4. Innovation & Design Process

- recognizes exemplary and innovative performance reaching beyond the existing credits in the rating system, as well as the value of including an accredited professional on the design team

## 5. Regional Priority Credit

- encourages projects to focus on earning credits of significance to the project's local environment

(Source: www.usgbc.org/leed/nd/)

# Sustainable neighborhood development checklist

## 1. Smart Location & Linkage

- Location
- Ecosystems and open spaces
- Contaminated sites
- Transit-accessible locations
- Cycling facilities
- Jobs and housing proximity

## 2. Neighborhood Pattern & Design

- Walkable streets
- Compact development
- Neighborhood connections
- Mixed uses
- Affordable and diverse housing
- Parking and transportation demand
- Parks and recreation
- Universal design
- Community participation
- Local food
- School access and design

## 3. Green Infrastructure & Buildings

- Construction techniques
- Energy efficiency and conservation
- Energy production and distribution
- Water efficiency and conservation
- Stormwater and wastewater
- Green building process
- Historic and existing building reuse
- Heat islands
- Recycling and reuse
- Light pollution

(Source: www.usgbc.org/leed/nd/)

# Land use and density

- Sustainable land use
  - Developers vs. Planning authority
  - Developers
    - Land buyers, purchase a site as an investment
    - Aim to maximise return on investment
  - Planning authority (or government)
    - Strategic view of the long-term needs for the area
    - Guide the use and development of land
  - Ideal situation: the objectives of developers and planning authority are in harmony

# Land use and density

- Greenfield versus Brownfield
  - Greenfield = sites that have not previously been built on (e.g. countryside)
    - Protect its wildlife, landscapes and heritage
  - Brownfield = development in built-up areas
  - Sometimes, the most sustainable option is:
    - To refurbish existing buildings rather than demolish and build new (“sustainable refurbishment”)
  - Mitigation measures: extensive use of soft landscaping & green roofs, water bodies, trees

# Example: Headquarters of the Electrical and Mechanical Services Department (EMSD) at Kowloon Bay (Reuse of a former air cargo terminal building, HACTL2 Building)

(Further info: www.emsd.gov.hk/emsd/e_download/about/new_hqs_commemorative_booklet/)

(Image source: www.emsd.govhk)

# Land use and density

- Conditions and nature of site
  - Issues in a brownfield site
    - Contaminated land and underground obstructions
    - Asbestos (石棉) in existing buildings
  - Obstacles in a greenfield site
    - High ecological value (e.g. protected trees, flora, fauna)
    - On a migratory route of birds
  - Topography (地形) and ground conditions
    - Building on a slope is more expensive (e.g. HKU)
    - Take advantage of slope for view, sun/wind exposure

# Land use and density

- Flood risk
  - Become a focus in the global warming debate
    - Such as flooding in Bangkok, Taiwan and Hong Kong
  - Attenuation of flood water by a combination of soft landscape and green roofs
  - Uncontrolled growth of development in river catchment areas => increase in flood events

# Land use and density

- Accessibility and transport

  - A poorly connected residential development
    - Separate from the community; heavy reliance on cars
    - Critical mass required to form a viable community
  - The ideal: all able to walk or cycle safely to the amenities (e.g. schools, healthcare, shops); good links to centres of employment & transport hubs

- Infrastructure and services (capacity)
  - Existing infrastructure of utilities and roads
  - Demand reduction measures & on-site renewables

# Land use and density

- Density of development
  - Major factors to consider:
    - Efficient use of land (dwellings per unit land area)
    - Sustainability of tall buildings (??)
    - Social impacts of high rise development
  - High density cities and development
    - Support closer amenities
    - Encourage reduced trip lengths & public transport
    - Economic advantage: ‘agglomeration effect’ through businesses clustering, economic of scale, etc.

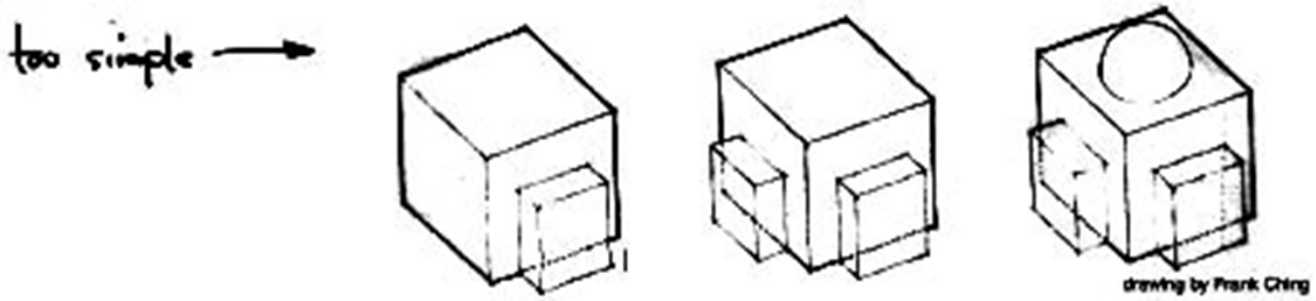
# Hong Kong

# Land use and density

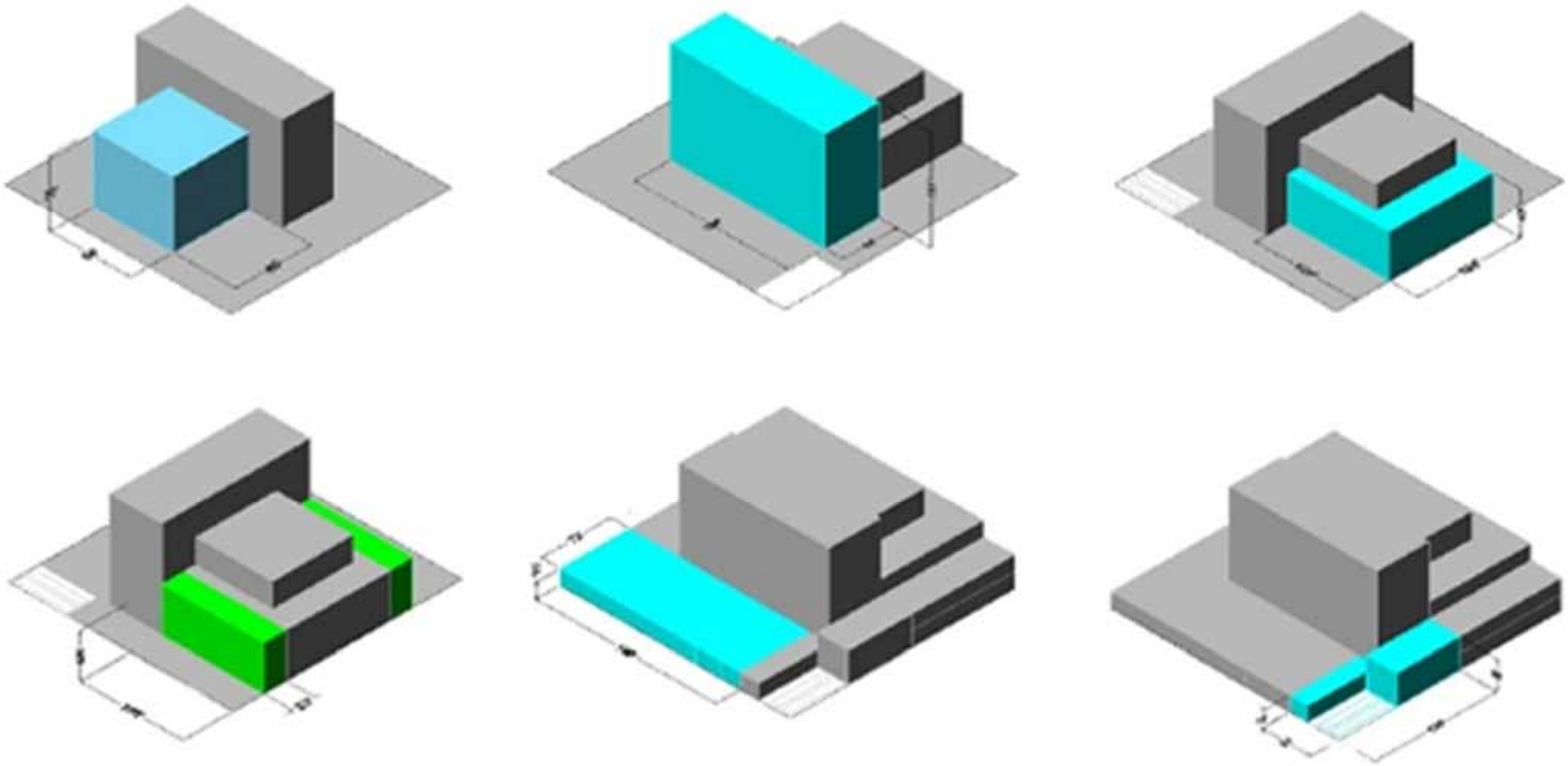
- Land use planning and zoning (in HK)
  - Town Planning Board, www.info.gov.hk/tpb/
    - Outline zoning plans (OZP)
    - Development permission area (DPA) plans
    - Urban Renewal Authority (URA) development scheme plans
  - Planning Department, www.pland.gov.hk
    - Hong Kong Planning Standards & Guidelines
    - Planning studies and development strategies
  - Lands Department, www.landsd.gov.hk

# Massing and microclimate

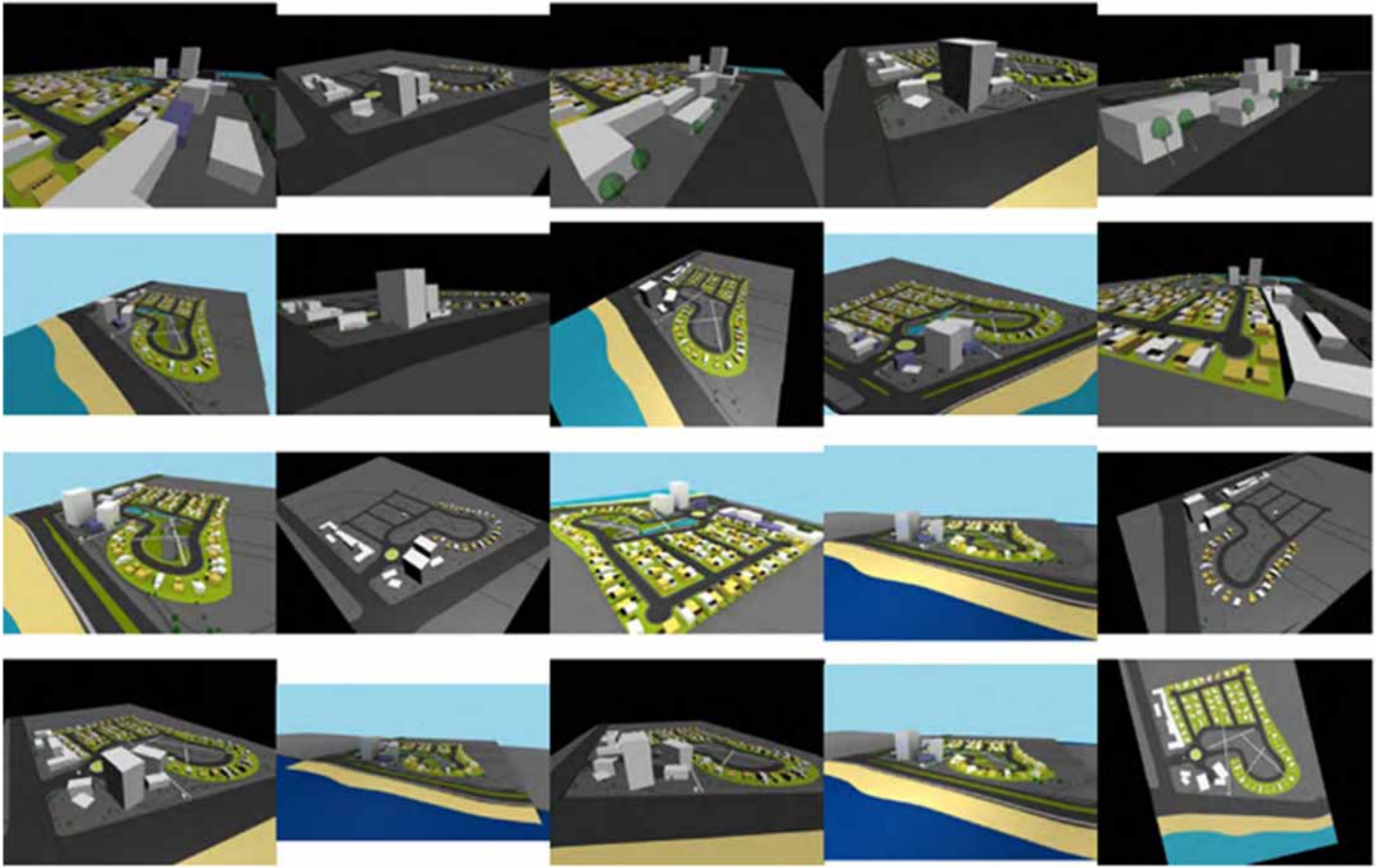
- Massing (architectural)
  - It means the general shape or shapes of a building, in three dimensions (e.g. massing models)
  - The early stages of built form creation
  - Massing of the building on the site
    - Important for high density urban development
    - Help to study the microclimatic factors of the site



# Building massing diagrams



# Massing design and analysis process



(Source: www.jagpstudio.com)

# Massing and microclimate

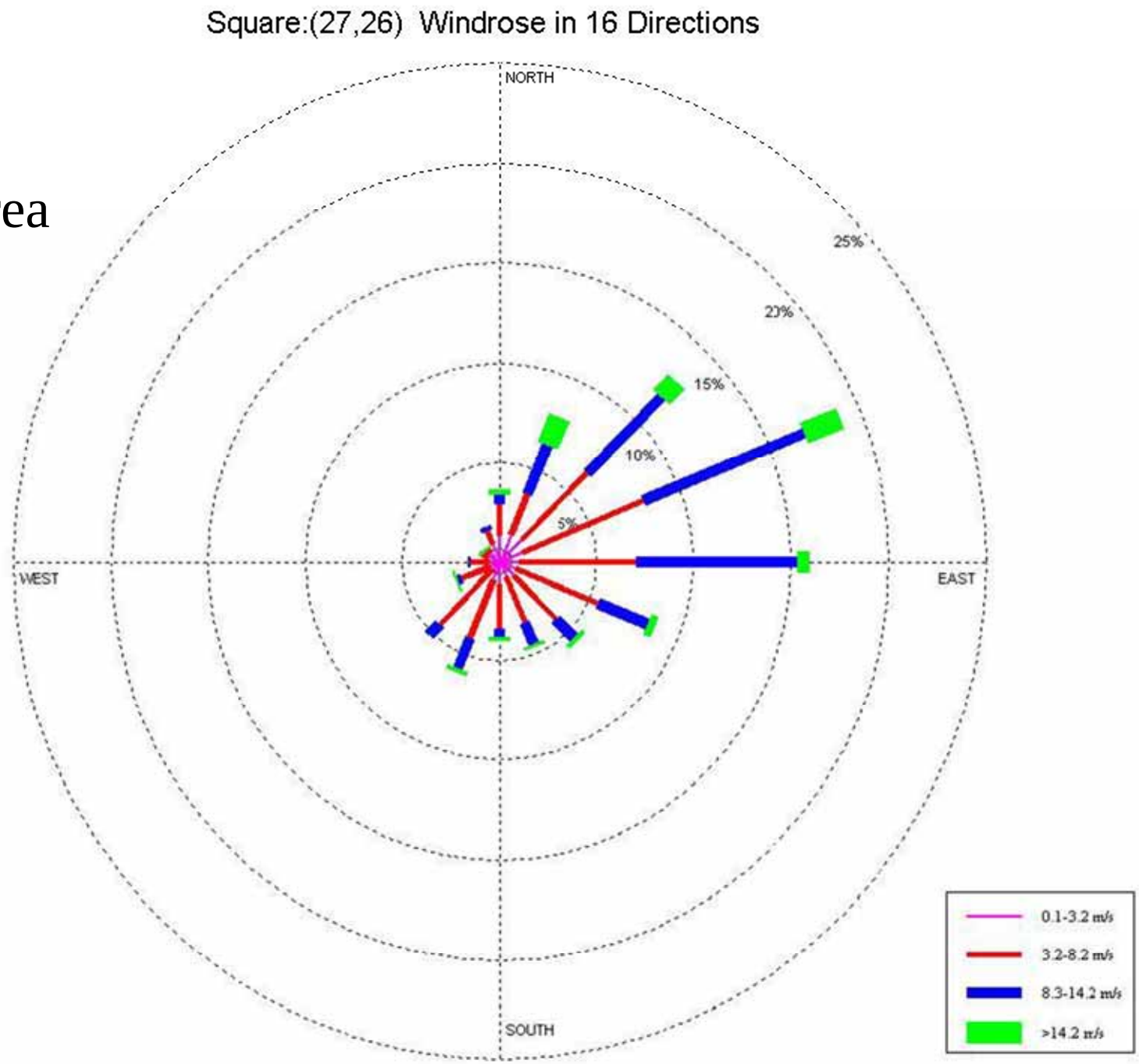
- Microclimate and site issues
  - 1. Wind environment (for pedestrians using entrances, landscaped areas and public space)
  - 2. Daylight, overshadowing and glare
  - 3. Visual impact
  - 4. Flight path and height limit (if any)
  - 5. Noise and air quality

# Massing and microclimate

- 1. Wind environment
  - Impact on the safe and comfortable use of balconies, terraces and entrances
  - For driving natural ventilation or wind turbines
  - In Hong Kong, evaluation can be made using the air ventilation assessment (AVA) system*
    - Study site and local wind availability
    - Computational fluid dynamics (CFD) study
    - Wind tunnel study of buildings and structures

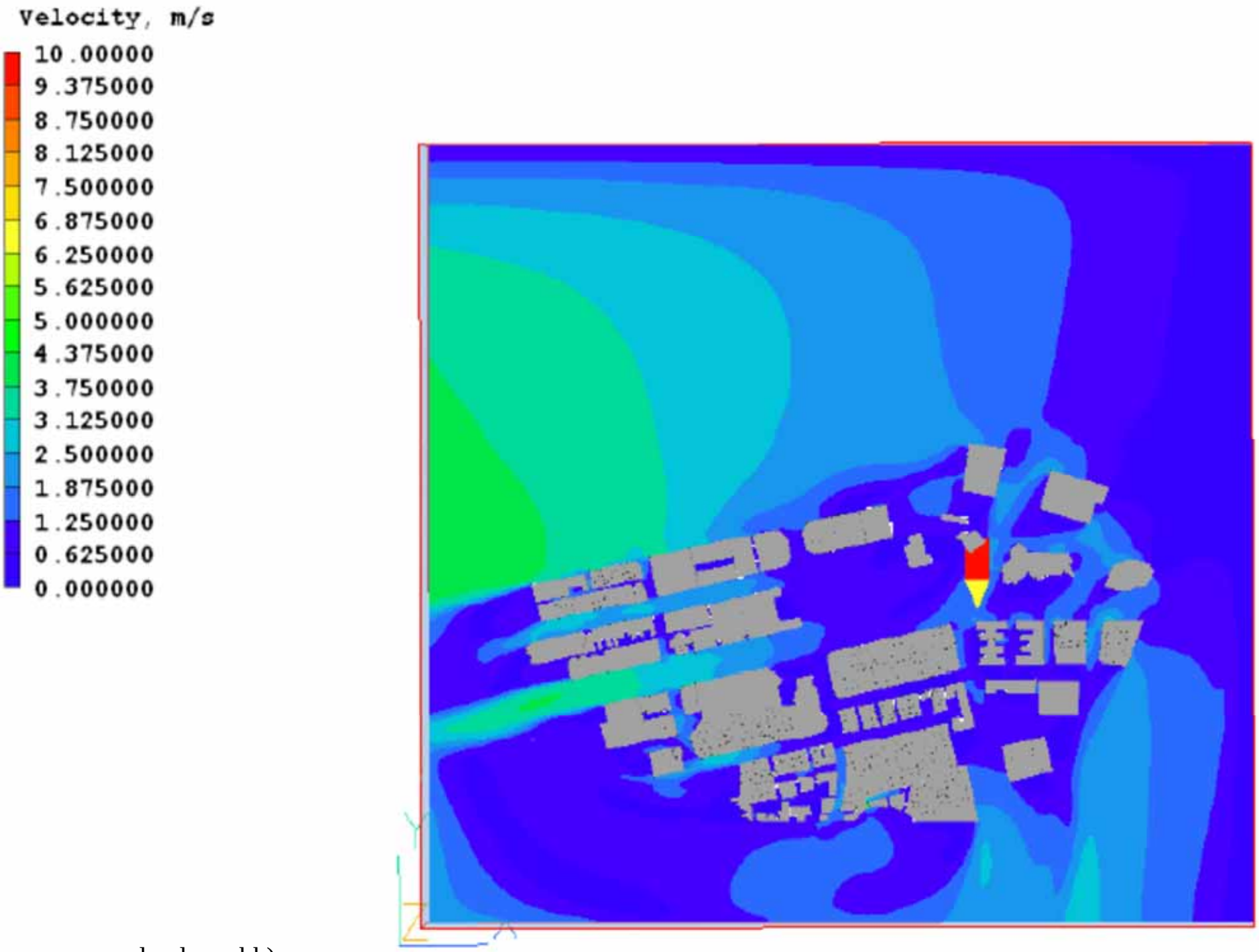
(* Further info.: http://www.pland.gov.hk/pland_en/p_study/comp_s/avas/avas_eng.html)

# Wind rose for Tsimshatsui area in Hong Kong



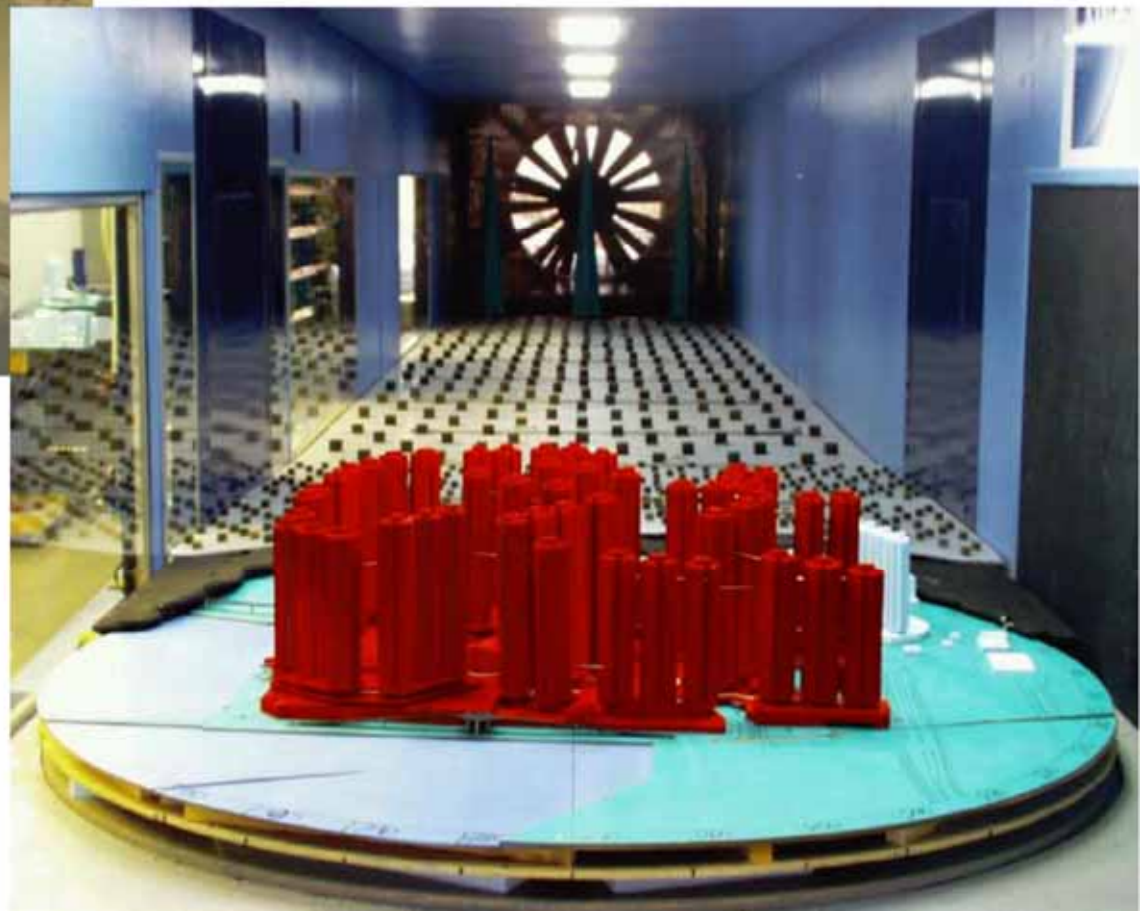

(Source: www.pland.gov.hk)

# Computational fluid dynamics (CFD) study of wind environment




(Source: www.pland.gov.hk)

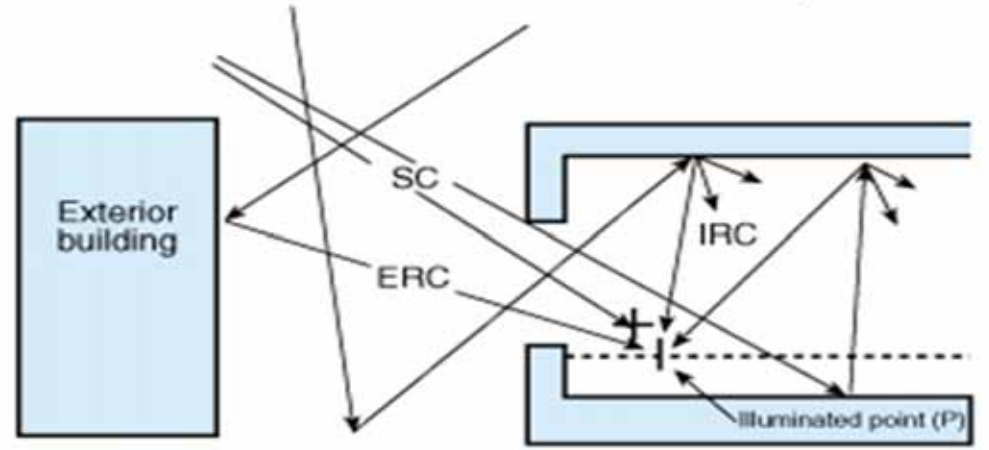
# Wind tunnel study of buildings and topography

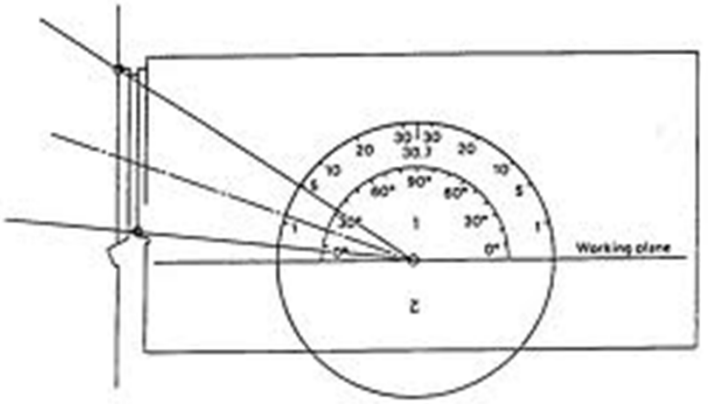


(Source: www.pland.gov.hk)

# Massing and microclimate

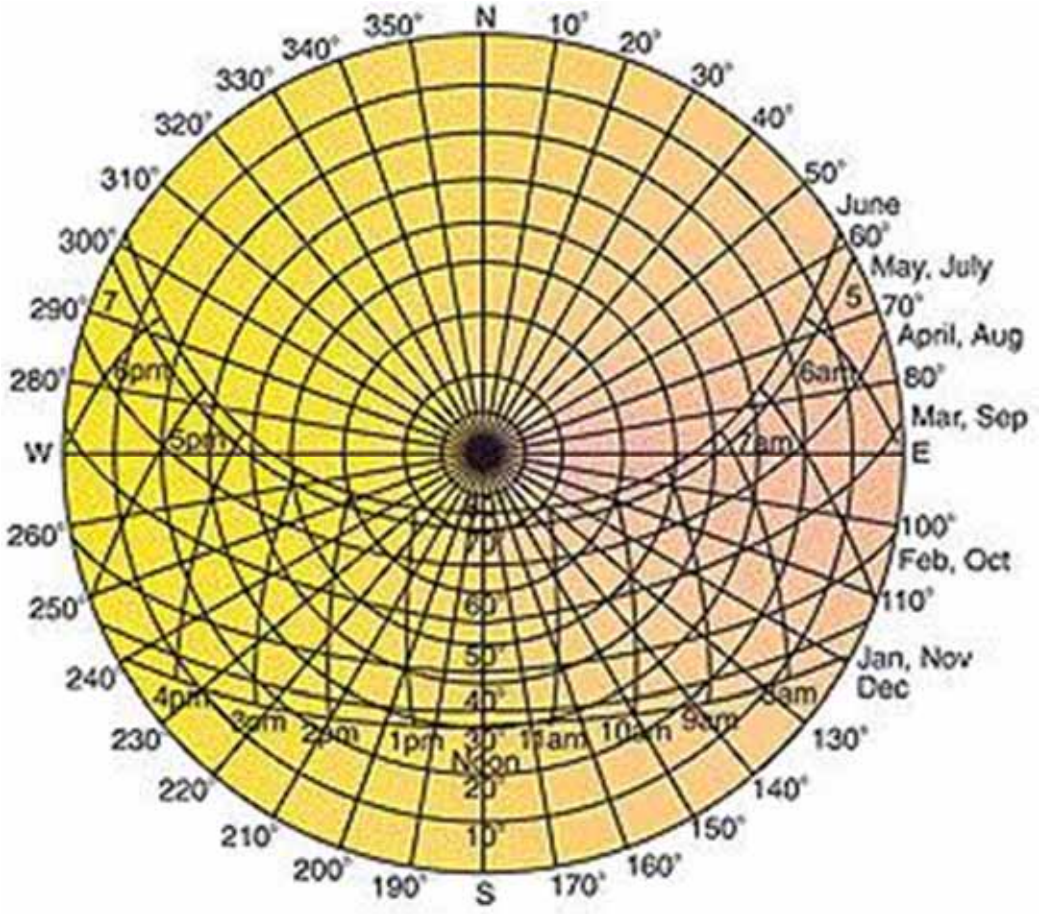
- 2. Daylight, overshadowing and glare
  - Assess daylight availability and impact
    - Daylight factor (DF) determination
      - DF = SC + ERC + IRC
        - SC: sky component
        - ERC: externally reflected component
        - IRC: internally reflected component



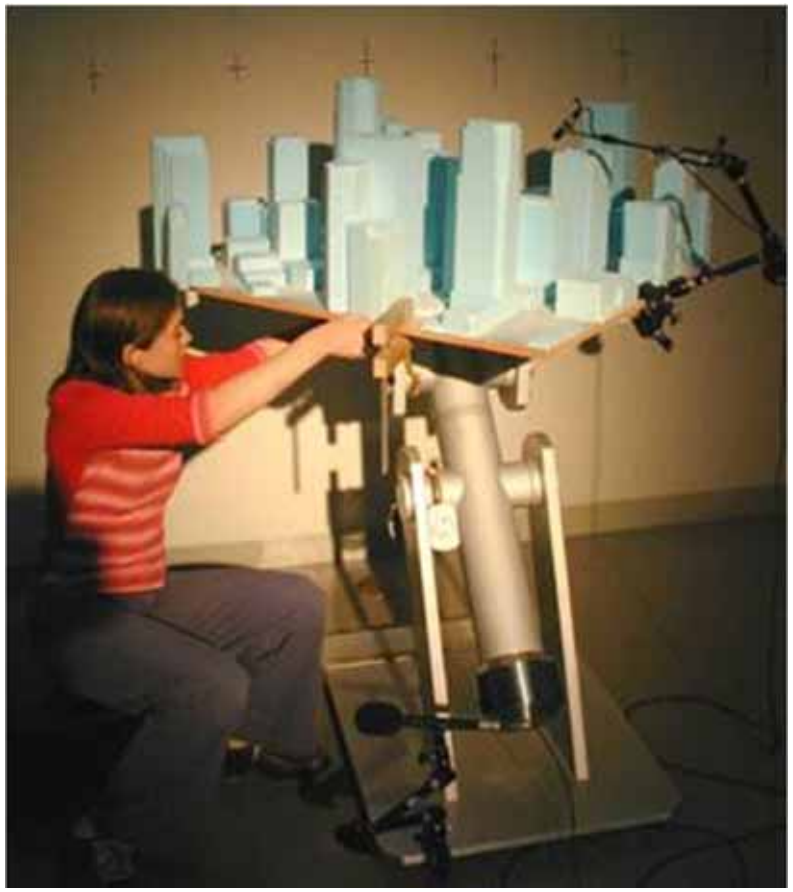



# Massing and microclimate

- Daylighting design may be evaluated by
  - Manual methods
    - Shading mask and sun path diagram
    - Nomographs or charts (e.g. daylight protractors)
  - Scale model photometry (e.g. using heliodons)
  - Computer programs (e.g. RADIANCE, Lumen Micro, Lightscape, LightCAD)
  - On-site measurements (e.g. using lux meter) and observations

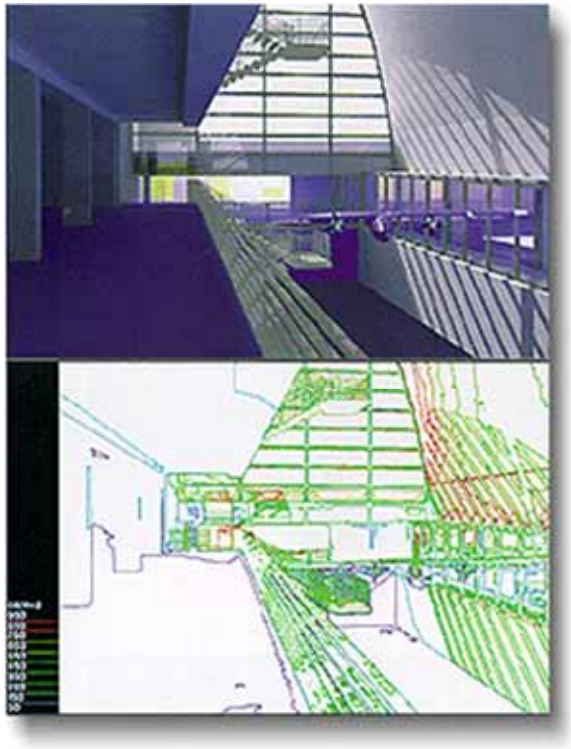



Sunpath diagram

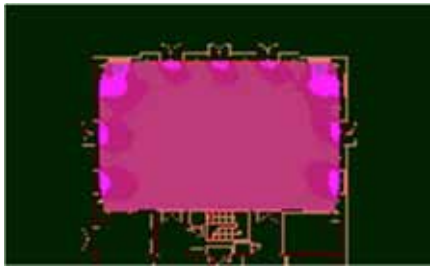
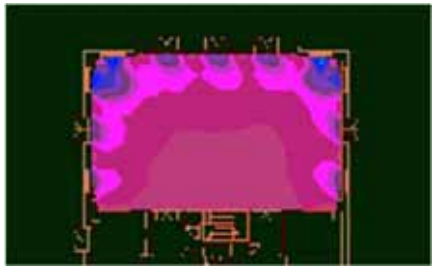
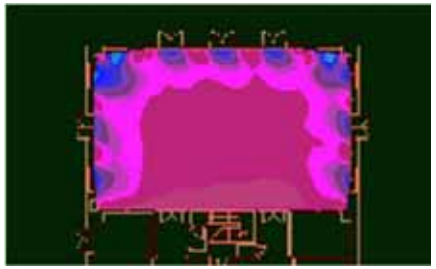
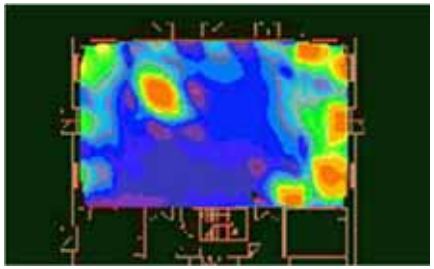
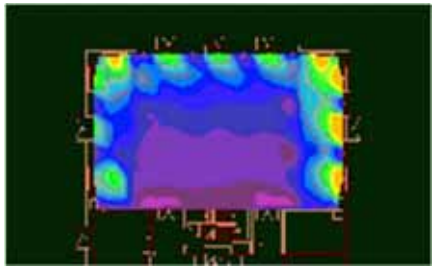
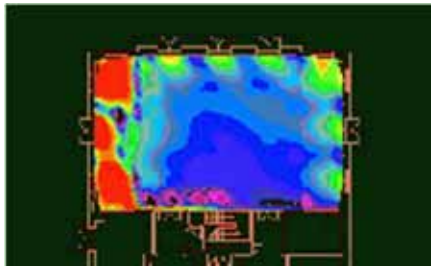


Heliodon studies

Daylighting design and analysis tools



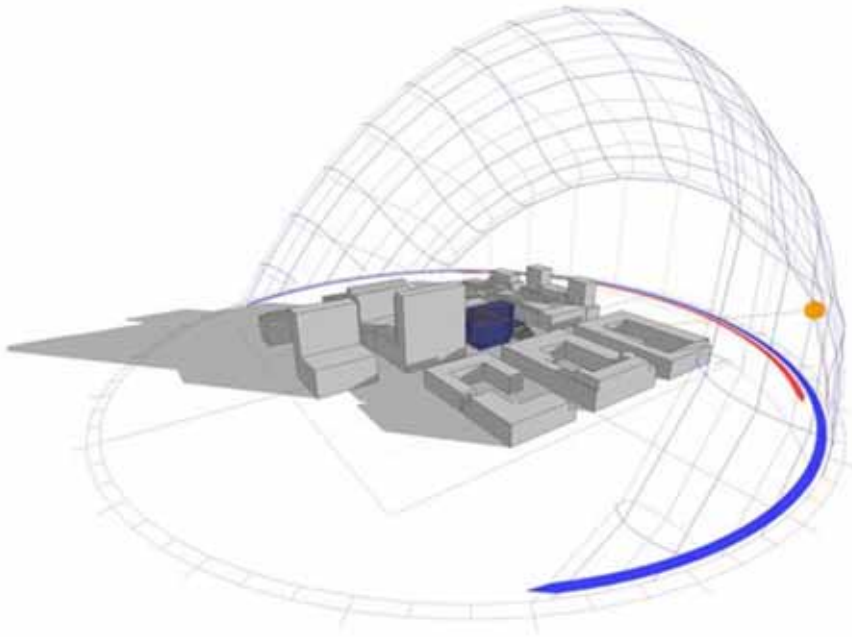
Daylight simulation using RADIANCE

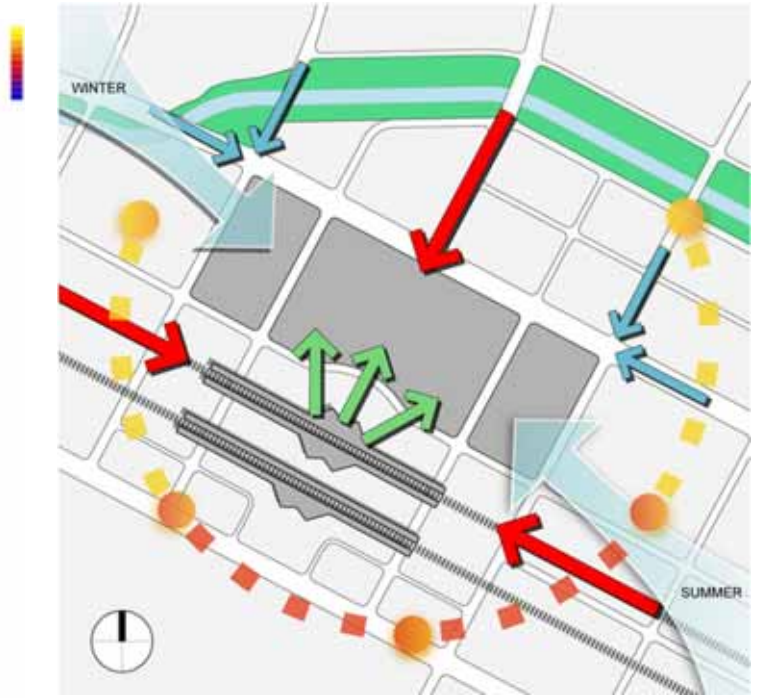
| | 9:00am | 12:00 noon | 3:00pm |
|---|---|---|---|
| Cloudy: |  |  |  |
| Sunny: |  |  |  |

Daylighting analysis

# Massing and microclimate

- Overshadowing of neighbouring buildings
  - Model shadow paths on an hourly basis for 21 March, 21 June, 21 September, 21 December to give an indication of transient overshadowing





# Massing and microclimate

- 3. Visual impact
  - Involve subjectivity (‘the eye of the beholder’)
  - Context is very important
- 4. Flight path and height limit
  - Tall buildings must be assessed
  - Height restriction: affecting navigable airspace
- 5. Noise and air quality
  - Mapping of noise and pollution levels
  - Noise sensitive activities and ventilation openings

# Social sustainability

- It concerns how individuals, communities and societies live with each other and set out to achieve the objectives of development models which they have chosen for themselves
- Many issues are involved
  - Equity and health
  - Participation, needs and social capital
  - Economy and environment
  - Happiness, well being and quality of life

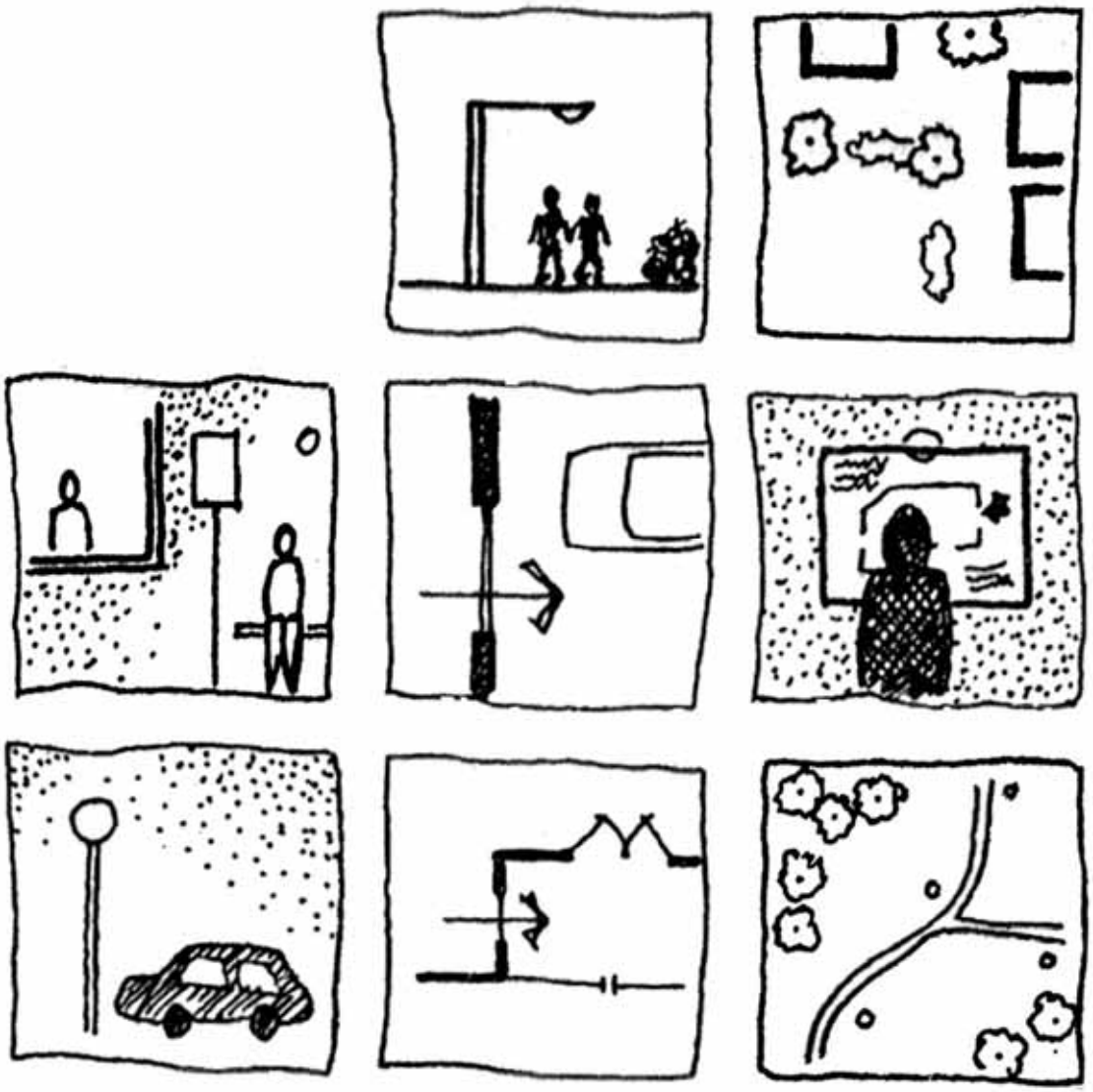
# Social sustainability

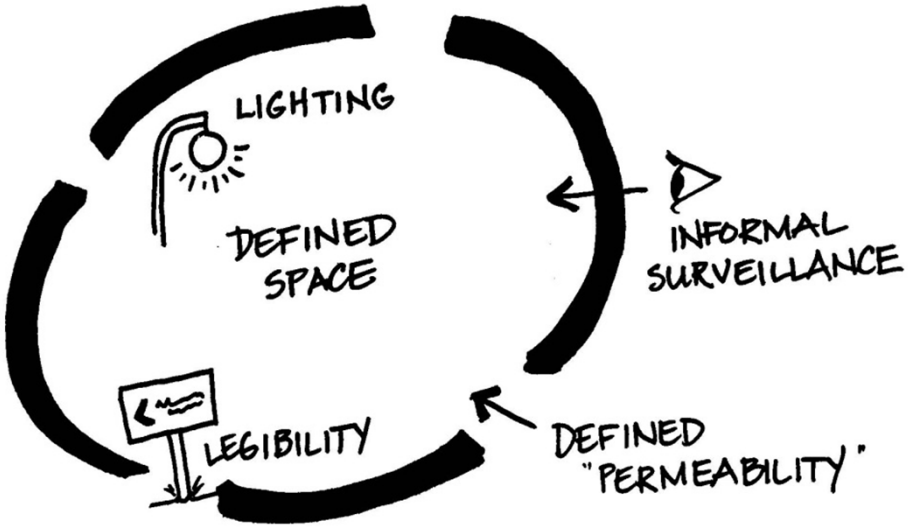
- Amenities and facilities
  - Access to shops, schools, healthcare, community, social and recreational facilities, transport nodes
  - Open space with play areas
  - For example, the requirements in UK Ecohomes:
    - At least 80% of development to be within 500 m safe walking distance of a food shop and post box, and within 1 km of other facilities
  - In HK, one can refer to the Hong Kong Planning Standards & Guidelines

# Social sustainability

- Secured by design
  - Safety, security and crime prevention
  - Should start at the masterplanning stage
  - Key principles: social and physical environments to design out ‘crime features’
    - Crime prevention through environmental design (CPTED)
    - Deter criminal behaviour and influence offender decisions that precede criminal acts

# Crime prevention through environmental design (CPTED)






[Source: www.cityofvancouver.us]

# Economic sustainability

- Economic sustainability is closely linked with social sustainability since the economic viability of an area has significant impact on social factors
- Economic growth is driven by:
  - Improved transport links, new businesses and jobs created to serve the area, and draw in visitors and shoppers from the region
- Job creation: contractors and new businesses

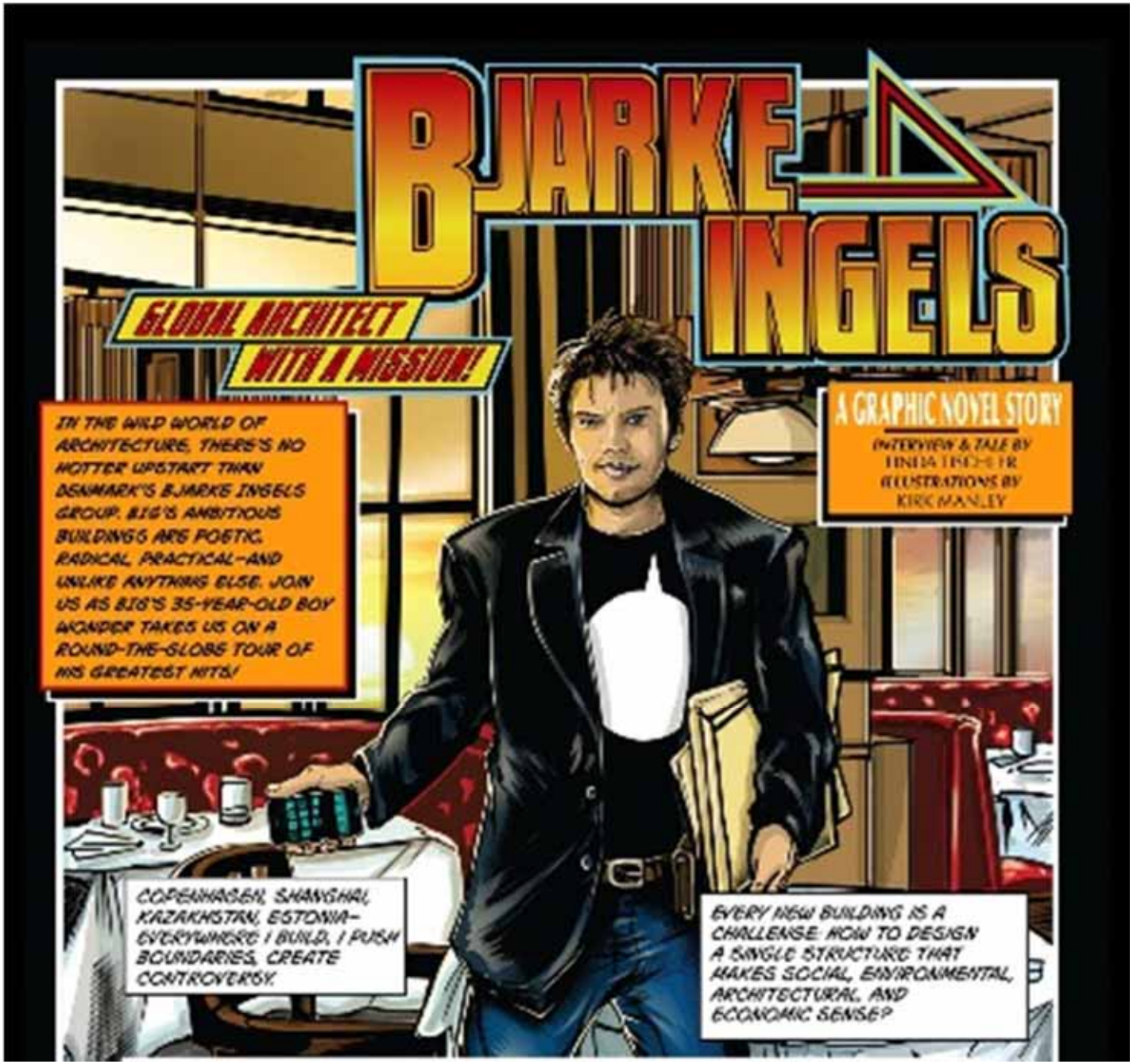
# Video Presentation

[Hedonistic: Pursuit of or devotion to pleasure]

- Bjarke Ingels: Hedonistic sustainability (22:25) (享樂主義的可持續性)
  - http://www.ted.com/talks/bjarke_ingels_hedonistic_sustainability.html
    - A Danish architect's (Bjarke Ingel) architecture is luxurious, sustainable and community-driven. He shows us his playful designs, from a factory chimney that blows smoke rings to a ski slope built atop a waste processing plant
  - Pleasure is the only intrinsic good for going green

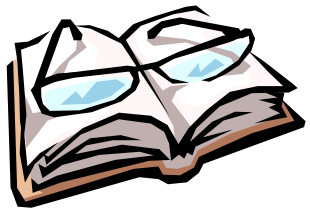
# Bjarke Ingels talks Hedonism Sustainability (w/ video 3:35)

www.treehugger.com/sustainable-product-design/bjarke-ingels-talks-hedonism-sustainability.html




(Image source: www.treehugger.com)

# Further Reading



- Creating successful masterplans: A guide for clients [CABE]
  - www.cabe.org.uk/masterplans
- Sustainable places [CABE]
  - www.cabe.org.uk/sustainable-places
- Basic guidelines for designing with the sun and natural ventilation in Hong Kong (Prof. K. P. Cheung, HKU Arch)
  - www.arch.hku.hk/teaching/lecture/65156-12.htm