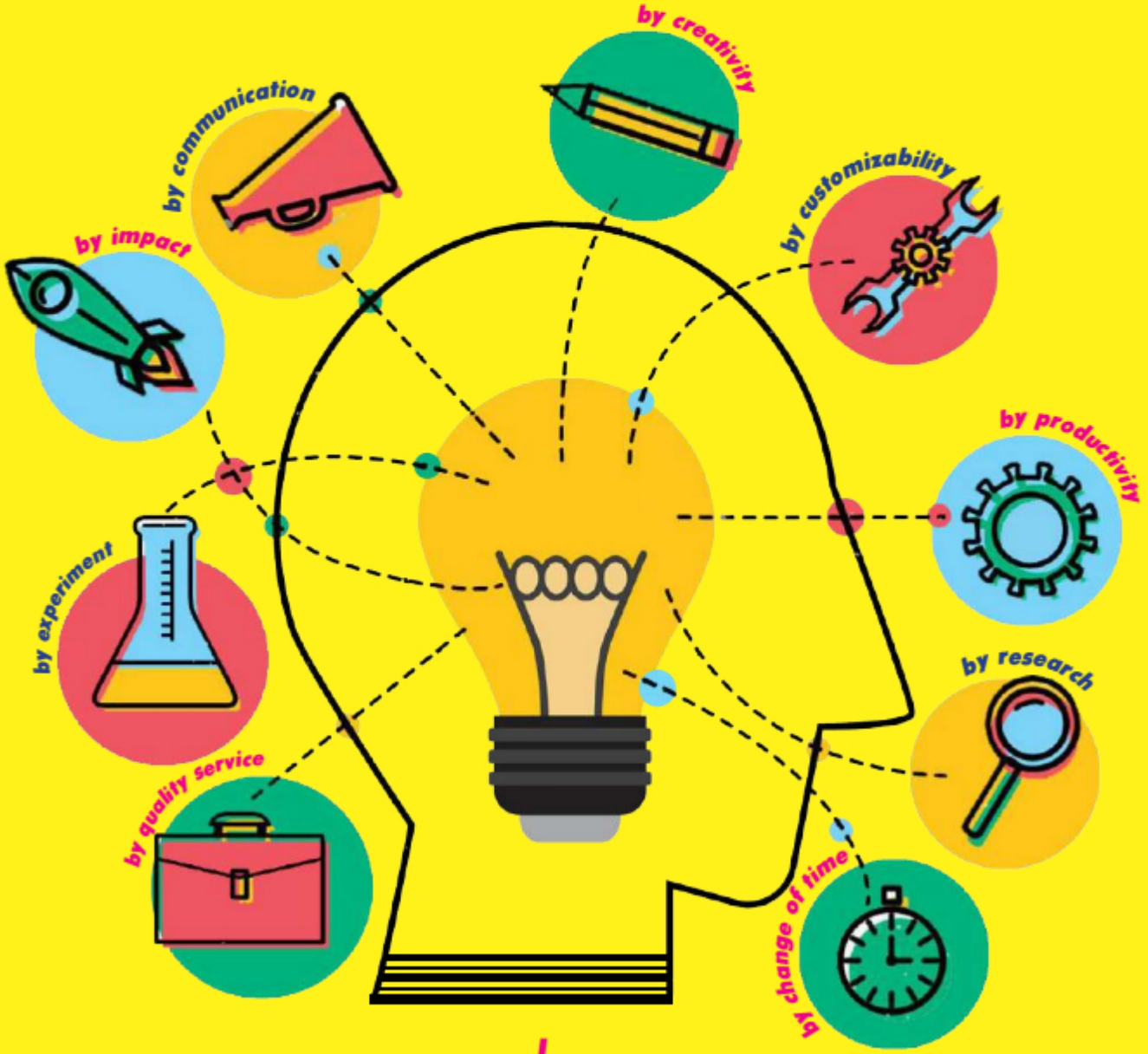
GAME CHANGER MAGAZINE // ISSUE 8 2022 AUGUST 2022

"a journal on **green architecture**, design ideas, discovery & innovation"

INNOVATION BY DESIGN

for problem solving, discovery and invention



by:
Ken Yeang
design by: Harris Emil & Winnie Soo Wei Yi

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INNOVATION BY DEVICES (ECOCELL)

SOLARIS

ONE-NORTH, SINGAPORE

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CONTENTS

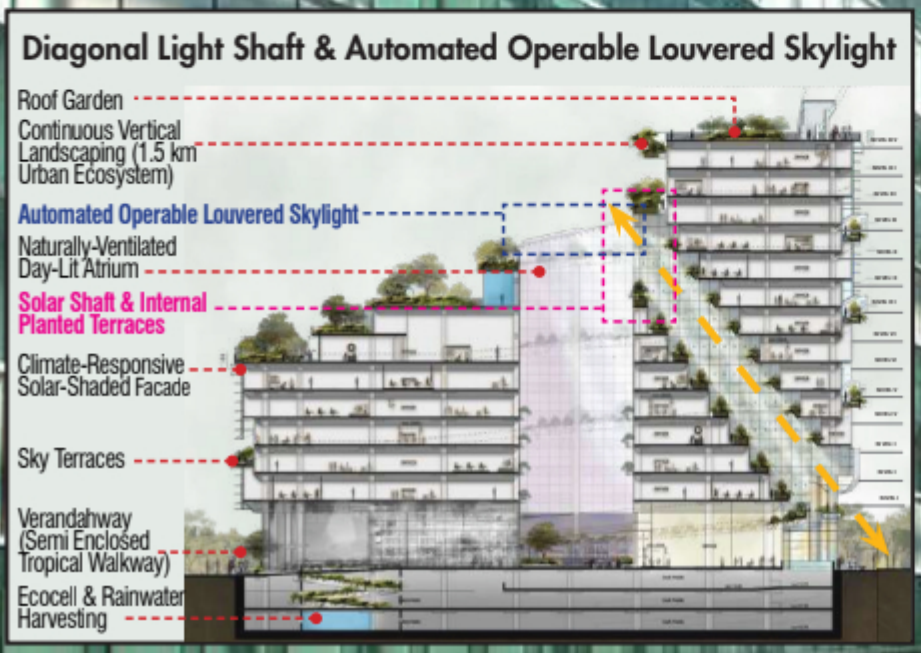
INNOVATION BY DEVICES (DIAGONAL LIGHT SHAFT)

Diagonal light shaft

Automated operable louvered skylight

Skybridge

Diagonal Light Shaft & Automated Operable Louvered Skylight



01 WHAT IS INNOVATION?

*This is a guide for **innovation**, discussing what it is and how we implement it from ideation to solution.*

What is innovation? Innovation is the means for making changes to the existing norm and established conditions, by introducing something improved and new. As such, it can be radical or incremental. It can be applied to products, to processes, to services, to organizations, to concepts, to principles, and to theories.

As market demands advance, as technology becomes increasingly powerful and as professional capabilities become more diverse, the traditional competitive advantage through technical expertise as specialized knowledge, and efficient delivering, become standard prerequisites of any business proposition, the new competency and competitive edge that sets businesses apart today is **innovation.** It is inventive solutions, supported by strong strategic capabilities to create designs with features, benefits and values.

We must all do our part in saving our Planet. Presented is an example of innovation as process that is a model for ecological design and for designing state-of-the-art eco-architecture.

Innovation is fundamental to the advancement of *architecture & design*.

KEN YEANG
(August 2022)

02 INNOVATION FROM PRODUCT CONFIGURATION

What are the types of innovation?

- There are different types of innovations which can range from being a product innovation (physically tangible) to a process innovation (intangible).

- This framework can be used as a diagnostic tool to assess how innovation be approached internally and to evaluate which aspects to improve.

TYPES OF INNOVATION

PRODUCT

Design Model	Network	Structure	Process	Product Performance

Tangible

TO PRODUCT EXPERIENCE

OFFERING

EXPERIENCE

Product System	Service	Channel	Brand	User Engagement

Intangible

Adapted from:

Keeley, L. , Pikkel, R. , Quinn, B. , Walters, H. (2013)
Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

- Successful innovators analyze the patterns of innovation in their industry. Then they make conscious, considered choices to innovate in different ways.

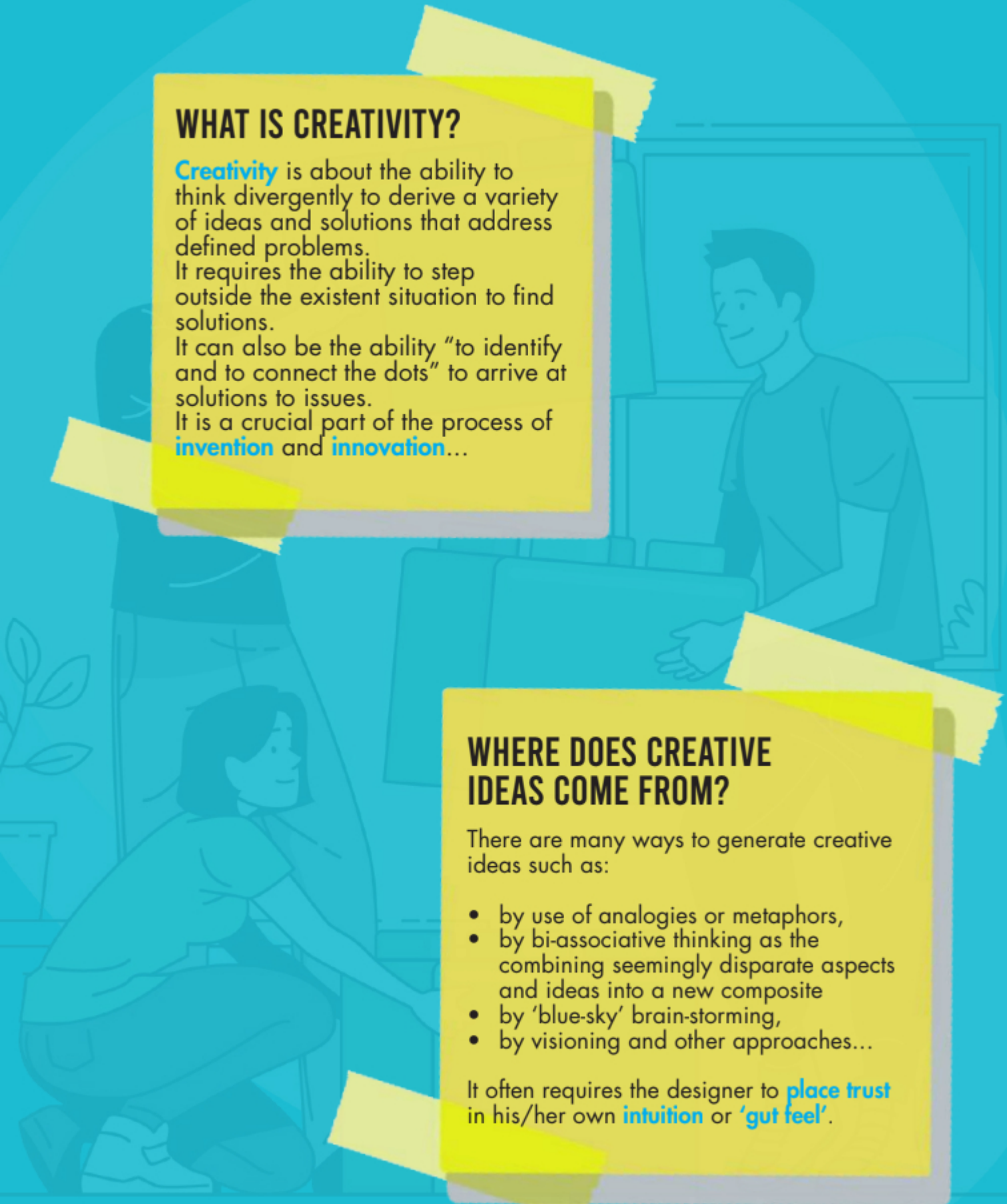
- Innovation can be broken down and analyzed. When we do so, we learn how we can succeed.

- Innovations can be built up systematically. Doing so increases the odds of success exponentially.

03 INNOVATION & CREATIVITY

WHAT IS CREATIVITY?

Creativity is about the ability to think divergently to derive a variety of ideas and solutions that address defined problems.
It requires the ability to step outside the existent situation to find solutions.
It can also be the ability "to identify and to connect the dots" to arrive at solutions to issues.
It is a crucial part of the process of **invention** and **innovation**...



WHERE DOES CREATIVE IDEAS COME FROM?

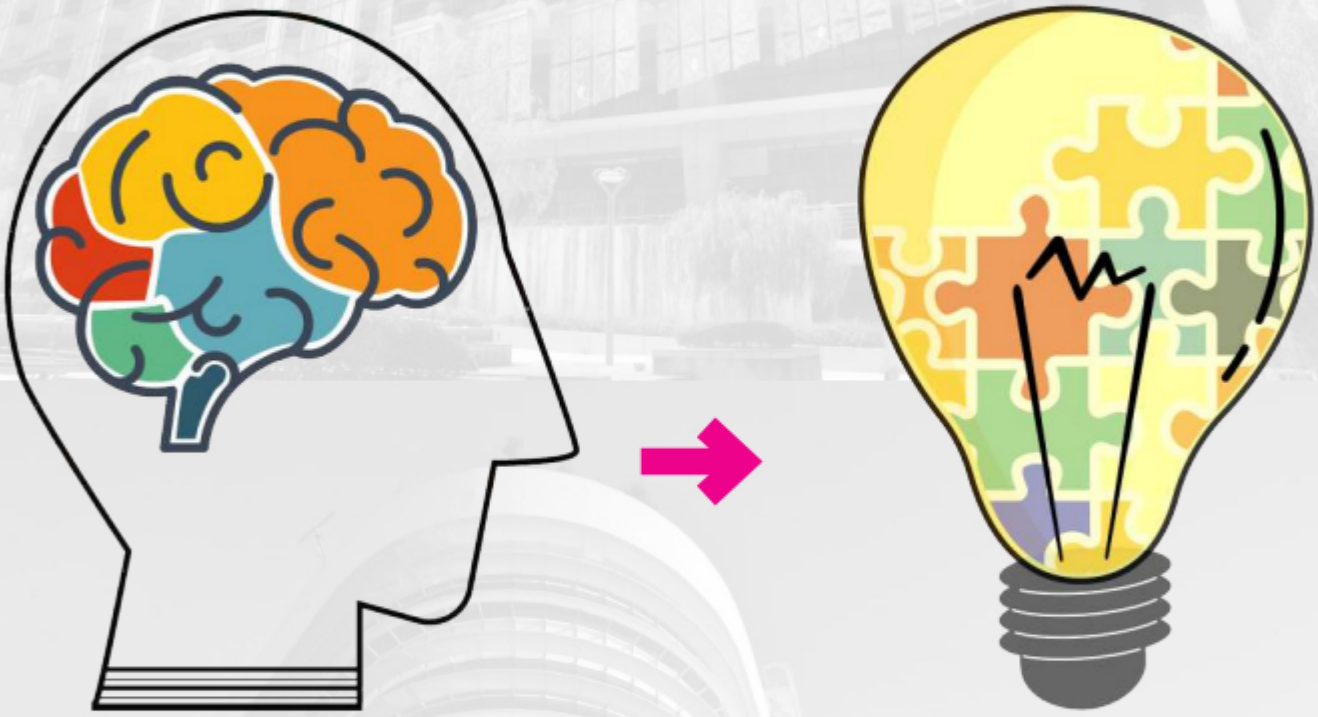
There are many ways to generate creative ideas such as:

- by use of analogies or metaphors,
- by bi-associative thinking as the combining seemingly disparate aspects and ideas into a new composite
- by 'blue-sky' brain-storming,
- by visioning and other approaches...

It often requires the designer to **place trust** in his/her own **intuition** or **'gut feel'**.

04 INNOVATION FROM IDEATION TO SOLUTION

Demonstrated here are examples of innovation as invented products where innovative ideation are turned into solutions.



Ideas **Solutions**

INNOVATION FOR ECOLOGICAL NEXUS

The project stands as a dramatic demonstration of the possibilities inherent in an ecological approach to building design. The building became a vibrant focal point for community through the introduction of open interactive spaces, creative use of skylights and courtyards for natural light and ventilation and a continuous spiral landscaped ramp.

The main ecological sustainable significance of the project is its 1.5 km long continuous perimeter landscaped ramp from the basement to roof garden, which demonstrating ecological nexus and connectivity. Furthermore, the vegetation has compensates cleared vegetation for construction on-site, which exceeding site footprint by 80%. These is how Solaris strives to enhance its site's existing ecosystems.

What delights users and public?

• Roof Gardens

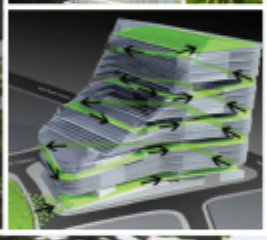
Sky terraces at the corner of the building that forms interesting green landscapes and contributes **unique social meeting points** connected to nature.

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

United Nations Sustainable Development Goals

• "Vertical Linear Park"



The 1.5 km long continuous green ramp acts as an **ecological armature**. With each building corner, the spiral ramp expands into generous double-volume sky terraces.

3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

United Nations Sustainable Development Goals

• Operable louvers over Atrium

This innovative device allows wind to **cross-ventilate the atrium while keeping out the rain**. This device is composed as a series of glazing panels, separated by perforated panels.

3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

United Nations Sustainable Development Goals

awards received by project

- *First Prize - Skyrise Greenery Awards 2009*
- *Platinum Rating - BCA GreenMark 2009*
- *Green GOOD DESIGN Award 2010*
- *Gold Medal - WACA Award 2011*
- *Gold Award -PAM Awards 2011*
- *Finalist - RAIA International Architecture 2012*
- *NPark Leaf Certificate Awards 2014*
- *AIA IR Design Awards 2014, Hong Kong*
- *FuturARC Green Leadership Award 2015*
- *FIABCI World Prix d' Excellence Awards 2016*

Uppermost roof garden

Mid roof garden

Spiral ramp as "Vertical Linear Park"

"Eco Cells"

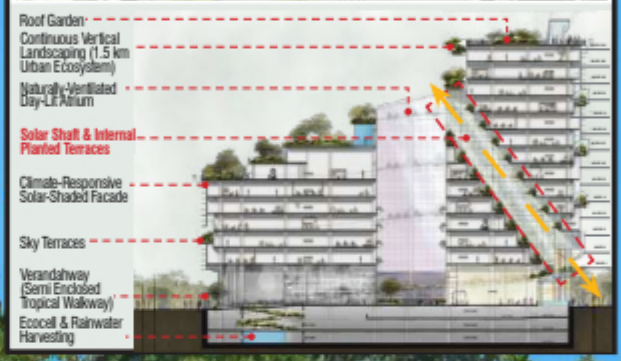
BY CONTINUOUS VEGETATED RAMP

What makes it innovative?

3 GOOD HEALTH AND WELL-BEING
7 AFFORDABLE AND CLEAN ENERGY
United Nations Sustainable Development Goals

• Experimental diagonal light shaft

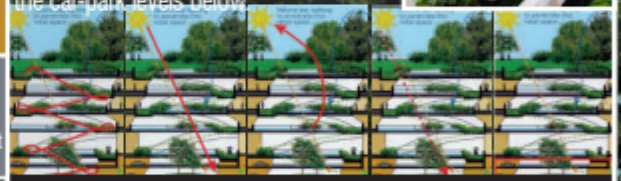
Innovating environmental device is the "Solar Shaft" that cuts through the upper floors of Tower A to **allow daylight to penetrate into the deep interior spaces.**



6 CLEAN WATER AND SANITATION
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
United Nations Sustainable Development Goals

• "Eco Cells"

The "eco cell" is a device that **allows for vegetation, daylight, natural ventilation and rainwater harvesting** to extend into the car-park levels below.



3 GOOD HEALTH AND WELL-BEING
11 SUSTAINABLE CITIES AND COMMUNITIES
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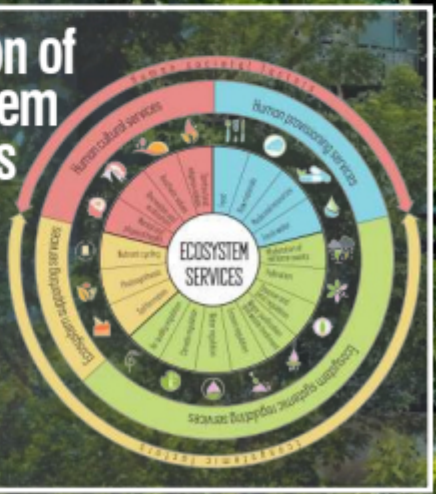
Provision of Ecosystem Services



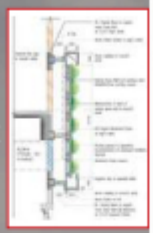
SOLARIS
ONE-NORTH, SINGAPORE

INNOVATION FOR ECOLOGICAL NEXUS

What makes it innovative?

• continuous vertical green wall

The façades of the Data Centre incorporate **extensive vertical green walls** that act as **living habitats**. The large greenery components also act as means of filtering and improving the building's ambient indoor air quality.



3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

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• solar shading

The building is clad with white aluminium panels, clear glass windows, and spandrels with horizontal blades that provides solar shading and anti-glare performance that gives the image of a contemporary climatic reponsive built form.

3 GOOD HEALTH AND WELL-BEING

8 DECENT WORK AND ECONOMIC GROWTH

United Nations Sustainable Development Goals

• renewable energy

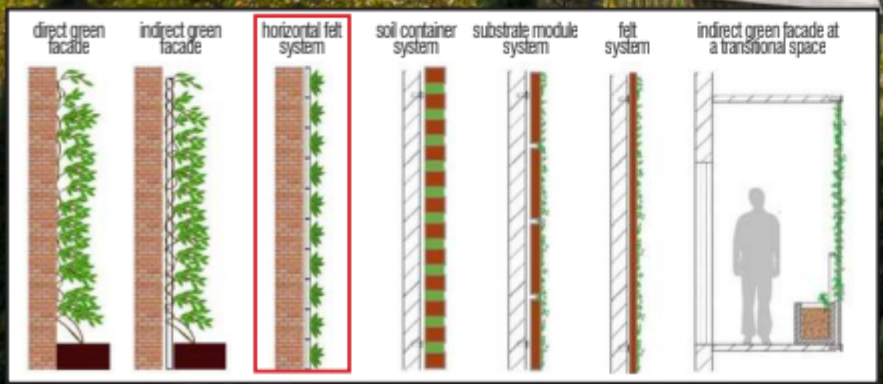
An array of **photovoltaic panels** is installed on the building's uppermost roof area. The 234 m² PV array generates approximately 35.28KWh of electricity on site with all power generated feeding directly back into the municipal power grid.

3 GOOD HEALTH AND WELL-BEING

8 DECENT WORK AND ECONOMIC GROWTH

13 CLIMATE ACTION

United Nations Sustainable Development Goals



BY CONTINUOUS GREEN WALL

The DIGI Technology Operation Centre located in Malaysia's Subang High Tech Park was completed in 2010 and has since been awarded a GBI Gold rating. The Client's brief was to design a data centre with ecological features and is based on the 'IT Data Centre's Uptime Institute' Tier III platform with the possibility of scaling up to Tier IV security. A key feature of the DIGI Centre is a vegetated green wall that wraps around its four facades - meant to act as living habitats and as means of filtering and improving its ambient indoor air quality.

What delights users and public?

3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

United Nations Sustainable Development Goals

• spacious internal spaces & daylighting

The main office and circulation spaces are glazed using full-height Low-E curtain walls to provide maximum daylight penetration and enables energy efficient lighting systems within the spaces. Secondary rooms are also fitted with operable windows for natural ventilation and daylight.

Continuous green

Naturally ventilated elevated lobby

- **Project Type:** Data Centre
- **Site Area:** 17,078sqm
- **Total GFA:** 12,648sqm
- **No. of Storeys:** 4 storeys
- **Completion Year:** 2010

DIGI DATA CENTRE

SUBANG JAYA, MALAYSIA

INNOVATION TO AUGMENT PROVISION BY ECOLOGICAL CORRIDORS

The aim is to foster as a new role model for the development of sustainable and green art and cultural center in the 21st century through the adoption of sustainable planning and design principles. The proposal meets the highest standards for ecological design through the careful consideration of materials and the consumption of energy in its built systems. Create renewables resources of energy with solar and wind energy.

Encourage sustainable lifestyle , healthy lifestyle , water and energy efficient , eliminate wasteful consumerism reduce garbage , sustainable industries , less wastage. The proposed Eco-masterplan comprises of the following elements:

- Green Eco-Fingers
- Potential Transport Hub with Iconic Buildings and Sky Garden
- Civic Plaza
- Business and Commercial Park with Sky Garden
- Museum Park
- Interactive Educational Park with Sky Garden
- Botanical Park And Garden
- Sea Facing Artificial Beach
- Floating Pool
- Leisure Park (Cinemas, Restaurants, Bowling Alley)
- Urban Solar Paneled Verandah Way
- Centralise Sport Precinct that houses the athletics club, racket club, gymnasium and martial arts club
- Community Precinct Squares that houses the community market

What makes it innovative?

- **"..creation of green fingers interwoven with urban areas.."**

close weaving of nature into the urban environment to augment the provision of ecosystem services to urban areas.

Corridor with fingers

3 GOOD HEALTH AND WELL BEING

13 CLIMATE ACTION

United Nations Sustainable Development Goals

OF ECOSYSTEM SERVICES & FINGERS

LA REUNION

INDIAN OCEAN, LA REUNION, FRANCE

INNOVATION FOR INTERNAL ECOLOGICAL

NEXUS BY STEPPED PLANTERS

The main feature of the building is a continuous landscaped internal garden which steps upwards from the ground floor to the roof garden and terrace. Adjoining the landscaped steps are water features, a grand stair, terraces and cafeteria. The thickly vegetated landscaped stair displays a variety of tropical plants while the cascading water feature generates an ambience of water relaxing to both the visitors and users of the building. On the outside the form reflects on the façade the stepped garden.

At the same time, the internal atrium space operates as a passive (naturally ventilated) space with the ability to switch to a mixed-mode when required. The cascading water feature acts as a cooling agent for the unenclosed spaces through passive evaporation.

What makes it innovative?

- **continuous indoor planting**

The continuous landscaped ramp functions as an ecological green lung to the building that enhances the quality of the office and public spaces.

Continuous indoor planting

MEWAH OILS HQ

SELANGOR, MALAYSIA

INNOVATION FOR ECOLOGICAL NEXUS

What makes it innovative?

• stepped trellis

Continuous vertical green walls that meander around the building. They act as living habitat and as means of filtering and improving the building's ambient indoor air quality. It also helps to reduce solar heat gain and contributes together with the shading devices to reduce building energy consumption costs.

United Nations Sustainable Development Goals

Plaza VADS formerly IBM Plaza which ascend a PAM award is a 24-storey Office Tower completed in 1985 with a diagonal vertical planter that climbs on one side of the building to the 14th floor where a landscaped void deck occurs.

The design concept for the New Annex Block takes its reference from the existing tower and translates the concept and the sustainable features into the next decade.

BY VEGETATED TRELLIS

PLAZA VADS

KUALA LUMPUR, MALAYSIA

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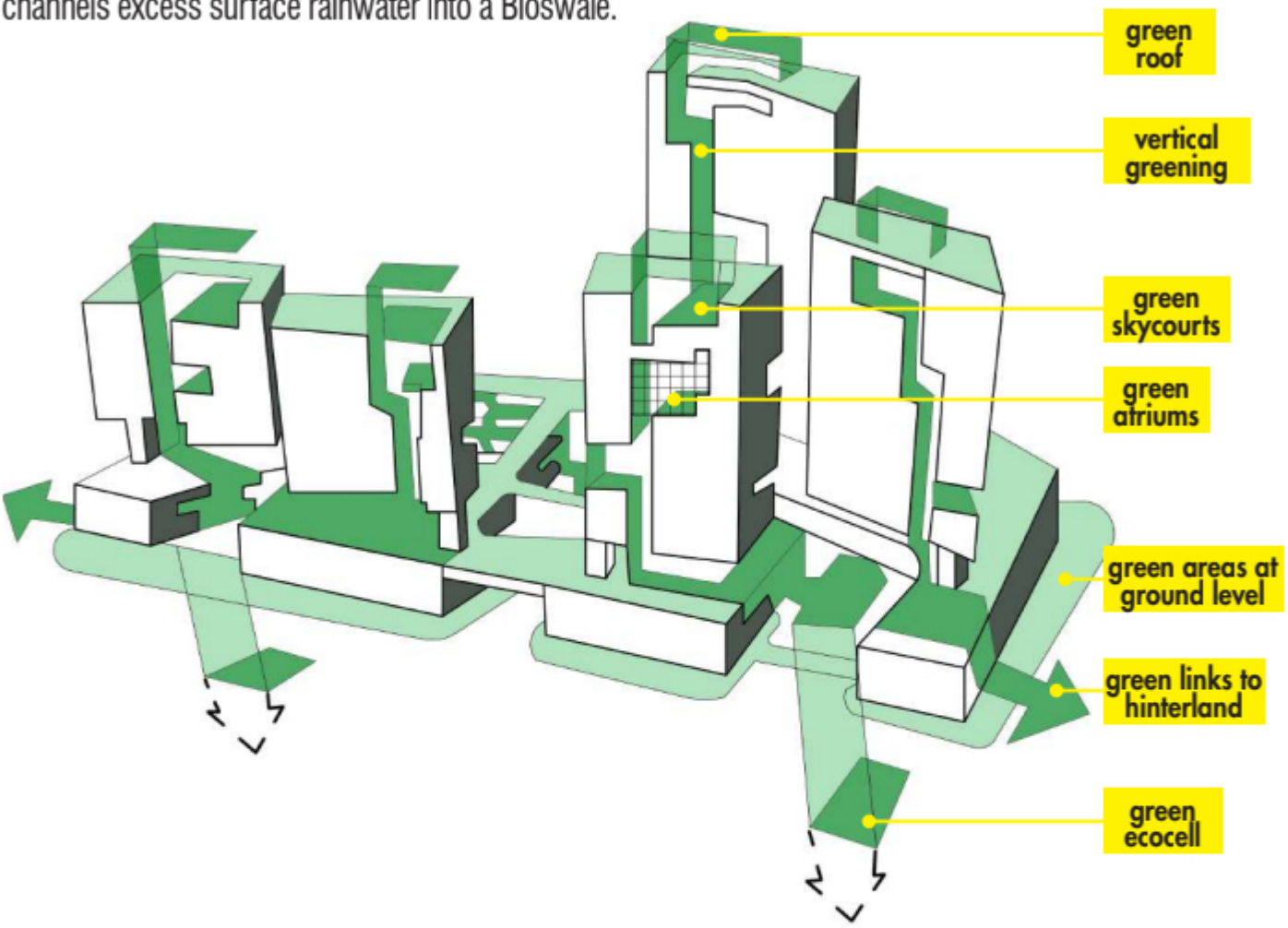
INNOVATION REGENERATE IMPAIRED ECOLOGY

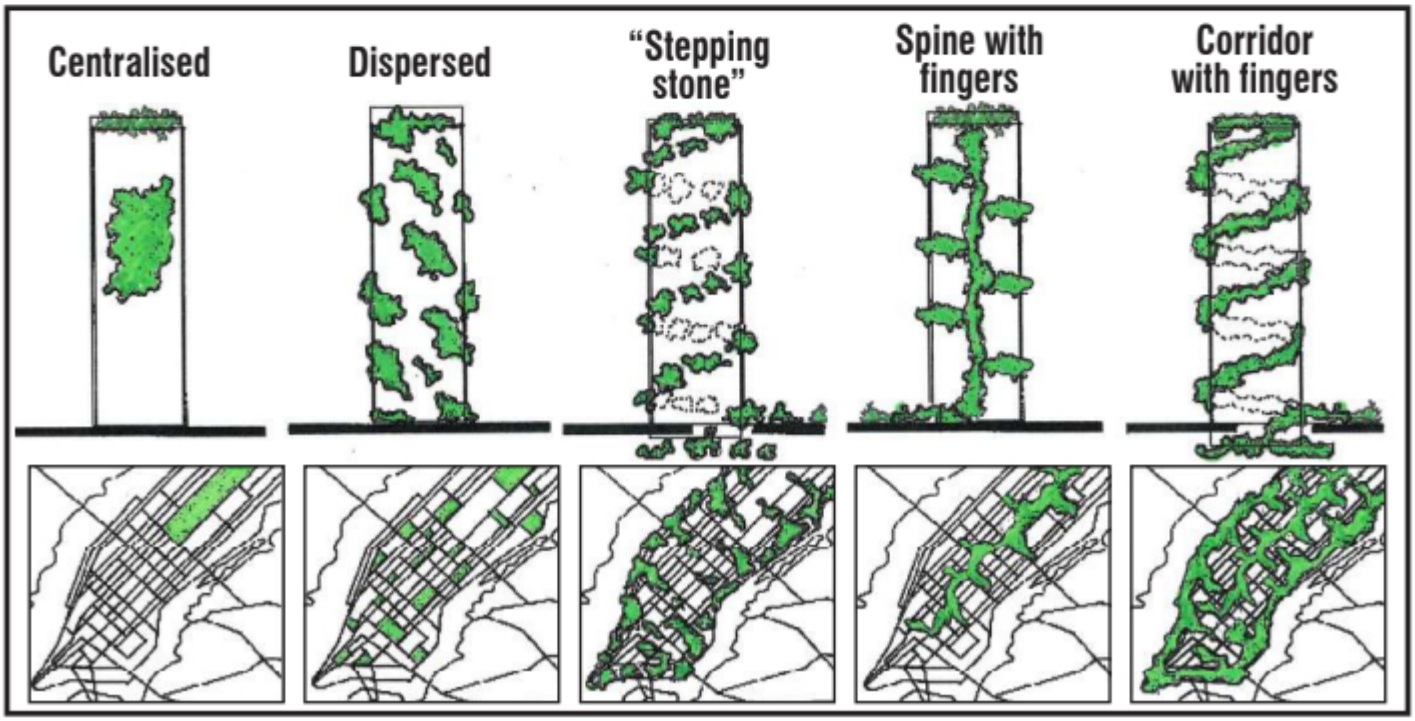
Creating habitats in locality

Our building must be designed to have habitats within it that interface with each other.

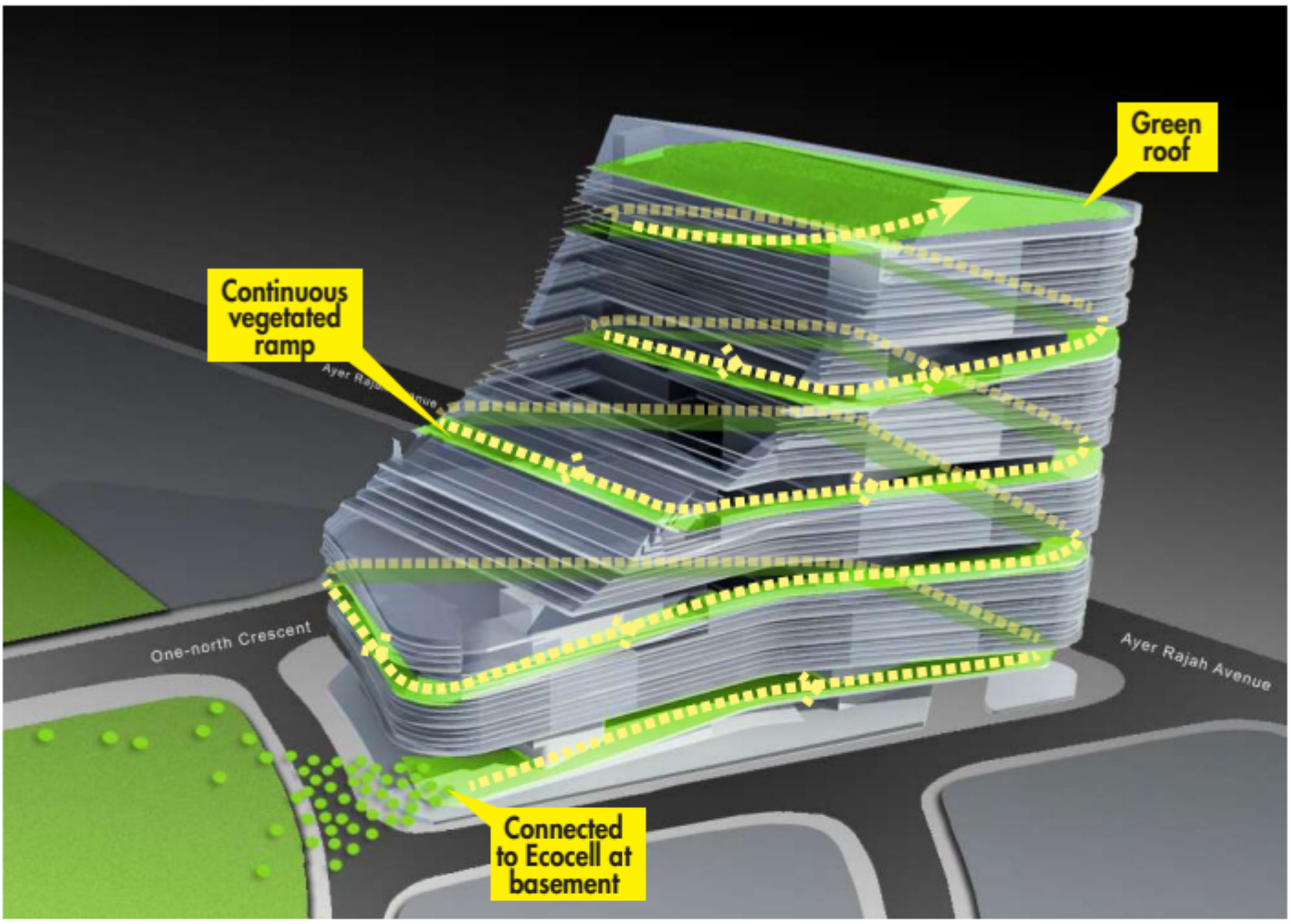
Ecosystem connectivities can be achieved by conserving and maintaining a connected network.

The eco-cell connects the vertical landscaping from ground level garden down to Basement level, and channels excess surface rainwater into a Bioswale.





LOCAL BY CREATING HABITATS WITHIN BUILTFORM



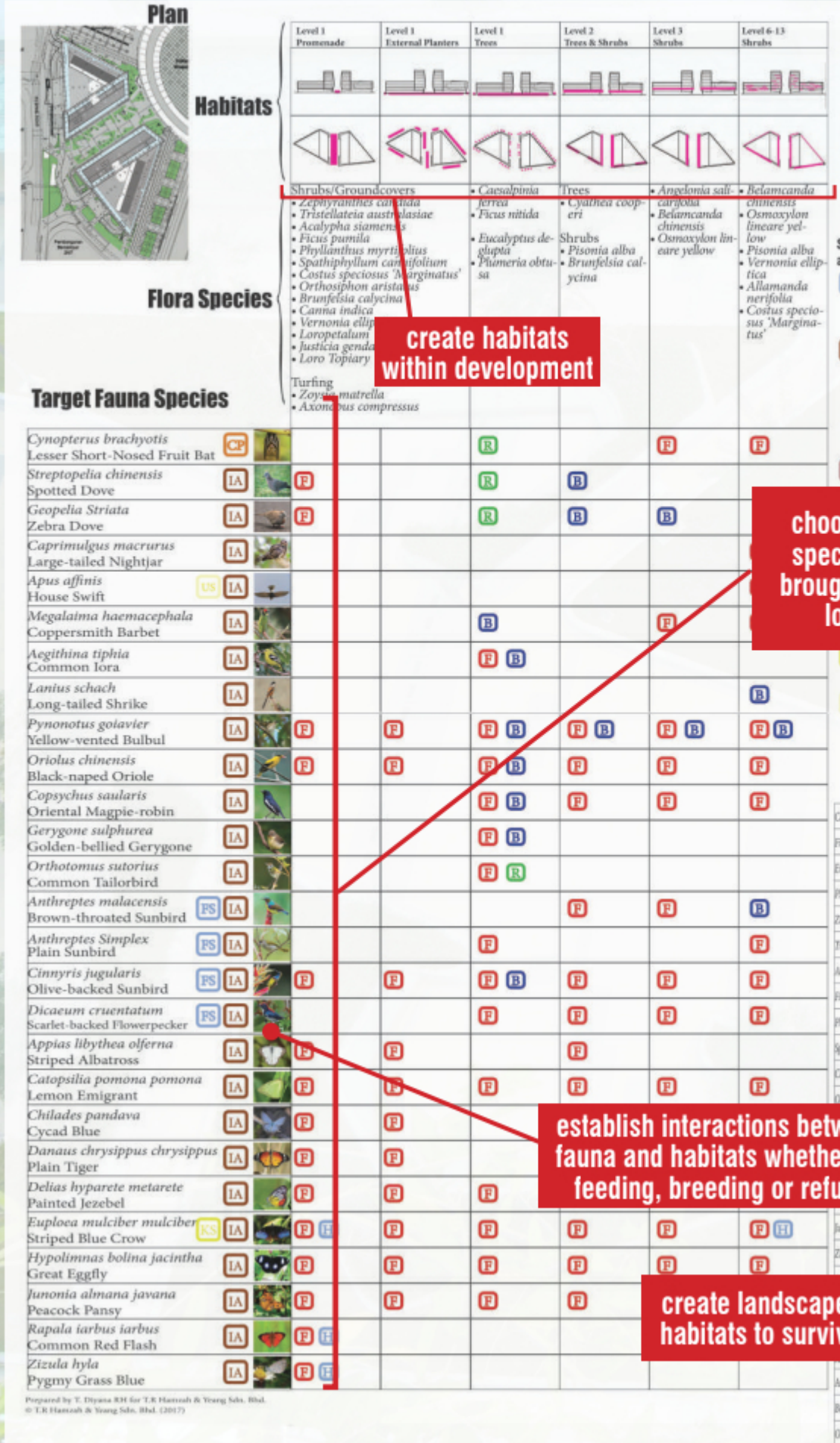
INNOVATION BY DEVICES (CONTINUOUS VEGETATED RAMP

SOLARIS

ONE-NORTH, SINGAPORE

INNOVATION FOR INCREASING BIODIVERSITY

Matrix for selection of species



BY CREATING HABITATS

Target Species

1. Priority species for nature conservation
2. Flagship species that could symbolise scheme success
3. Indicator of good populations of small mammals
4. Indicator of good population of small birds
5. Indicator of good populations of fish/amphibians
6. Indicator of good populations of invertebrates
7. Indicator of good water quality
8. Species with special aesthethis qualities or interest to man. eg. conspicuous beauty, song or tendency to use artificia refuges.

Keys

R Roost
WQ Water Quality
F Feeding
DPS Dominant Plant Species
H Host
B Breeding

Species with Social/Amenity/Cultural/Educational Values:

FS 'Flagship' – species that champion the biodiversity of the wider landscape in which they are found, often because of their conspicuousness, appealing appearance/behaviour or cultural iconography

IA 'Innate Appeal' – Species of above-average value to people in terms of its aesthetic value or curiosity value. for example, a species of bird with particularly melodious song or perhaps a plant with particularly appealing perfume; or species contributing to a valued whole ecosystem aesthetic such as 'lushness' or 'multicoloured beauty' to which society responds positively

EW 'Early Warning' – species that may give an early warning of threats to our own health rather like a Canary in a coal mine. Classic examples include the Peregrine Falcon and DDT, lichen assemblages and sulphur dioxide and invertebrate populations in rivers and water pollution

Species with 'Innate' and 'Ecosystem Support' Values:

CP 'Conservation Priority'– species of innate biodiversity value which may be assessed, for example, on the basis of rarity or value as a particularly high-quality example of its kind.

KS 'Keystone' – species having a disproportionate effect in the functioning of the local environment.

US 'Umbrella' (US) – species of value in making conservation-related decisions, typically because protecting these species indirectly protects a wide variety of other species and habitats. They are species which characterise the presence of an overall balanced habitat at good conservation status.

Flora Species

Caesalpinia ferrea	Leopard Tree	
Ficus nitida	Indian Laurel Fig	
Eucalyptus deglupta	Rainbow eucalyptus	
Plumeria obtusa	Frangipani	
Zephyranthes candida	Fairy lily	
Tristellateia australasiae	New Caledonia	
Acalypha siamensis	Tea leaf	
Ficus pumila	Creeping fig	
Phyllanthus myrtifolius	Mousetail plant	
Spathiphyllum cannifolium	Peace Lily	
Costus speciosus 'Marginatus'	Spiral ginger Var.	
Orthosiphon aristatus	Cat's Whiskers	
Brunfelsia calycina	Ystrd-Today-Tmrw	
Canna indica	Bunga Tasbih	
Vernonia elliptica	Curtain Creeper	
Loropetalum	Purple Diamond	
Justicia gendarusa	Daun Rusa	
Zoysia matrella	Carpet Grass	
Axonopus compressus	Cow Grass	
Cyathea cooperi	Lacy Fern Tree	
Pisonia alba	Moonlight Tree	
Allamanda nerifolia	Bunga Loceng	
Angelonia salicarifolia	Angel Flower	
Belamcanda chinensis	Vase Plant	
Osmoxylon lineare yellow	Yellow Aralia	

INNOVATION TO ENHANCE BIODIVERSITY

designing for biodiversity: fauna & habitats

viverra tangalunga

glaucomys sabrinus

chimarrogale hantu

cynopterus brachyotis

nyctalus noctula

pernis ptilorhynchus

butorides striatus

ardea cinerea

bubulcus ibis

halcyon smyrnensis

varanus salvator

merops viridis

megalaima haemacephala

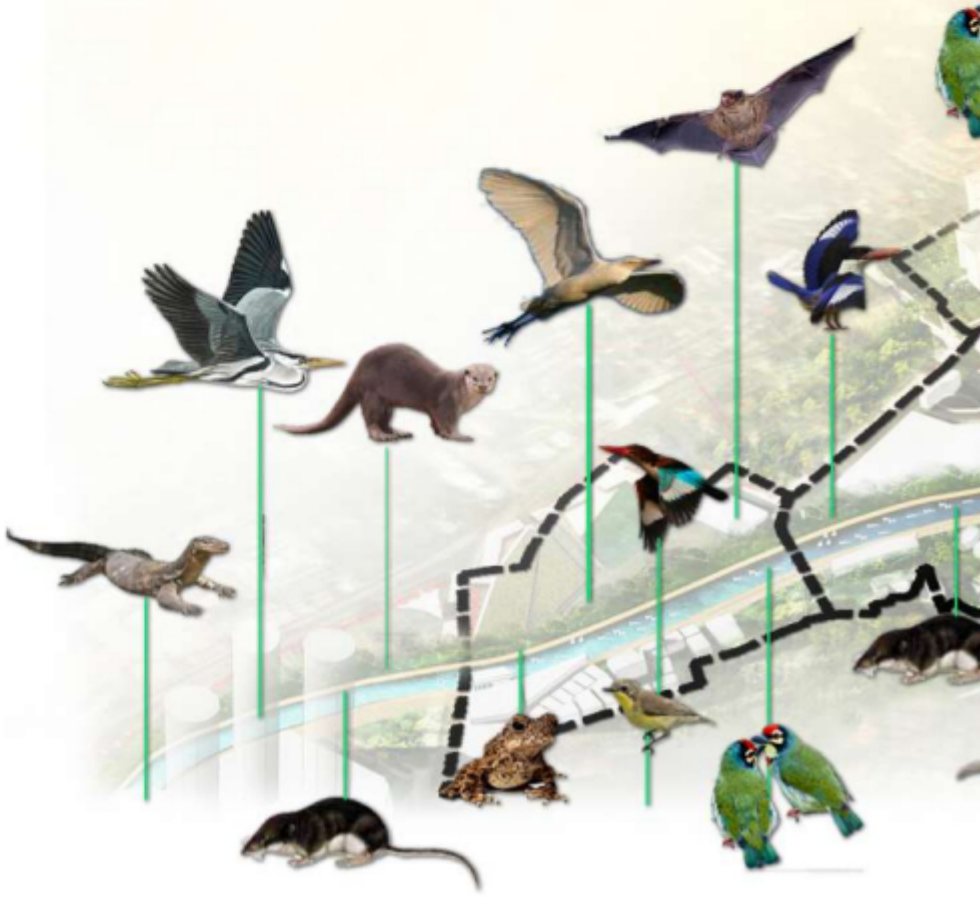
aegithina tiphia

halcyon pileata

gerygone sulphurea

oriolus chinensis

anthreptes malacensis



BY CREATING HABITATS IN DEVELOPMENT

INNOVATION FOR INCREASING LOCAL BIOTIC BY PERIPHERAL VEGETATED

The objective was to design an office building that is more than series of multiple 'cookie-cutter' enclosed concrete trays stacked in the air. Here in this building are the 'corner terraces' on each floor. These terraces are located at all corners all the way up the building. These terraces or skycourts permit:

- the introduction of planting and landscaping in the upper floors.
- a flexible zone for potential of future addition of executive wash rooms.
- adequate sun-shading to allow full height glazing to enhance the quality of light in the office workspace.
- the potential for the location of supplementary air-conditioning units

This is currently not possible in most existing buildings.

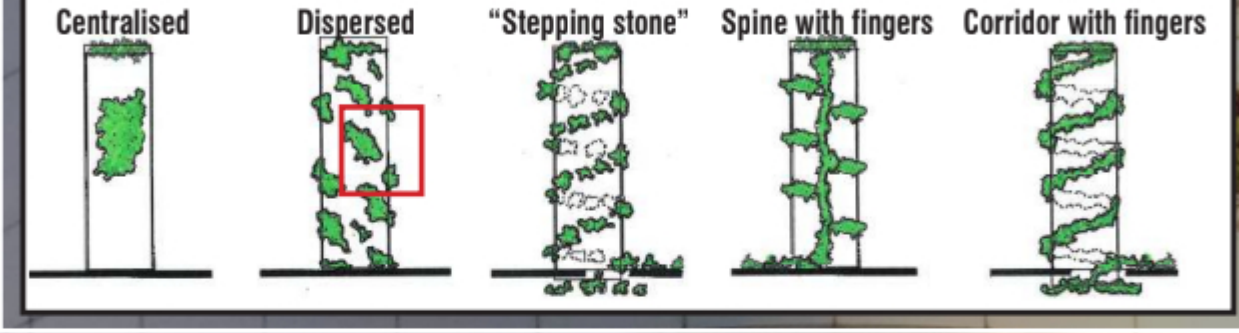
CONTENT & CARBON CAPTURE SKYCOURTS

What makes it innovative?

United Nations Sustainable Development Goals

• green connectivity

Ecological connectivity is essential to promoting biodiversity and ecosystem services. A sustainable design needs to provide a variety of new natural habitats (e.g. green roofs, green sky courts, green plazas, green walls, etc) and relate these habitats to species endemic to the locality to enhance and increase the biodiversity. Studies have shown that new habitats often bring back species that were previously thought to be extinct or non-existent in that locality. For sustainable design, biodiversity targets need to be set for each of the habitats and ways indicated to achieve these targets over the life of the development.



BOUSTEAD TOWER

KUALA LUMPUR, MALAYSIA

INNOVATION FOR SOLAR SHADING

What delights users and public?

• Verandahway

Complement the 'songket' glass canopy located at the covered pedestrian arcade with retail spaces at the bottom edges of each block **give weather protection to pedestrians**.

3 GOOD HEALTH AND WELL-BEING

United Nations Sustainable Development Goals

• Central Promenade

Active public realm with seating zones, planting areas as temporal event spaces and faces the retail and F&B spaces, and semi-covered seating areas. The **tower blocks provide shadows sun-shading** over the promenade for most parts of the day.

3 GOOD HEALTH AND WELL-BEING

11 SUSTAINABLE CITIES AND COMMUNITIES

United Nations Sustainable Development Goals

awards received by project

- *Bronze Award -Regional Holcim Awards 2011*
- *Silver Award -Green Building Index (GBI) 2014*
- *Winner -Cityscape Global Awards 2018/2019*
- *Winner - Malaysia GBC Best New Green Commercial Building 2020*

Skycourt

Planter box

Promenade

BY FRITTED-GLASS

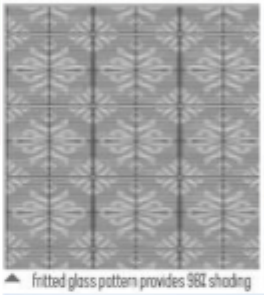
The most crucial for this project is its unique ecological sustainable feature as a Biodiversity Matrix' for designing to increase local biodiversity, introducing native fauna attracting non-hazardous fauna to otherwise inorganic built form on cleared barren land.

Biodiversity Matrix evaluates interactions of constructed habitats with flora selected to attract fauna for feeding, breeding, refuge, seeking water. This unique approach is invented for ecological design and with this, new habitats are created within building and terrain.

What makes it innovative?

3 GOOD HEALTH AND WELL-BEING
8 DECENT WORK AND ECONOMIC GROWTH
United Nations Sustainable Development Goals

• Glass Sun-shading



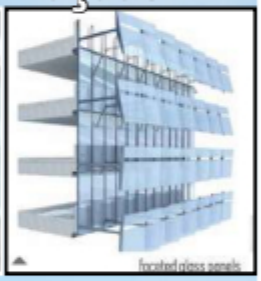
Fritted glass pattern provides 98Z shading

openings inspired by leaf cracks

The sunshade glazing also assist in establishing **comfortable micro-climates in habitable spaces** along the building's exterior.

3 GOOD HEALTH AND WELL-BEING
8 DECENT WORK AND ECONOMIC GROWTH
United Nations Sustainable Development Goals

• Double-Skin Façade



fractated glass panels

The building's enter facades are faceted to present itself as a **crystalline diamond-like structure**, by the use of angled glass sun-shading that wraps around the building.

6 CLEAN WATER AND SANITATION
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
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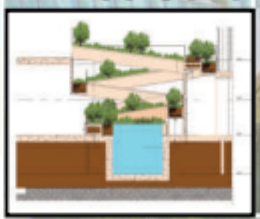
• "Eco Cells"



The continues vegetation **connects the green area** from Level 1 retail garden down to Basement 2 level, and **channels surface rainwater** into a drain at Basement 2 then will be pumped up back to ground level.

SUASANA PUTRAJAYA

PUTRAJAYA, MALAYSIA

INNOVATION TO PROVIDE ECOSYSTEM

What makes it innovative?

• the ecomasterplan

The masterplan the recommended ecological design approach is one of working with the natural gradients of the site which underpin its biodiversity and to create enriched habitats on the land, not occupied by buildings, with a higher carrying capacity for valued species per unit area than the existing lands.

Roof garden

Public realm

Ecological corridor

Elevated walkway

SERVICES BY ECOLOGICAL CORRIDORS

NITTE UNIVERSITY
MANGALORE, INDIA

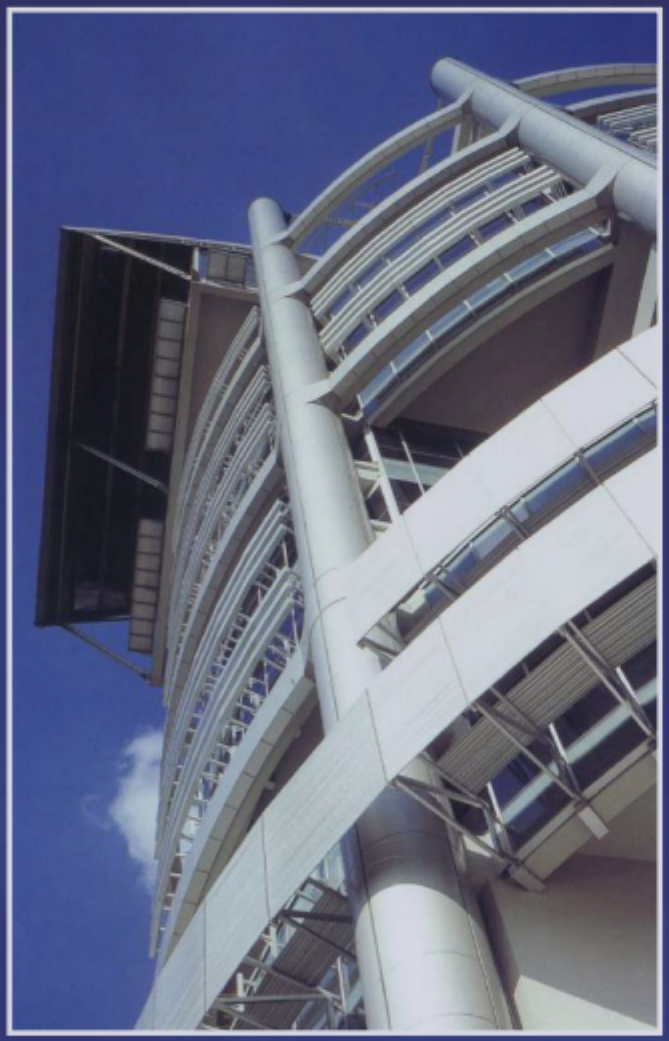
INNOVATION FOR PASSIVE MODE LOW-ENERGY

The building brings together the principles of the bioclimatic approach to the design of tall buildings.

In particular, the building has the following features:

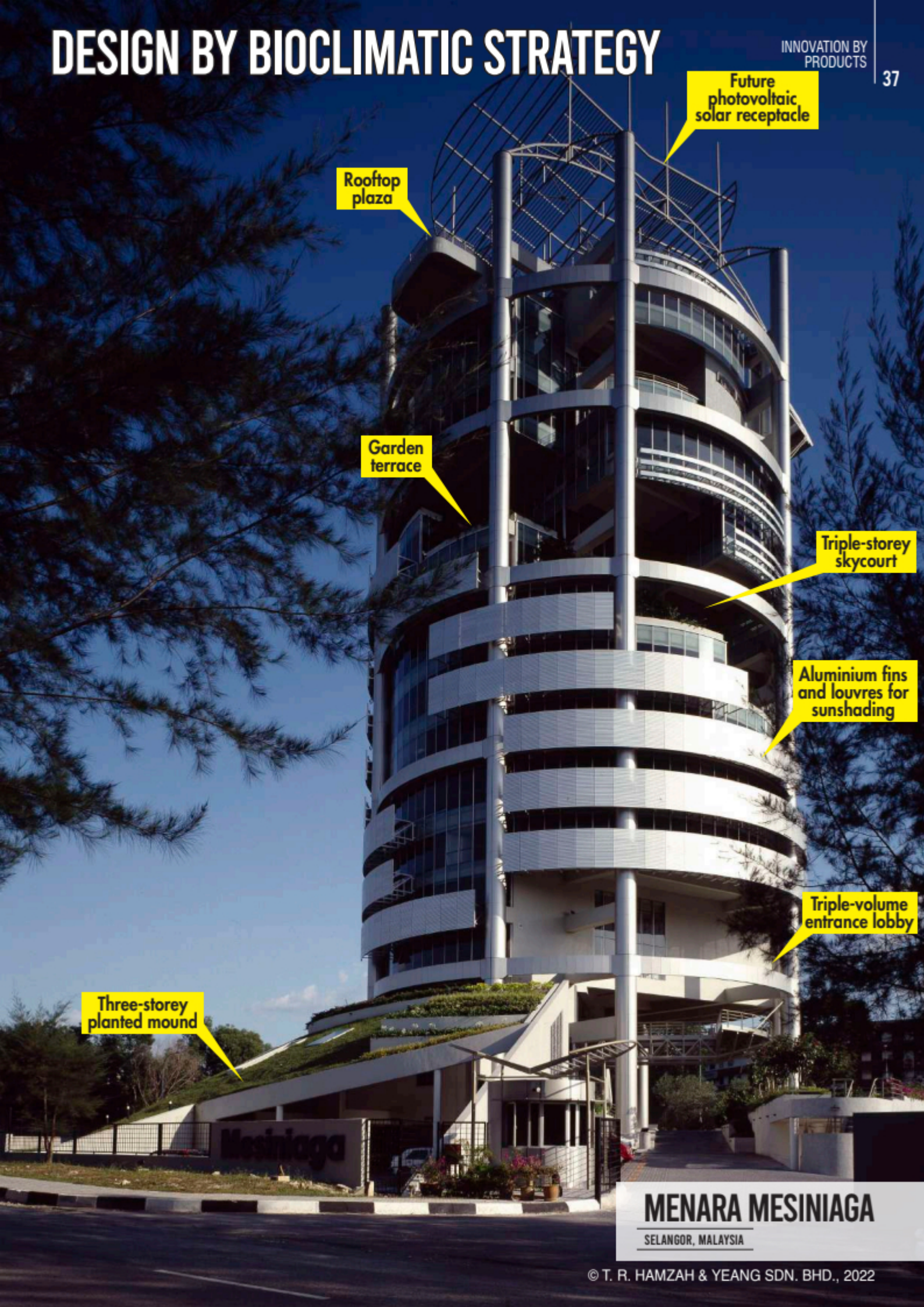
- **"Vertical Landscaping"** (planting) is introduced into the building facade and at the "skycourts". In this building the planting starts by mounding up from ground level to as far up as possible at one side of the building. The planting then "spirals" upwards across the face of the building with the use of recessed terraces (as skycourts).

- A number of **passive low-energy features** are also incorporated: All the window areas facing the hot sides of the building (ie. east and west sides) have external louvres as solar-shading to reduce solar heat gain into the internal spaces. Those sides without direct solar insolation (ie. the north and south sides) have unshielded curtain-walled glazing for good views and to maximise nautral lighting.



The Aga Khan Award for Architecture

DESIGN BY BIOCLIMATIC STRATEGY



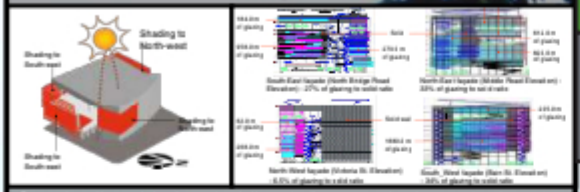
MENARA MESINIAGA

SELANGOR, MALAYSIA

INNOVATION TO ABSORB AERIAL POLLUTION BY

What makes it innovative?

• Sun-shading

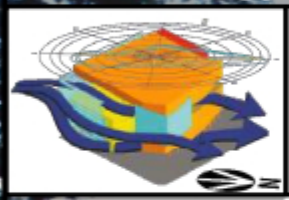


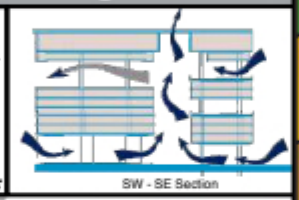
Sunshading blades boldly define tropical aesthetics for the building besides providing solar shading and anti-glare performance that in totality gives the image of a **contemporary climatic-responsive built form.**

3 GOOD HEALTH AND WELL-BEING

United Nations Sustainable Development Goals

• Low energy design





Passive mode strategies used are assembled together as collective strategy for low energy and high comfort building.

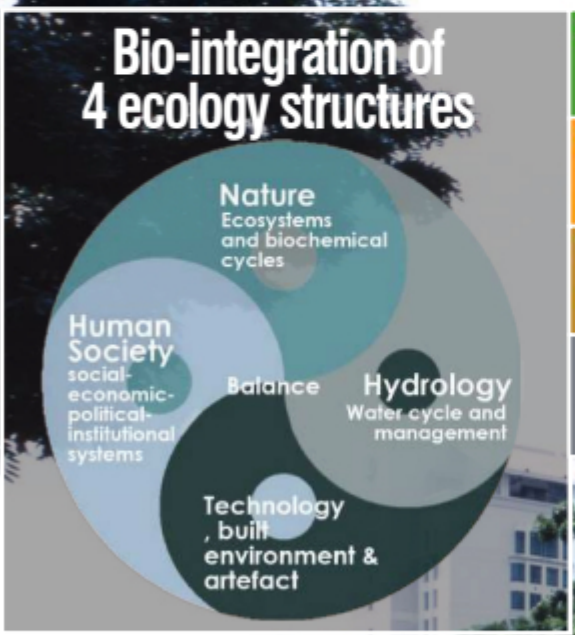
3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

United Nations Sustainable Development Goals

Bio-integration of 4 ecology structures



3 GOOD HEALTH AND WELL-BEING

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

United Nations Sustainable Development Goals

Skycourt

awards received by project

- **BCA Green Mark Platinum 2005**
- Silver Award - 3rd SIA Façade Design Excellence Awards 2006
- Shortlisted in sustainability category -RICS Awards 2006
- First Prize - **ASEAN Energy Efficiency Awards 2007**
- Silver Award -BCA's Universal Design Awards 2007
- **BCA Green Mark Platinum 2009**

PHYTOREMEDIATION AND VEGETATED SKYCOURTS

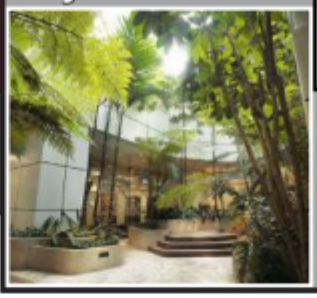
What about the interiors?

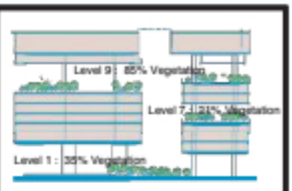
3 GOOD HEALTH AND WELL-BEING

8 DECENT WORK AND ECONOMIC GROWTH

United Nations Sustainable Development Goals

• Vegetated Skycourts





SW - SE Section

Over 6,300 m2 is designated a 'green space' that creates urban "Skycourts" providing a **positive psychological effect on building users and improving general working environments.**

3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

United Nations Sustainable Development Goals

• Green material

The use of **recycled and reused materials** generally (such as carpet, wall fabrics and sustainable-forested local timber) contribute to an environmentally low impact design.

What delights users and public?

3 GOOD HEALTH AND WELL-BEING

11 SUSTAINABLE CITIES AND COMMUNITIES

United Nations Sustainable Development Goals

• Public Realm

At the heart of the scheme is the Public Events Plaza which is a **communal space** that becomes main focal point of the site and subsequently leading visitors into main foyer and library proper.

The NLB building's ecological sustainable significance is its ecomimicry of biological structure of ecosystems, balancing built structure's abiotic content with extensive landscape elements in the two multi-storey skycourts. And the building contains over 6,300sqm 'green' "skycourts" throughout.

The design intention is to provide the NLB with a state-of-the-art and innovative library for the tropics that serves as an icon for the region and its locality. It mimics ecosystems responses to climate being tropical. As to elaborate, it responds to the locality's sunpath by appropriate shading, use of low-e glass, natural ventilation at entrances and Plaza, use of non-heat absorbing colour (white) and extensive cooling landscaping. The building is a classic example of climate-responsive tropical architecture.

NATIONAL LIBRARY

VICTORIA ST, SINGAPORE

INNOVATION FOR SOLAR COOLING

The house is designed as a life-size working prototype of the architect's bioclimatic design ideas. Buildings seen conceptually as are "enclosure systems that operate as environmental filters within the landscape".

The design is a systemic effort to use climatic factors to opportunistically to shape the building's enclosure, its configuration and spatial organisation.

The planning of the internal spaces follow a radial configuration along an East-West axis and in this way integrates the spaces between the building and the site boundary walls as mini-courtyards.

BY LOUVERED CANOPY

What makes it innovative?

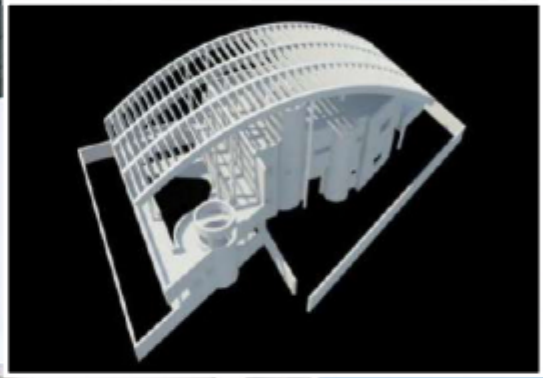
3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

United Nations Sustainable Development Goals

• large 'baffle' roof

This secondary roof shades the roof-terrace immediately underneath the pool enhancing the cooling breezes into the lower floors. The sectional design of the 'baffle' roof is angled or shaped over the building to reduce the insolation over the west and noon-day sun while letting in the morning sun.

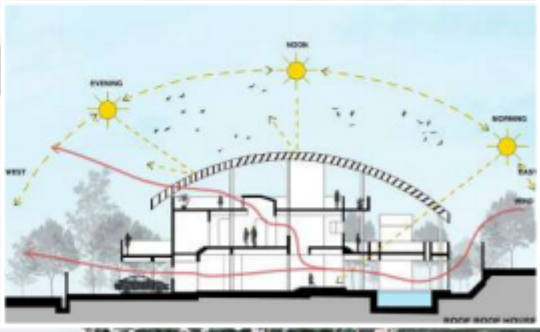


13 CLIMATE ACTION

United Nations Sustainable Development Goals

• built-form orientation

The design is a systemic effort to use climatic factors to opportunistically to shape the building's enclosure, its configuration and spatial organisation. For instance, its north-south orientation protects the major spaces from the tropical sun. The ground floor living-spaces face the East and the spaces open out to the pool-side which takes advantage of the prevailing SE to NW wind to modify the micro-climate.



ROOF - ROOF HOUSE

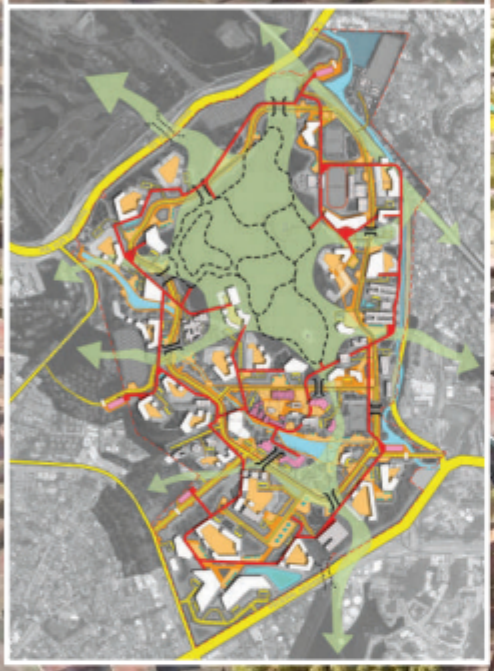
SELANGOR, MALAYSIA

INNOVATION FOR SOLAR SHADING

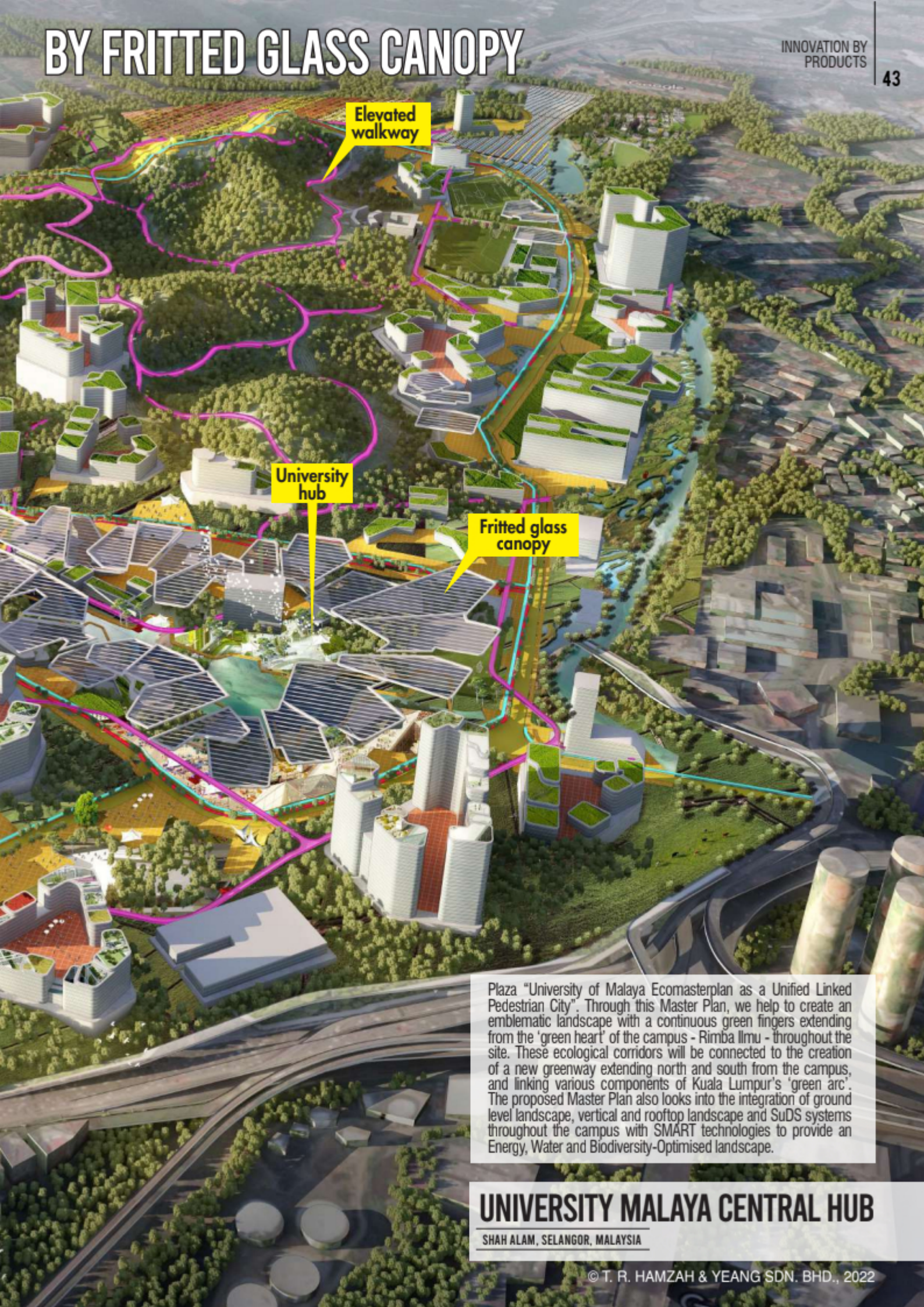
What makes it innovative?

• the ecomasterplan

The masterplan focuses on people and gives them a seamless covered walkway that links all the buildings and unifies the campus. A series of sky plazas along the skywalk provides hangout spaces for the students, staffs as well as the visitors.



BY FRITTED GLASS CANOPY



Plaza "University of Malaya Ecomasterplan as a Unified Linked Pedestrian City". Through this Master Plan, we help to create an emblematic landscape with a continuous green fingers extending from the 'green heart' of the campus - Rimba Ilmu - throughout the site. These ecological corridors will be connected to the creation of a new greenway extending north and south from the campus, and linking various components of Kuala Lumpur's 'green arc'. The proposed Master Plan also looks into the integration of ground level landscape, vertical and rooftop landscape and SuDS systems throughout the campus with SMART technologies to provide an Energy, Water and Biodiversity-Optimised landscape.

UNIVERSITY MALAYA CENTRAL HUB

SHAH ALAM, SELANGOR, MALAYSIA

INNOVATION FOR REDUCING SOLAR

This is a 3-storey building with offices on one wing and a golf clubhouse on the other wing. The offices are the HQ peremises for Guthrie Property Development Holding Sdn. Bhd. (GPDH) [a division of Kumpulan Guthre Berhad]. The company's business is solely in real estate development. The building is intended to be a landmark building and to be the most prestigious building visible from the highway as visitors enter the locality. Sunshades are located along the east and west faces of the buidling to reduce heat gain.

HEAT GAIN BY INFLATED CANOPY

What makes it innovative?

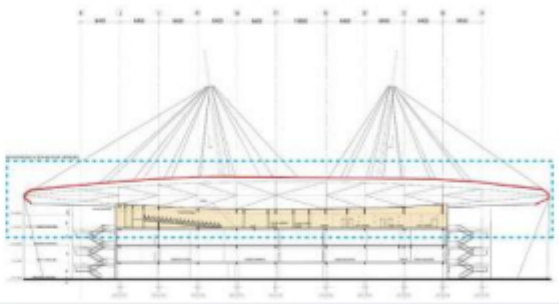
3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

United Nations Sustainable Development Goals

• air-filled roof canopy

The air-filled roof canopy is an independent structure, acting as an "umbrella" over the building. The roof shields the building from the sun, reducing glare and air-conditioning load whilst providing a usable roof terrace overlooking the golf course on the north and east.



air-filled roof canopy

GUTHRIE PAVILION

SHAH ALAM, SELANGOR, MALAYSIA

INNOVATION FOR ROOF CANOPY

BY MODULAR COMPONENTS

Xiong An Station, also known as "Station in the Park" rethinks the preconception of a high speed railway station - integrating public spaces, ecology and state-of-the-art rail services. With a focus on sustainable precepts and people-oriented design, Station in the Park not only offers safe, high quality and seamless interchange facilities, it blends with the local environment to provide pleasurable and ecological public spaces - a memorable and picturesque destination. Conceived as an iconic gateway into the city, the architecture of the station is an innovative construction that combines cutting edge technology with close references to and respect for the local context and Chinese culture. Emerging as a key regional transport node, Station in the Park exemplifies the aspiration of Xiong An New District to become a city of the future.

What makes it innovative?

• homogeneuos canopy roof

Conceived as an iconic gateway into the city, the architecture of the station is an innovative that combines a cutting edge technology with close references to and the respect for the local context and the Chinese culture.

XIONG'AN STATION

XIONG'AN, BEIJING, CHINA

INNOVATION FOR LOWERING AMBIENT

What makes it innovative?

- **the "water-court"**

A pool courtyard that consists of a tropical pool and the semi-outdoor patio functions as a separator and connector between the public domain and private wing. Apart from the sun deck that can be accessed from the gallery, the in-pool steps are built to serve as entry/ exit points and functions as a sun shelf for sitting and lounging in the pool.

3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

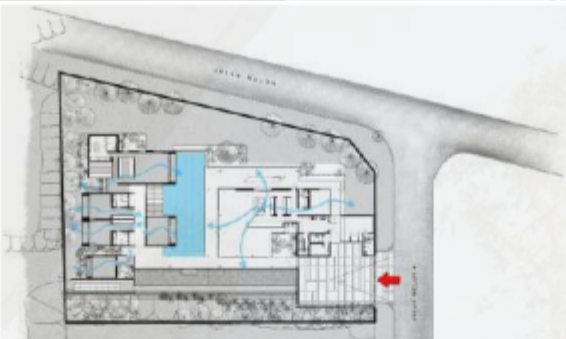
United Nations Sustainable Development Goals

Swimming pool

The house is designed based on the programmes that reflect the lifestyle and culture of a family of an expatriate couple who divide their time between Malaysia and Singapore. It is an experimental building design where the comfort cooling is provided by integration with the pool and koi pond for evaporative cooling with the extensive and lush landscape throughout. In its simplicity, the building consists of a public domain that houses the family area, a games room and semi-outdoor patio and a private wing that consists of the bedrooms, a study room and a sun deck. Other spaces include: dry and wet kitchens, utility room, yard, bathrooms, driveway, driver's space, maids' bedrooms, gallery & space for showcase of artworks.

TEMPERATURE BY EVAPORATIVE COOLING

United Nations Sustainable Development Goals



Passive cooling by good cross ventilation and the use of large water bodies.

• passive cooling

Comfort cooling is provided via evaporative cooling from the pool and koi pond. The house maximizes cross ventilation by having openings at both sides of the wings at both the ground and first floor levels. The building's shallow floor plan facilitates natural ventilation in all areas, with windows and doors located on opposite walls to encourage cross ventilation.

R-HOUSE

JOHOR, MALAYSIA

INNOVATION FOR LOWERING AMBIENT

TEMPERATURE BY EVAPORATIVE COOLING

REYNOLDS HOUSE

JOHOR, MALAYSIA

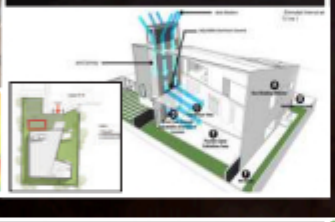
INNOVATION FOR NATURAL VENTILATION

The Ganendra Art House is a trend setter in its innovative experimental 'wind chimney' never before tested in Malaysia. The shaft has 360 degree openings at its top as an omni-directional device to catch wind from all directions and is internally partitioned to channel the wind down the shaft, into the gallery and living spaces for comfort-cooling and natural ventilation. The extent of wind-flow into the internal space can be manually controlled by operable glass louvers. The building encourages nature to flourish, inviting native flora and fauna to be part of its realm. Its passive non-aircontioned sustainable design features reduce the negative heat-island thermal impacts on its surrounding context.

What makes it innovative?

• wind flue design

The innovative 'wind chimney' similar to the ventilating chimneys used in Middle-East. The devices function as a down shaft to channel the external wind to the gallery spaces to provide comfort cooling and natural ventilation.



3 GOOD HEALTH AND WELL-BEING

United Nations Sustainable Development Goals

• built-form orientation

The building configuration is oriented based on the location's solar path and south. The west side has minimum window openings to reduce solar heat gain. Double brick wall are used for greater cooling and noise insulation.

Building Orientation Diagrams

3 GOOD HEALTH AND WELL-BEING

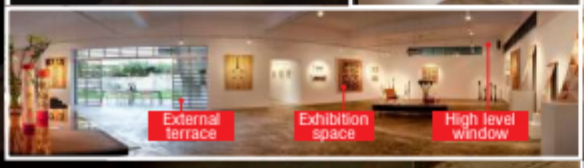
13 CLIMATE ACTION

United Nations Sustainable Development Goals

Functional interiors

• indirect daylight

Daylight to the building enters through windows, door openings, under facade shading devices and skylights. The lighting level is generally uniform with no significant contrasts for better visual comfort.



3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

United Nations Sustainable Development Goals

Continuous vegetated ramp

External terrace

COOLING BY DOWN-DRAFT FLUE

Natural ventilated exhibition area

What delights users and public?

3 GOOD HEALTH AND WELL-BEING
11 SUSTAINABLE CITIES AND COMMUNITIES
United Nations Sustainable Development Goals

• flexible open plan layout

The primary gallery areas have an open plan layout as flexible exhibition spaces for multipurpose exhibition and cultural space.

3 GOOD HEALTH AND WELL-BEING
13 CLIMATE ACTION
United Nations Sustainable Development Goals

• courtyard & outdoor patio

The **vegitated green ramp** connected the lanscape from ground level to the green balcony at the upper level.

3 GOOD HEALTH AND WELL-BEING
13 CLIMATE ACTION
United Nations Sustainable Development Goals

• sun-shading

Shading devices are critical due to the intense solar radiation of the tropical climate. All openings & glass window are shaded using a combination of horizontal and vertical sun shade elements. There are also deep roof overhang at the 1st floor of the balcony. These shading features serve to reduce glare to the internal gallery areas.

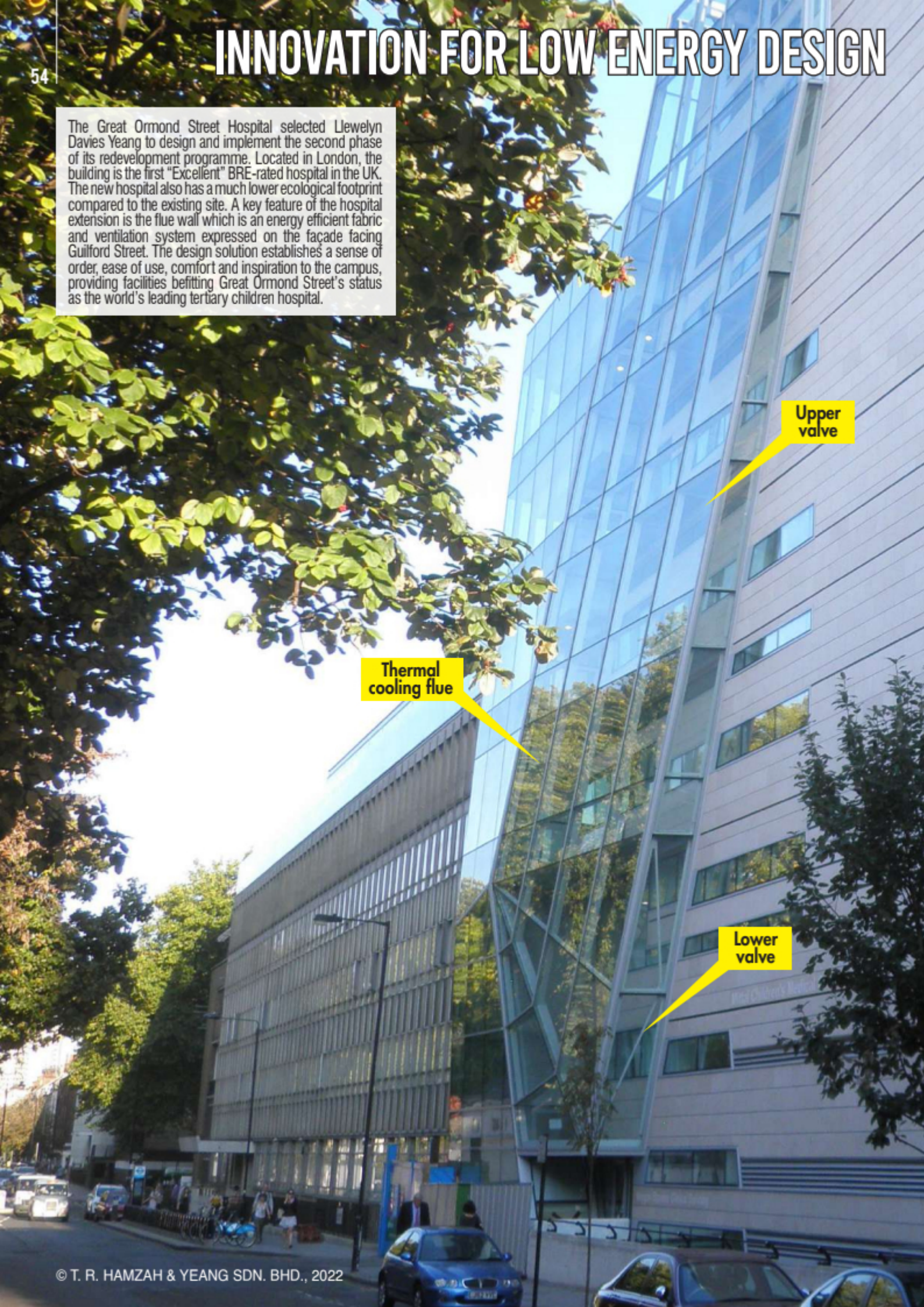
- **Project Type:** Art Gallery
- **Site Area:** 771.4sqm
- **Total GFA:** 633.4sqm
- **No. of Storeys:** 2 storeys
- **Completion Year:** 2011

GANENDRA ART HOUSE

PETALING JAYA, MALAYSIA

INNOVATION FOR LOW ENERGY DESIGN

The Great Ormond Street Hospital selected Llewelyn Davies Yeang to design and implement the second phase of its redevelopment programme. Located in London, the building is the first "Excellent" BRE-rated hospital in the UK. The new hospital also has a much lower ecological footprint compared to the existing site. A key feature of the hospital extension is the flue wall which is an energy efficient fabric and ventilation system expressed on the façade facing Guilford Street. The design solution establishes a sense of order, ease of use, comfort and inspiration to the campus, providing facilities befitting Great Ormond Street's status as the world's leading tertiary children hospital.



BY MIXED-MODE GLASS FLUE

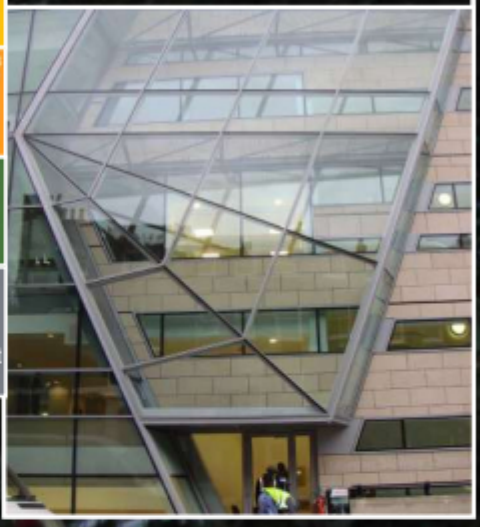
What makes it innovative?

3 GOOD HEALTH AND WELL-BEING
7 AFFORDABLE AND CLEAN ENERGY
11 SUSTAINABLE CITIES AND COMMUNITIES
13 CLIMATE ACTION

United Nations Sustainable Development Goals

• the "flue wall"

Naturally ventilates the lower 3 floors during the mid-seasons (Spring & Autumn) and reduces annual energy consumption.

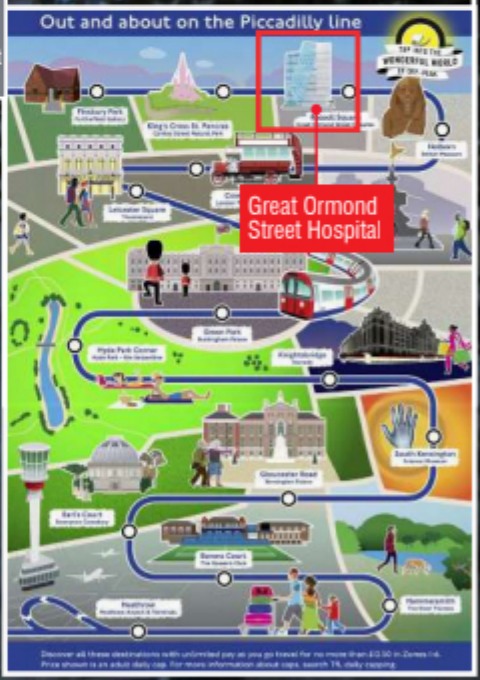


11 SUSTAINABLE CITIES AND COMMUNITIES

United Nations Sustainable Development Goals

• featured building

Great Ormond Street Hospital is featured in a poster at the London Underground Station.



GREAT ORMOND STREET HOSPITAL

LONDON, UNITED KINGDOM

INNOVATION FOR NATURAL DAYLIGHT

The Client is a religious organization seeking a facility for their weekend services, creative performances, training institute and for hosting of events. The brief has 3 main components: the Convention Centre, the Institutional complex and Administration and Commercial Centre. In the design brief, the following were to be incorporated in the design:

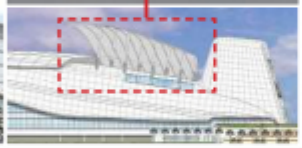
- A rainbow inspired feature
- A fountainhead
- An object of spiritual significance

to be proposed by the architect

What makes it innovative?

• operable roof

The **operable 'wings'** powered by hydraulic arms allow daylight and natural ventilation into the auditorium when opened. It can provide natural cross ventilation into the auditorium, as a low energy strategy when the hall is not in full use.



3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

United Nations Sustainable Development Goals

• mixed-mode cooling

The building uses Mixed Mode cooling in transitional spaces, where natural ventilation is supplemented by mechanical means such as fans, in central transition spaces (lobbies, foyers, courtyard). These spaces include the covered plaza with fan assisted cooling.

3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

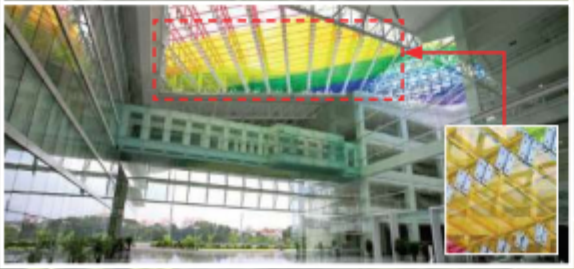
12 RESPONSIBLE CONSUMPTION AND PRODUCTION

United Nations Sustainable Development Goals

What about the interiors?

• rainbow plaza

The plaza and entrance lobby atrium is a sky-lit space with an array of **rainbow-coloured laminated glass** fins oriented perpendicularly below the skylight so that as the sun moves over the skylight, its motion will generate a "moving rainbow" across the floor of the entrance plaza.



3 GOOD HEALTH AND WELL-BEING

7 AFFORDABLE AND CLEAN ENERGY

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

United Nations Sustainable Development Goals

Operable roof

& VENTILATION BY OPERABLE ROOF

What delights users and public?

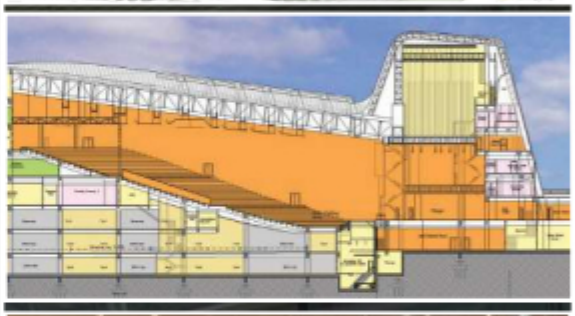
3 GOOD HEALTH AND WELL-BEING

13 CLIMATE ACTION

United Nations Sustainable Development Goals

• main auditorium

The **5000-seating** auditorium is designed to be sub-dividable into three smaller halls and features a built-in structure in the ceiling for future installation of foldable ceiling-mounted "skyfield" partitions up to 10 metres in height.

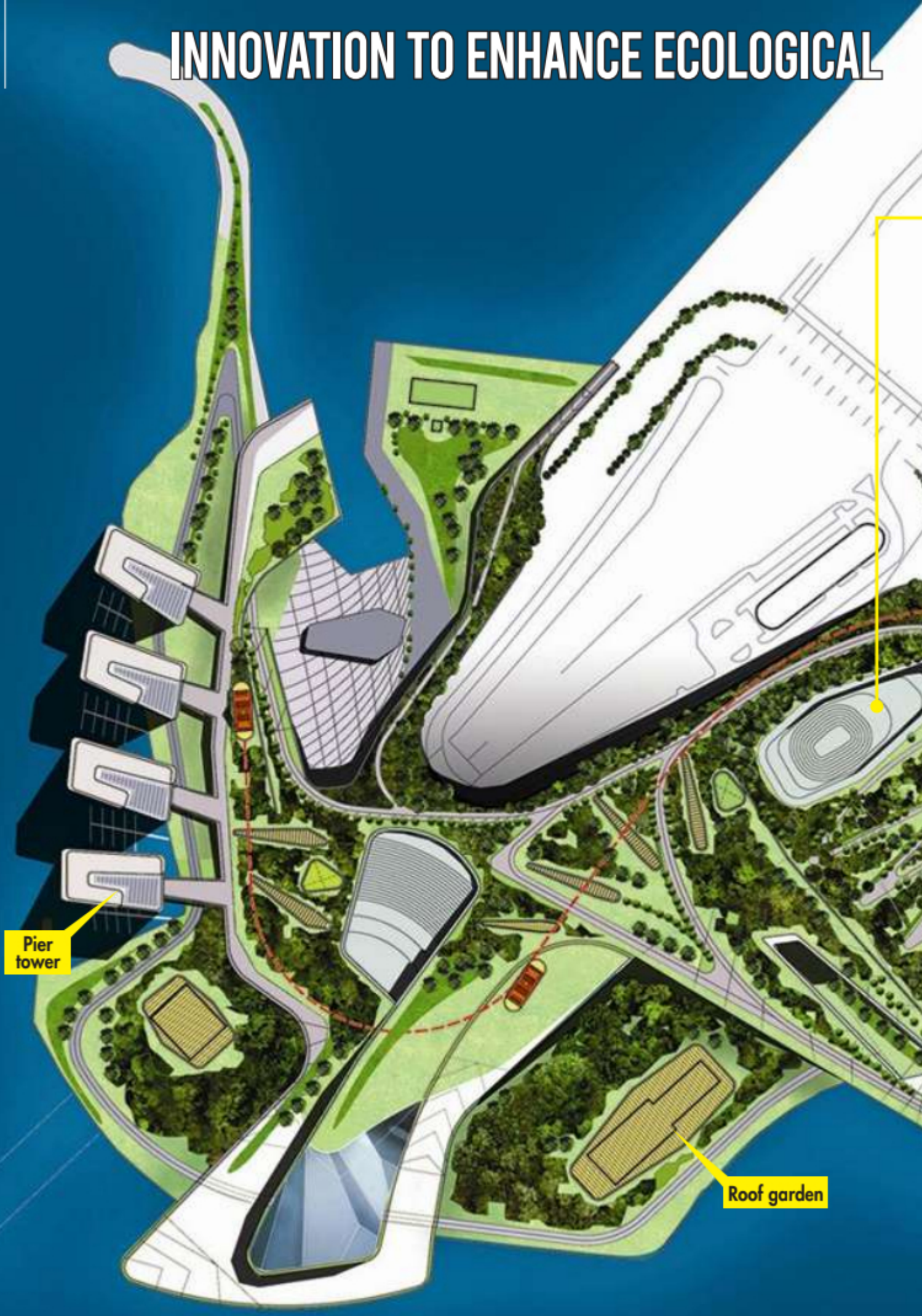


- **Project Type:** Convention Centre
- **Site Area:** 55,487sqm
- **Total GFA:** 35,920sqm
- **Client: Calvary Church**
- **Completion Year:** 2012
- **Number of Storeys:**
  - 4-storey Convention Block
  - 6-storey Institutional Block
  - 3-storey Basement

CALVARY CONVENTION CENTRE

BUKIT JALIL, MALAYSIA

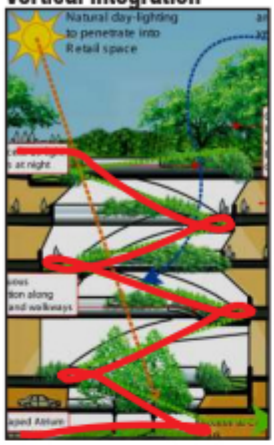
INNOVATION TO ENHANCE ECOLOGICAL



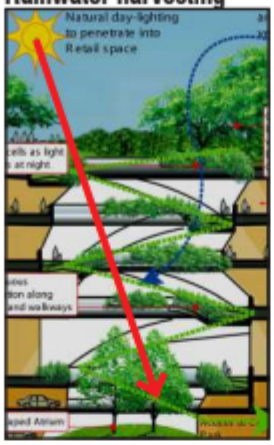
CONNECTIVITY BY ECOCELL

Eco-cell

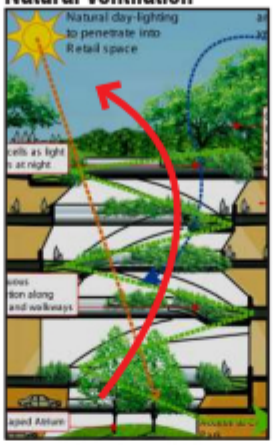
Vertical integration



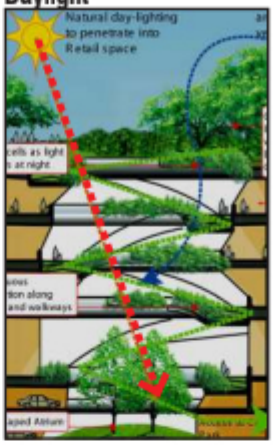
Rainwater harvesting



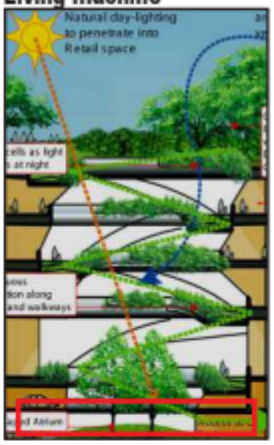
Natural ventilation



Daylight



Living machine



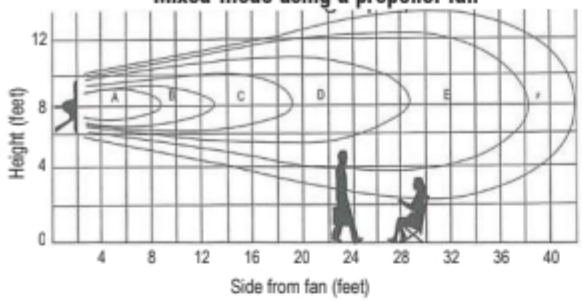
KOWLOON MASTERPLAN

HONG KONG

INNOVATION FOR LOW-ENERGY DESIGN

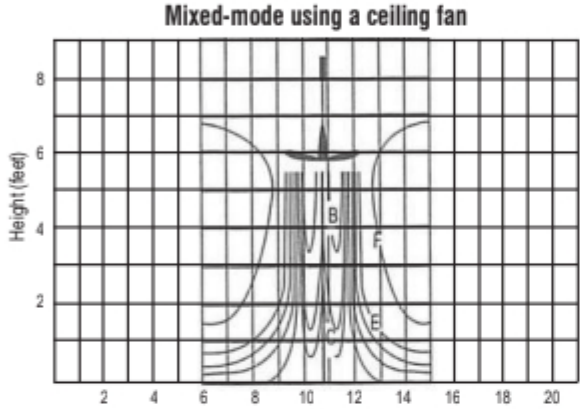
Horizontal Throw

Mixed-mode using a propeller fan



Vertical Throw

Mixed-mode using a ceiling fan



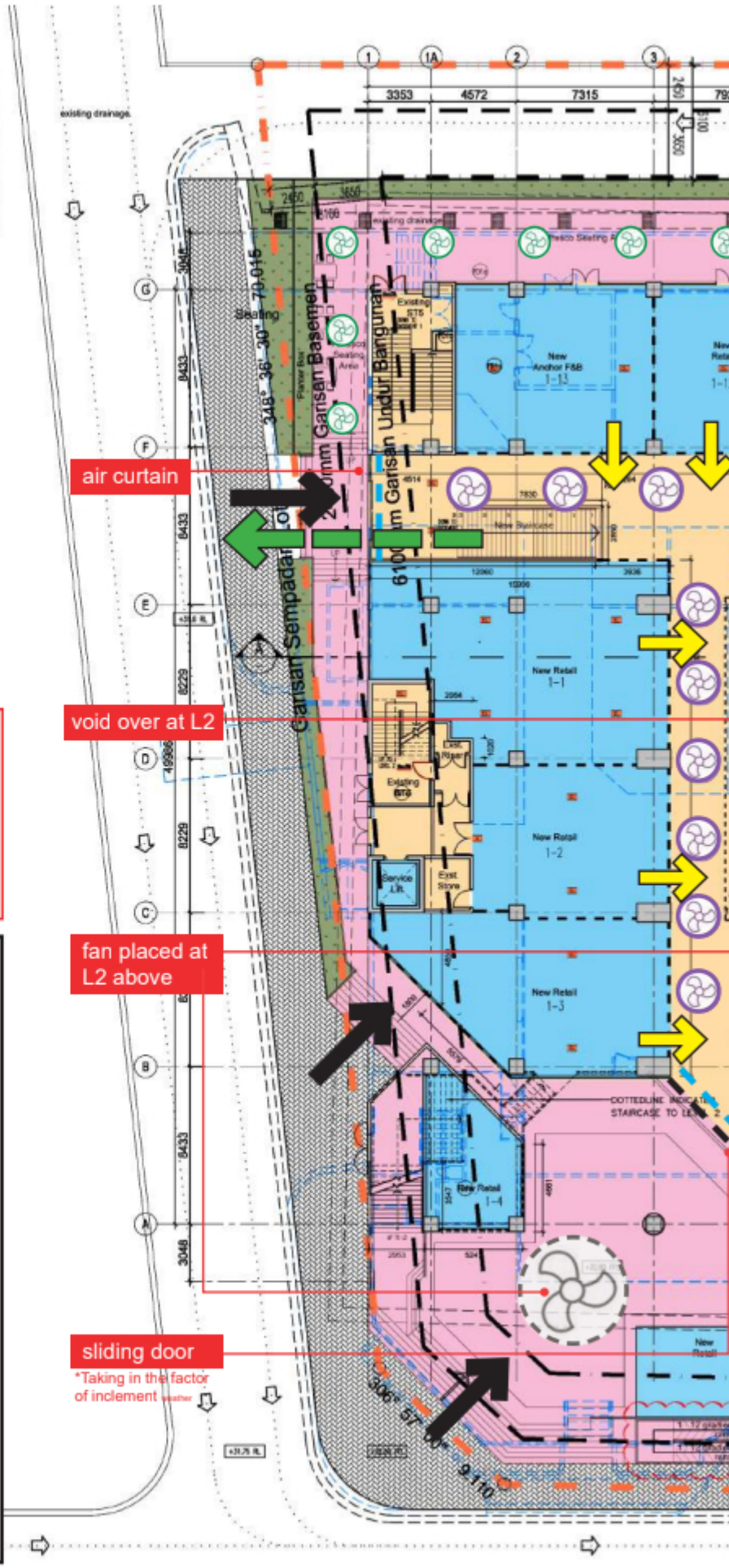
NOTE:

- "Plan shows mixed-mode study only (not exact temperature).
- Computational Fluid Dynamics modeling (CFD) is needed to scientifically simulate building's airflow and heat transfers before and after ventilation improvements.

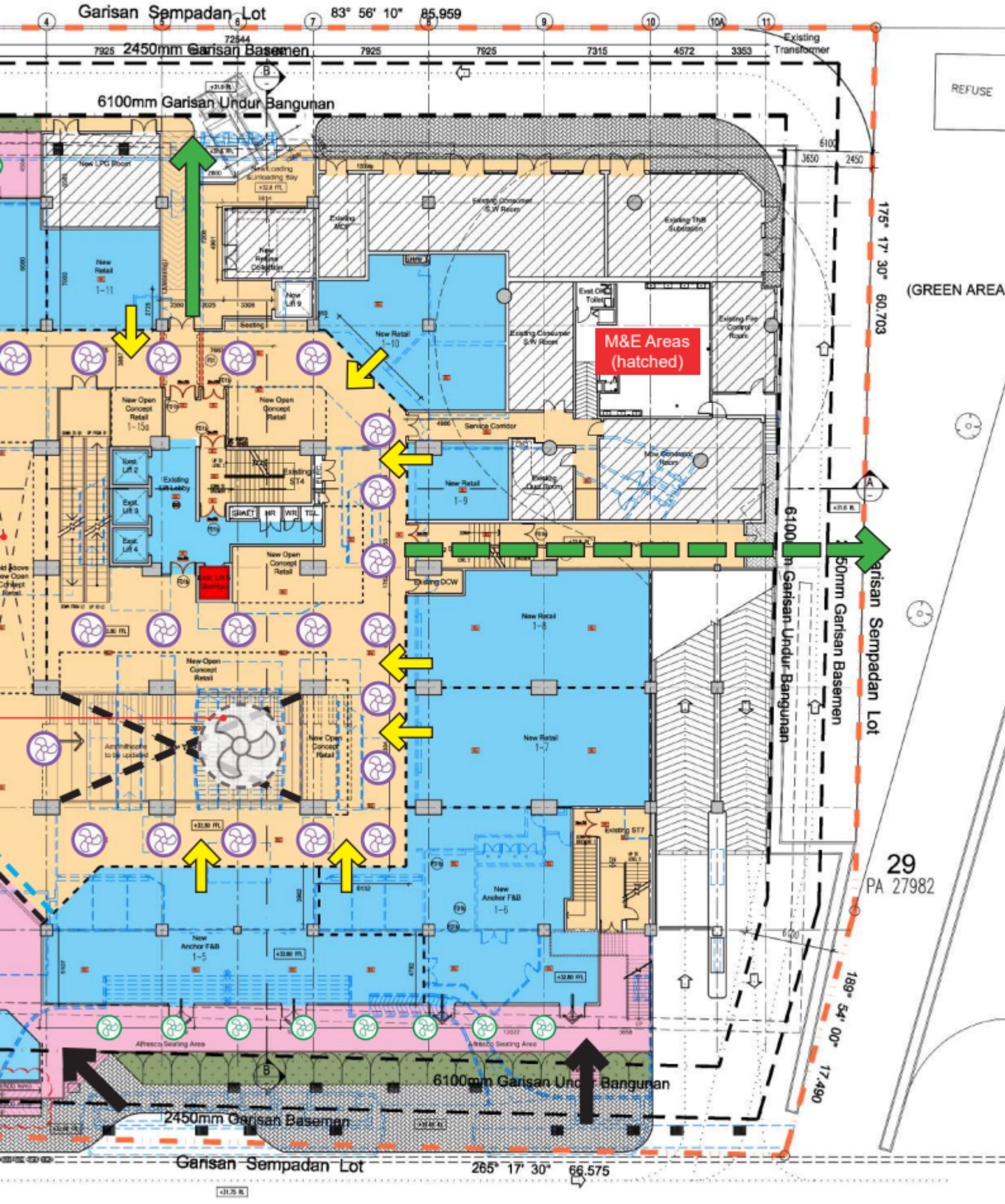
Legend

- Large Diameter Ceiling Fan (7.5m - 8.0m diameter)
- Small Diameter Ceiling Fan (2.5m - 3.0m diameter)
- Medium Diameter Ceiling Fan (4.5m - 5.0m diameter)
- (Micro) Diameter Ceiling Fan (1.0m diameter)
- Cool air blown outside to the corridor areas
- Air Exhaust Fan (automated: switched on only when required)
- Air Curtain (to be verified by engineer)
- open-to-sky area(s)
- non air-conditioned areas
- air-conditioned areas

***All partial M&E systems to be verified by engineer.**

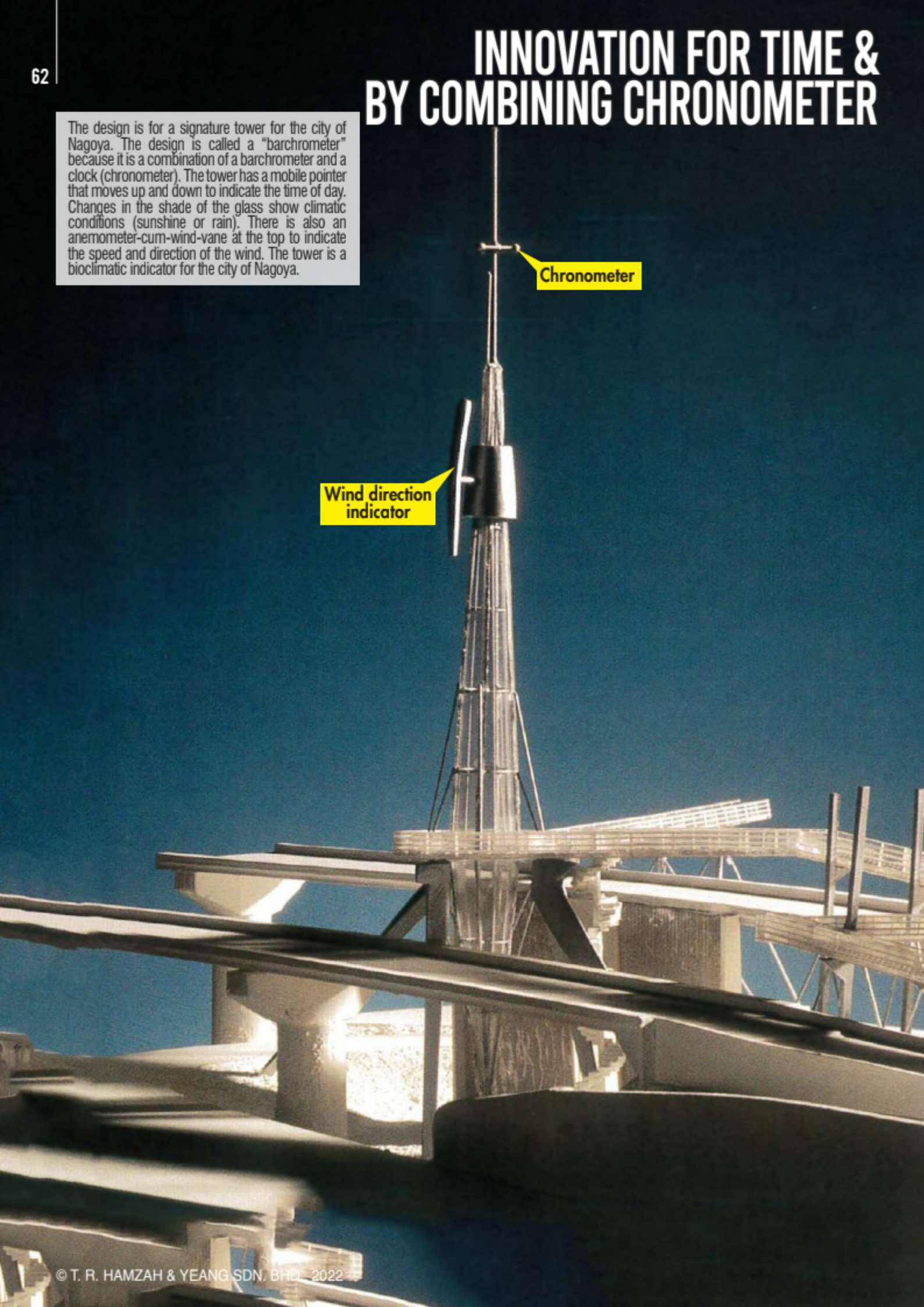


BY MIXED-MODE SYSTEMS (PARTIAL M&E)

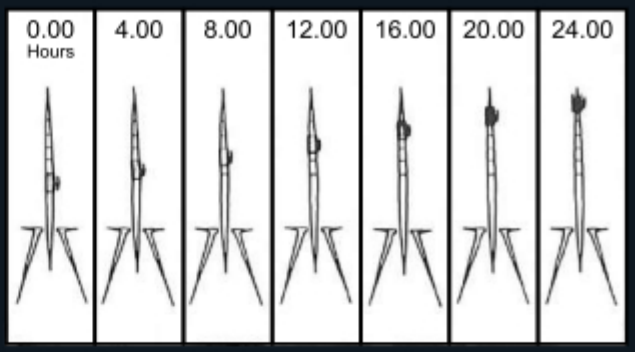


INNOVATION FOR TIME & BY COMBINING CHRONOMETER

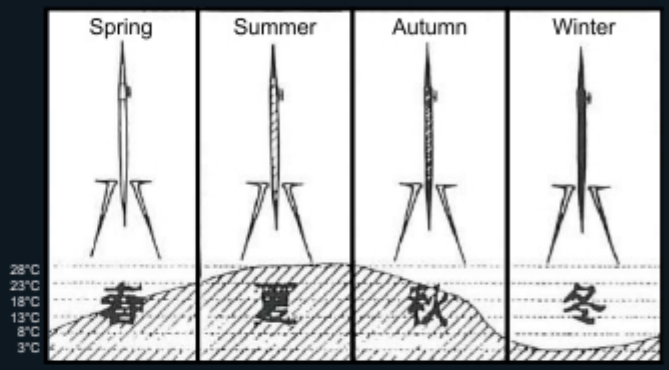
The design is for a signature tower for the city of Nagoya. The design is called a "barchrometer" because it is a combination of a barchrometer and a clock (chronometer). The tower has a mobile pointer that moves up and down to indicate the time of day. Changes in the shade of the glass show climatic conditions (sunshine or rain). There is also an anemometer-cum-wind-vane at the top to indicate the speed and direction of the wind. The tower is a bioclimatic indicator for the city of Nagoya.



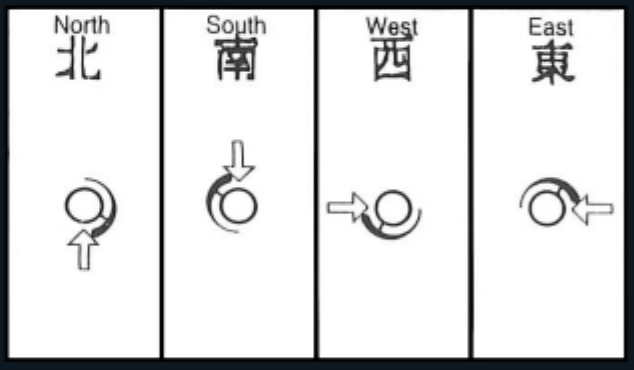
WEATHER INDICATOR WITH WEATHER STATION



• Time of Day Indicator



• Season of Year Indicator



• Wind Direction Indicator

• Weather Indicator

NAGOYA BARCHROMETER

NAGOYA, JAPAN

INNOVATION FOR ECOLOGICAL NEXUS

Corridor with fingers

Continuous linked vegetated ramps from ground level

Vegetated skycourts

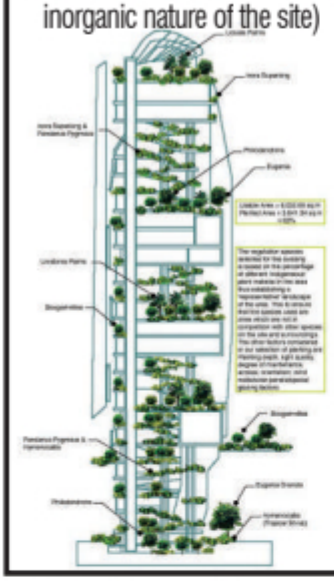
Urban design involves 'place making'. In creating 'vertical places', our design brings 'street-life' to the building's upper-parts through wide landscaped-ramps upwards from street-level. Ramps are lined with street-activities: (stalls, shops, cafes, performance spaces, viewing-decks etc.), up to first 6 floors. Ramps create a continuous spatial flow from public to less public, as a "vertical extension of the street" thereby eliminating the problematic stratification of floors inherent in all tall buildings typology. High-level bridge-linkages are added to connect to neighbouring buildings for greater urban-connectivity.

EDITT TOWER

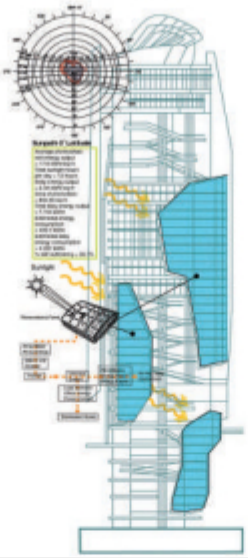
SINGAPORE

BY LINKED VEGETATED RAMPS

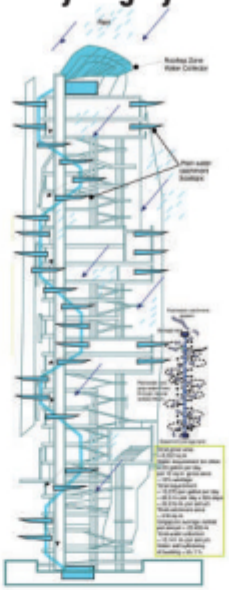
Planting Concept
(Reintroduction of organic mass to urban site to counter balance inorganic nature of the site)



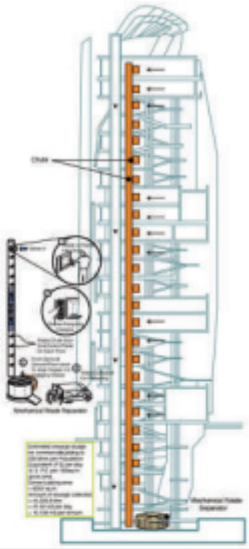
Productive Mode: Photovoltaics

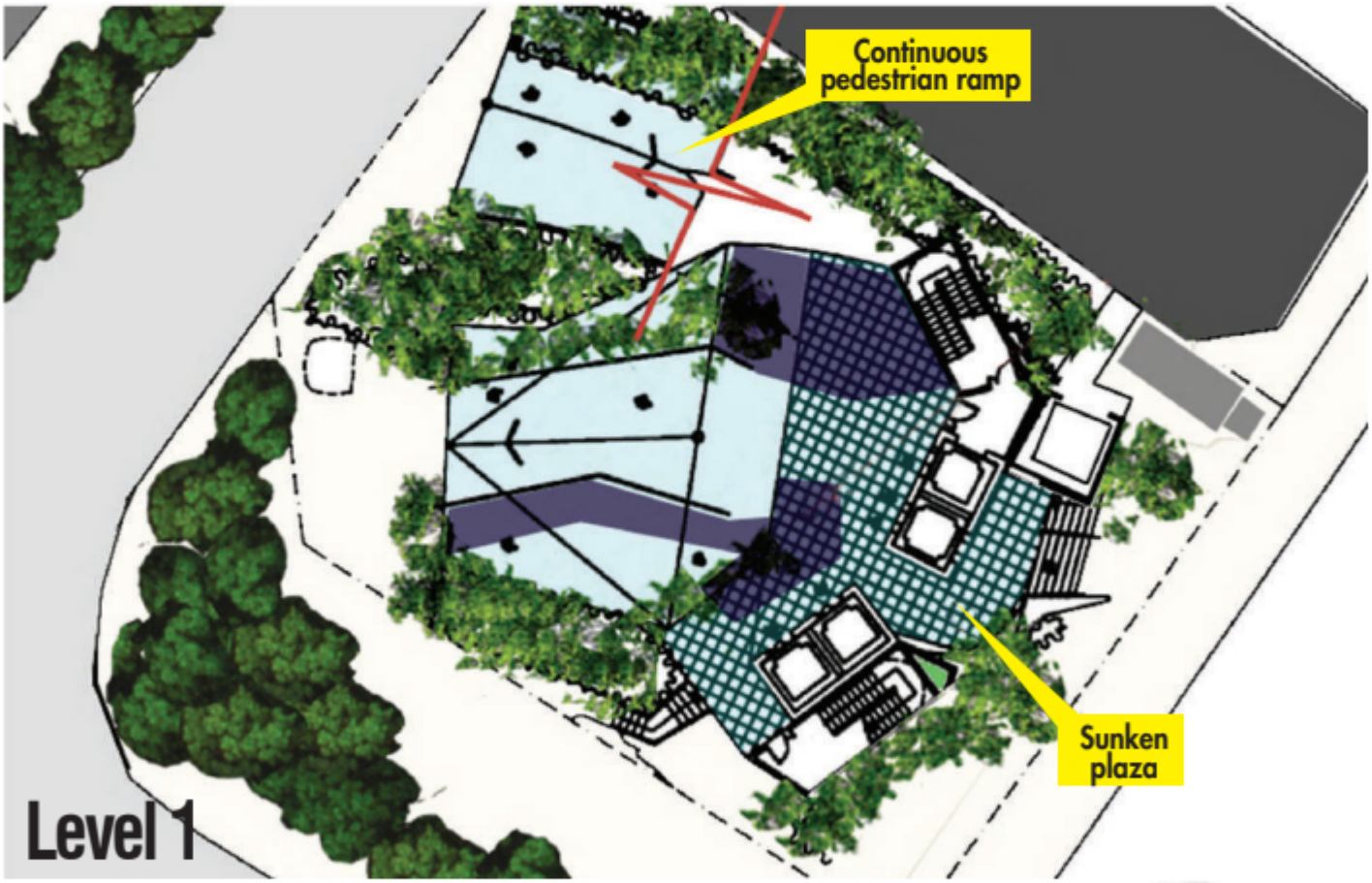


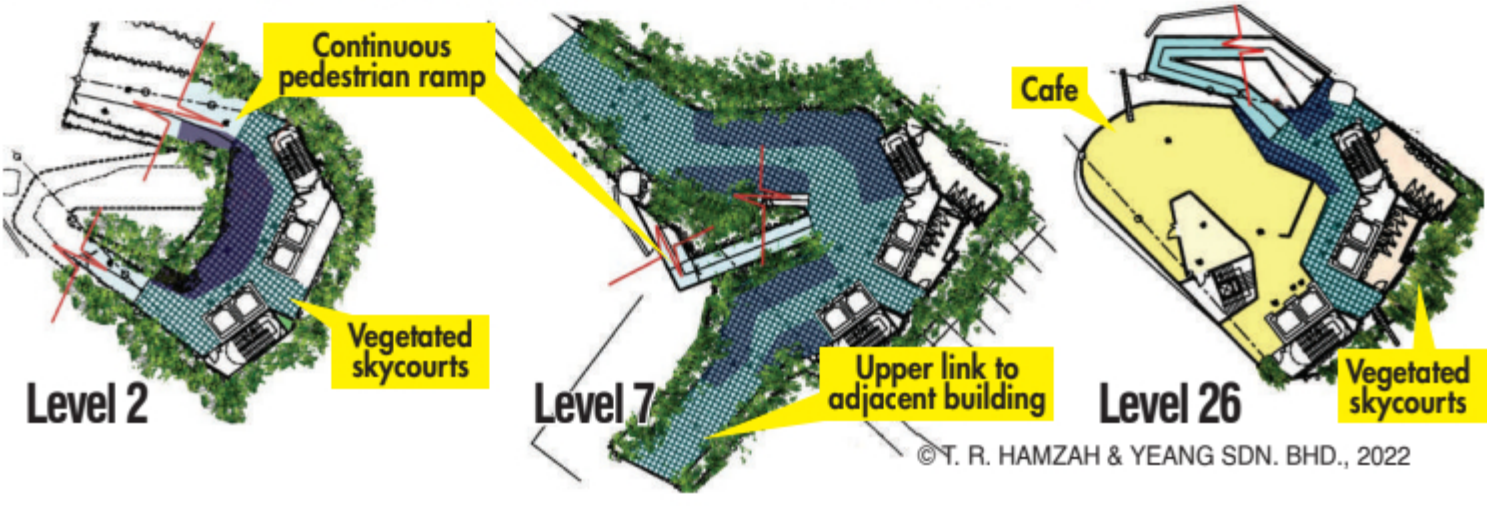
Rainwater Collection & Recycling System



Solid-Waste Recycling System





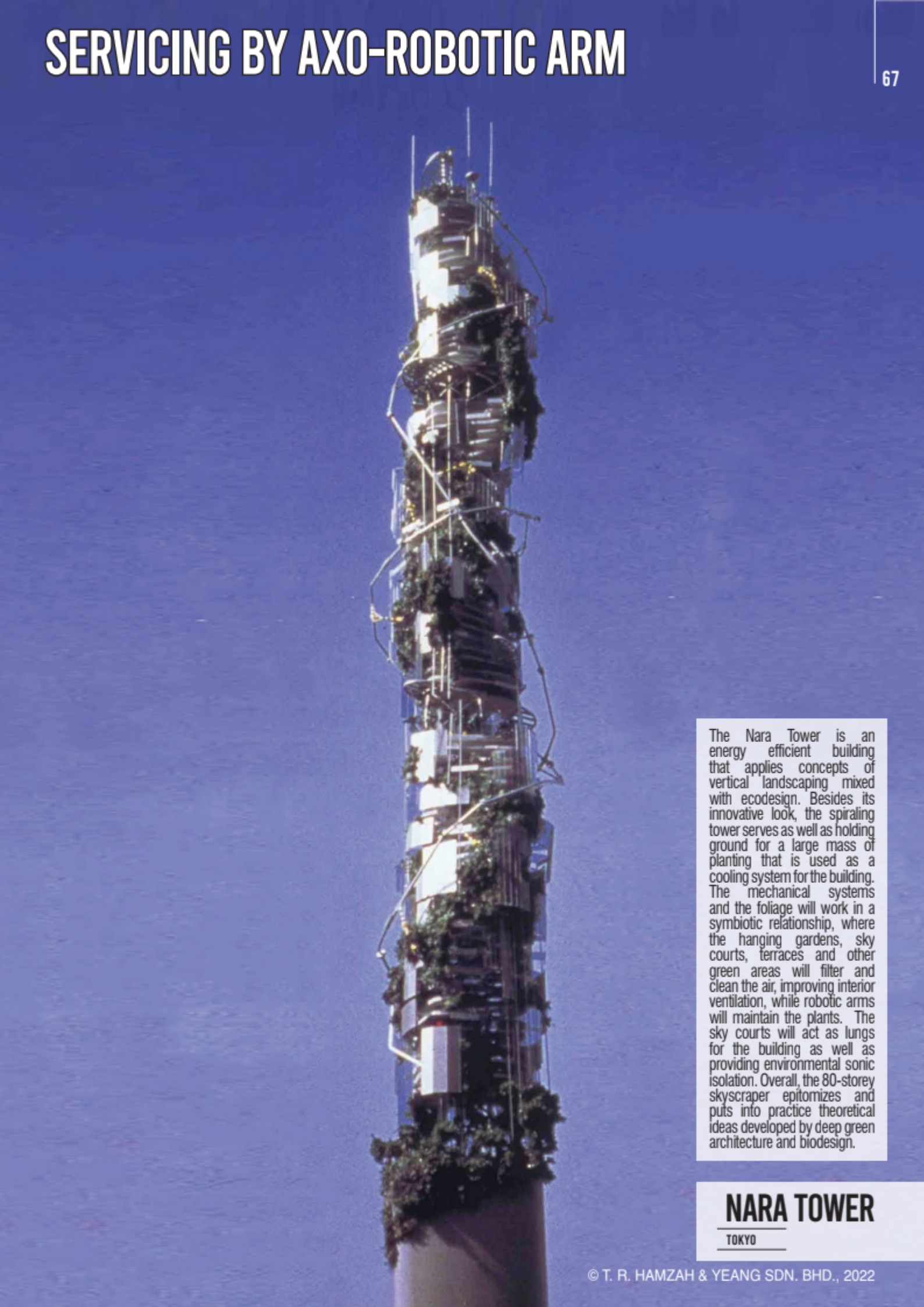


INNOVATION FOR EXTERNAL AUTOMATED

Architecture Magazine
at 08
1992 august

- Tropical Architecture in Southeast Asia
- Macao is a city Presenting European face in Asia

SERVICING BY AXO-ROBOTIC ARM



The Nara Tower is an energy efficient building that applies concepts of vertical landscaping mixed with ecodesign. Besides its innovative look, the spiraling tower serves as well as holding ground for a large mass of planting that is used as a cooling system for the building. The mechanical systems and the foliage will work in a symbiotic relationship, where the hanging gardens, sky courts, terraces and other green areas will filter and clean the air, improving interior ventilation, while robotic arms will maintain the plants. The sky courts will act as lungs for the building as well as providing environmental sonic isolation. Overall, the 80-storey skyscraper epitomizes and puts into practice theoretical ideas developed by deep green architecture and biodesign.

NARA TOWER

TOKYO

06 INNOVATION BY BIOINTEGRATION

Biointegration of the organic with inorganic to create hybrids

the biosphere
- biogeochemical processes
- energy and material resources
- ecosystems

community of plants & animals

plant community | animal community | community of plant & animal microbes

biological constituents

biotic

physical environment

site characterised by given climate features | site characterised by given edaphic

physical constituents

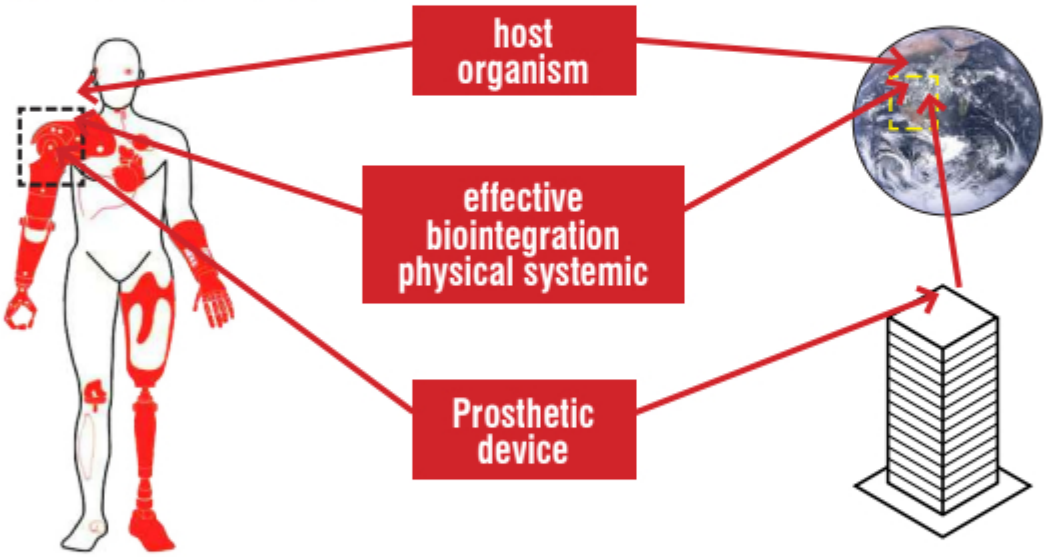
abiotic

The biological structure of the ecosystem of biotic and abiotic constituents needs to be emulated in the remade built environment as a hybrid constructed ecosystem.

The ecosystem as a unit in Nature in a specific geographic area has plants, animals, and other organisms, as well as weather and landscape, a natural physical environment that works together to form a bubble of life.

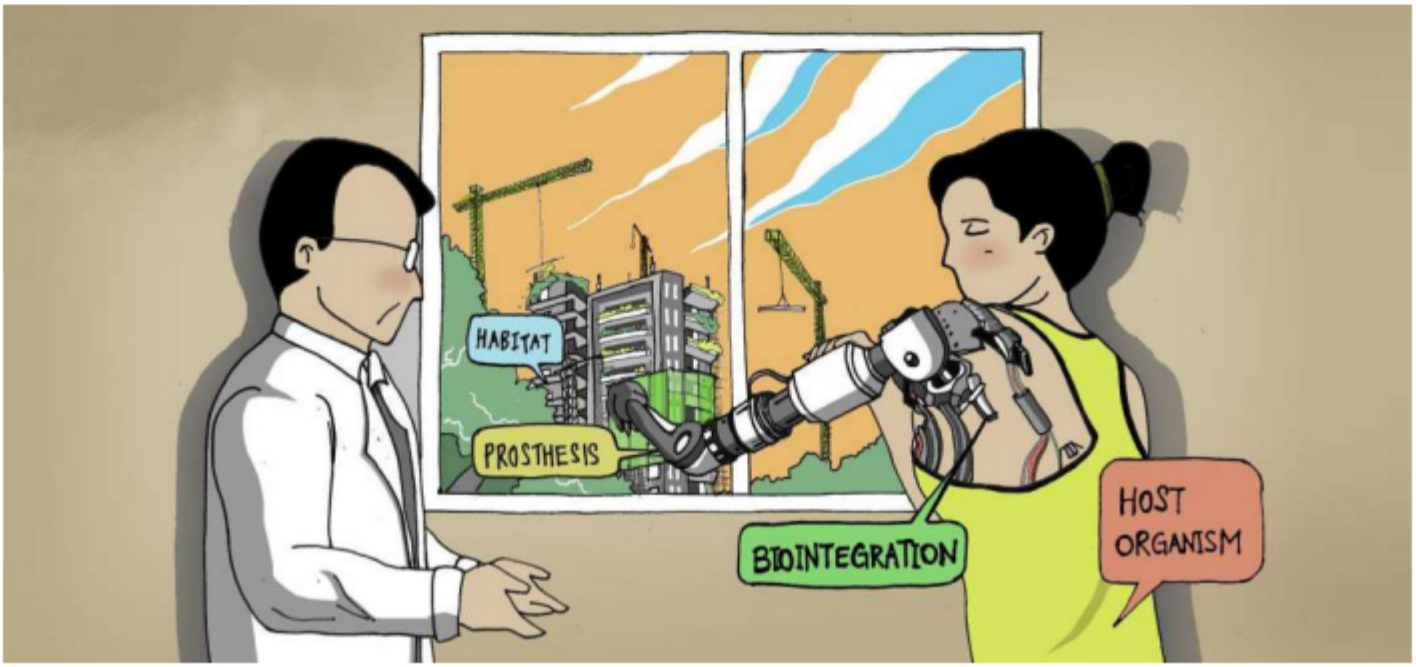
Ecosystems contain biotic, or living, parts as well as abiotic factors, or non-living parts where the biotic factors include plants, animals, and other organisms.

Prosthesis as biointegration



- the biosphere
- biogeochemical cycles
- natural systems

- built systems
- technology
- artefacts
- semi-artificial systems



INNOVATION BY DEVICES (CONTINUOUS VEGETATED RAMP)

07 INNOVATION BY DESIGN STRATEGY

Innovation can be a product or a process or a model for design

Examples of types of innovation: Product / Process / System

INNOVATION as PRODUCT

photocopy machine
by CHESTER CARLSON in 1938

INNOVATION as PRODUCT

car
by KARL BENZ in 1886

INNOVATION as PROCESS

credit card
by JOHN BIGGINS in 1946

Product System

Process

INNOVATION as PRODUCT

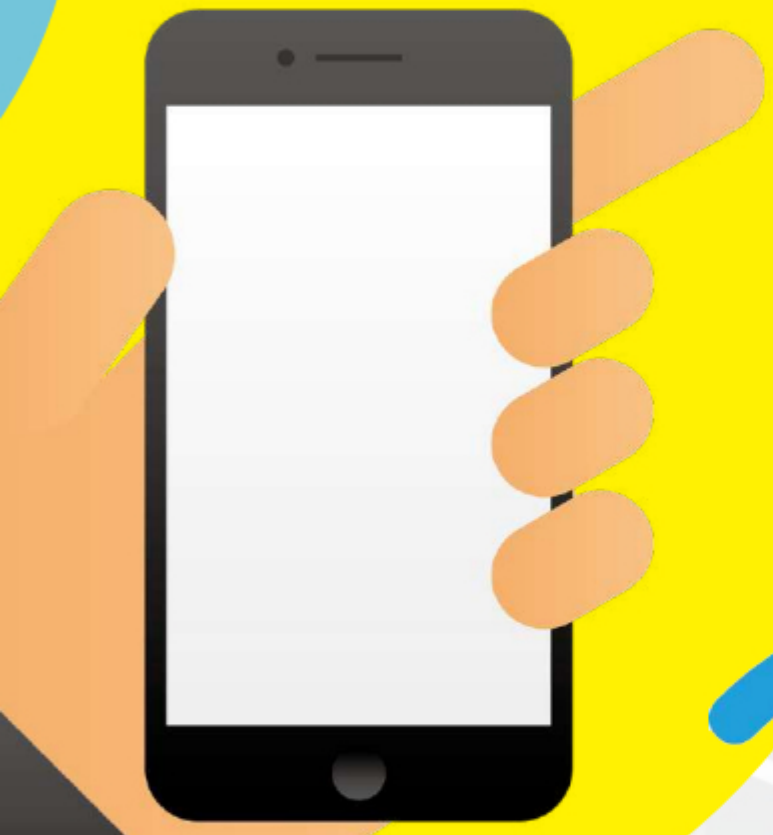
polaroid camera

by EDWIN H. LAND in 1948

INNOVATION as PRODUCT

mobile phone

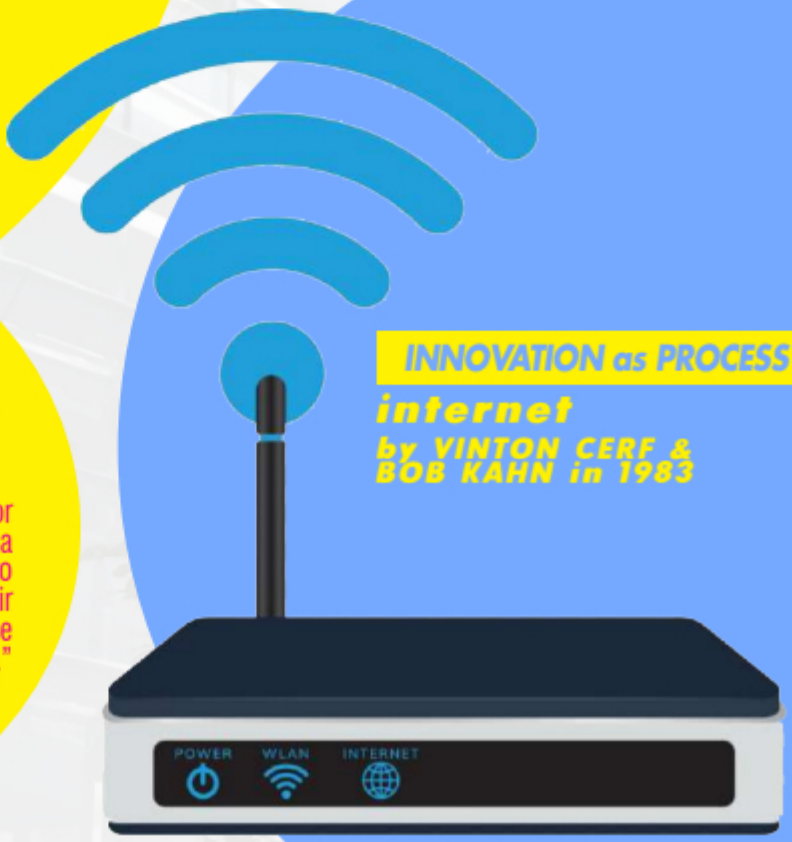
by MARTIN COOPER in 1973



INNOVATION as PROCESS

internet

by VINTON CERF & BOB KAHN in 1983



Innovation by Redefining and Integration of two Exisiting Product into one

"Apple didn't invent the smartphone. Nor was it first to concoct the concept of a tablet computer. What it did was take two existing gadget categories, redefine their core purpose and focus on fulfilling those roles as cleverly and elegantly as possible."

08 INNOVATION AS PROCESS: FRAMEWORK FOR ECOLOGICAL DESIGN

Ecological design is the biointegration of 5 sets of infrastructures as a whole to create constructed ecosystems.

The key design factors are the following:-

nature — GREEN

- biosphere
- biogeochemical cycles
- abiotic constituents
- biotic constituents
- ecosystems
- habitats
- species
- biodiversity

NPEI
(Net Positive Ecological Impact)

human society — BROWN

- social
- economic
- political
- institutional
- ecologically responsible behavior
- ecological responsible diet

NWS
(Net Well-being & Happy Society)

hydrology — BLUE

- ground water
- rainfall
- waterways
- seas
- snow
- dew
- lakes
- water conservation
- water reuse & recycling
- water management

NZW
(Net Zero Water)

structure & infrastructures — GREY

- technologies
- buildings
- artefacts
- food production
- recycling
- reuse
- carbon capture
- hydrogen production without emitting carbon
- large scale electricity storage
- zero carbon steel
- zero carbon cement
- zero carbon fertilizer
- zero carbon plastic
- zero carbon food production
- zero carbon hydrogen production
- Dispense with things you cannot use

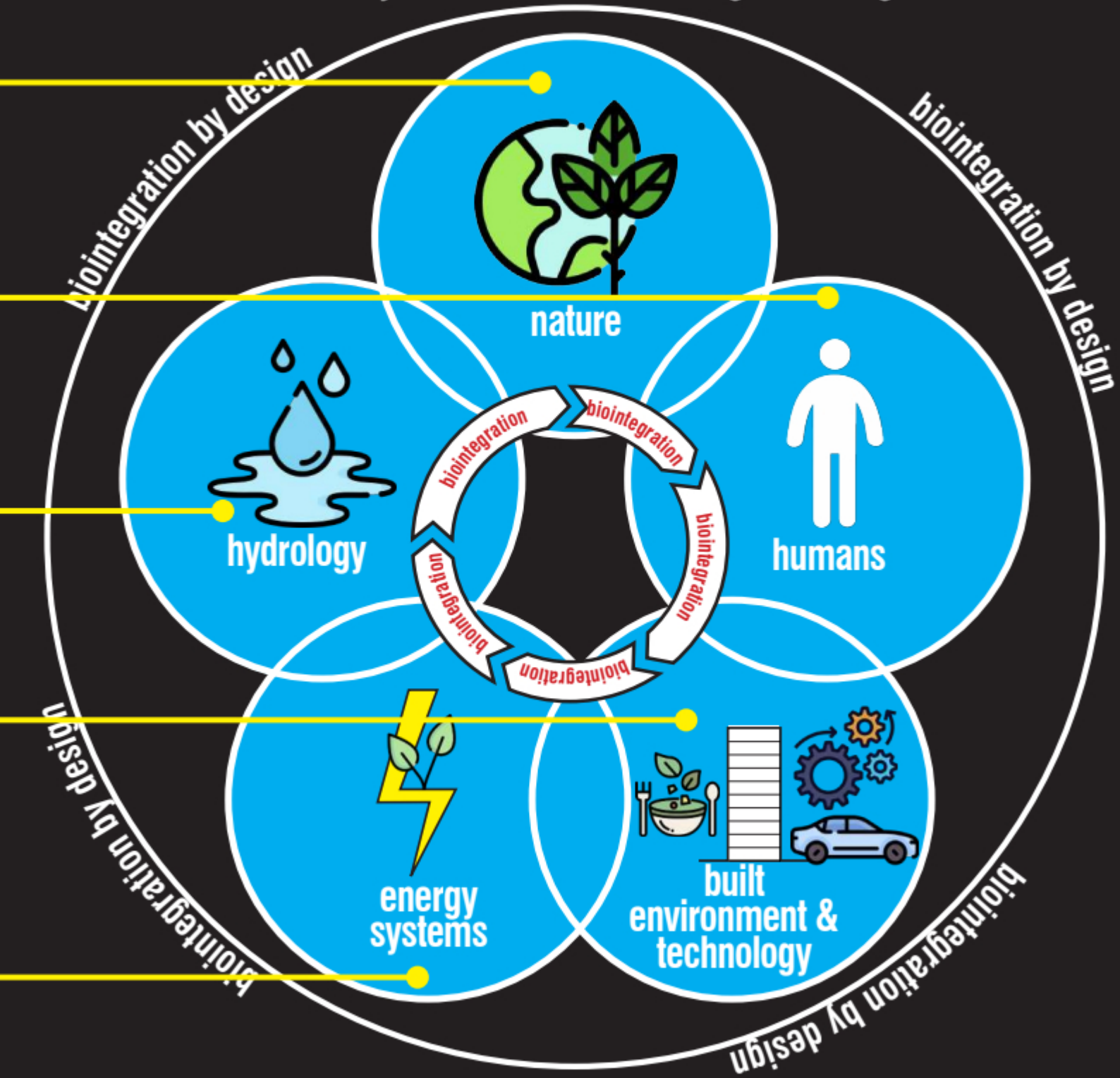
NZW/E
(Net Zero Waste / Emissions)

energy systems — RED

- renewable
- ambient
- electronic fuels
- advance biofuse
- geothermal energy
- thermal storage

NZE/C
(Net Zero Energy / Carbon)

General system for model ecological design



Ecological design as the seamless biointegration of our built environment with nature, hydrology, energy and human society

08 INNOVATION BY CONCEPT: REINVENTING THE HUMAN-MADE WORLD AS

Addressing the environmental crisis and seeking to save and regenerate our planet for humanity and wildlife is the most compelling issue facing architects, designers, planners, engineers and everyone whose work impinges on the natural environment writes Ken Yeang.

We need to envision a different type of world and built environment than what currently exists, an 'ecotopia' – where human society and all of its systems are in symbiotic harmony with nature – and then make it happen. This may not mean a total redesign or reinvention of our existing built environment, technological systems and society, but it is clear that fundamental changes are urgently needed. We have to go further and seek to create a built environment and society that are not deleterious to nature, but contribute positively to it and are regenerative. Our approach needs to be 'ecocentric', adopting the science of ecology as the guiding principle for everything regarding the planet. The first aspect required to envision our future is anthropocentric. Addressing the problems concerning the current environmental crisis do not start with technological systems, but with us, the human beings that create these systems. What we need to rethink and change are complex societal social-economic-political-institutional systems and our customs and cultures so that all of these act benignly with nature. This will require a sea-change and epochal re-envisioning of our societal mindsets, perceptions and ideologies. Designing and taking appropriate ecological action requires a switch in humanity's mindset, from a relationship of exploitation to one of benign stewardship. Humanity needs to change its role, and also the role of its built environment and technological systems, so that its ideology and mindset towards nature moves from regarding it as an endless source of resources to be exploited, to partnership.

It might be argued that the purpose of design is to make people happy and to enhance their wellbeing. But, while this is a desirable outcome, it must not cause irreversible damage to nature, its ecosystems and its biogeochemical cycles. We need to rethink and change crucial aspects of our existing social-economicpolitical- institutional systems to give critical consideration to the natural environment. The second factor that we need to envision and change concerns the things that we make, our built environment, humanity's technological and engineering infrastructure that comprises the physical constructs that we design and manufacture. This includes all of humanity's artefacts, structures and technologies, both the 'unenclosed' urban utilities and the 'enclosed' internal utilities being the mechanical/electrical/IT servicing systems within the built environment. The

CONSTRUCTED ECOSYSTEMS

current approach is almost entirely technocentric, without consideration of the impact on nature, its systems, and on its extensive use of limited non-renewable natural resources such as fossil fuel energy and other key resources like water. Our existing technological systems impact not just the ecosystems and land upon which they take place, but also because their solid, liquid and gaseous emissions contaminate their environments. The legacy is pollution, and these emissions persist well into the future.

The next crucial aspect we need to address is closing the water cycle to reuse, recycle and conserve water, working in unison with the planet's hydrological systems and its ground water, waterways and seas. Potable water is a limited resource and society's waste of water will deplete its availability. Without water most living systems and organisms cannot survive. But not just water, we need to close the materials cycle. Humanity need to take stock of the devastations that it has already inflicted upon nature, its ecosystems and its biogeochemical cycles, and must urgently seek to help it regenerate and heal. We need to ensure that all of humanity's acts do not have a negative irreversible impact on nature, but are ecologically positive. It is crucial that all of humanity's activities, built systems and technological systems are carried out in an ecocentric way guided by the planet's ecology. We can regard all of these factors as infrastructures: humanity's socialeconomic-political-institutional systems, its built environment and technological systems, its hydrological systems and nature and its systems. The practical means for achieving a harmonious and symbiotic future for the planet is therefore to focus on benign impacts, to biointegrate these four sets of infrastructures into a physical and systemic whole, where the built environment becomes remade human-made ecosystems, a 'constructed ecosystem'. Creating this requires the biointegration of the natural world with the built environment, including all components of nature from biogeochemical cycles to flora and fauna, and all of the built components of human society from managed water systems and artefacts to societal systems. In essence, the constructed ecosystem must become an integral partner with nature where it emulates, replicates and augments naturally-occurring ecosystems.

Envisioning humanity's resilient future requires effecting a world which is the balanced, seamless and ecologically-informed blend of these constituents, a biointegrated composite 'constructed ecosystem'. This is the challenge that confronts humanity today.

10 INNOVATION TECHNOLOGY READINESS

- Technology readiness levels (TRLs) are a method for estimating the maturity of technologies during the acquisition phase of a program.
- The use of TRLs enables consistent, uniform discussions of technical maturity across different types of technology.
- To take the various types of innovations to the market place to be technology ready.
- The innovation must at least achieve **Technology Readiness LEVEL 6** to be considered technology ready.

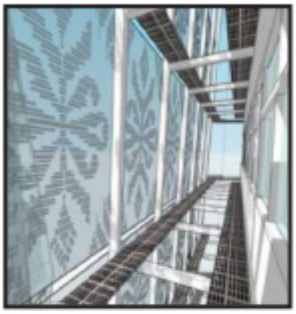
TRL	Definition	Hardware Description	Software Description	Exit Criteria
1.	Basic principles observed and reported.	Scientific knowledge generated underpinning hardware technology concepts/applications.	Scientific knowledge generated underpinning basic properties of software architecture and mathematical formulation.	Peer reviewed publication of research underlying the proposed concept application.
2.	Technology concept and/or application formulated.	Invention begins, practical application is identified but is speculative, no experimental proof or detailed analysis is available to support the conjecture.	Practical application is identified but it speculative, no experimental proof or detailed analysis is avilable to support the conjecture. Basic properties of algorithms, representations and concepts defined. Basic principles coded. Experiments perofrmed with synthetic data.	Documented description of the application/concept that addresses feasibility and benefit.
3.	Analytical and experimental critical function and/or characteristics proof of concept.	Analytical studies place the technology in an appropriate context and laboratory demonstrations, modelling and simulation validate analytical prediction.	Development of limited functionality to validate critical properties and predictions using non-integrated software components.	Documented analytical/ experimental results validating predictions of key parameters.
4.	Component and/or breadboard validation in laboratory environment.	A low fidelity system/component breadboard is built and operated to demonstrate basic functionality and critical test environments and associated performance predictions are defined relative to the final operating environment.	Key, functionally critical, software components are integrated and functionally validated, to establish interoperability and begin architecture development. Relevant Environments defined and performance in this environment predicted.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of relevant environment.
5.	Component and/or breadboard validation in relevant environment.	A medium fidelity system/ component brassboard is built and operated to demonstrate overall performance in a simulated operational environment with realtistic support elements that demonstrates overall performance in critical areas. Performance predictions are made for subsequent development phases.	End-to-end software elements implemented and interfaced with existing systems/simulations conforming to target environment. End-to-end software system, tested in relevant environment, meeting predicted performance. Operational environment performance predicted. Prototype implementations developed.	Documented test performance demonstrating agreement with analytical predictions. Documented definition of scaling requirements.
6.	System/sub-system model or prototype demonstration in an operational environment.	A high fidelity system/component prototype that adequately addresses all crtical scaling issues is built and operated in a relevant environment to demonstrate operations under critical environmental conditions.	Prototype implementations of the software demonstrated on full-scale realistic problems. Partially integrate with existing hardware/software systems. Limited documentation available. Engineering feasibility fully demonstrated.	Documented test performance demonstrating agreement with analytical predictions.
7.	System prototype demonstration in an operational environment.	A high fidelity system/component prototype that adequately addresses all crtical scaling issues is built and operated in a relevant environment to demonstrate operations under critical environmental conditions.	Prototype software exists having all key functionality available for demonstration and test. Well integrated with operational hardware/software systems demonstrating operational feasibility. Most software bugs removed. Limited documentation available.	Documented test performance demonstrating agreement with analytical predictions.
8.	Actual system completed and "flight qualified" through test and demonstration.	The final product in its final configuration is successfully demonstrated throught test and analysis for its intended operational environment and platform (ground, airborne or space).	All software has been thoroughly debugged and fully integrated with all operational hardware and software systems. All user documentation, training documentation, and maintenance documentation completed. All functionality successfully demonstrated in simulated operational scenarios. Verification and Validation (V&V) completed.	Documented test performance verifying analytical predictions.
9.	Actual system flight proven through successful mission operations.	The final product is successfully operated in an actual mission.	All software has been thoroughly debugged and fully integrated with all operational hardware/software systems. All documentation has been completed. Sustaining software engineering support is in place. System has been successfully operated in the operational environment.	Documented mission operational results.

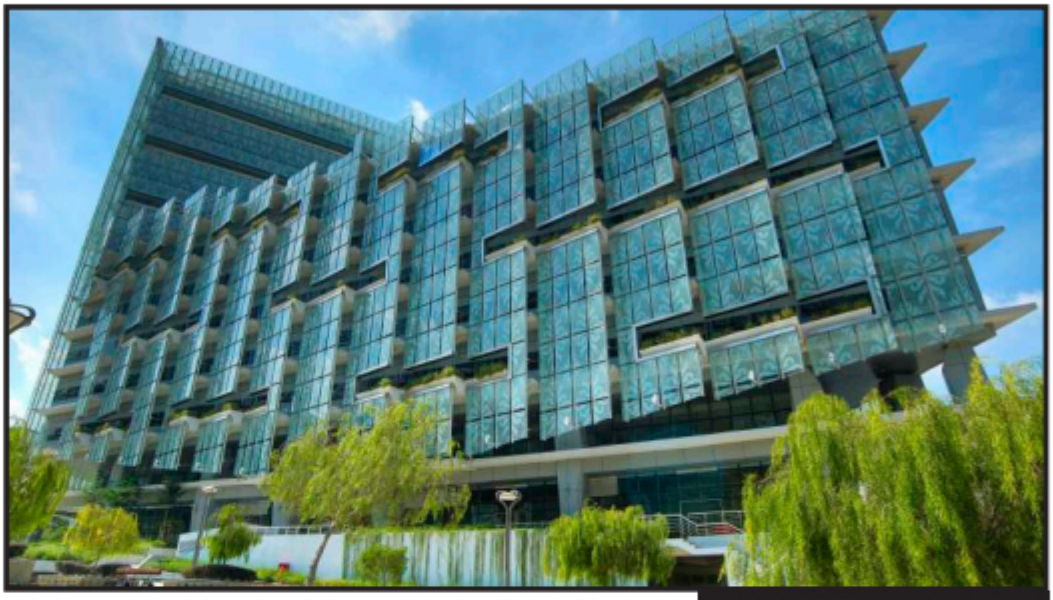
11 INNOVATION BY DESIGN OF DEVICES

Innovative devices:

• double-skin façade

The building's enter facades are faceted to present itself as a **crystalline diamond-like structure**, by the use of angled glass sun-shading that wraps around the building.

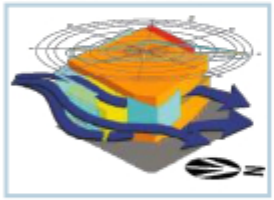




- SUASANA PUTRAJAYA, MALAYSIA -

• low energy design

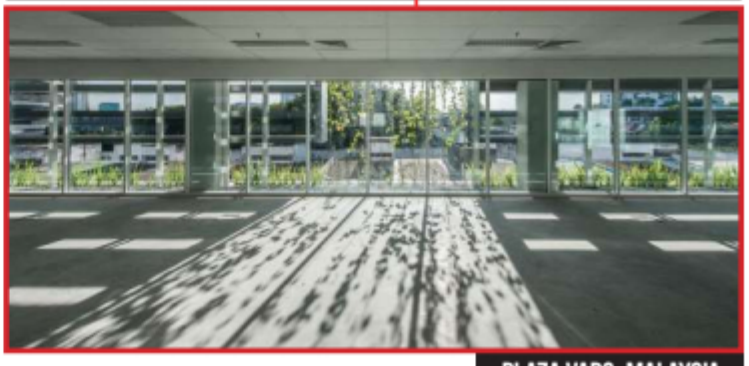
Passive mode strategies used are assembled together as collective strategy for low energy and high comfort building.



- NATIONAL LIBRARY, SINGAPORE -

• stepped trellis

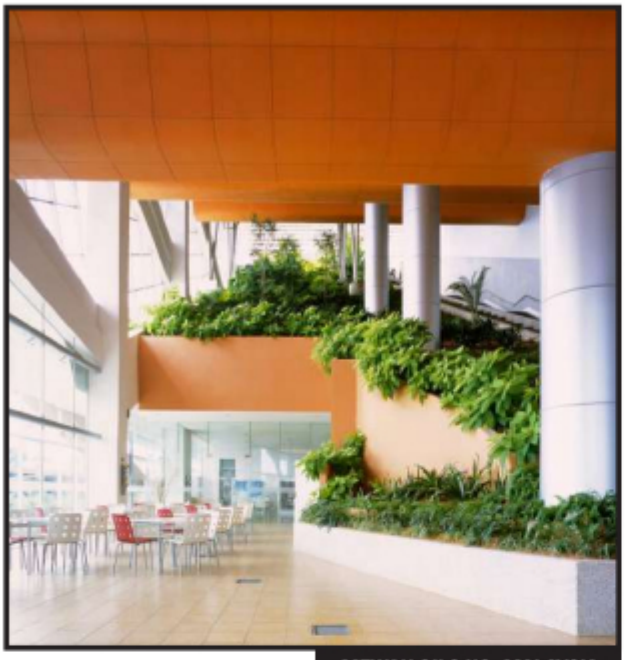
They act as living habitat and as means of filtering and improving the building's ambient indoor air quality. It also helps to reduce solar heat gain and contributes together with the shading devices to reduce building energy consumption costs.



- PLAZA VADS, MALAYSIA -

• continuous indoor planting

The continuous landscaped ramp functions as an ecological green lung to the building that enhances the quality of the office and public spaces.



- MEWAH OILS HQ, MALAYSIA -

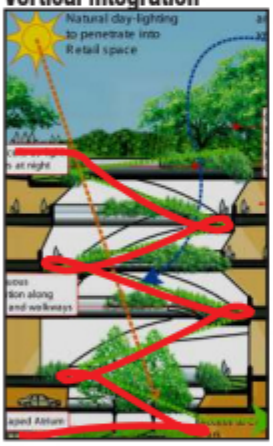
- GANENDRA ART HOUSE, MALAYSIA -

- SOLARIS, SINGAPORE -

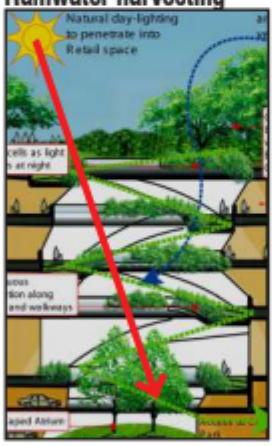
• eco-cell

The eco-cell connects the vertical landscaping from ground level garden down to Basement level, and channels excess surface rainwater into a Bioswale.

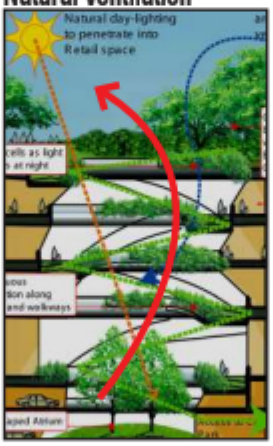
Vertical integration



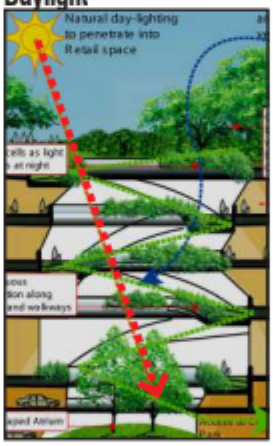
Rainwater harvesting



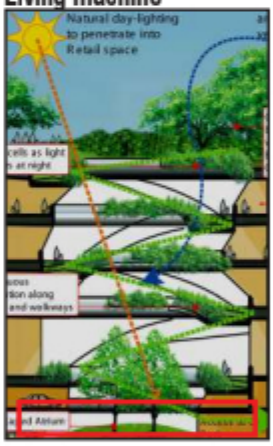
Natural ventilation



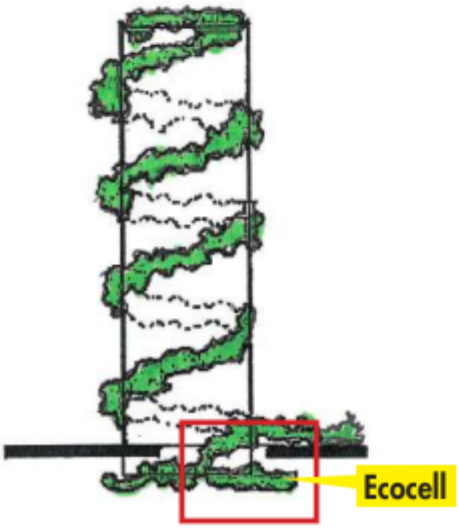
Daylight



Living machine



Corridor with fingers



- SUASANA PJH, SINGAPORE -

12 MAKING INNOVATION HAPPEN

"The enterprise that does not INNOVATE inevitably ages and declines. And in a period of rapid change such as the present... the decline will be fast."

- Peter F. Drucker -

"Educator, Author & Father of Modern Management"

"There are three kinds of people in the world:
those who make things happen,
those who watch things happen,
and those who wonder what happened."

- Jim Lovell -

"Apollo 13, Commander"

"Screw it, just do it"

- Sir Richard Branson -

"British billionaire, entrepreneur, and business magnate"

13 INNOVATION BY CONSTANT IMPROVEMENTS

Learning from Nokia

We must not stay still, as the competition is rapidly changing and advancing. This applies to not just our architecture and design but to our entire business model and the way we deliver design and projects.

It is clear that if we don't constantly innovate and constantly improve, we will left behind and become irrelevant to the market, and suffer the same fate as *Nokia*.

Nokia at its peak was the top-selling mobile. During the press conference when the Nokia CEO delivers this speech that Nokia is being acquired by Microsoft, he said: "..we didn't do anything wrong, but somehow, we lost..".
Upon saying that, all his Management team, himself included, teared sadly.

Nokia had been a respectable company and at its peak was a mobile beating much of the competition. Yes, they didn't 'do anything wrong' in their business, but the world changed too fast. Their competitors were simply too effective and fast in advancing their products.

Nokia missed out on adapting, and they lost the opportunity to remain a market leader. Not only did they miss the opportunity, they lost their ability to compete for survival.

The message of this story is that if one don't change, he shall be simply removed from the market.

The lesson is, "It's not wrong not to want to learn new things, but if your thoughts and mindset cannot catch up with the competition, you will be eliminated".

the lesson:

- The business advantage you have yesterday, will be replaced by the trends of tomorrow. You don't have 'to do anything wrong', but your competitors will catch the wave and do it right, and you will lose out and worse, fail.
- To change, improve and innovate is giving yourself a second chance.
- To be forced by others to change, is like being discarded.
- Those who refuse to learn & improve, will become redundant, not relevant to the industry, and will learn the lesson in a hard & expensive way.

14 MAKING INNOVATION DESIGN EFFECTIVE

To be effective by innovation a design must fulfill these criteria:

- **be functional**
  it must work and ensure it is a good design that function well

- **meet legislative criteria**
  it must comply with governmental legislative, health and safety regulations delivered on time within budget with high quality construction

- **be immensely beautiful**
  it must be aesthetically fulfilling which is subjective but it must be hypergreen evident in our design work

- **be hypergreen**
  it must be environmentally benign evident in all our design work

- **enhance users' well-being, happiness & livability**
  it must give joy & pleasure to the people who uses the design & we strive to achieve this in all of our work

BRAD PITT

in design + e^2, PBS documentary, Episode 6

ON INNOVATION
review by others

".. wind, rain and sun in the minds of most architects, they are enemies, but what if buildings can utilise and respond to the conditions of the environment? what if the urban environment itself became a living, breathing organism? to **Ken Yeang** it is.."

INNOVATION BY DEVICES (NATURAL VENTILATED ATRIUM)

16 ABOUT THE AUTHOR

Ken Yeang is an architect and ecologist, known for his signature hyper-green architecture, a field he pioneered since 1971. His work is differentiated by an ecology-based approach that performs beyond conventional green-rating systems (LEED and others). His work has a visually distinct verdant green aesthetic that enhances the locality's biodiversity designed as constructed ecosystems.

His projects include DiGi Data Centre, Suasana Putrajaya, Genome Research Building (Hong Kong), National Library (Singapore), Great Ormond Street Children's Hospital Extension (UK).

The work has received numerous awards that include the Aga Khan Award, Prince Claus Award (Netherlands), LiangSiCheng International Award (China), Merdeka Award (Government of Malaysia), Malaysian Institute of Architects Gold Medal and other.

He work seeks to advance the principles of ecological and bioclimatic architecture. He has authored over 12 books on the topic.

The British newspaper, Guardian names him "one of the 50 people who could save the Planet'.

Innovation is a hallmark of his work.

KEN YEANG

Receiving the Government of Malaysia Merdeka Award for the 'Environment' category (2011) from Prime Minister

An innovative mindset requires:

● CURIOSITY

A curious mindset is the source of creativity and innovation.

● AMBIGUITY TOLERANCE

It may feel uncomfortable and challenging, but it is necessary in the face of complexity.

● AFFIRMATIVE JUDGMENT

Focusing on a new idea's value helps motivate and promotes a sense of progress.

● COMMUNICATION

In taking the innovation from ideation to a workable solution

Our Offices

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