Net Zero Energy & Carbon Neutral Design: Passive Mode

• Roof Roof House, Malaysia
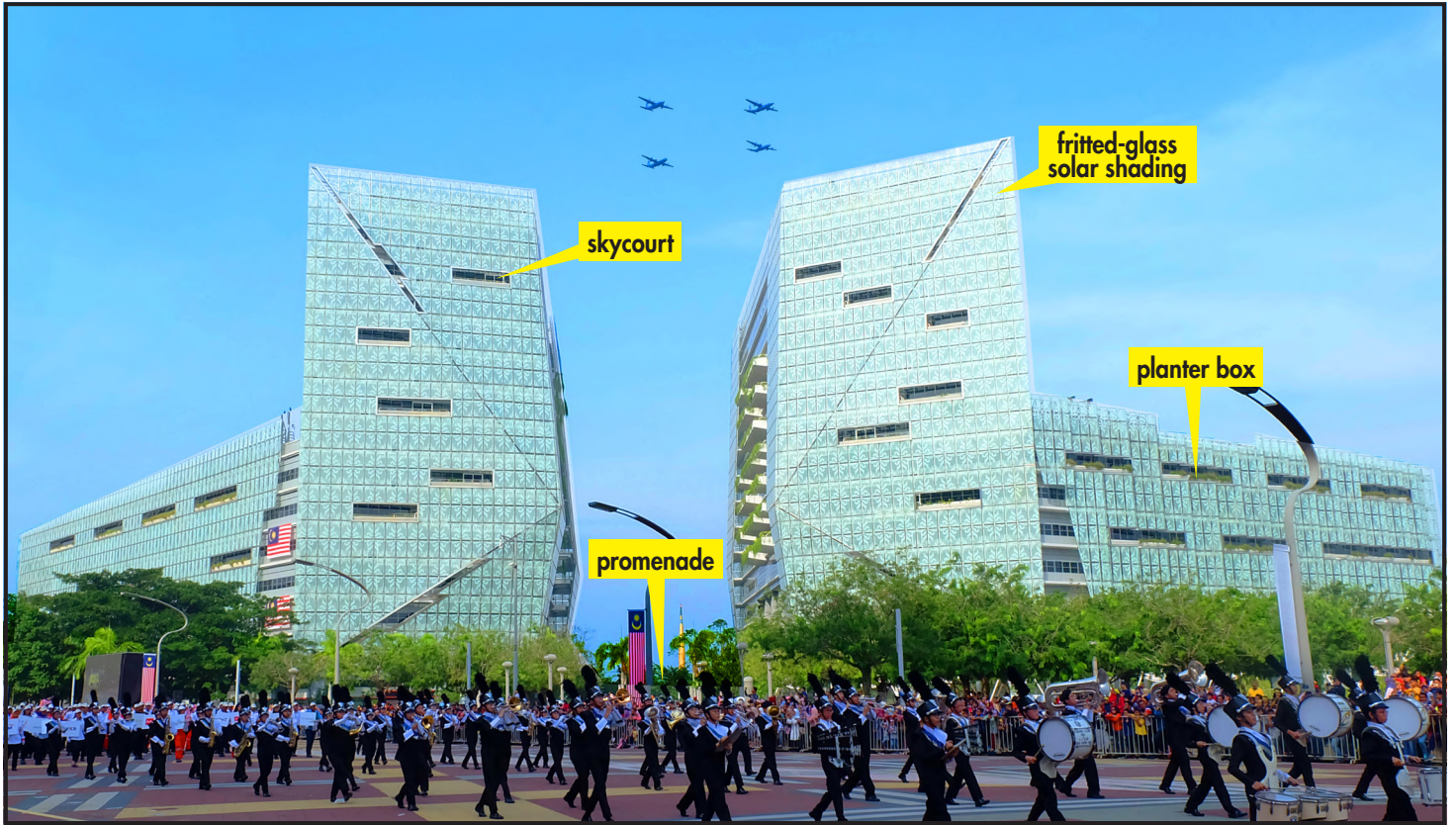

'baffle roof'

roof terrace

• passive mode experimental prototype

louvered roof

secondary roof

wind flow

Evening

Morning

Cross Ventilation

"Wind walls" allow through ventilation

• large 'baffle roof'

prevailing winds

Preva

Evening

Morning

swimming pool cools the prevailing winds

configuration of building layout in relation with sun path and prevailing winds

Prevailing winds

• evaporative cooling device

Location: Ampang, Malaysia
Total Built-up Area: 3,500 sqft
Year of Completion: 1984
Scope of Services: Architect

The house is designed as an experimental life-size working prototype. The design is based on a theoretical idea that buildings should be designed as "enclosural systems that operate as a valve within the optimissed landscape". The design uses climatic factors opportunistically to shape the building's form (by solar orientation, wind direction, etc.), in its configuration and spatial organisation.

Ecoarchitecture: biodiversity enhancement
• Suasana Putrajaya, Malaysia

Labels: fritted-glass solar shading · skycourt · planter box · promenade

Biodiversity Targets Matrix

Plan

① create habitats

Habitats

Shrubs/Groundcovers
• Zephyranthes candida
• Tristellateia australasiae
• Acalypha siamensis
• Ficus pumila
• Phyllanthus myrtifolius
• Spathiphyllum cannifolium
• Costus speciosus 'Marginatus'
• Orthosiphon aristatus
• Brunfelsia calycina
• Canna indica
• Vernonia elliptica
• Loropetalum
• Justicia gendarusa
• Loro Topiary

Turfing
• Zoysia matrella
• Axonopus compressus

• Caesalpinia ferrea
• Ficus nitida
• Eucalyptus deglupta
• Plumeria obtusa

Trees
• Cyathea cooperi
Shrubs
• Pisonia alba
• Brunfelsia calycina

• Angelonia salicariifolia
• Belamcanda chinensis
• Osmoxylon lineare yellow

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• Osmoxylon lineare yellow
• Pisonia alba
• Vernonia elliptica
• Allamanda nerifolia
• Costus speciosus 'Marginatus'

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.

Target Fauna Species

Species		Level 1 Promenade	Level 1 External Planters	Level 1 Trees	Level 2 Trees & Shrubs	Level 3 Shrubs	Level 6-13 Shrubs
Cynopterus brachyotis / Lesser Short-Nosed Fruit Bat	CP			R		F	F
Streptopelia chinensis / Spotted Dove	IA	F			B		
Geopelia Striata / Zebra Dove	IA			R	B	B	
Caprimulgus macrurus / Large-tailed Nightjar	IA					F	
Apus affinis / House Swift	US					F	
Megalaima haemacephala / Coppersmith Barbet	IA					F	
Aegithina tiphia / Common Iora	IA						
Lanius schach / Long-tailed Shrike	IA					B	
Pycnonotus goiavier / Yellow-vented Bulbul	IA	F	F	F B	F B	F B	F B
Oriolus chinensis / Black-naped Oriole	IA	F	F	F B	F B		
Copsychus saularis / Oriental Magpie-robin	IA			F B	F B		
Gerygone sulphurea / Golden-bellied Gerygone	IA			F B			
Orthotomus sutorius / Common Tailorbird	IA			F			
Anthreptes malacensis / Brown-throated Sunbird	FS IA			F		F	B
Anthreptes Simplex / Plain Sunbird	FS IA						
Cinnyris jugularis / Olive-backed Sunbird	FS IA	F	F				
Dicaeum cruentatum / Scarlet-backed Flowerpecker	FS IA						
Appias libythea olferna / Striped Albatross	IA	F	F	F			
Catopsilia pomona pomona / Lemon Emigrant	IA	F	F	F		F	
Chilades pandava / Cycad Blue	IA	F		F			
Danaus chrysippus chrysippus / Plain Tiger	IA	F	F				
Delias hyparete metarete / Painted Jezebel	IA			F			
Euploea mulciber mulciber / Striped Blue Crow	CP	F	F	F		F H	
Hypolimnas bolina jacintha	IA		F				
... / Pygmy Grass Blue	IA						

② select native fauna species to be brought back to locality: for feeding, breeding, refugee from prey

③ select non-invasive flora species to attract fauna

④ establish interactions between fauna and habitats

Flora Species

Caesalpinia ferrea	Leopard Tree
Ficus nitida	Indian Laurel Fig
Eucalyptus deglupta	Rainbow eucalyptus
Plumeria ...	Frangipani
...nthes candida	Fairy lily
...istia australasiae	New Caledonia
...pha siamensis	Tea leaf
...umila	Creeping fig
...yanthus 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 salicariifolia	Angel Flower

• habitats creation

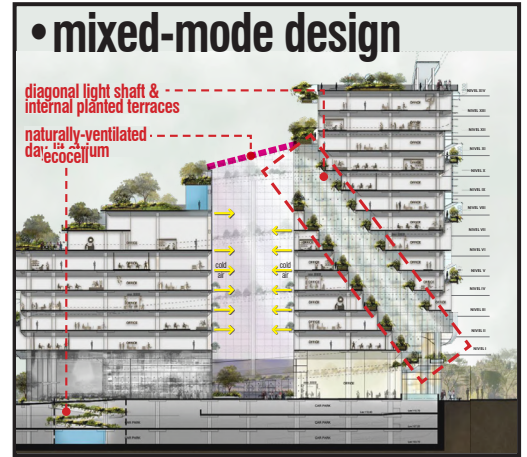## • double skin fritted glass sunshading

• ecocell

Location: Putrajaya, Malaysia
Total GFA: 813,316 sqft
Year of Completion: 2017

The building is a 14-storey mixed-commercial development. The development is two almost symmetrical 7-storey podiums, and two 7-storey towers on top of the podiums. A landscaped Central Promenade is designed between the two blocks along the axists to Millennium Monument.
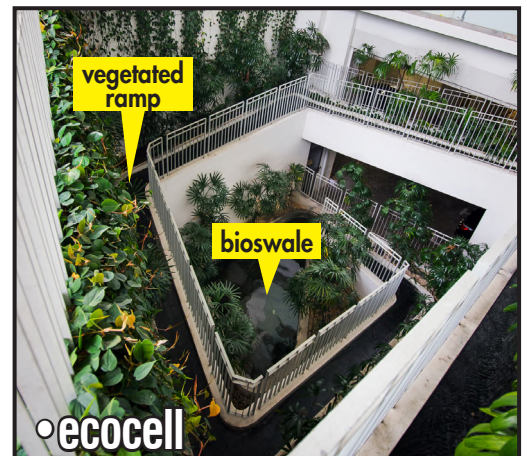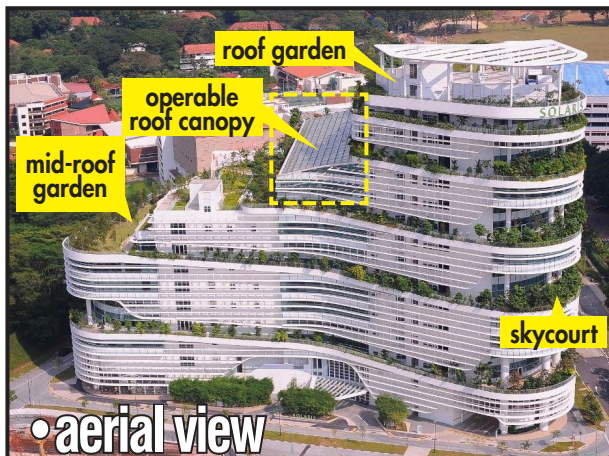
Ecoarchitecture: vegetated ramp; Net Zero Energy & Carbon Neutral Design: Mixed Mode atrium
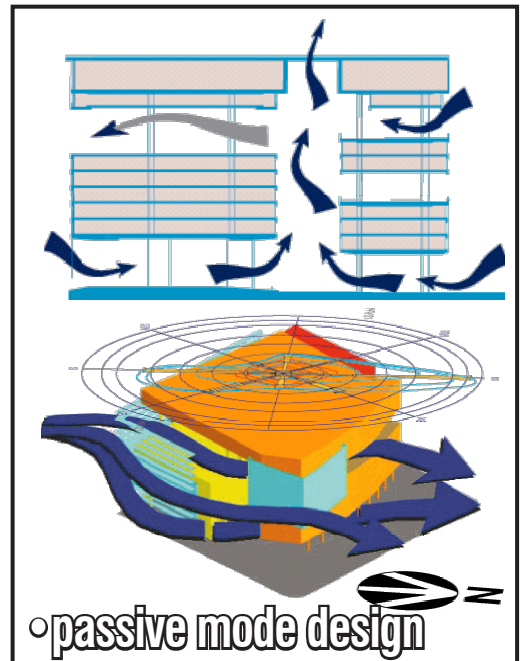
• Solaris, Singapore

Uppermost roof garden

mid-roof garden

spiral ramp as "Vertical Linear Park"

skycourt

eco-cell

• mixed-mode design

diagonal light shaft & internal planted terraces

naturally-ventilated day-lit ecocellum

cold air

• diagonal light shaft

natural day-lit & ventilation

glass louvers shut during inclement weather

automated opening for natural ventilation

• operable roof canopy

continuous vegetated ramp

• ecological connectivity

continuous vegetated ramp

service walkway

Location: One North, Singapore
Total GFA: 541,112.54 sqft
Year of Completion: 2010

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

roof garden

operable roof canopy

mid-roof garden

skycourt

• aerial view

vegetated ramp

bioswale

• ecocell

Ecoarchitecture: vegetated skycourts & overhead canopy

• National Library, Singapore

roof canopy

skycourt

• day-lit atrium

office with natural daylight

panoramic views of the Singapore skyline

• observation pod

6m deep sunshading blades

high ceiling skycourt

• vegetated skycourt

• sunshading blades

∘ passive mode design

N

Location: Victoria Street, Singapore
Total GFA: 635,393.63 sqft
Year of Completion: 2005

The design is the National Library of Singapore is designed as a state-of-the-art library for the tropics that serves as an icon for the region and it's locality. More than 6,300sqm of this building are given to green spaces in the form of urban skycourts, constituting more than 60% of the building's footprint.

Ecoarchitecture: ecological nexus: continuous vertical green wall

• DIGI Technology Operation Centre, Malaysia

photovoltaic roof canopy

continuous vertical green wall

• Use of plants to absorb VOC (Volatile Organic Compounds)

Emitters	Absorbers
Plants	**Bamboo palm**
formaldehyde	formaldehyde
xylene / toluene	trichloroethylene
benzene	benzene
alcohols	
	Peace lily
People	formaldehyde
acetone	trichloroethylene
ethyl alcohol	benzene
methyl alcohol	alcohols
ethyl acetate	acetone
Chairs	
formaldehyde	**English ivy**
	formaldehyde
Photocopiers	various other
xylene / toluene	
benzene	
trichloroethylene	
ammonia	
Chipboards	
formaldehyde	
xylene / toluene	
benzene	
alcohols	
Correction Fluids	
acetone	
Computer Screen	
xylene / toluene	

indoor plants

office area

photovoltaic roof canopy

PV area: 200sqm
canopy area: 583sqm

• renewable energy

Location: Subang, Malaysia
Total GFA: 134,204.44 sqft
Year of Completion: 2010

The DIGI Technology Operation Centre is located in Subang High Tech Park. It 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 - to act as living habitats and as means of filtering and improving its ambient air quality. The roof canopy is covered with PV panels.
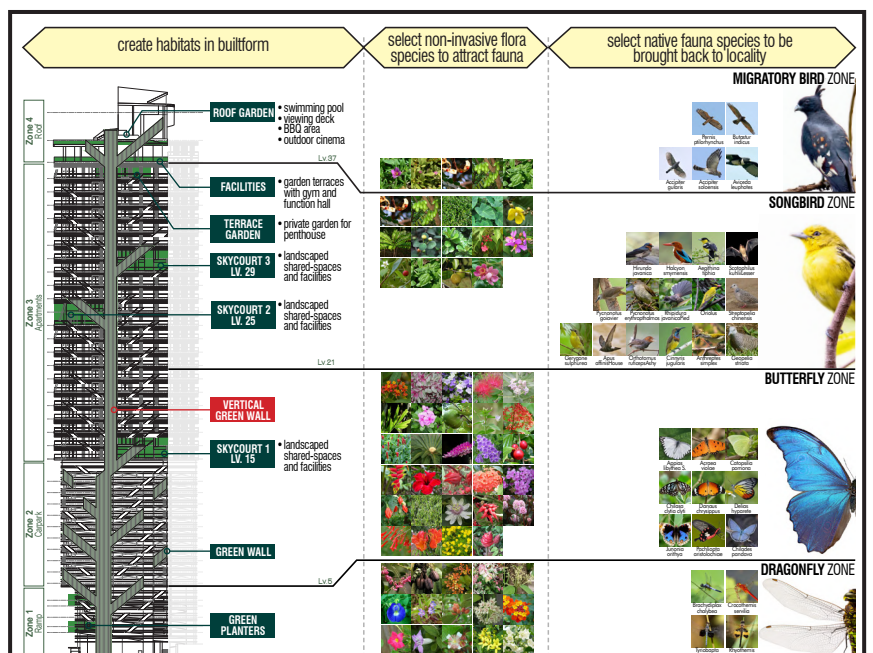

• continuous vertical green wall

Net Zero Energy & Carbon Neutral Design: Mixed Mode canopy roof

• Skylon Residence, Malaysia

roof garden

vertical green wall

skycourt

vertical green wall

place of calmness and respite for dwellers

skycourt

•vertical green wall connected to skycourts

kids pool

lap pool

family pool

jacuzzi pool

•4 types of swimming pools

Location: Kuala Lumpur, Malaysia
Total GFA: 172,588 sqft
Year of Completion: under construction
Scope of Services: Architect and Interior Designer

This development provides a world-class residential building. The green features includes a vertical green wall that connects the vegetation from the ground to the skycourts and link to the roof garden. The innovative vegetated skycourts create a place of respite for the dwellers.

create habitats in builtform | select non-invasive flora species to attract fauna | select native fauna species to be brought back to locality

MIGRATORY BIRD ZONE

SONGBIRD ZONE

BUTTERFLY ZONE

DRAGONFLY ZONE

ROOF GARDEN — • swimming pool • viewing deck • BBQ area • outdoor cinema

FACILITIES — • garden terraces with gym and function hall

TERRACE GARDEN — • private garden for penthouse

SKYCOURT 3 LV. 29 — • landscaped shared-spaces and facilities

SKYCOURT 2 LV. 25 — • landscaped shared-spaces and facilities

VERTICAL GREEN WALL

SKYCOURT 1 LV. 15 — • landscaped shared-spaces and facilities

GREEN WALL

GREEN PLANTERS

•Biodiversity Targets Matrix

Net Zero Energy & Carbon Neutral Design: Flue-wall (mixed mode & full mode)

• Great Ormond Street Children Hospital Extension, London

upper valve

thermal cooling flue

lower valve: mixed mode floors (3 floors)

naturally ventilates the lower 3 flrs during the mid-seasons (Spring & Autumn)

•the "flue wall"
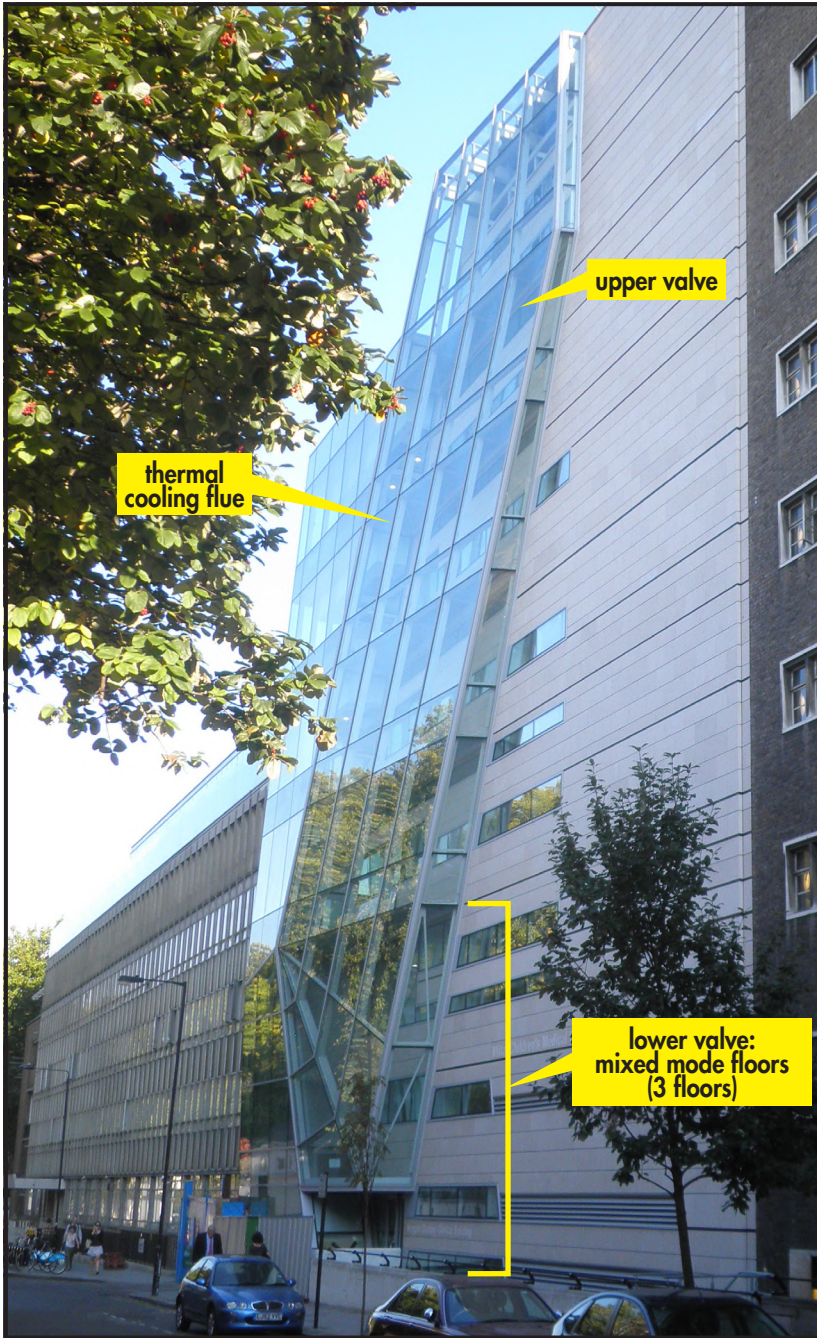
Out and about on the Piccadilly line

Great Ormond Street Hospital

• building featured in London underground

•night view

Location: London, UK
Total GFA: 199,132.34 sqft
Year of Completion: 2012

The Great Ormond Street Hospital Extension building is the first "Excellent" BRE-rated hospital in the UK. A key feature of the hospital extension is the flue wall which is an energy efficient ventilation system expressed on the façade facing Guilford Street. The glass flue-wall naturally ventilates the lower 3 floors during the mid-seasons (Spring & Autumn) and reduce the energy consumption.

Net Zero Energy & Carbon Neutral Design: Mixed Mode canopy roof

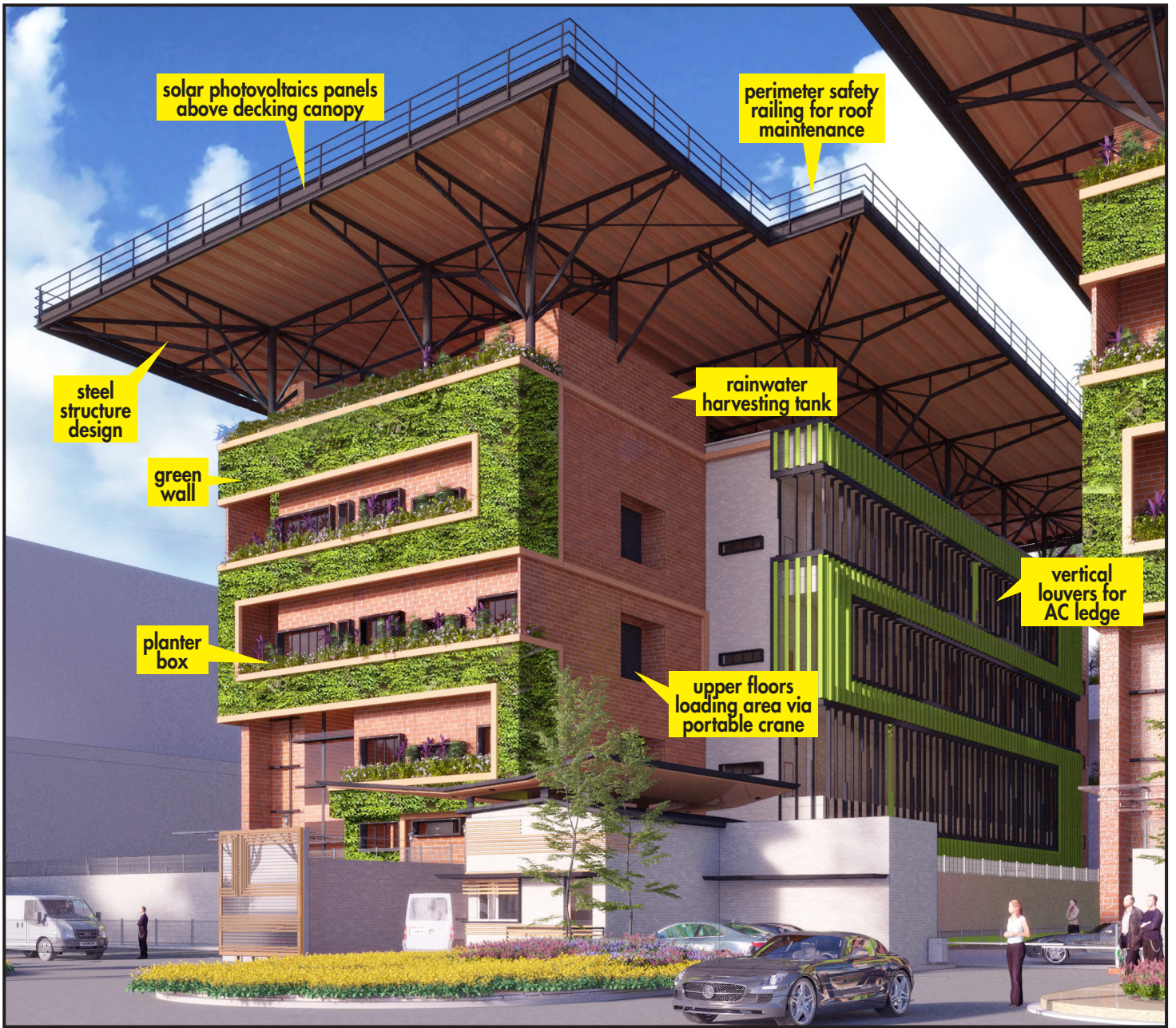# • Xiong'an Station, Beijing, China

homeogeneous canopy roof

Location: Xiong'an, Beijing
Scope of Services: Architect

The building is known as the "Station in the Park". It integrates the public spaces, ecology and state-of-the-art rail services conceived as an iconic gateway into the city. The design of the station is an innovative construction that combines cutting edge technology with close references to the local context and Chinese culture.

eco-architecture: productive mode design (photovoltaic canopy)
• B Data Centre, Cyberjaya (on-going)

solar photovoltaics panels above decking canopy

perimeter safety railing for roof maintenance

steel structure design

green wall

rainwater harvesting tank

planter box

vertical louvers for AC ledge

upper floors loading area via portable crane

roof canopy area >50% of total GFA

• aerial perspective

• continuous vertical green wall

Location: Subang, Malaysia
Total GFA: 56,079.97sqft
Green Rating: targeted LEED Gold / Platinum rating
PUE: 1.49 (current)
Data Centre's Tier Classification: tageted Tier IV

The Client's brief was to design a data centre with ecological features with high-security. A key feature of the Data Centre is a continuous vegetated green wall that brings the vegetation from the gound level to the rooftop level- meant to act as living habitats and as means of filtering and improving its ambient indoor air quality.

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