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Preparing for the 2030 Challenge:

Maximizing Sustainable and High Performance Design through Zero Carbon and Zero Emissions

Friday, May 16, 8:15 a.m. to 9:45 a.m.

FR25

Preparing for the 2030 Challenge:

Acknowledgements/Credits

Thank you to Kiss+Cathcart for permission to include images and information from their firm's projects in this presentation.

Thank you to architecture2030.org and the Society of Building Science Educators for their support in putting this presentation together.

Preparing for the 2030 Challenge:

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Overview:

Using case studies of recent high performance architecture, this session will identify key strategies required to increase sustainable methods towards achieving zero carbon goals by the year 2030. The case studies examine design strategies and processes for the next generation of sustainable architecture, going beyond current best practices through synergistic approaches to bio-climatic site design, envelope, energy optimization, daylighting, passive and active systems, and materials.

Learning Objectives

- Participants will be able to **incorporate comprehensive sustainable strategies** into their projects based upon bioclimatic considerations that relate to building type and size.

- Participants will be able to **prioritize the critical design issues** and questions to meet advanced sustainable design targets, leading to the **potential to incorporate zero energy/zero emissions** and carbon neutral.

- Participants will be able to **create a list of key questions** that must be asked for each project in order to select suitable strategies in order to **reduce the environmental impact** and **increase performance**.

What IS the 2030 Challenge?

“Credible scientists give us 10 years to be well on our way toward *global* greenhouse gas (GHG) emissions reductions in order to avoid catastrophic climate change. Yet there are hundreds of coal-fired power plants currently on the drawing boards in the US. **Seventy-six percent (76%) of the energy produced by these plants will go to operate buildings**.

Buildings are the major source of demand for energy and materials that produce by-product greenhouse gases (GHG). Slowing the growth rate of GHG emissions and then reversing it over the next ten years is the key to keeping global warming under one degree centigrade (° C) above today's level. It will require immediate action and a concerted global effort.”

Source: www.architecture2030.org

2030 Targets:

To accomplish this, Architecture 2030, with Edward Mazria, has issued **The 2030 Challenge** asking the global architecture and building community to adopt the following targets:

• All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.

• At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.

• Implement a fossil fuel reduction standard for all new buildings

Source: www.architecture2030.org

Fossil Fuel Reduction Standard:

The fossil fuel **reduction standard** for all **new buildings** shall be increased to:

60% in 2010
70% in 2015
80% in 2020
90% in 2025
Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).

Source: www.architecture2030.org

How to reach these targets?

These targets may be accomplished by:

• implementing innovative sustainable design strategies,

• generating on-site renewable power and/or

• purchasing (20% maximum) renewable energy and/or certified renewable energy credits.

• **avoid counting on the practice of purchasing offsets by aiming for a zero energy state**

Why are we here:

- We are architectural educators who have been teaching in the area of environmental and sustainable design for many years
- We represent the Society of Building Science Educators (SBSE) – a non-profit group of like minded individuals who see education towards a sustainable future our primary focus
- Students have a greater exposure to these key current issues than do most practitioners
- We are here to share our experience and resources

Source: www.sbse.org

Outline:

This is suggested as a two part presentation:

Part One: Preparing for the 2030 Challenge

Examines the key concepts that designers must focus on within the advanced sustainable design palette to prepare for Carbon Neutral Design.

Part Two: The LEAP to Zero Carbon (4:00 pm)

Looks in detail at design guidelines used to achieve Carbon Neutrality through current case studies.

The LEAP to Zero Carbon…

- Energy Efficient (mid 1970s “Oil Crisis” reaction)
  - Green (environmentally responsive)
    - Sustainable (holistic and accountable)
      - High Performance (accountable)
        - Carbon Neutral

…a steady increase in the nature and expectations of performance criteria

Carbon Neutral - Definition

"So what do designers actually mean when they refer to carbon-neutral buildings? Europeans tend to use the phrase "zero carbon," and typically are referring to "net" zero, meaning that a building's carbon emissions are offset by the generation of energy through non-carbon-emitting means. The phrase commonly used in the U. S. is zero-energy building (ZEB)—one that consumes no non-renewable energy, or produces more renewable energy on site on an annual basis than any non-renewable energy it consumes. Since carbon emissions are a direct result of fossil-fuel use, a zero-carbon building is necessarily a zero-fossil-fuel energy building."

Source: http://construction.com/CE/articles/0710ZeroEnergy-1.asp

2030 readiness and “Sustainable”:

- Current Sustainable design does not go far enough in the nature of its accountability

- LEED™ does not “count carbon” in its credits – although it does set a good stage on many levels to prepare to incorporate this in strategies to improve design

- High Performance design begins to focus on certain areas of energy related accountability

- Carbon Neutral Design builds on facets of Sustainable and High Performance Design

Next Generation Design Strategies: Toward Zero-Energy/Zero-Emission Design

PREMISE: Architects need to re-engage the forces of sun and wind to inform design and foster an ecologically-based future

EXEMPLARS: Next generation of ecological thinking can be found in the emerging body of zero-energy and zero-emission architecture

ZERO-ENERGY/ZERO-EMISSION VISION:

- At one end of a continuum, zero-energy design is merely a set of technical performance standards that elevate buildings to a new threshold of energy efficiency.
- At the other end, the essence of zero-energy and zero-emission design is a radical proposition; radical in the root sense of the word from the Latin *rādix*, which means arising from the root or source, fundamental.

Three Key Steps for 2030 readiness:

Build on "sustainable" and "high performance" initiatives:

#1 - **Reduce loads/demand FIRST** (passive heating and ventilation, daylighting, shading, orientation, etc.) – BACK TO BASICS!

#2 - **Meet loads efficiently** (energy efficient lighting, high-efficiency MEP equipment, controls, etc.)

#3 - **Use on-site generation/renewables to meet energy needs** (doing the above steps *before* will result in the need for much smaller renewable energy systems, making carbon neutrality achievable.)

Bio-climatic Design:

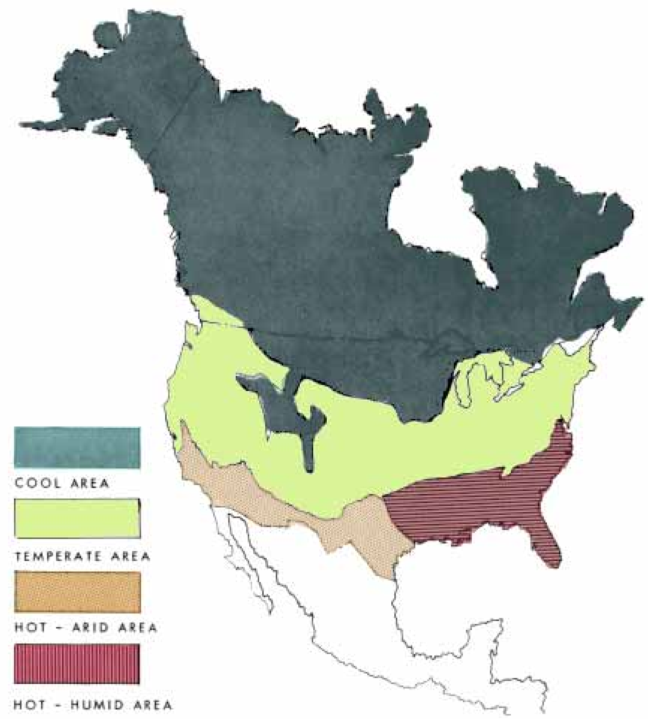
Design must first acknowledge regional, local and microclimate impacts on the building and site.

COLD

TEMPERATE

HOT-ARID

HOT-HUMID



11. Regional climate zones of the North American continent.

1963 “Design With Climate”, Victor Olgyay.

Bio-climatic Design: COLD

Where **winter** is the dominant season and concerns for conserving heat predominate all other concerns. Heating degree days greatly exceed cooling degree days.

RULES:

- **First INSULATE**
- *exceed* CODE requirements
- minimize infiltration (build tight to reduce air changes)
- **Then INSOLATE**
- fenestrate for DIRECT GAIN
- apply THERMAL MASS to store the FREE SOLAR HEAT
- ORIENT AND SITE THE BUILDING PROPERLY
- maximize south facing windows for easier control
- create a sheltered MICROCLIMATE

Bio-climatic Design: HOT-ARID

Where **very high summer temperatures** with great fluctuation predominate with dry conditions throughout the year.

RULES:

- Solar avoidance : keep DIRECT SOLAR GAIN out of the building
- avoid daytime ventilation
- promote nighttime flushing with cool evening air
- achieve daylighting by reflectance and use of LIGHT non-heat absorbing colours
- create a cooler MICROCLIMATE by using light / lightweight materials
- respect the DIURNAL CYCLE
- use heavy mass for walls and DO NOT INSULATE

Bio-climatic Design: HOT-HUMID

Where **warm to hot** stable conditions predominate with **high humidity** throughout the year.

RULES:

- SOLAR AVOIDANCE : large roofs with overhangs that shade walls and to allow windows open at all times
- PROMOTE VENTILATION
- USE LIGHTWEIGHT MATERIALS that do not hold heat
- use STACK EFFECT to ventilate through high spaces
- use of COURTYARDS and semi-enclosed outside spaces
- use WATER FEATURES for cooling

Bio-climatic Design: TEMPERATE

The summers are hot and humid, and the winters are cold. In much of the region the topography is generally flat, allowing cold winter winds to come in form the northwest and cool summer breezes to flow in from the southwest. The four seasons are almost equally long.

RULES:

- BALANCE strategies between COLD and HOT-HUMID
- maximize flexibility in order to be able to modify the envelope for varying climatic conditions
- understand the natural benefits of SOLAR ANGLES that shade during the warm months and allow for heating during the cool months

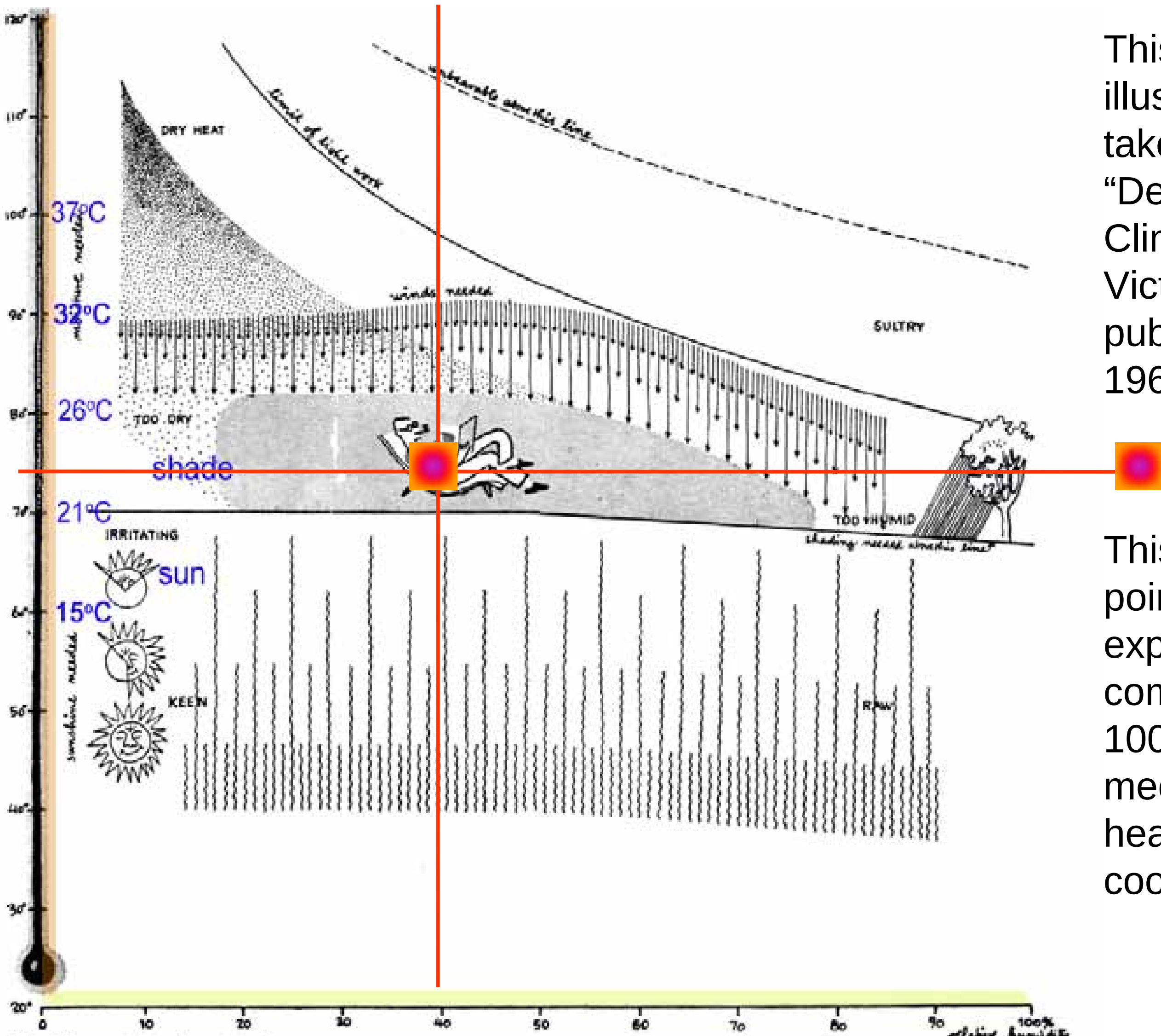
Bio-climatic Design:

Comfort expectations may have to be reassessed to allow for the wider “zone” that is characteristic of buildings that are not exclusively controlled via mechanical systems.

Creation of new **“buffer spaces”** to make a hierarchy of comfort levels within buildings.

Require **higher occupant involvement** to adjust the building to modify the temperature and air flow.

The Comfort Zone:



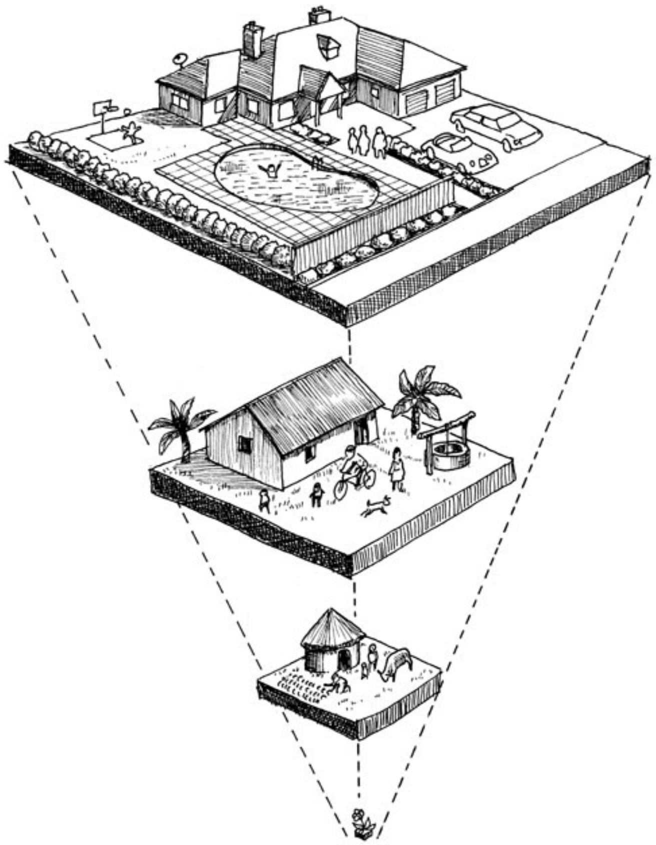
46. Schematic bioclimatic index.

This famous illustration is taken from “Design with Climate”, by Victor Olgyay, published in 1963.

This is the finite point of expected comfort for 100% mechanical heating and cooling.

Reduce loads: Building Size

"Ecological Footprint" → "Carbon Footprint"



The more you build, the more carbon is associated with your project – the more to "solve".

Source: http://www.kaospilotoutpost2007.com/carbon-neutral-beginners/

Passive Strategies for Climate Control

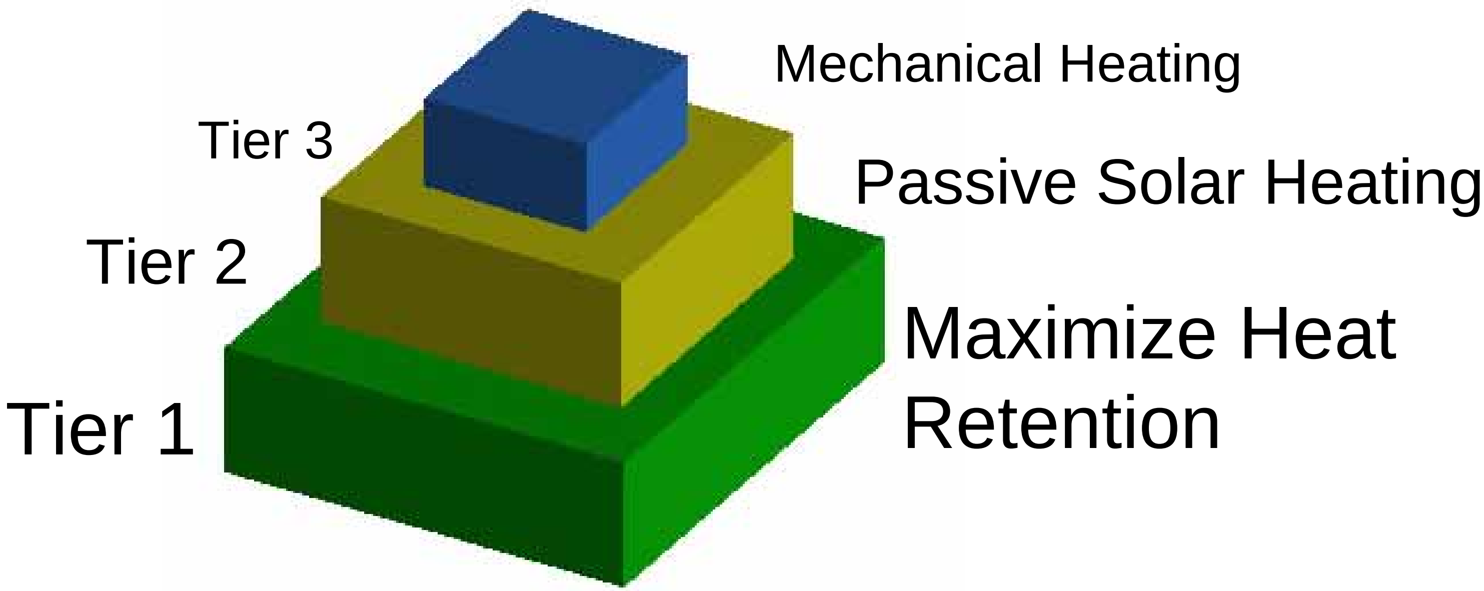
CONTROL STRATEGIES			CONDUCTION	CONVECTION	RADIATION	EVAPORATION
	WINTER	PROMOTE GAIN			Promote Solar Gain	
	WINTER	RESIST LOSS	Minimize Conductive Heat Flow	Minimize External Air Flow Minimize Infiltration		
	SUMMER	RESIST GAIN	Minimize Conductive Heat Flow	Minimize Infiltration	Minimize Solar Gain	
	SUMMER	PROMOTE LOSS	Promote Earth Cooling	Promote Ventilation	Promote Radiant Cooling	Promote Evaporative Cooling
		HEAT SOURCES		Atmosphere	Sun	
		HEAT SINKS	Earth	Atmosphere	Sky	Atmosphere

Figure 3a. Identification of hypothetical and practicable strategies of climate control.

Watson. Climatic Building Design.

Reduce loads: Passive Strategies

The tiered approach to reducing carbon for HEATING:



Maximize the amount of energy required for mechanical heating that comes from renewable sources.

Source: Lechner. Heating, Cooling, Lighting.

Passive Heating Strategies:
Maximize Heat Retention

1. Super insulated envelope
2. Tight envelope / controlled air changes
3. Provide thermal mass inside of thermal insulation to store heat

Passive Heating Strategies:
Maximize Solar Gain

1. primarily south facing windows
2. proportion to suit thermal mass and size of room(s)

4 MAIN STRATEGIES:

Direct Gain

Thermal Storage Wall

Sunspace

Convective Air Loop

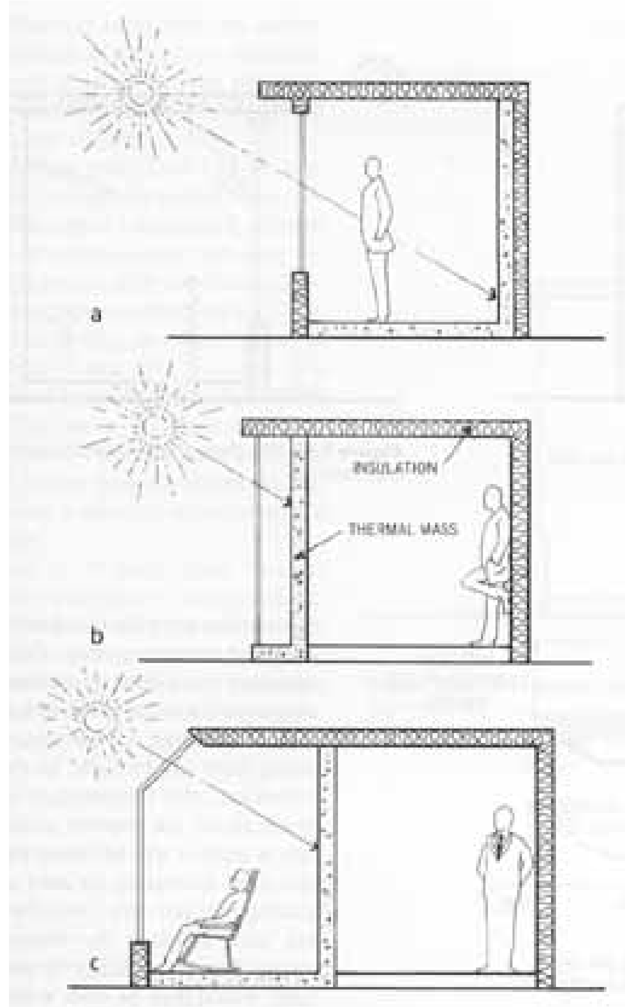


Figure 7.5a The three main types of passive solar space-heating systems: (a) direct gain, (b) Trombe wall, and (c) sun space

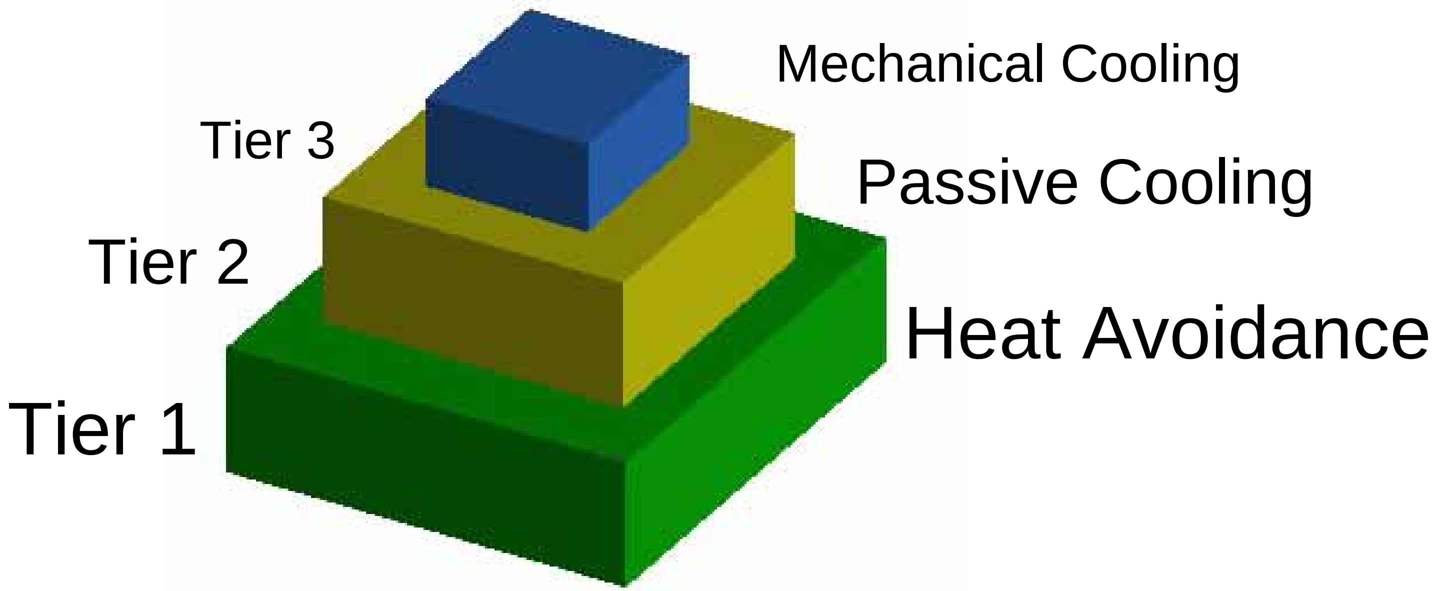
Source: Lechner, Heating Cooling Lighting

Passive Heating Strategies:
Use Renewables for Additional Heating

- Combined heat and power
- biomass
- verify carbon status of source

Reduce loads: Passive Strategies

The tiered approach to reducing carbon for COOLING:



Maximize the amount of energy required for mechanical cooling that comes from renewable sources.

Source: Lechner. Heating, Cooling, Lighting.

Passive Cooling Strategies:
Heat Avoidance

1. shade windows from the sun during hot months
2. design materials and plantings to cool the local microclimate
3. locate trees and trellis’ to shade east and west façades during morning and afternoon low sun

Passive Cooling Strategies:
Passive Cooling

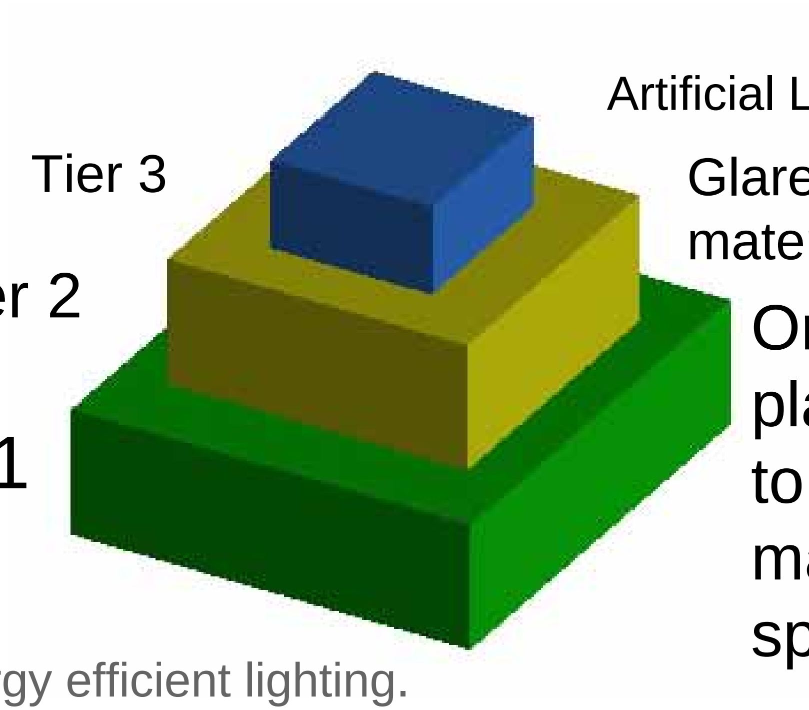
1. design for maximum ventilation
2. keep plans as open as possible for unrestricted air flow
3. use easily operable windows at low levels with high level clerestory windows to induce stack effect cooling

Passive Cooling Strategies:
Use Innovative Means for Cooling

1. wind cowls
2. solar chimneys
3. water features

Reduce loads: Daylighting

The tiered approach to reducing carbon with DAYLIGHTING:



Use energy efficient lighting.

Maximize the amount of energy required for artificial lighting that comes from renewable sources.

Source: Lechner. Heating, Cooling, Lighting.

Passive Lighting Strategies:
Orientation and building planning

- start with solar geometry

- understand context, sky dome, adjacent buildings and potential overshadowing

-be able to differentiate between sunlight (heat) and daylight (seeing)

- understand occupancy/use requirements

- maximize areas served by daylight

- explore different glazing strategies: side, clerestory, top

- consider light shelves and reflected light

Passive Lighting Strategies:
Glare, color, reflectivity and materials

- incorporate light dynamics
- avoid glare
- understand the function of material selection; ie. reflectivity and surface qualities
- balance color and reflectivity with amount of daylight provided

Passive Lighting Strategies:
Energy efficiency and renewables

- use energy efficient light fixtures

- use occupant sensors combined with light level sensors

- aim to only have lights switch on only when daylight is insufficient

- provide electricity via renewable means: wind, PV, CHP

Next Generation Design Strategies:
Toward Zero-Energy/Zero-Emission Design

ZED ASPIRATIONS:

- Zero-energy design takes us back to very fundamental questions, such as **how much energy and resources are appropriate to consume?**
- Zero-energy design challenges us to frame a vision of architecture for the 21st century that asks **how we might live differently in the future.**
- Zero-energy design **asks us to reconsider our daily lives.** It requires change; the status quo will not move us to a zero-energy, zero-emission, and carbon-negative future.

A new architecture of the sun and wind can provide direction for the profession to gain a new way of thinking and greater performance standards, while at the same time developing an ecological ethic and an aesthetic of design capable of shaping a new social consciousness.

Towards Zero Energy \ Zero Carbon:

BEDZed

Jubilee Wharf

case studies

Solar 2

IslandWood

BedZED:

Beddington Zero Energy Development

BedZED, Hackbridge, England, was created as a partnership with the BioRegional Development Group, the Peabody Trust, Bill Dunster Architects, Arup, and Gardiner and Theobald. The 82 houses, 17 apartments, and 1,405 m² of workspace were built between 2000-02. An example of early ZED design.

Climate: temperate, inland

BedZED:
Beddington Zero Energy Development

*Starts with **basic** sustainable principles of design:*

- ORIENTATION
- very high environmental standards
- high thermal insulation levels
- triple glazed windows
- sunlight / daylighting
- solar energy (direct gain + PV)
- reduction of energy consumption
- natural ventilation
- waste water recycling
- strong emphasis on roof gardens
- built from natural, recycled, or reclaimed materials
- reduction in parking – pedestrian oriented
- re-allocation of site/use distribution for community's best interests

BedZED: Then goes for Zero Energy….

Density and General Site Strategies

#1.

The development uses a higher density than typical.

#2.

This separates parking from housing.

#3.

And consolidates significant green space.

BedZED:
Alternative Parking/Car Strategies

#1.

Designed to encourage alternatives to car use.

#2.

A green transport plan promotes walking, cycling, and use of public transport.

#3.

A car pool for residents has been established. BedZED's target is a 50% reduction in fossil-fuel consumption by private car use over the next 10 years compared with a conventional development.

#4.

A "pedestrian first" policy with good lighting, drop curbs for prams (strollers) and wheelchairs, and a road layout that keeps vehicles to walking speed.

BedZED:
Landscape and Vegetation

#1.

Green space divided into large communal spaces + personal gardens/terraces.

#2.

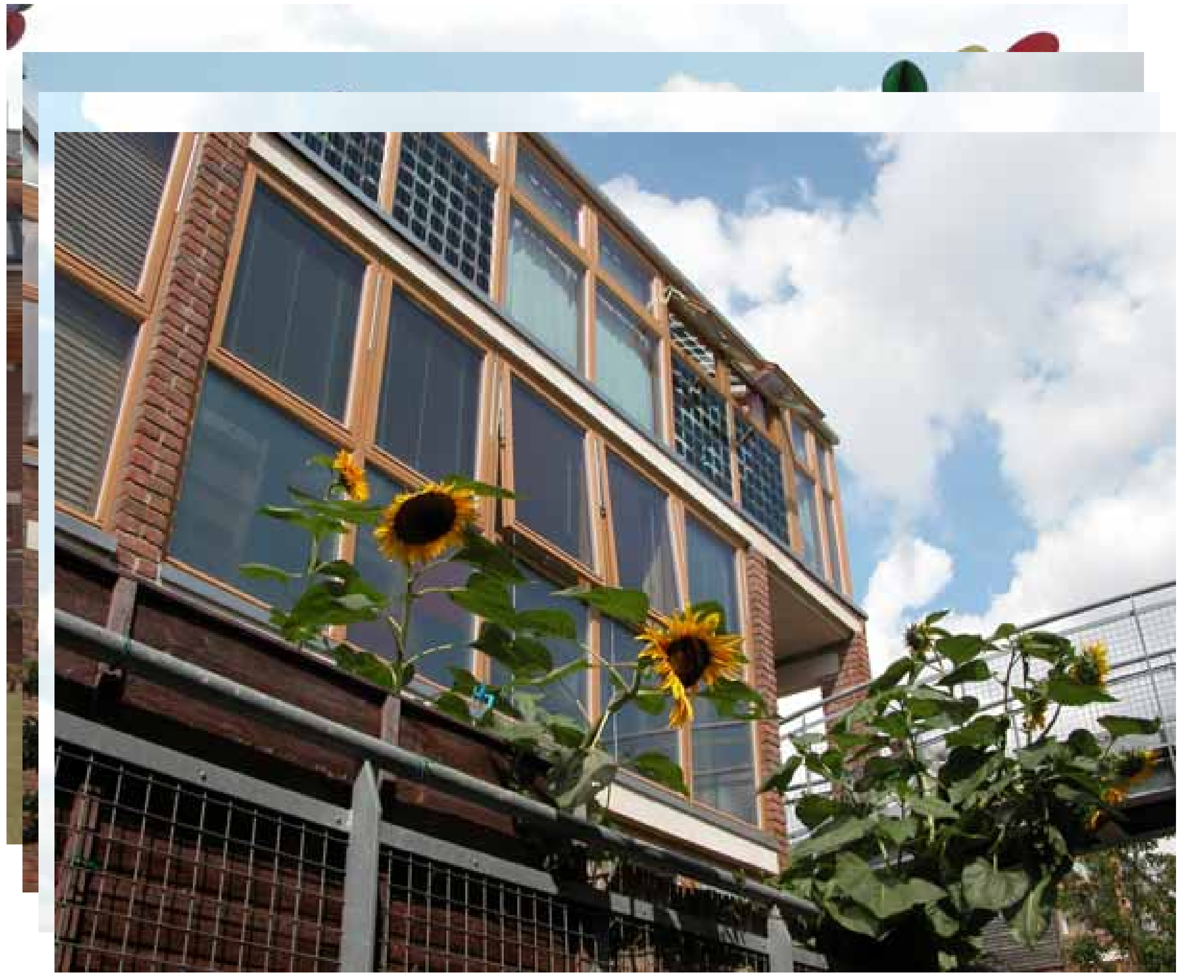
Green space at grade assists in lowering overall overheating in summer.

#3.

Green space at the roof level is private, and also incorporates seedum roofs.

#4.

Vegetable and edible crops are encouraged.



BedZED:
Passive Solar Strategies

#1.

Uses passive solar techniques to maximize heat gain for cool months

#2.

Houses are arranged in south facing terraces to maximize direct solar gain

#3.

Glass is maximized on south face (minimized on north side to prevent losses).

BedZED:
Passive Cooling Strategies

#1.

Each terrace is backed by north facing offices, which reduces the tendency to overheat and the need for air conditioning.

#2.

Large quantities of operable windows encourage natural ventilation.

#3.

PV is used to shade windows.

#4.

Wind cowls direct ventilation flow.

No A/C is provided.

BedZED:

Non-fossil fuel heating for space and water

Once needs have been reduced passively…

#1.

A centralized heat and power plant (CHP) provides hot water, which is distributed around the site via a district heating system of super-insulated pipes.

#2.

The CHP plant at BedZED is powered by off-cuts from tree surgery waste that would otherwise go to landfill.

The target was for zero fossil fuel use.

BedZED:
Material choices

#1.

Embodied energy (a measure of the energy required to manufacture a product) was key in choosing materials.

#2.

They were sourced within a 35-mile radius of the site when possible, reducing transportation energy.

#3.

Recycled materials and high recycled content were key.

75 year minimum target design life.

BedZED:
Generation of on Site Electricity

#1.

It was felt to be more efficient to generate electricity with the CHP facility.

#2.

PV panels were targeted at fueling electric vehicles.

#3.

PV was installed over 777m2 and was also used for shading.

Excess electricity is sold back to the grid.

BedZED:
Water Systems

Water use is carefully planned…

#1.

Rainwater is collected and used for irrigation and toilet flushing.

#2.

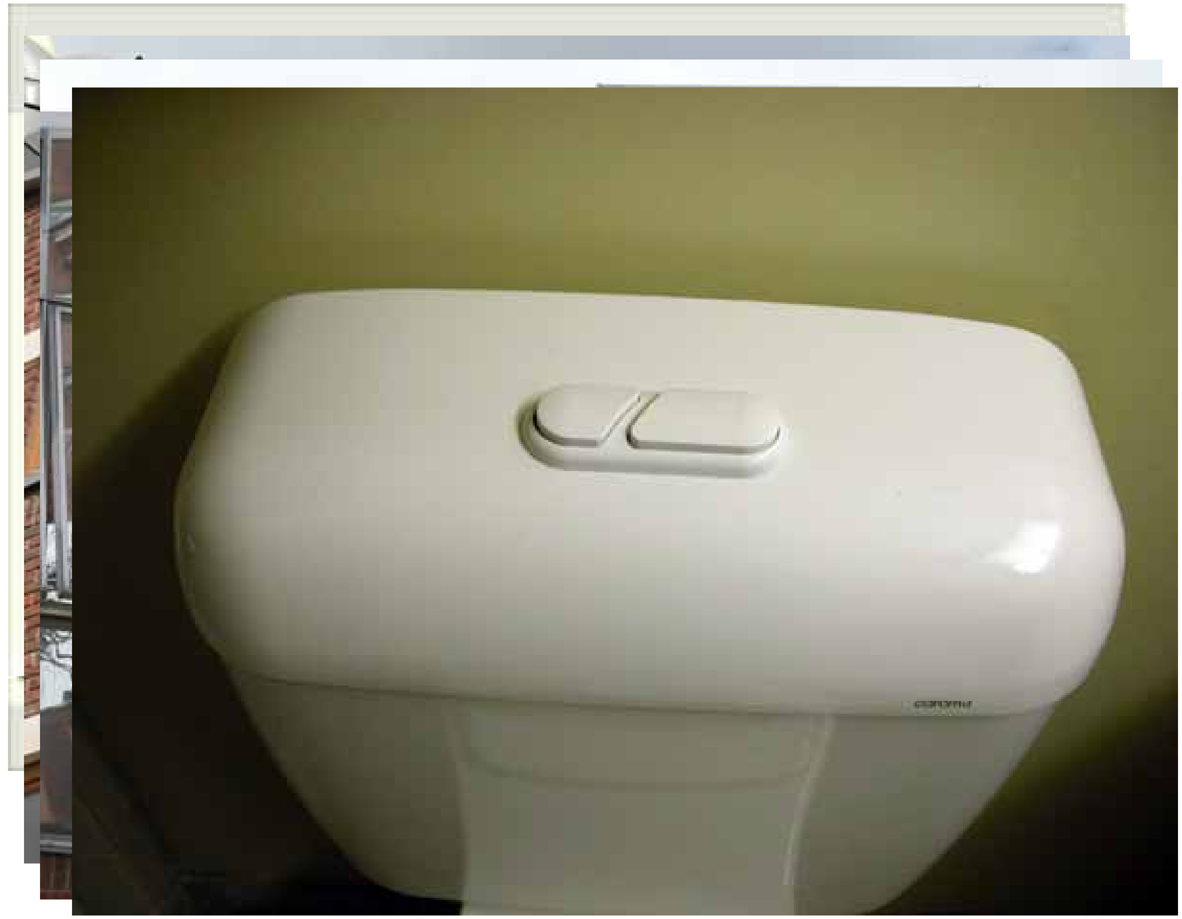
Black water is treated on site and cycled into the irrigation system.

#3.

Dual flush toilets reduce water consumption.

#4.

Shaped bathtubs reduce water requirement.



The target was to cut normal household use by 33%.

BedZED:
Waste Recycling

#1.

Waste recycling collection depots are located throughout the community.

#2.

Kitchens are outfitted with built in recycling storage.

#3.

On site composting.

The target was to reduce landfill waste by 66%.

BedZED:
Integrated Design Process

KEY WORKING CONCEPT:

Such a complex design with delicately inter-layered, synergistic systemic requirements mandates use of the ***Integrated Design Process*** from the early concept stages of development.

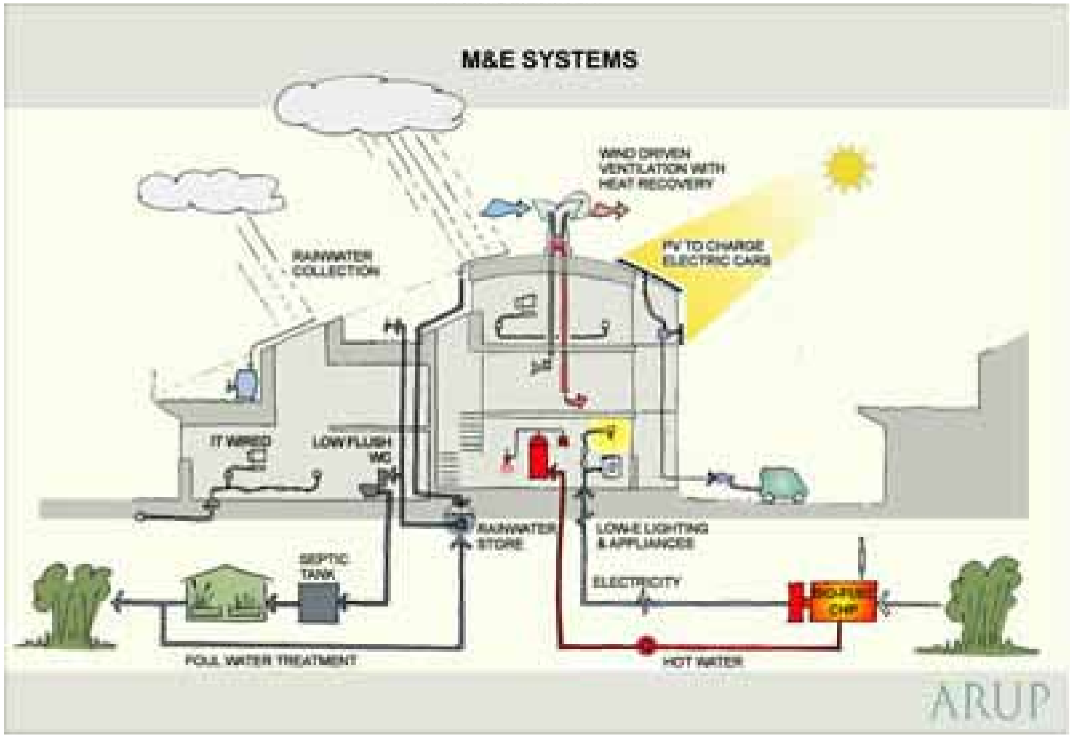


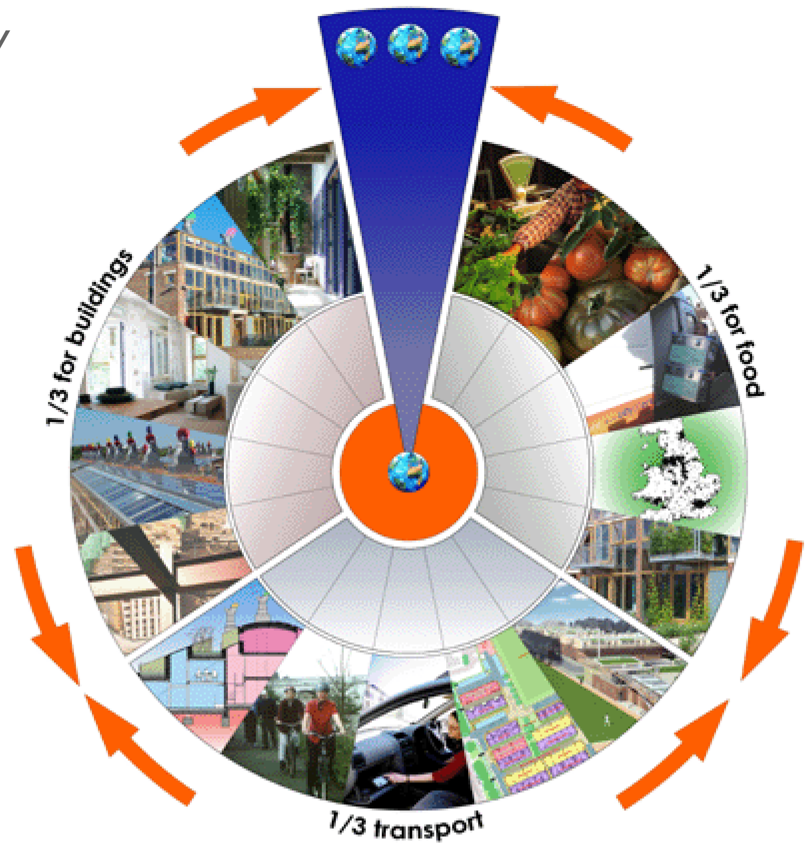
Image credit: ARUP

Zero emission design requires strict adherence to a philosophy of conservation and cooperation.

The ZEDfactory Philosophy…

Key to the necessary paradigm shift required to go ZED, is a re-visioning of priorities for design.

“Architects and engineers say that reaching a zero-energy goal necessarily requires a much more integrated design process than is typical for a conventional building.”



Current, unsustainable UK consumption

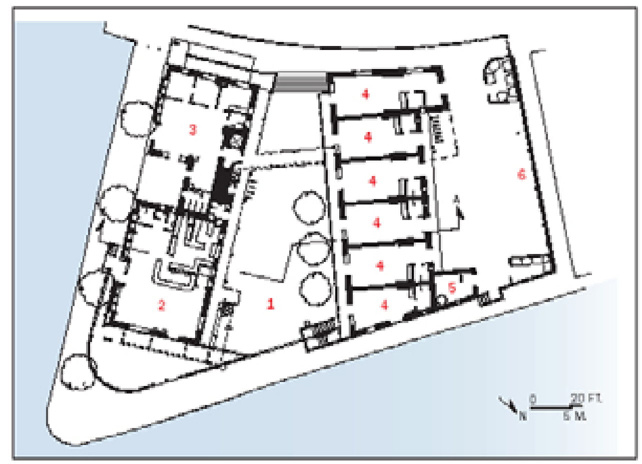
Image credit: ZEDfactory

The ZEDfactory Philosophy…

Post BEDZed, ZEDfactory has set a list of priorities that are now incorporated into most designs:

- First consider the site, climate, solar angles
- Use brownfields
- Maximize density, while keeping green amenity space
- Keep a loose fit to allow for change, adaptation over time
- Design out the need to travel
- Minimize thermal and electrical requirements as it is easier to save electricity than to generate it
- Make an energy efficient envelope
- Use efficient appliances
- Use passive solar energy for heat and sun for daylighting
- Use natural ventilation
- Use wind cowls to assist natural ventilation
- Generate maximum renewable energy *from within the site boundaries*
- Incorporate wind turbines and PV
- Allow for upgrade paths if not all systems can be installed
- Use reclaimed or local materials

Jubilee Wharf: ZEDfactory



GROUND FLOOR PLAN

1 Courtyard
2 Cafe
3 Community hall
4 Workshop
5 Boiler room
6 Parking

Architect: ZEDfactory
Location: Jubliee Wharf, Penryn, Cornwall
Client: Robotmother Ltd
Description: Mixed use with residential, workshops and nursery
Start / Completion: October 2004 - September 2006
Climate: temperate, coastal

Image credits: ZEDfactory

Jubilee Wharf:
Integrated Design Process

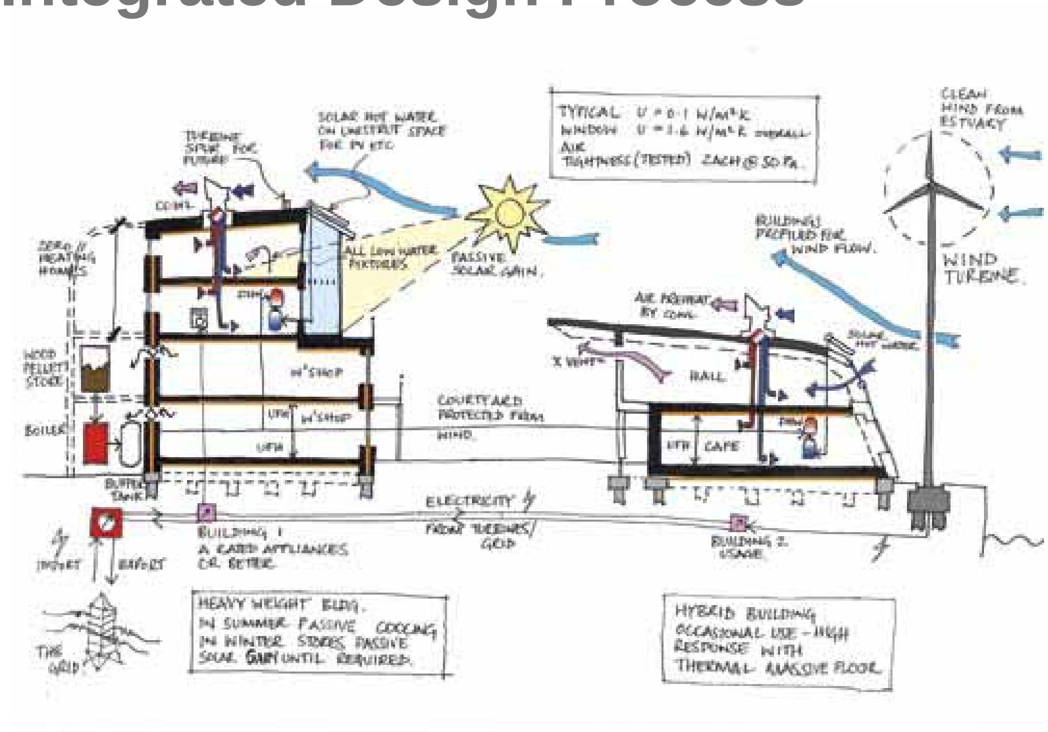


Image credit: ZEDfactory

The project begins with an integrated design approach that takes all of the key ZED concepts into account – from the beginning, starting with the sun, wind and climate.

The IDP diagram provides the basis for decisions throughout the project. It reveals how the building has been zoned by use – intensive residential use on the left, and occasional use on the right. This makes better use of the systems and site.

Jubilee Wharf:
Key Strategies List | Site and Community

Brownfield Site –
The site was previously occupied by a coalyard.

Community creation & revitalization - a hub for craft makers, quality childcare onsite, health & fitness classes, café for socializing.

Pedestrian and public transit oriented - good public transport links, located in central Penryn for easy pedestrian access.

Image credits: ZEDfactory

Jubilee Wharf:
Key Strategies List | Envelope

Super Insulation –
300mm insulation reduces energy consumption to less than half a conventional building. This level of efficiency is necessary to reduce consumption and make fossil fuel avoidance possible.

Thermal Mass –
The interior surfaces are made from concrete block, concrete and plaster so that heat is stored efficiently.

Air Tightness –
The interior surfaces are parged with plaster, making sure to seal all cracks between joining materials.

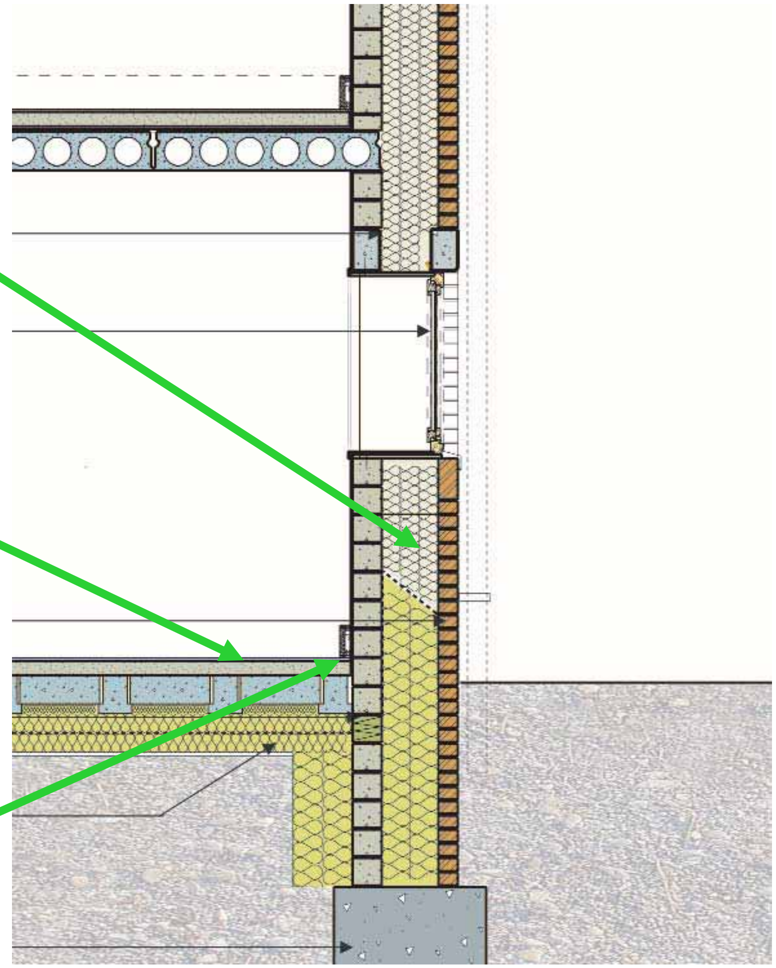


Image credit: ZEDfactory

Jubilee Wharf:

Key Strategies List | Reclaimed Materials

Using local & reclaimed materials - old floorboards, granite, Cornish cedar cladding and larch soffits, and some unused windows from BedZed

For example:
The ceiling of the Yoga space is made of reclaimed floorboards from a Victorian house. The boards have not been changed but simply treated and cut to length.

Image credit: ZEDfactory

Jubilee Wharf:
Key Strategies List | Healthy Materials

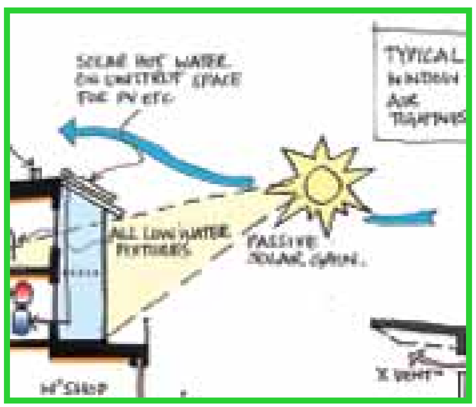
Healthy materials - low VOC paints, low formaldehyde floor coverings, natural fibers & surfaces, PVC only where unavoidable – with emphasis on creating a healthy environment.

Image credits: ZEDfactory

Jubilee Wharf:
Key Strategies List | Energy and Systems

Passive solar heating –
The sun space faces south and is used as a buffer space. In cold months the thermal mass heats up. In hot months the space can be closed off to keep the interior cool. It also shades the interior space.

Daylighting –
Window placement makes use of natural light.



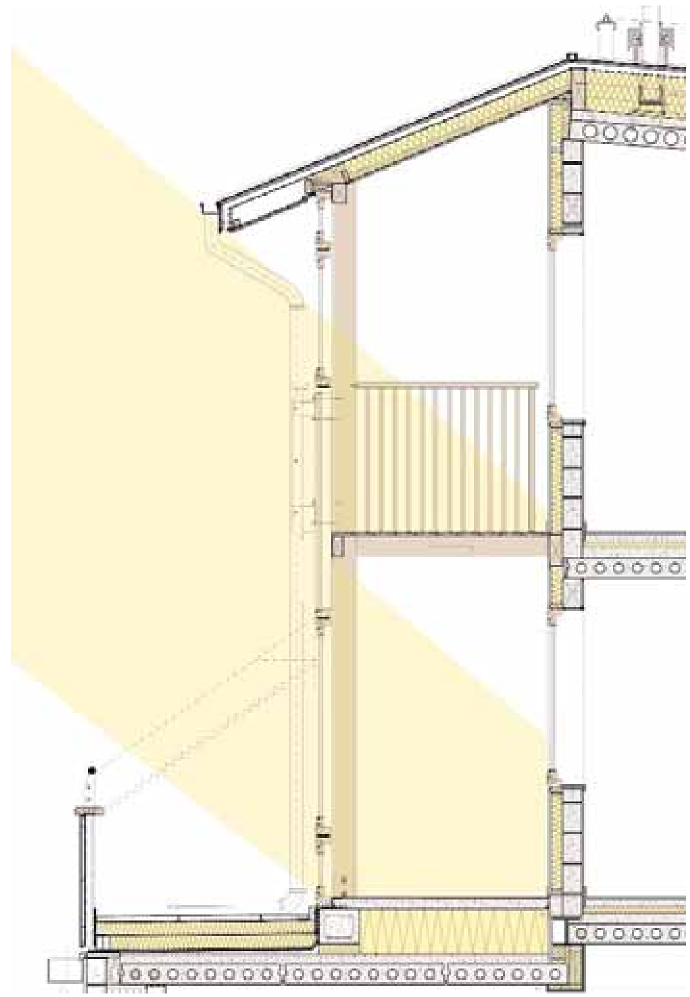


Image credits: ZEDfactory

Jubilee Wharf:
Key Strategies List | Energy and Systems

Natural ventilation –
Wind cowls ventilate without the need for electric fans.

Being passive it uses no electricity.

This displacement ventilation provides fresh air at low level and extracts air at the high level when the temperature of the air in the room has risen.

The cowl turns to face the wind drawing fresh air in via a heat exchanger which warms the incoming air with the outgoing air.

The heat exchanger is 70 - 80% efficient and minimizes heat loss from the building while providing a constant supply of fresh air.

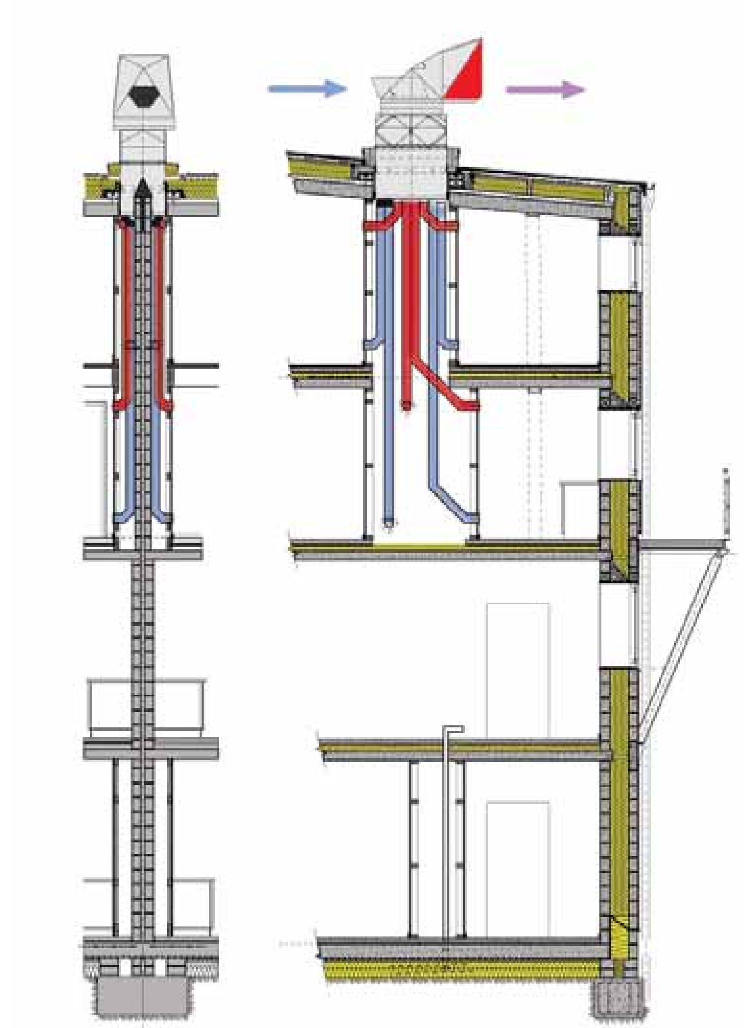


Image credit: ZEDfactory

Jubilee Wharf:
Key Strategies List | Energy and Systems

Solar panels –
The project uses evacuated tubes for water heating – one panel per residence.

Photovoltaics –

Photovoltaic cells were not included in the original budget but provisions have been made for them to be fitted later.

Reduced water consumption –
Low flush toilets, aerated taps, grade “A” consumption appliances.

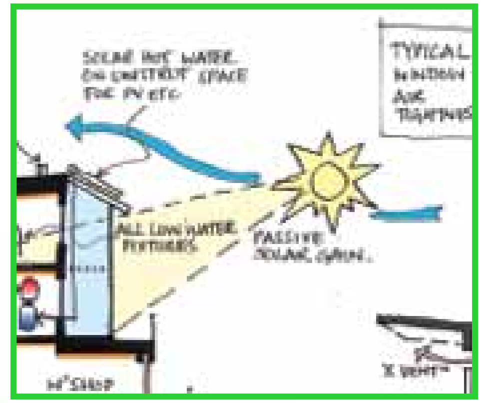


Image credits: ZEDfactory

Jubilee Wharf:

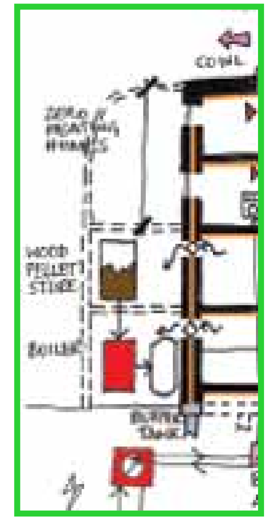
Key Strategies List | Energy and Systems

Biomass heating –

Under floor heating and hot water from a 75kW wood pellet boiler.

Onsite micro generation –

4 x 6kW Proven wind turbines provide most of the electricity – giving back to the grid or drawing from as required.



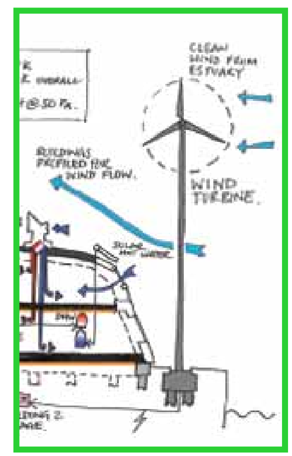


Image credits: ZEDfactory

IslandWood – Mithun Architects and Planners

IslandWood is an education center, on Bainbridge Island near Seattle, Washington. It was awarded LEED™ Gold Certification in 2002.

Team members (too numerous to fully list):

Mithun Architects

KEEN Engineering (Stantec)

Berger Partnership Landscape

Western Sun

2020 Engineering

Browne Engineering

IslandWood – Using the LEED™ System

A high LEED™ rating can be used as the basis for considering *extending performance to Zero Carbon.*

Need also to go “back to the basics” of:

•Orientation

•Climate

•Passive solar design

•Passive cooling

•Daylighting

•Low impact materials: low embodied energy, reclaimed, recycled

•Minimization of site impact

•Maximizing energy efficiency of envelope and building

•Reduction of electricity usage

•Minimizing need for additional fuel – maximizing on site renewables

IslandWood – Sustainable Sites
(9/14 possible points)

SS Prerequisite 1, Erosion & Sedimentation Control

SS Credit 1, Site Selection

SS Credit 4.1, Alternative Transportation, Public Transportation Access

SS Credit 4.2, Alternative Transportation, Bicycle Storage & Changing Rooms

SS Credit 4.4, Alternative Transportation, Parking Capacity

SS Credit 5.1, Reduced Site Disturbance, Protect or Restore Open Space

SS Credit 5.2, Reduced Site Disturbance, Development Footprint

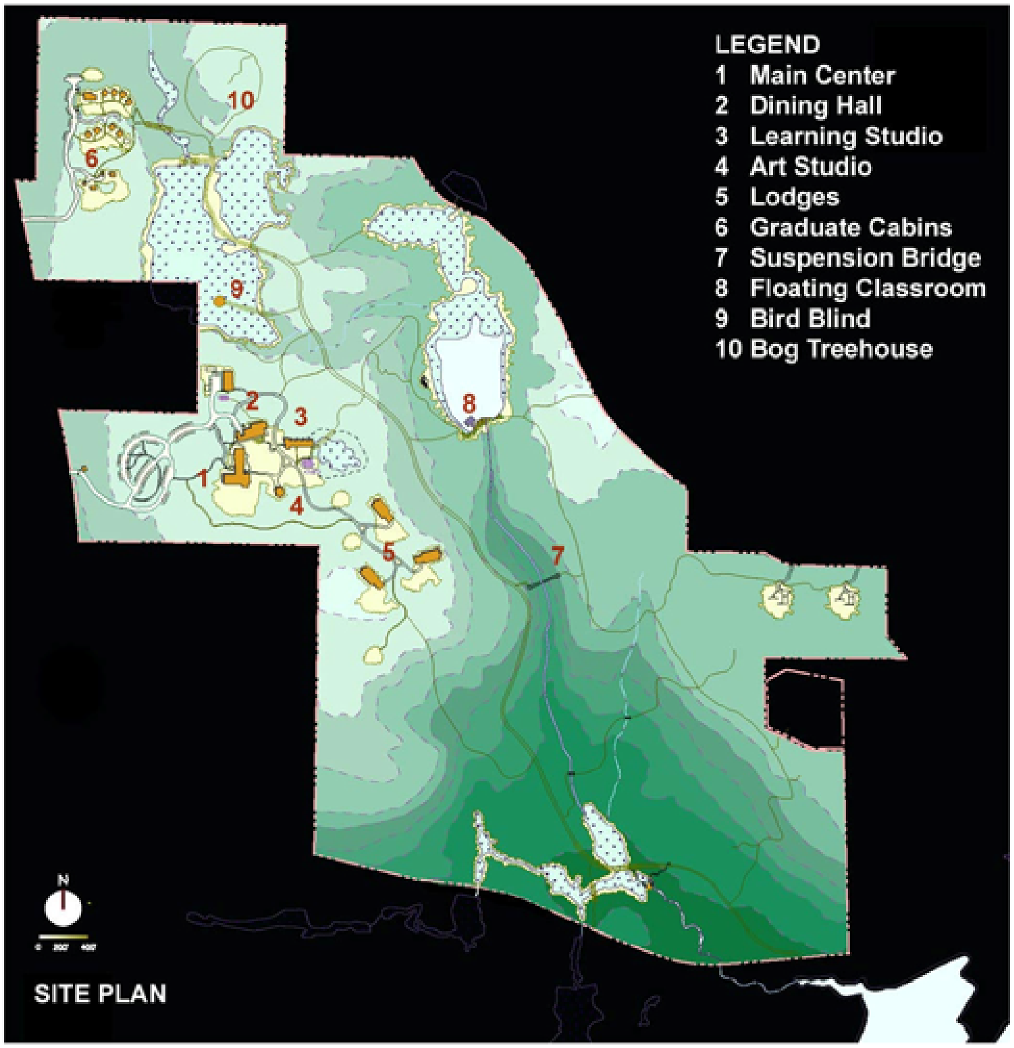
SS Credit 6.2, Stormwater Management, Treatment

SS Credit 7.1, Landscape & Exterior Design to Reduce Heat Islands, Non-Roof

SS Credit 8, Light Pollution Reduction

IslandWood – Sustainable Sites
(9/14 possible points)

Overview map of the development showing topography and building clustering to ensure the minimum disruption and impact on the land.



http://www.designshare.com/index.php/projects/islandwood/images

IslandWood – Sustainable Sites
(9/14 possible points)

- •Wetland was protected
- •Building done on most degraded part of site
- •Buildings were clustered to 3% of the site
- •Parking was limited
- •Pathways mostly pervious
- •Landscape was considered to promote indigenous species

IslandWood – Energy and Atmosphere
(4/17 possible points)

EA Prerequisite 1, Fundamental Building Systems Commissioning

EA Prerequisite 2, Minimum Energy Performance

EA Prerequisite 3, CFC Reduction in HVAC&R Equipment

EA Credit 1.1a, Optimize Energy Performance, 15% New 5% Existing

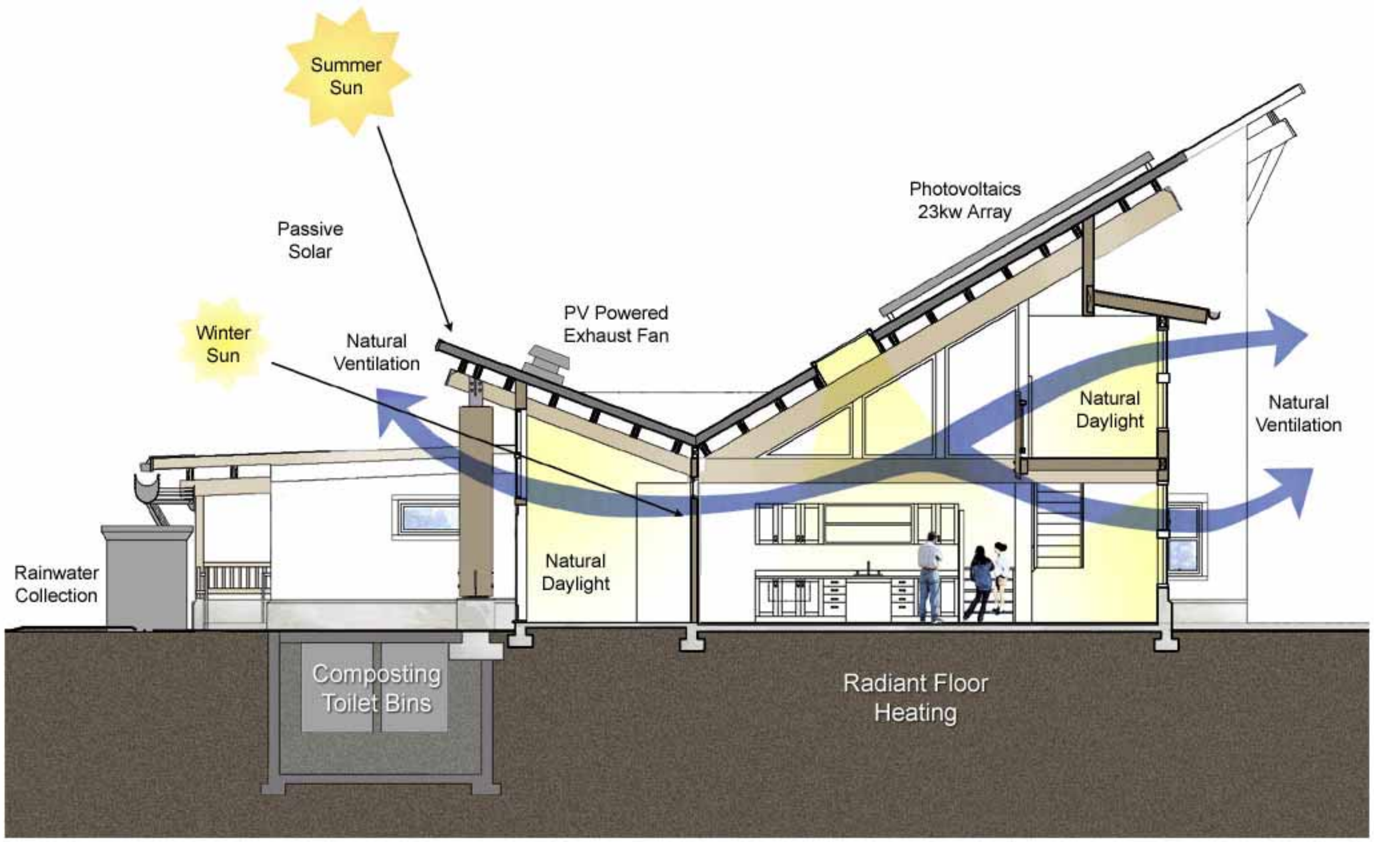
EA Credit 1.1b, Optimize Energy Performance, 20% New 10% Existing

EA Credit 1.2a, Optimize Energy Performance, 25% New 15% Existing

EA Credit 4, Ozone Depletion

The building was designed to work with the Bioclimatic condition of Bainbridge Island. ***West Coast*** *(coastal)****Temperate.***

IslandWood –
Passive Design Strategies



http://www.designshare.com/index.php/projects/islandwood/images

IslandWood – Energy and Atmosphere
(4/17 possible points)

- Exploration of passive heating systems
- Solar orientation, creation of “solar meadow” to ensure solar gain
- Large overhangs to prevent overheating
- Natural ventilation
- Solar hot water heating
- Photovoltaic panels

IslandWood – Water Efficiency
(5/5 possible points)

WE Credit 1.1, Water Efficient Landscaping, Reduce by 50%

WE Credit 1.2, Water Efficient Landscaping, No Potable Water Use or No Irrigation

WE Credit 2, Innovative Wastewater Technologies

WE Credit 3.1, Water Use Reduction, 20% Reduction

WE Credit 3.2, Water Use Reduction, 30% Reduction

IslandWood – Water Efficiency
(5/5 possible points)

- Rainwater collection from all roofs – use water for irrigation
- Composting toilets
- Waterless urinals and low flush toilets
- Living Machine to treat blackwater to tertiary level of purification

IslandWood – Materials and Resources
(7/13 possible points)

MR Prerequisite 1, Storage & Collection of Recyclables

MR Credit 2.1, Construction Waste Management, Divert 50%

MR Credit 2.2, Construction Waste Management, Divert 75%

MR Credit 3.1, Resource Reuse, Specify 5%

MR Credit 4.1, Recycled Content: 5% (post-consumer + 1/2 post-industrial)

MR Credit 5.1, Local/Regional Materials, 20% Manufactured Locally

MR Credit 5.2, Local/Regional Materials, of 20% Above, 50% Harvested Locally

MR Credit 7, Certified Wood

IslandWood – Materials and Resources
(7/13 possible points)

- All timber cleared on site was milled into siding and furniture
- Buildings designed with exposed structural systems, including roof trusses, wood shear walls, and concrete slabs, eliminating need for interior finish materials
- Concrete with 50% flyash
- strawbale used for studio
- innovative recycled content “everywhere”

IslandWood – Indoor Environmental Quality
(12/15 possible points)

EQ Prerequisite 1, Minimum IAQ Performance

EQ Prerequisite 2, Environmental Tobacco Smoke (ETS) Control

EQ Credit 1, Carbon Dioxide (CO2) Monitoring

EQ Credit 2, Increase Ventilation Effectiveness

EQ Credit 3.1, Construction IAQ Management Plan, During Construction

EQ Credit 3.2, Construction IAQ Management Plan, Before Occupancy

EQ Credit 4.1, Low-Emitting Materials, Adhesives & Sealants

EQ Credit 4.2, Low-Emitting Materials, Paints

EQ Credit 4.3, Low-Emitting Materials, Carpet

EQ Credit 4.4, Low-Emitting Materials, Composite Wood

EQ Credit 5, Indoor Chemical & Pollutant Source Control

EQ Credit 6.1, Controllability of Systems, Perimeter

EQ Credit 7.1, Thermal Comfort, Comply with ASHRAE 55-1992

EQ Credit 8.2, Daylight & Views, Views for 90% of Spaces

IslandWood – Indoor Environmental Quality
(12/15 possible points)

- All buildings are extensively daylit
- windows are operable
- extensive incorporation of low emitting materials

IslandWood – Innovation in Design Process
(3/5 possible points)

ID Credit 1.1, Innovation in Design "Environmental Education"

ID Credit 1.2, Innovation in Design "High Volume Fly Ash"

ID Credit 2, LEED® Accredited Professional

Solar 2 – Kiss + Cathcart

Image credit: Kiss + Cathcart

Kiss + Cathcart

Ove Arup and Partners

Community Environmental Center

Dome Tech Group

Turner Construction

Main Street Design

“**SOLAR 2** is recognized and supported as a key initiative in Mayor Bloomberg’s PlaNYC 2030. A ‘net-zero’ energy use facility, SOLAR 2 will generate more clean energy than it consumes and will be New York City’s first carbon-neutral building, using solar power and advanced mechanical systems to prevent the production and emission of carbon dioxide. Slated to replace the current temporary facility in Stuyvesant Cove Park, SOLAR 2 will set the standard for building performance in New York City while becoming a hub for environmental activity both regionally and nationally.”

Solar 2 – Primary Objectives

Working within the bioclimatic region of **cold** and coastal.

Added issues given the highly urban context and location adjacent to an elevated freeway.

- LEED™ Platinum
- Zero Carbon
- educational demonstration center
- setting example for NYC

Solar 2 – Key Sustainable Features

Recycled and renewable materials will be used in the building structure and interior furnishings.

A roof with integrated photovoltaic panels will utilize the energy of the sun to generate even more electrical power than the building will require.

Geothermal wells will keep **SOLAR 2** warm during the winter months using a technology that conducts heat from the Earth's interior. There will be 22 of them that sink 1500 feet into the ground.

Green screens – exterior walls that provide a trellis-like structure for vegetation — will supply natural shading and filtered sunlight.

A living green roof to provide many benefits, including: reducing heating and cooling loads on the building; filtering carbon dioxide and other pollutants out of the air; combating the urban heat effect, which makes cities measurably hotter than surrounding areas; and reducing storm water runoff, helping to alleviate the load on New York City's wastewater management system and thereby preventing the flow of raw sewage into the natural waterways.

The building's efficient use of **daylight and natural ventilation** will save energy and money.

Rainwater collection will provide all non-potable water, conserving the municipal water supply.

Source: http://solar1.org/solar2/

Solar 2 – Recycled and Renewable Materials

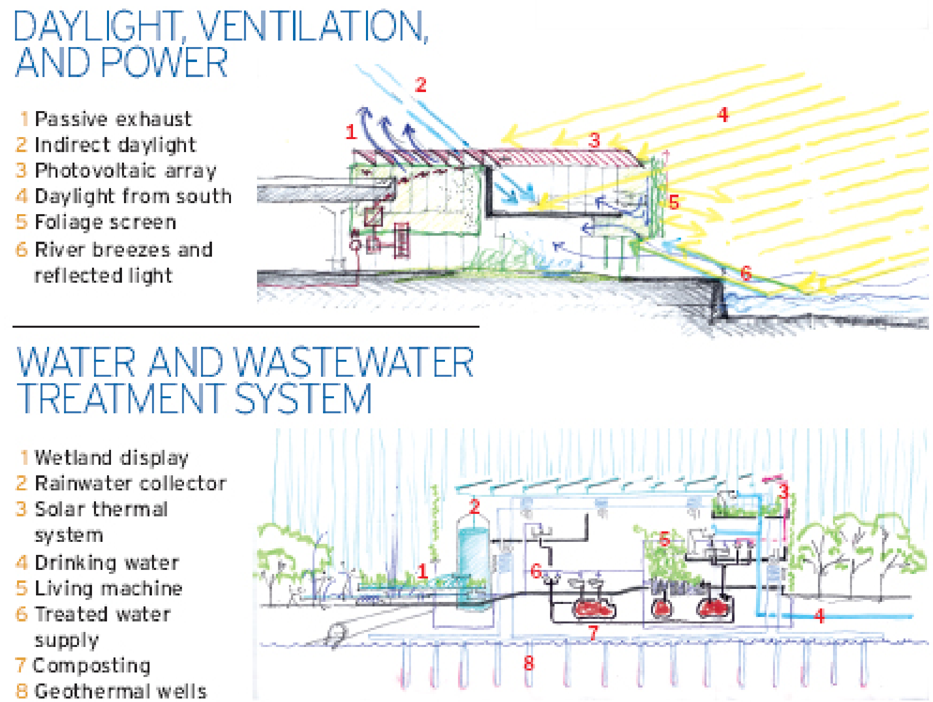
Because it is a learning model and a showcase, the architects will incorporate a variety of materials into the building envelope for demonstration purposes. While cautioning that Solar 2 is still in the schematic design phase, project architect Clare Miflin shared their plans. The structure will be steel with a high percentage of recycled content. One wall may be brick-clad, like a typical Manhattan apartment building, but with recycled newspaper as insulation. Another wall may be made with fiber-cement panels, with yet another in recycled aluminum. These sort of sustainable gestures are only the beginning of the project's comprehensive strategy for achieving zero-energy status.

Solar 2 – Passive Strategies

Daylighting, passive solar design, glazing, shading, and insulation are directly related to the need for electrical lighting and affect heating and cooling loads. According to current plans for Solar 2, a north-facing skylight system and copious glazing will provide enough daylight so that use of electric lights will not be required for roughly 80 percent of peak operational hours. The orientation of the skylight and a vegetated screen wall will help limit solar heat gain.

Solar 2 – Integrated Design Methodology

- A team approach to design
- Working out the synergies of the systems
- Understanding the relationship to the site
- Designing the systems so they could be part of the educational experience



Solar 2 – Integrated Design Methodology

Architects and engineers say that reaching a zero-energy goal necessarily requires a much more integrated design process than is typical for a conventional building. “When energy use is not important, you engineer to meet the codes,” says Fiona Cousins PE, a principal at Arup, Kiss + Cathcart’s mechanical consultant on Solar 2. However, the interrelationship between systems and building envelope, for example, requires close collaboration among the various design disciplines. “If you set a low-energy goal, design has to be a team effort,” she says.

The approach Arup developed for Solar 2, as well as for other low-energy projects, focuses on three main areas: load reduction, the thermal efficiency of the building envelope, and the power source. “The first thing we ask is how to reduce the loads,” Cousins says. Arup runs whole-building simulations to analyze the potential for energy savings through incorporating lower-energy lamps, reducing the number of light fixtures, and specifying energy-efficient building systems. Low wattage fixtures will be installed throughout Solar 2 and the building’s elevator will be 50 percent more efficient than conventional models. Some spaces will have carbon dioxide (CO_2) monitors so that when there are fewer people in the building, the mechanical system will respond and decrease the intake of fresh air and thus reduce the amount of supply air that needs to be cooled or heated.

Solar 2 – On Site Energy

Once the demand for power is reduced as much as possible without compromising the building’s performance or the health and comfort of its occupants, the focus of the design process turns to the building’s energy sources. Solar 2’s energy needs will be fully met by on-site supplied solar energy. However, other on-site generation strategies, such as combined heat and power (CHP), which allows capture of the energy that is normally lost in conversion and transmission from a utility, should also be considered when striving to meet a low-energy goal, says Cousins. CHP, also known as co-generation, produces both heat and electricity from a single source. Plants relying on this strategy are more efficient than separate-source plants and produce fewer emissions.

Solar 2 – the plan

Site Plan

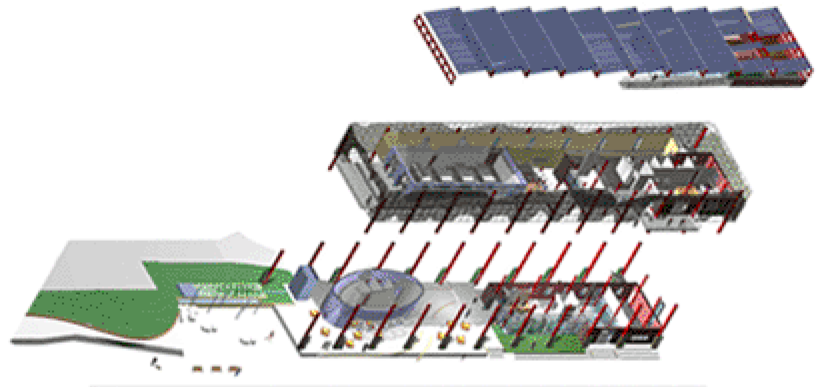
Working from schematic design through to detail design, incorporating interdependencies and environmental systems.

Ground Floor Plan

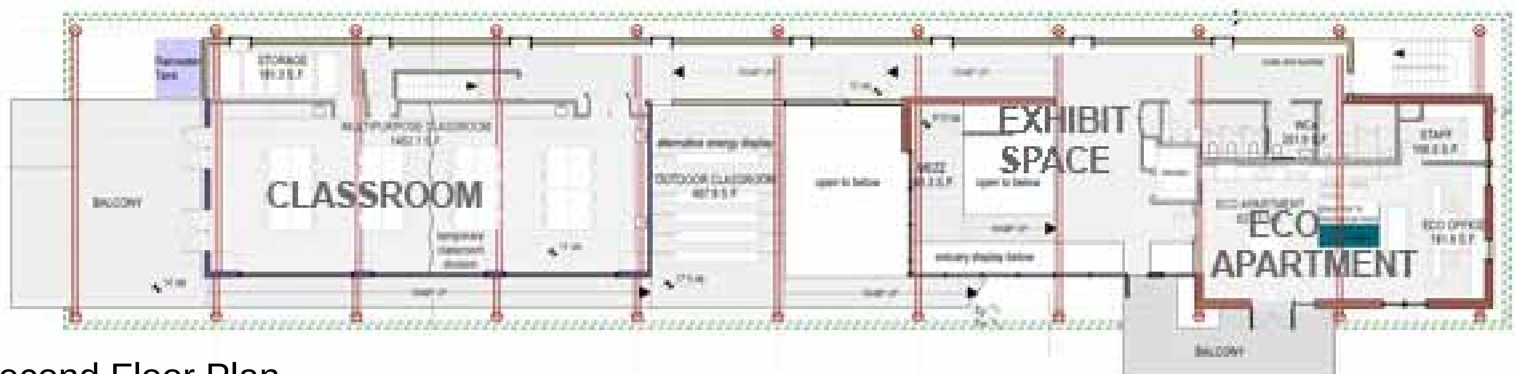
Image credits: Kiss + Cathcart

Solar 2 – systems approach

Understanding the building as a series of systems.



Exploded axonometric



Second Floor Plan

Image credits: Kiss + Cathcart

Solar 2 – Green Screen

The building is virtually surrounded by “green screen” walls – large trellis structures that support planting – providing shade/natural cooling in the summer – and light penetration/heat in the winter.

Solar 2 – Roof

In New York City is costs over $1000 to plant a small tree that takes many years to grow to have a a 16 foot canopy.

It costs far less to build 16 square feet of green roof, which will give the same amount of oxygen, faster.

Image credit: Kiss + Cathcart

Solar 2 - Photovoltaics

SOLAR 2 will have a **85kW rated PV Roof** designed to generate renewable energy ± 94,000 KwH per year.

SOLAR 2 's PV Roof will generate more than enough power to supply all of the building's electrical needs thereby creating a **'net zero energy'** building.

The 'excess' power will be put back into New York City's grid and SOLAR 2 will benefit from the sale of this power. Battery storage is not to be used.

Image credits: Kiss + Cathcart

Solar 2 – Classroom

The classroom is to serve as a living laboratory for sustainable design and will host numerous groups from pre-school age to senior citizens.

Image credits: Kiss + Cathcart

Solar 2 – Eco Apartment

Exhibits include an outfitted “Eco Apartment” designed to show New Yorkers what they can do to upgrade their own residences.

The Eco Basement explains some of the less apparent geo-thermal systems used in Solar 2.

Image credits: Kiss + Cathcart

Solar 2 - Theater

The exterior theater extends the functional area of the building through this seasonal space.

Image credits: Kiss + Cathcart

Solar 2 - Wetland

Insert info here about Solar 2's wetland.

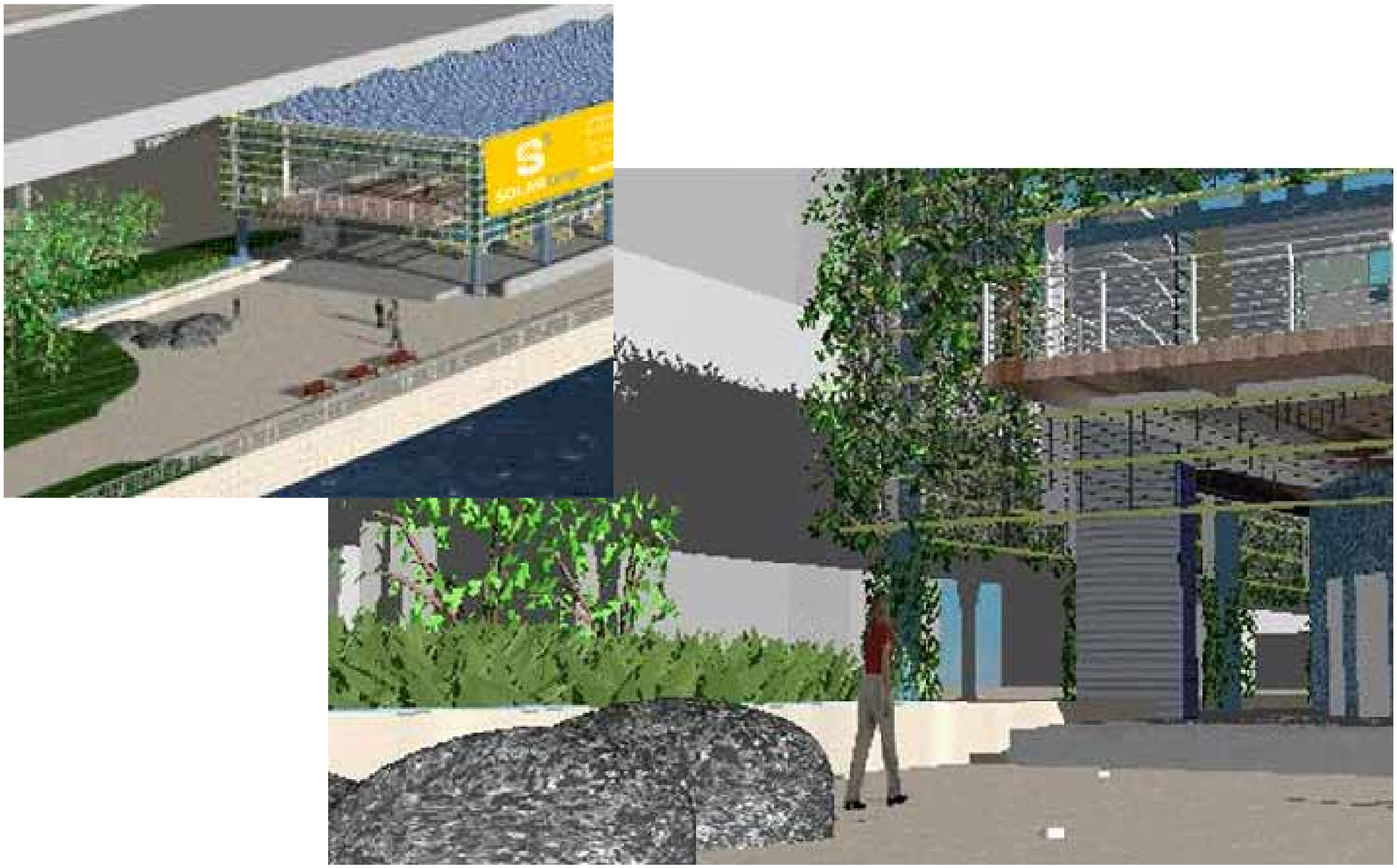


Image credits: Kiss + Cathcart

Solar 2 – Café and Exhibit Areas

Insert info here about the Café and exhibit area features.

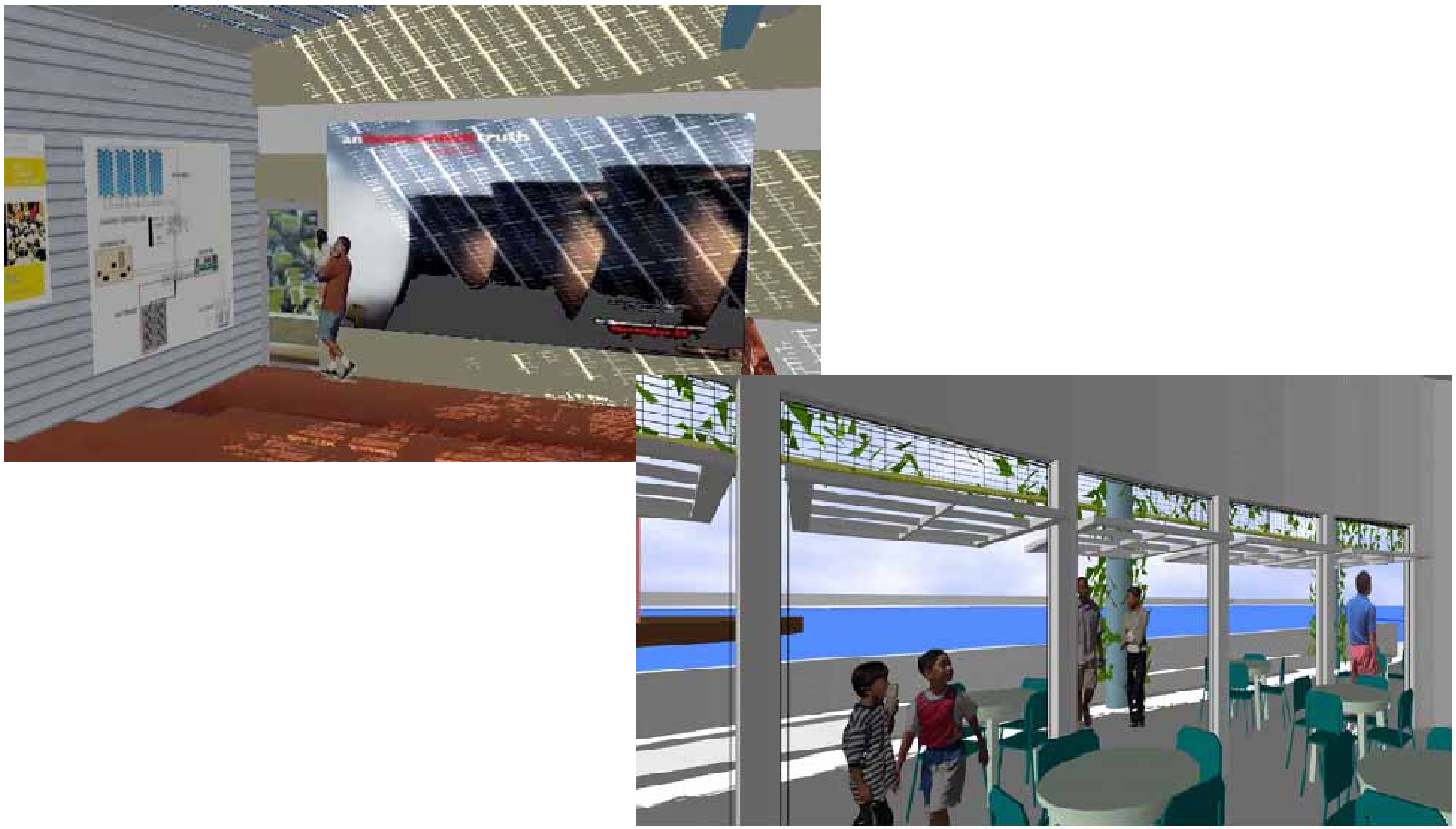


Image credits: Kiss + Cathcart

Looking to the Future….

The Vertical City….

The 2020 Tower illustrates that Zero Carbon/Zero Energy building IS possible on a much more urban scale.

Image credit: Kiss + Cathcart

2020 Tower – Kiss + Cathcart

Kiss + Cathcart, in collaboration with Arup Engineers was invited by the National Building Museum to design a speculative building for "Big + Green“ exhibition in 2003. They created a design that targeted new ecological, urbanistisic and quality-of-life standards for the tall building. The design is technologically advanced, but not a Utopian vision, rather a building that has been carefully engineered to be feasible, practical and economical by the year 2020.

The goal of a rigorous re-examination of all parts of the tall building - program, structure, energy, water, HVAC, safety - will add up to a building that is a better place to be, more economical to operate, and a benefit to its environment.

Image credit: Kiss + Cathcart

2020 Tower – planimetric view

Comparing the scale of the plan view to the World Trade Tower floor plate. The configuration minimizes the distance from windows for daylighting and reduces the impact of the core.

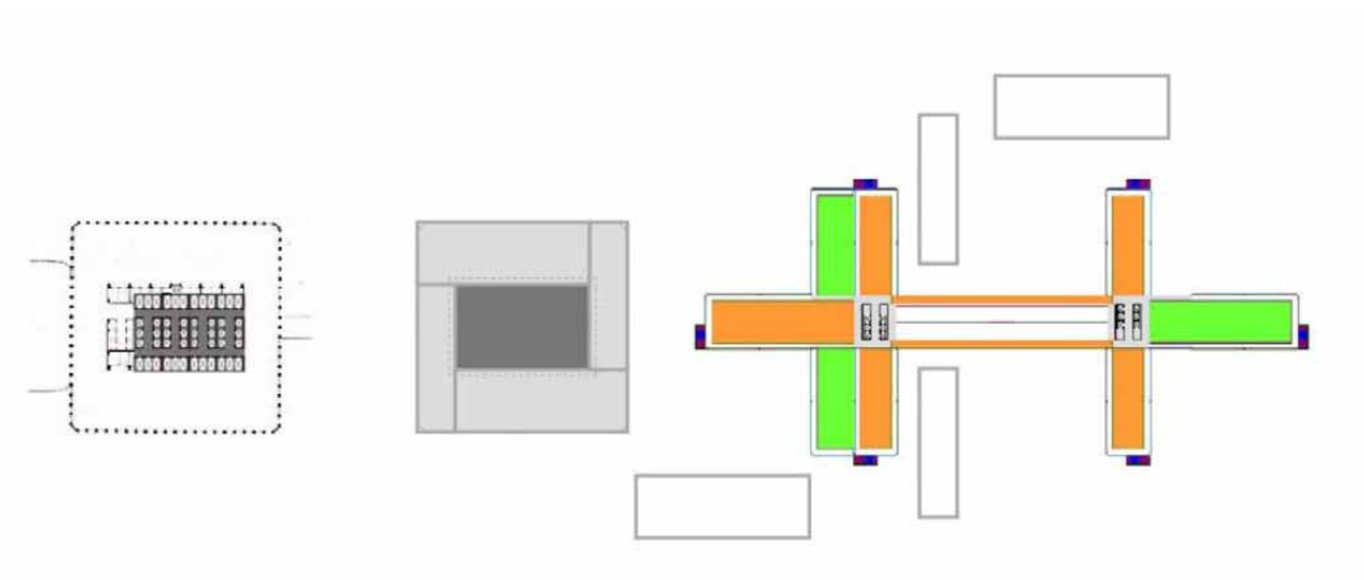
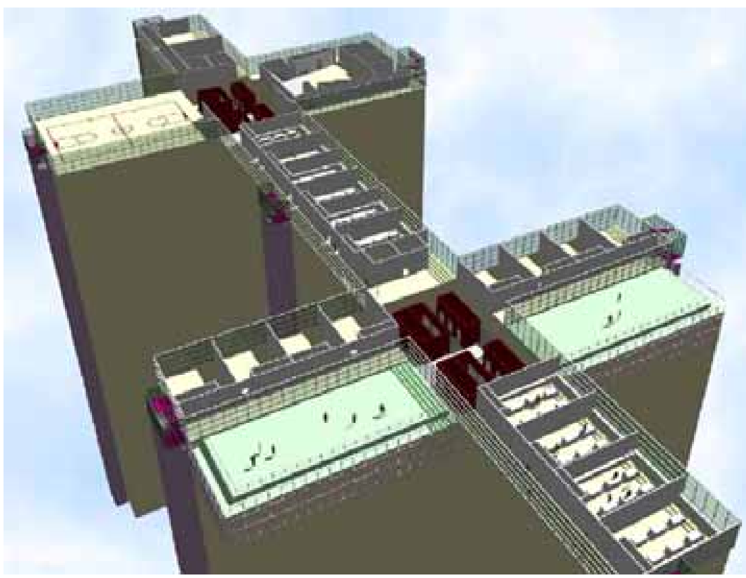


Image credit: Kiss + Cathcart

2020 Tower – massing, zoning and use

-massing and zoning to achieve carbon neutrality – i.e. preserve daylighting and passive potential of buildings



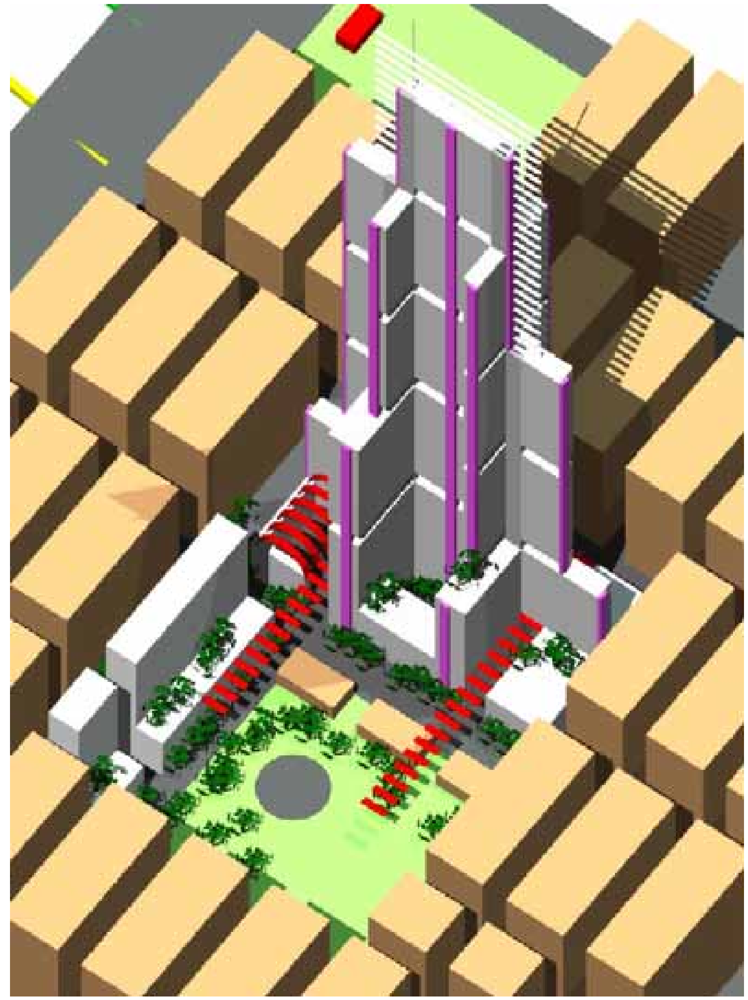


Image credits: Kiss + Cathcart

2020 Tower – massing and repetition

Multiples would be arranged to preserve light and solar access that feed the lower energy concepts of the vertical city.

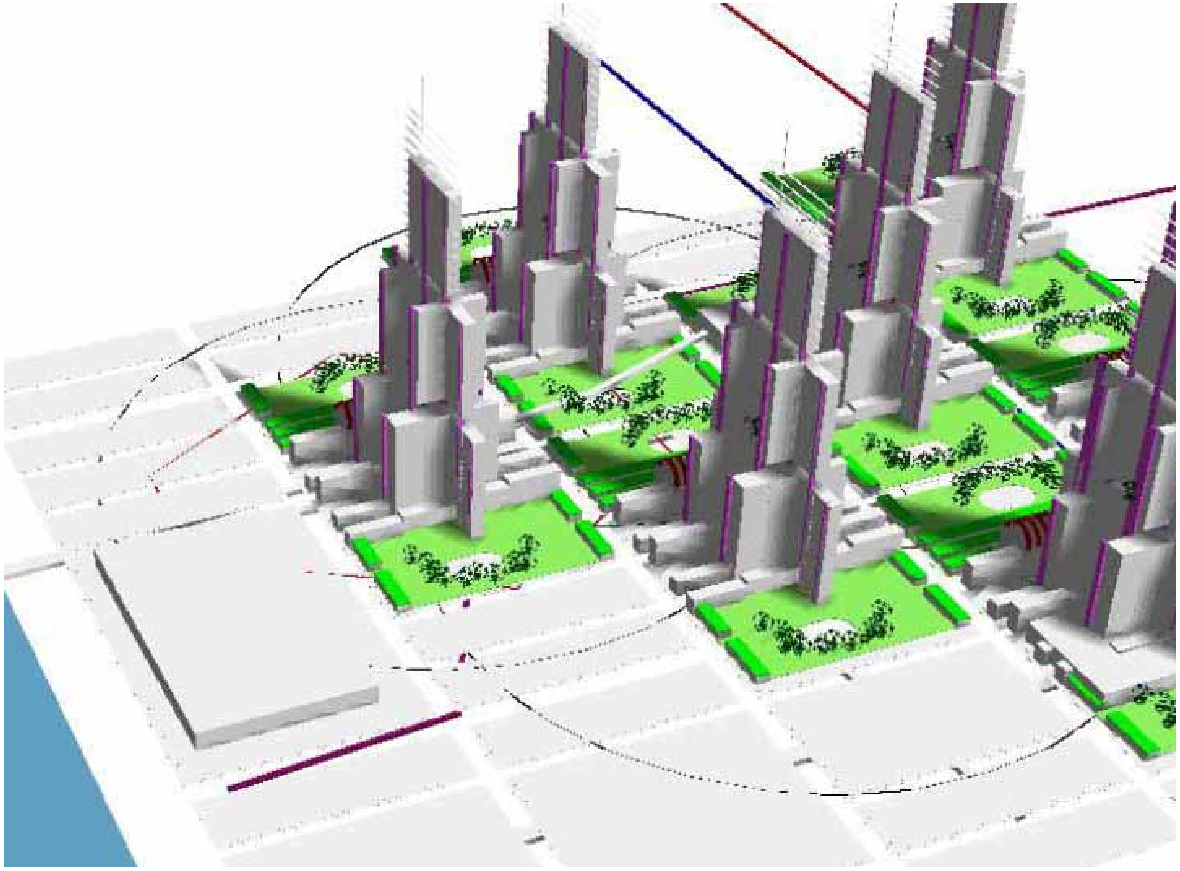


Image credit: Kiss + Cathcart

2020 Tower – PV façade

The entire façade of the structure would be clad in photovoltaic cells

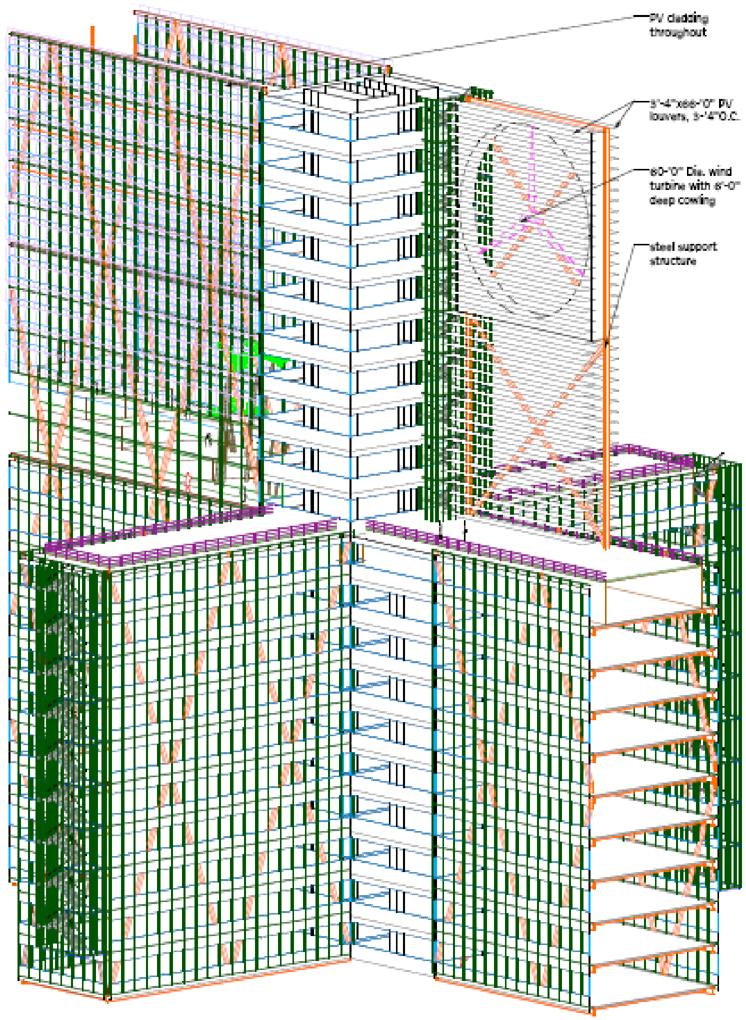
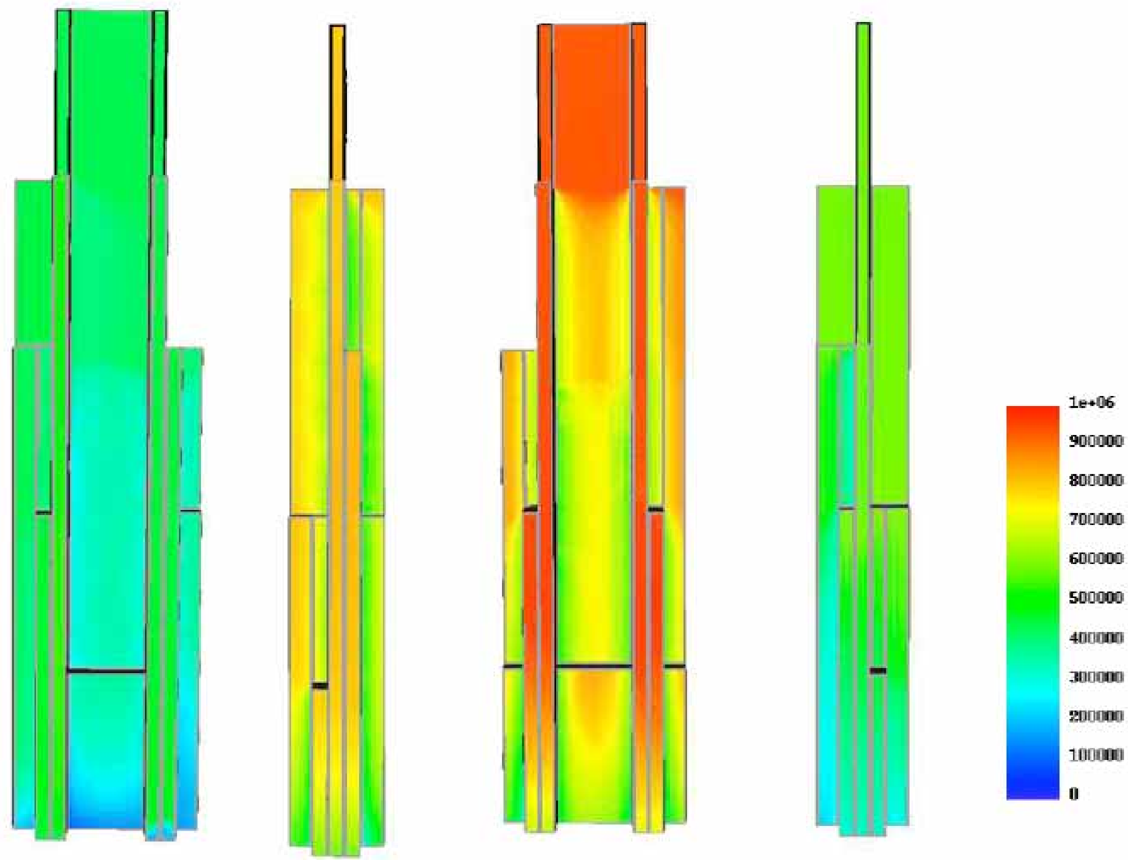


Image credit: Kiss + Cathcart

2020 Tower – Solar Exposure



Solar exposure maps - annual solar energy on the building perimeter, accounting for shadowing and weather conditions.

Image credit: Kiss + Cathcart

2020 Tower – Specialty Systems

Image credits: Kiss + Cathcart

2020 Tower - conclusions

- Summary of 2020's systems and their impact on carbon neutrality and the 2030 challenge

Image credits: Kiss + Cathcart

Summary:

What are the key sustainable strategies that are tied to Bioclimatic considerations?

- Point 1
- Point 2
- Point 3
- Point 4

Summary:

Prioritized list of critical issues to prepare for Carbon Neutral/Zero Carbon Design:

- Issue 1
- Issue 2
- Issue 3
- Issue 4
- Issue 5
- Issue 6
- etc

Summary:

List of key Questions that reflect readiness of a project to meet 2030 objectives?

- Point 1
- Point 2
- Point 3
- Point 4
- Point 5
- Point 6
- etc

Invitation!

Please join us at 4:00 pm for FR65

“The LEAP to Zero Carbon”

Where we will look in more detail at the specific implementation of Zero Carbon Emission strategies in exemplary building case studies, including the recently completed Aldo Leopold Center.

Room:

Evaluation

Speakers

(List alphabetically by last name regardless of speaking order)

- Boake, Terri Meyer
- Guzowski, Mary

Contact Information

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