COMPARATIVE PASSIVE GREEN BUILDING CASE STUDIES ANALYSIS

-ZERO ENERGY BUILDING PIXEL BUILDING

INTRODUCTION The Zero Energy Building at BCA Academy showcases Singapore's early move toward sustainability, conventional transforming structure into an eco-retrofitted educational hub that sets the

standard for tropical green buildings.



Energy Target:

Net Zero Energy

BCA Academy, Singapore 2009 (Retrofitted) **Function:**



Research Facility **Sustainability Focus:**

Tropical Climate Optimization and Education





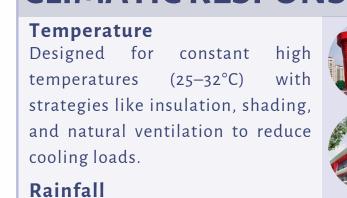
Surrounded by tropical greenery and

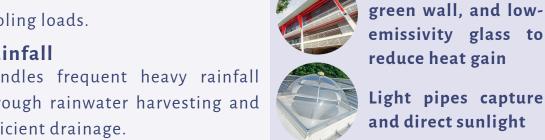
facing an internal courtyard. Response: Integrated rooftop gardens to cool the building and blend with the

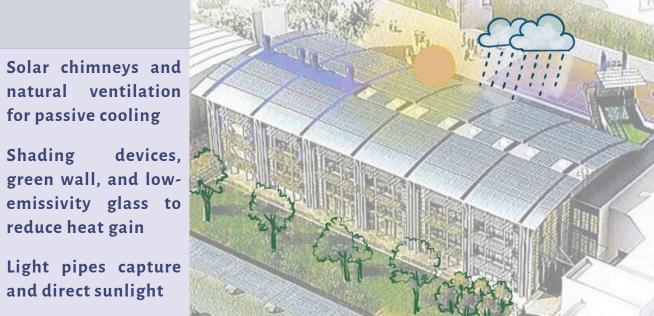
Flat, urban terrain on an educational Response: To optimize solar panel

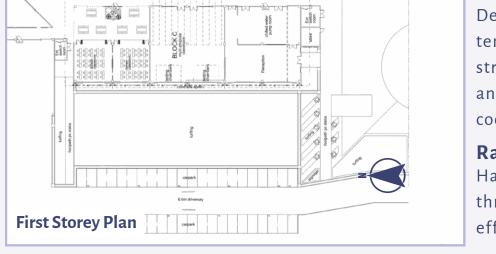
performance and manage stormwater using permeable surfaces.

CLIMATIC RESPONSE









Light Pipes

A vertical pipe on the roof

channels natural sunlight

indoors. Light pipes are more

efficient than skylights, with

less energy loss due to their

smaller surface area.

heat from direct sunlight.

Light Shelves & Ceilings:

ZEB uses reflective light shelves

and ceilings to direct daylight

deeper indoors while also reducing

SITE PLANNING

SITE CONTEXT

The site is surrounded by high foot

Response: Permeable walkways and

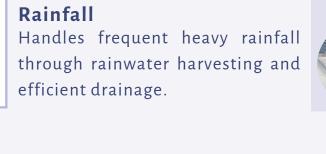
Positioned in Singapore's educational

Response: Acts as a symbol of Singapore's

environmental leadership in education.

district, emphasizing sustainability.

shaded areas for circulation and cooling.





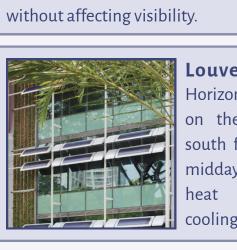


FACADE DESIGN

DAYLIGHTING



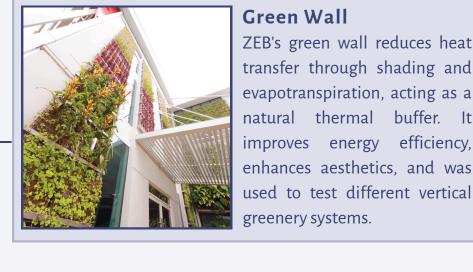
Reflects UV and infrared rays to cut heat gain



outh facades block

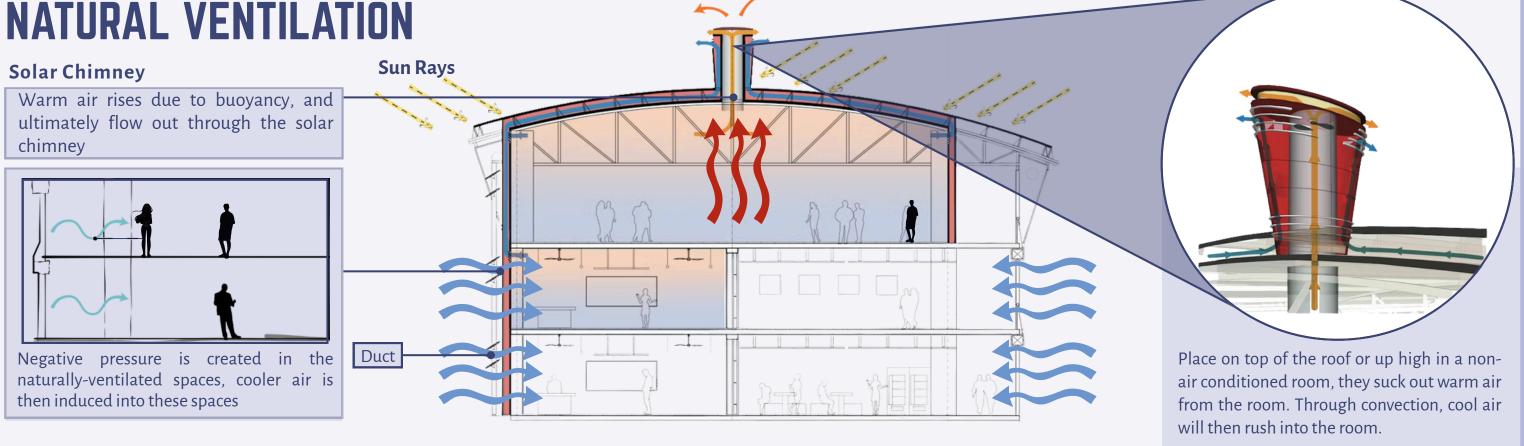






Mirror Ducts





STRATEGIC LANDSCAPING







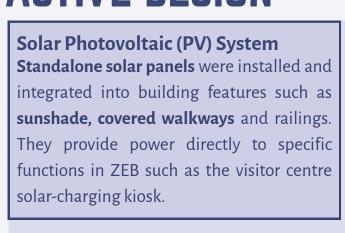
Temperature (°C)

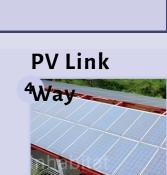
Vegetation and soil on green wall add a natural insulation layer, reducing heat transfer through building walls, helping the building achieve a low Envelope Thermal Transfer Value (ETTV) of approximately 31.76

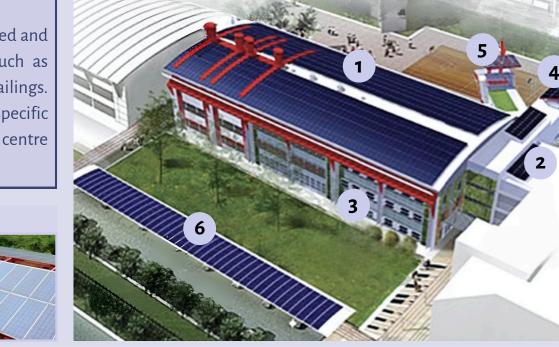
Energy Savings Based on Heat Flux

Difference (kWh/m2/year)

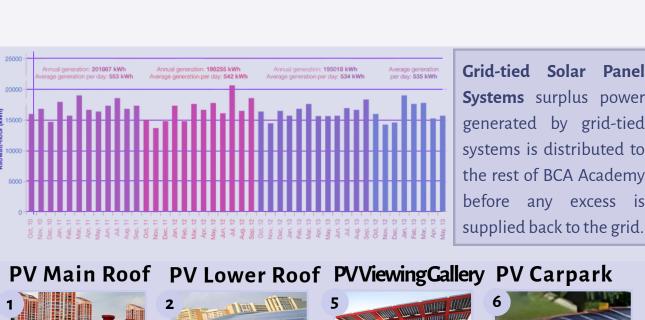
ACTIVE DESIGN







TUTOR | NIK SYAZWAN WAHAB



Grid-tied Solar Panel **Systems** surplus power generated by grid-tied systems is distributed to the rest of BCA Academy before any excess is

COMPARATIVE ANALYSIS

TAYLOR'S UNIVERSITY

Wisdom • Integrity • Excellence



SITE CONTEXT

Emphasizes passive design strategies suitable for tropical climates, such as green roofs and walls to reduce heat gain.

DAYLIGHTING

Uses light shelves, pipes, and mirror ducts to channel daylight deep into interior spaces.

FACADE DESIGN

Equipped with sunshades, green façades, and solar panel

integration. NATURAL VENTILATION

Solar chimneys at use solar heat to drive airflow, drawing cool air in and expelling warm air

STRATEGIC LANDSCAPING

Green roofs and vertical greenery reduce urban heat and enhance insulation.

SITE CONTEXT

Green roof acts as insulation

First Storey Plan

Light Wells

Situated in an urbanized, commercial

zone with adjacent high-rise buildings.

Response: Ground-level pavement

integrates vibrant finishes and materials

Flat inner-city plot with tight space

Response: Vertical design to maximize

space and enhance urban connectivity.

BOUVERIE STREET

Uses light wells to

direct sunlight from the roof into

deeper interior

reliance on

spaces, **reducing**

artificial lighting

y **capturing**

guide it down

through the

deeper zones

Dynamic Colorful Faceted Façade Panels

building, softly

The design not only

enhances visual

reduces glare, and

controls

contributes

improving

Night Purging

Living Edge Reed Bed

Urban Heat Island Reduction

Green elements around and or

the building mitigate thermal

mass and promote cooling.

together

SITE CONTEXT

DAYLIGHTING

while reducing heat gain.

FACADE DESIGN

cooling and biodiversity.

day's cooling load.

Other floors planted

• Operable windows and vents allow cool night air to

Reduces internal temperature and lowers the next

flush out heat from the building.

comfort.

but also

light,

shading indoor

above, light wells

that stand out in a high-density area.

Queensberry St, Carlton VIC 3053, Australia 2010

Pixel Building is a bold symbol of

Australia's innovation, merging

experimental form with eco values.

Its dynamic façade and smart

systems show a futuristic vision of

sustainability, making it a pioneer

CLIMATIC RESPONSE

26°C) using thermal mass

and passive ventilation.

Responds to seasonal Oriented to capture

temperature changes (6- northern sunlight, uses

Shading fins block high sun, façade panels and thermal

cross-ventilation, and the roof adds insulation to

operable windows allow mass store heat,

green roof cools the surface. retain warmth

heat gain.

Winter:

Building Orientation

shading to reduce summer

Wind - Driven Cross Ventilation

Green Roof

Heat Reduction:

reducing heat absorption.

Vegetation reflects sunlight,

Water vapor from plants lowers roof

temperature, reducing heat transfer.

Green roof moderates heat

fluctuations, preventing summer heat gain and winter heat loss.

Stormwater Management &

Rainwater Filtration:

Strategic window

placement and openings support passive cooling by enabling cross ventilation.

> The building is designed to

maximize wind flow

through internal

conditions permit.

spaces when

in net-positive architecture.

Architect:

Studio 505

Energy Target:

Net Positive Energy

and Carbon Neutral

INTRODUCTION

Commercial Office / Prototype

SITE PLANNING

An urban redevelopment site on the

former CUB site, in a dense area with

Response: Utilizes a green roof to

maximize the small urban plot and

Located in Melbourne's commercial

area, focusing on innovation and

Response: Reflects Melbourne's identity

as a hub for sustainable innovation in

DAYLIGHTING

performance windows

maximize natural

daylight while

minimizing heat gain.

FACADE DESIGN

Sustainability Focus:

Temperate Design

Innovation in

limited green space.

sustainability.

architecture

Large Window

Sun-Shading System

panels to block

direct sunlight,

High-Performance Glazing

NATURAL VENTILATION

STRATEGIC LANDSCAPING

and heat gain

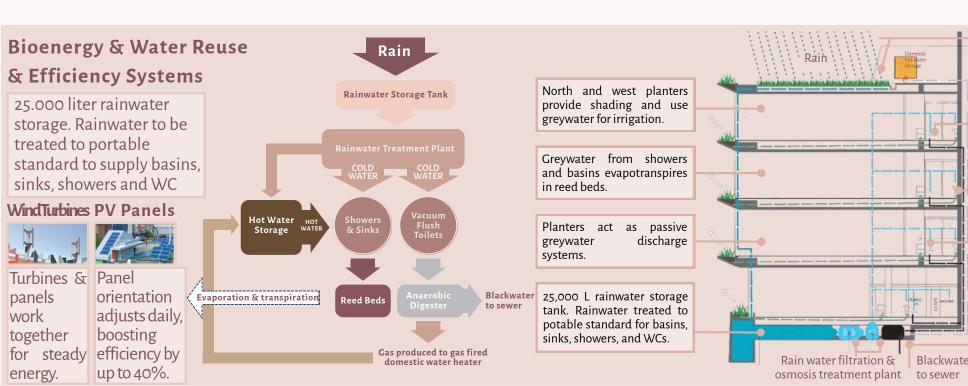
improves insulation and

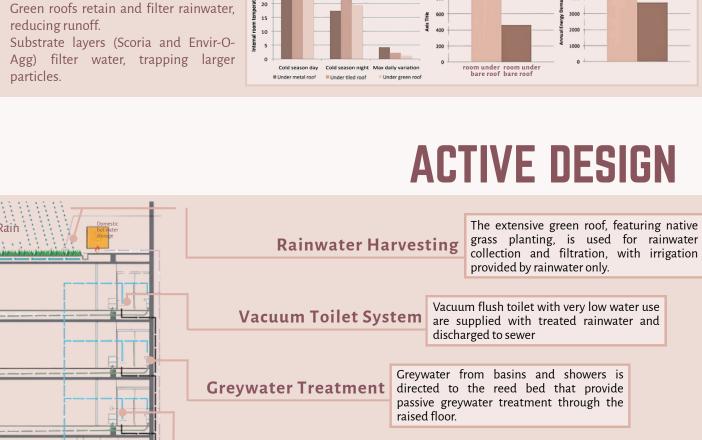
controls heat and light.

Wind turbines that

reduce heat island effects.

Function:





COMPARATIVE ANALYSIS

Only potable water supply is to drinking tap

Concentrated waste to anaerobic digester to

produce gas to heat hot water unit on roof



NATURAL VENTILATION

Natural cross-ventilation through operable windows and smart façade design.

Built on urban redevelopment site integrates unique facade, wind

turbine and solar panel response to Melbourne climate.

Distinctive colorful, aluminum façade shading system.

STRATEGIC LANDSCAPING Living roof with native plants irrigated by recycled rainwater supports

Large low-E double-glazed windows and light wells maximize daylight