

Energy 2004

U.S. Department of Energy

“Doing it Right from the Start”
August 11, 2004

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AP
HOK



• HOK Guidebook to Sustainable Design

- 3 LEED Certified Projects
- 200 Current “green” projects
- 20 LEED Registered
- 170+ LEED AP



How important is an Integrated Design Approach?

or

Is sustainable design simply a collection of best practices that reduce environmental burden, or is it fundamental to the process of design?



IFICATION of the Process

		Project Name	Project Location		
LEED 2.1 Project Checklist					
Sustainable Sites				14 Possible Points	Points Earned
<input checked="" type="checkbox"/>	Prereq 1	Erosion & Sedimentation Control		Required	
<input type="checkbox"/>	Credit 1	Site Selection		1	
<input type="checkbox"/>	Credit 2	Development Density		1	
<input type="checkbox"/>	Credit 3	Brownfield Redevelopment		1	
<input type="checkbox"/>	Credit 4.1	Alternative Transportation, Public Transportation Access		1	
<input type="checkbox"/>	Credit 4.2	Alternative Transportation, Bicycles, Storage & Changing Rooms		1	
<input type="checkbox"/>	Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles		1	
<input type="checkbox"/>	Credit 4.4	Alternative Transportation, Parking Capacity		1	
<input type="checkbox"/>	Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space		1	
<input type="checkbox"/>	Credit 5.2	Reduced Site Disturbance, Development Footprint		1	
<input type="checkbox"/>	Credit 6.1	Stormwater Management, Rate and Quality		1	
<input type="checkbox"/>	Credit 6.2	Stormwater Management, Treatment		1	
<input type="checkbox"/>	Credit 7.1	Heat Island Effect, NonRoof		1	
<input type="checkbox"/>	Credit 7.2	Heat Island Effect, Roof		1	
<input type="checkbox"/>	Credit 8	Light Pollution Reduction		1	
Total				14	0
Water Efficiency				5 Possible Points	Points Earned
<input type="checkbox"/>	Credit 1.1	Water Efficient Landscaping, Reduce by 50%		1	
<input type="checkbox"/>	Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation		1	
<input type="checkbox"/>	Credit 2	Innovative Wateruse Technologies		1	
<input type="checkbox"/>	Credit 3.1	Water Use Reduction, 20% Reduction		1	
<input type="checkbox"/>	Credit 3.2	Water Use Reduction, 30% Reduction		1	
Total				5	0
Energy & Atmosphere				17 Possible Points	Points Earned
<input checked="" type="checkbox"/>	Prereq 1	Fundamental Building Systems Commissioning		Required	
<input checked="" type="checkbox"/>	Prereq 2	Minimum Energy Performance		Required	
<input checked="" type="checkbox"/>	Prereq 3	CFE Reduction in HVAC/R Equipment		Required	
<input type="checkbox"/>	Credit 1	Optimize Energy Performance		2	
<input type="checkbox"/>	Credit 2.1	Renewable Energy, 5%		1	
<input type="checkbox"/>	Credit 2.2	Renewable Energy, 10%		1	
<input type="checkbox"/>	Credit 2.3	Renewable Energy, 20%		1	

Doing it Right From the Start

1. Integrated Design Definition
2. Case Studies
3. Observations

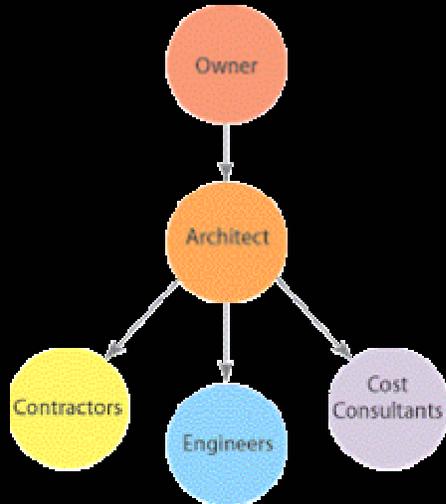
Integrated Design Process

TEAMING

TIMING

TRACKING

TEAMING



TRADITIONAL DESIGN TEAMS

Traditional

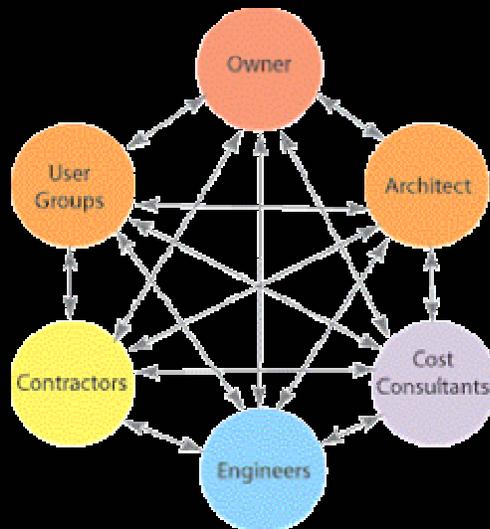
Hierarchical Organization

Owner - Architect - Engineer

Transactional Design Process

Silo-ed Disciplines

TEAMING



INTEGRATED DESIGN TEAMS

Emerging

Holistic Thinking

Team Based

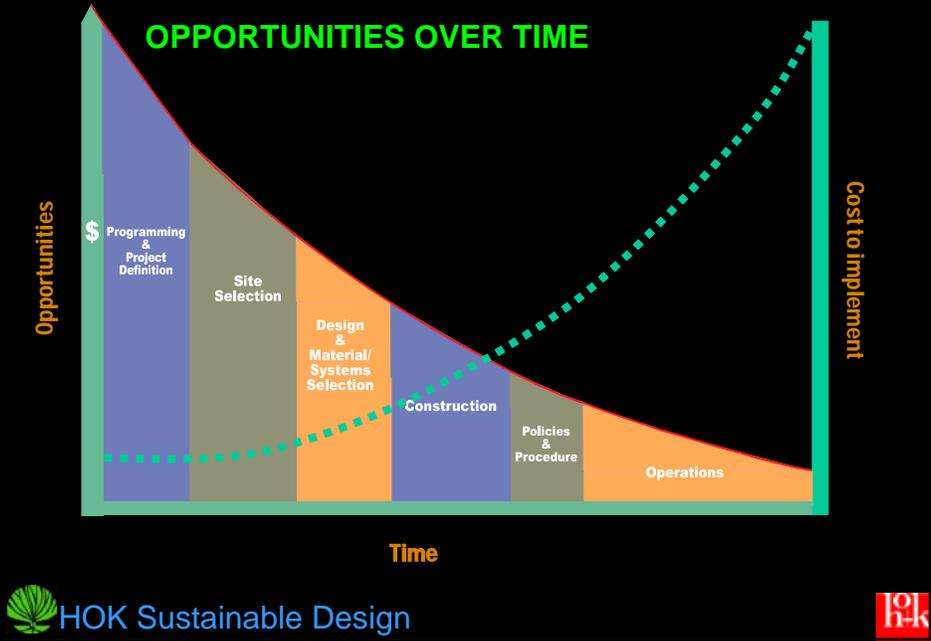
Organic Design Process

Larger Team

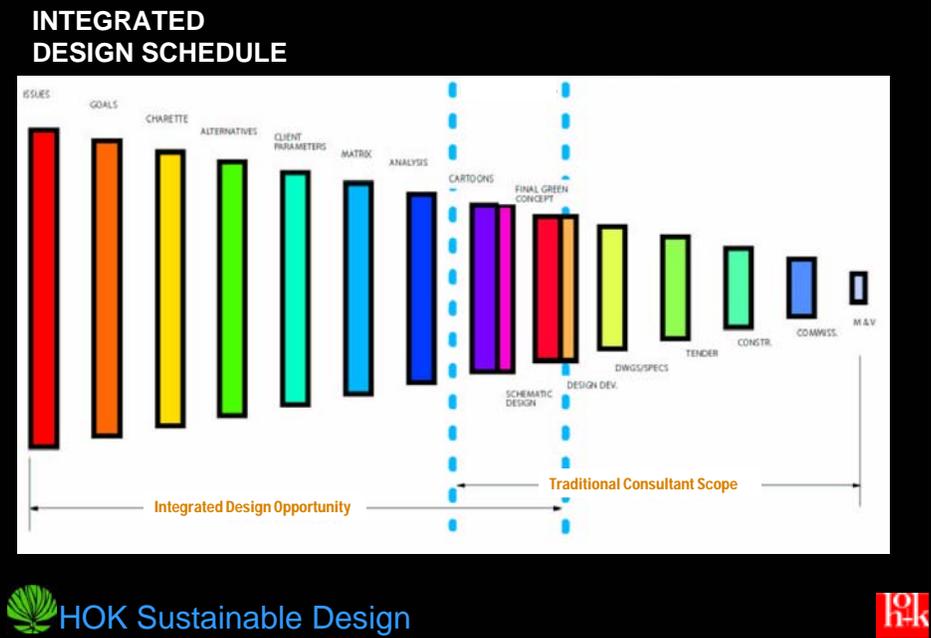
Users, Operators, Constructors

Innovation encouraged by Client

TIMING



TIMING



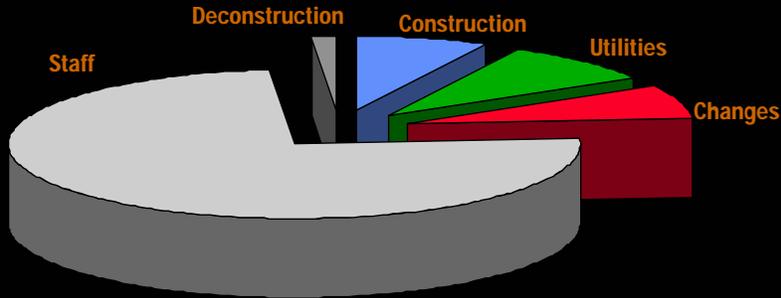
TIMING

LIFE CYCLE COST OF BUILDINGS

Target of typical efficiencies

vs.

Target of most impact



TRACKING



TEAM METRICS

LEED™ Green Building Rating System

Five major categories in which to earn points of credits towards a certification level:

- ☑ Sustainable Sites
- ☑ Water Efficiency
- ☑ Energy and Atmosphere
- ☑ Materials and Resources
- ☑ Indoor Environmental Quality

Credits may also be earned for design innovation



Case Study

Emory University Whitehead Biomedical Research Building

Location: Atlanta, Georgia

Project Type: Office and Lab

Size: 325,000 SF

Cost: \$82 Million

Completion: Dec 2001

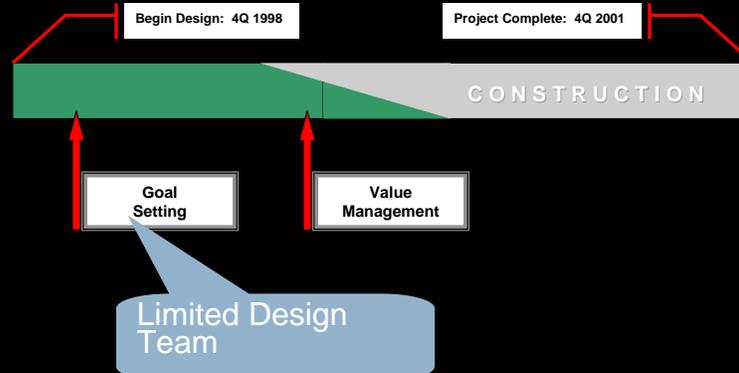
Delivery: CM at Risk

HOK role: Arch, Interiors,
Planning



Case Study

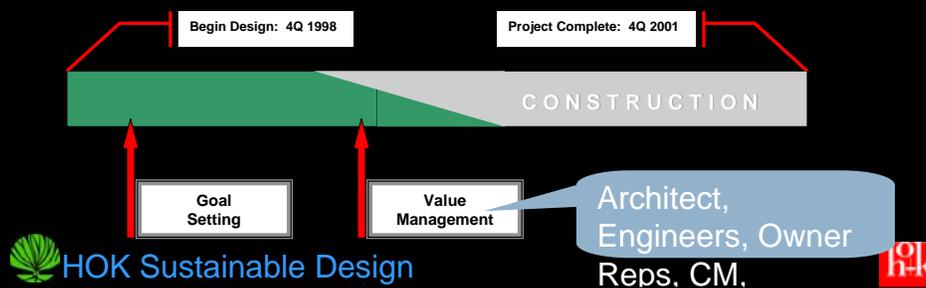
Context of the Design Process. . .



Design Process - Value Management

Looked at 3 key major areas:

- Lighting controls
- Enthalpy Wheel
- Finishes

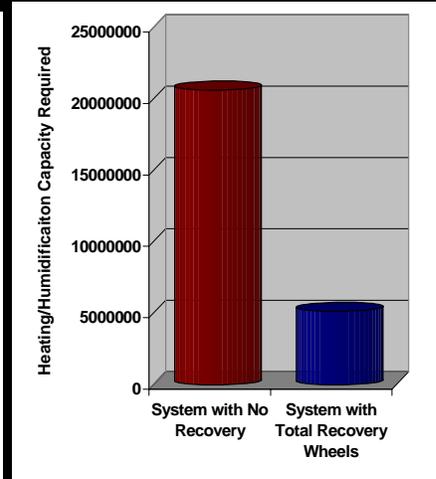
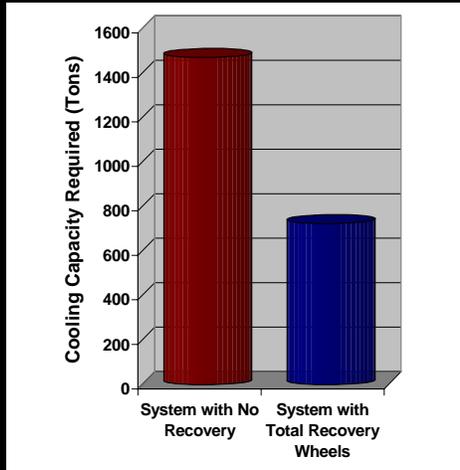


Design Process - Value Management

Enthalpy Wheel - Whitehead Life Cycle Analysis

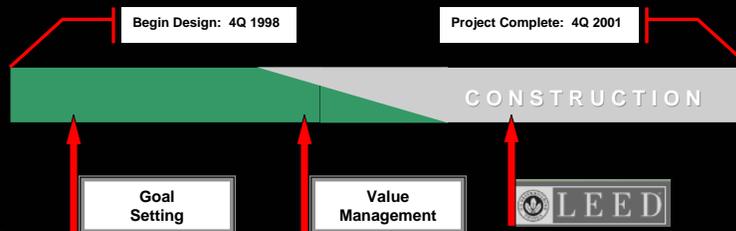
- Total energy recovery wheels save an estimated \$245,000 annually, three times that of a coil to coil recover option
 - Total recovery cut 750 tons of chiller capacity and 450 Boiler horsepower
 - Provided a positive present value cash flow of \$1,700,000 based on 20 year life cycle
 - Provides estimated energy savings in the amount of \$5,900,000 based on a 20 year life cycle analysis*
- * Assumes: inflation at 2.5% and cost of capital of 8%, 50% taxes

Economics: Whitehead Building



Design Process - Construction To LEED or Not to LEED?

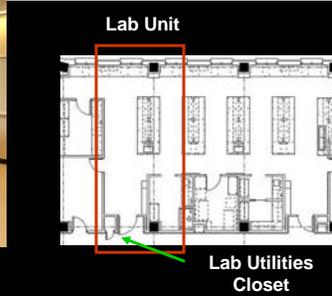
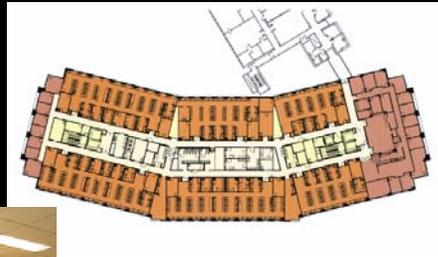
- Owner driven request to pursue LEED
- Joint Team Training
- Meetings every 2 weeks
- Some Changes made in construction



Sustainable Design Strategies

Flexible Design

Modular Lab / Office Plan
Modular HVAC & Piping Design



Sustainable Sites

- LEED Credit 2 – Urban Redevelopment
- 61,700 SF per acre
- LEED 4.1 – Public Transportation



Water Efficiency -

LEED 1.2 Water Efficient Landscaping

Local Plant Material – no grass.
Rainwater collected in cistern for irrigation



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Water Efficiency -

LEED 3.2 Water Use Reduction - 30%



Condensate Pipe Out

32% reduction in potable water through enthalpy wheel
reduction in humidification levels
and cold room compressor



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Energy & Atmosphere -

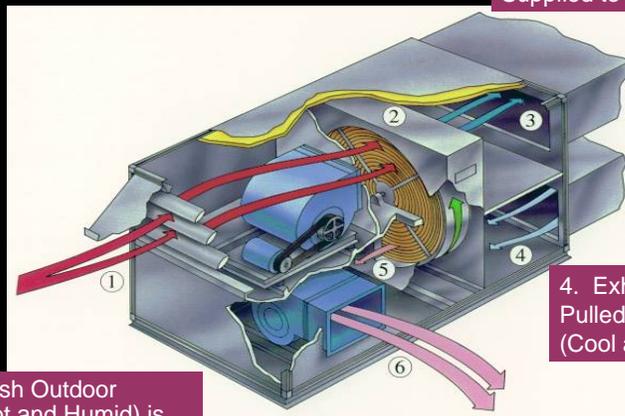
LEED 1.1 Optimize Energy 20%



- Long East/West Axis
- Enthalpy Wheel – Heat recovery
- High Performance Glazing
- Cage Wash

Enthalpy Wheel

How it Works? (cooling mode)



1. Fresh Outdoor Air (Hot and Humid) is Passed Through the Wheel

2-3. Outdoor Air is Cooled, Dehumidified then Supplied to HVAC System

4. Exhaust Air is Pulled from the Space (Cool and Dry)

Energy & Atmosphere -

LEED 1.1 Optimize Energy 20%



Daylighting Sensors

Materials and Resources -

LEED 4.2 – 50% Recycled Content:

1. Selected materials that contributed at no add'l cost
 - Steel
 - Flooring
 - Used metal strapping in place of wood blocking
 - Counters – Trespa Toplab

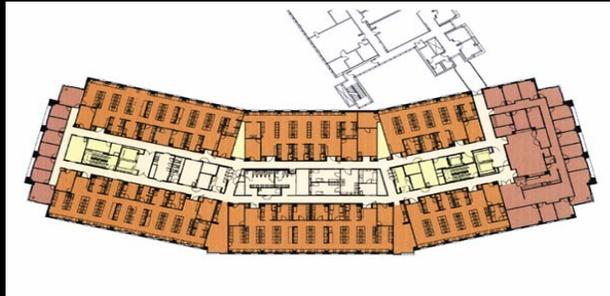
LEED 5.1 – Local/Regional Materials

2. EIFS cladding (local plant)
3. Block/concrete

Indoor Environmental Quality

LEED 4 – Low Emitting Materials: paint, carpet, adhesives

LEED 8.2 – Daylight and Views: 94% of spaces



Innovation Credit

Robotic Cage Wash



*Case Study –
Biomedical Research Building/Emory University*

Keys to success:

- Visionary, involved client
- Early goal-setting and documentation = **TIMING**
- Effective leadership
- Team / consensus building (buy-in) = **TEAMING**
- Value management
- Documentation and periodic review of internal and external goals = **TRACKING**
- Effective use of available design tools



TENACITY



Stuart Lewis,
Atlanta



Case Study

Charlottetown Government of Canada Building

Location: Charlottetown, PEI, Canada

Project Type: Office Building

Size: 17,345 M2

Cost: \$27M Canadian

Date of Completion: 2005

Team: HOK Architects, Keen Engineering, B, G, H J Assoc. Architects

Green: Flagship Sustainable Project; LEED Gold Anticipated

- Historic District Revitalization
- Rainwater capture and Greywater reclamation – 80% Reduction
- Mixed Mode Ventilation
- Building Mass as dynamic thermal storage (radiant heat and chilled slab)
- Maximum Daylight Harvesting
- Zoned Lighting Controls
- Target 60% Energy Reduction
- Predominant Local and Recycled Materials
- Low VOC Materials

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Case Study

Charlottetown Government of Canada Building

Building Envelope

Neutralize the Perimeter

Dynamic Thermal Storage

Stratification

Natural Ventilation

Local Source Materials

Site Selection

Building Orientation

Lighting Levels

Daylighting

Water Conservation

Renewable Energy



Cost-Effective Green Design: Working Drawing review proposed NO changes to the design

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Case Study

Charlottetown GOCB

- University Avenue
approach drive
'highway commercial'
- Euston Street
border to Downtown
- BGHJ office
- Municipal Capital
- Provincial
Government
Centre
- Queen Street
commercial 'Main Street'



- 'gateway'
grid shift at
border to Downtown
- Atlantic Technology
Centre
- Province House
ceremonial focal point
- Great George Street
cultural street
- Confederation
Landing

Sustainable Design

Charlottetown GOCB

	Site/Water	Energy	Materials	Indoor Environment
Sustainable Design	<ul style="list-style-type: none"> Orientation of building Native landscaping Ground water recharge Public transport Minimize foot print Public open space Bicycle storage Carpool parking Stormwater - control, capture as greywater 	<ul style="list-style-type: none"> Natural ventilation Operable windows Photovoltaic Waste energy reclaim Passive and active solar High performance building envelope, thermal mass heating and cooling, daylight, orientation, building geometry, right time flushing 	<ul style="list-style-type: none"> Regional materials, within 500 km radius Low maintenance, long life Recycled content, recyclability after use, life cycle cost, environmental impact during manufacturing process, manufacturer's environmental record 	<ul style="list-style-type: none"> Natural materials Vegetation Living wall Low VOC's Products manufactured with natural materials 100% fresh air Daylighting, displacement ventilation, thermal comfort control
Supportive Work Environment	<ul style="list-style-type: none"> Attractive outdoor open space Suntrap Celebrate winter - all seasons Xeroscape landscape Water features Storm water cisterns Evaporative cooling 	<ul style="list-style-type: none"> Increased personal control Material, building structure, community, mother nature Sun, building systems, user education 	<ul style="list-style-type: none"> Regional economy Natural environment Indoor environment Occupants, building owner 	<ul style="list-style-type: none"> High quality indoor air Daylight and views to outside Increased performance Decreased absenteeism Increased satisfaction
Connectivity	<ul style="list-style-type: none"> Relationship to the urban environment, the livable city Transit Connection to diurnal and seasonal cycles Sun path Wind flow Awareness of weather 	<ul style="list-style-type: none"> Global warming Energy crisis Long life Macro environment Generations Bench mark Community Ecosystem 	<ul style="list-style-type: none"> Use of latest development in materials Show connection of materials to environment (natural, recycled, recyclable) Tactile experience Visual experience Community 	<ul style="list-style-type: none"> Connection to outside environment Seasons Community Daily weather patterns

Supportive Work Environment Charlottetown GOCB

	Culture	Space	Tools	Amenity
Sustainable Design	<ul style="list-style-type: none"> Awareness of environmental issues through building initiatives User-controlled aspects of green systems responsive to the changing environmental patterns of both day and night Responsive to localized users, active energy saving devices (reheat coils) Understanding of the building operation equals participation in its management. 	<ul style="list-style-type: none"> Superior quality of light and air - increased employee satisfaction Integration of recycling in data social space Flexibility ensures longevity of facility, maximum reuse of components 	<ul style="list-style-type: none"> Ease of reconfiguration supports user control 	<ul style="list-style-type: none"> Amenities connecting to outdoor environment Celebration of events
Supportive Work Environment	<ul style="list-style-type: none"> Community-building environment Space designed for work/life integration New worker looking for lack of hierarchy but seek out mentors Support Communication 	<ul style="list-style-type: none"> Master plan "bylaws" provide user guide to office space, user reconfigurable components reduces cost of churn Daylighting and views, mix of collaborative and private environments Zoning of open and closed spaces 	<ul style="list-style-type: none"> Kit-of-parts approach to tools - From desking to meeting rooms "Fold-in-go" user-changeable components Whiteboards and other mobile tools throughout to support informal collaboration and meeting 	<ul style="list-style-type: none"> Variety of supportive amenity spaces Accessible locations
Connectivity	<ul style="list-style-type: none"> Canada Place - connecting to national culture Fostering urban street life 	<ul style="list-style-type: none"> Organization provides connection to all amenities 	<ul style="list-style-type: none"> Tools support collaboration, internally and remotely 	<ul style="list-style-type: none"> Support of ties to the neighbourhood community Connection to amenities in other adjacent facilities



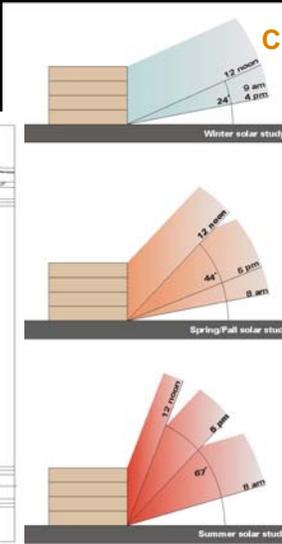
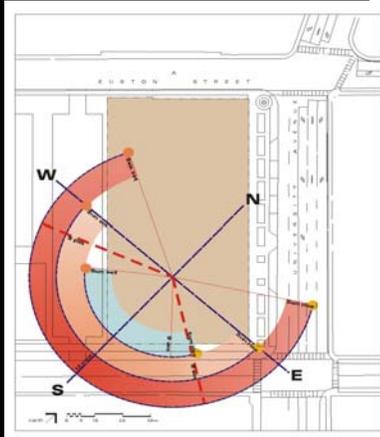

Connectivity Charlottetown GOCB

	Technology	Public	Governments	Neighbourhood
Sustainable Design	<ul style="list-style-type: none"> User oriented controls Increased monitoring of building systems and environments Higher efficiency and longevity of building services equipment 	<ul style="list-style-type: none"> Demonstrable commitment to the environment Stewardship through minimized operation costs 	<ul style="list-style-type: none"> 'Green' image representative of all government services 	<ul style="list-style-type: none"> Minimize sun shadow effects for neighbours Reduced air pollution through optimized operating systems Minimal light pollution
Supportive Work Environment	<ul style="list-style-type: none"> Collaborative workspaces Increased information access Increased flexibility (touchdowns) Multiple work environments Ease of churn 	<ul style="list-style-type: none"> Transparency of building organization from the street Welcoming reception/interaction areas Areas for research, meeting, community services, security Wayfinding 	<ul style="list-style-type: none"> Victor drop-in workspaces (Business Centre) 	<ul style="list-style-type: none"> Mixing/habitat building edges Landscape elements Public seating
Connectivity	<ul style="list-style-type: none"> Accessible technology pathways Adaptability to future technologies On-going monitoring program Work-anywhere opportunity 	<ul style="list-style-type: none"> Accessibility to all government services from a centralized location/ive and virtual 'Transparency' of government at work 'Humans' image of government services 	<ul style="list-style-type: none"> Increased accessibility to government services for both public and staff use Shared amenities between adjacent government facilities (municipal, provincial, federal) 	<ul style="list-style-type: none"> Accessibility and proximity of government services Transparency of building activities from the street Special events Receptive outdoor areas for all seasons Gateway to CBD Prominence on 'principal access route' Participation in neighbourhood economy




Case Study

Charlottetown GOCB

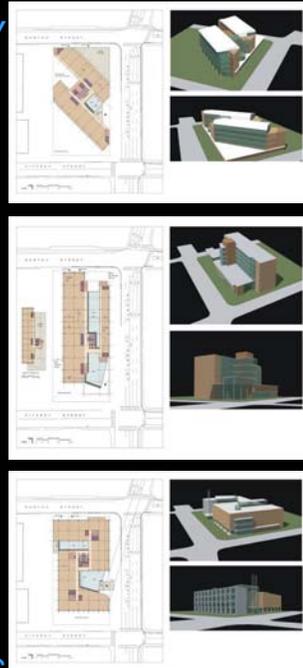


TECHNIQUES

- Building Envelope
- Neutralize the Perimeter
- Natural Ventilation
- Building Orientation
- Lighting Levels
- Daylighting
- Renewable Energy

Case Study

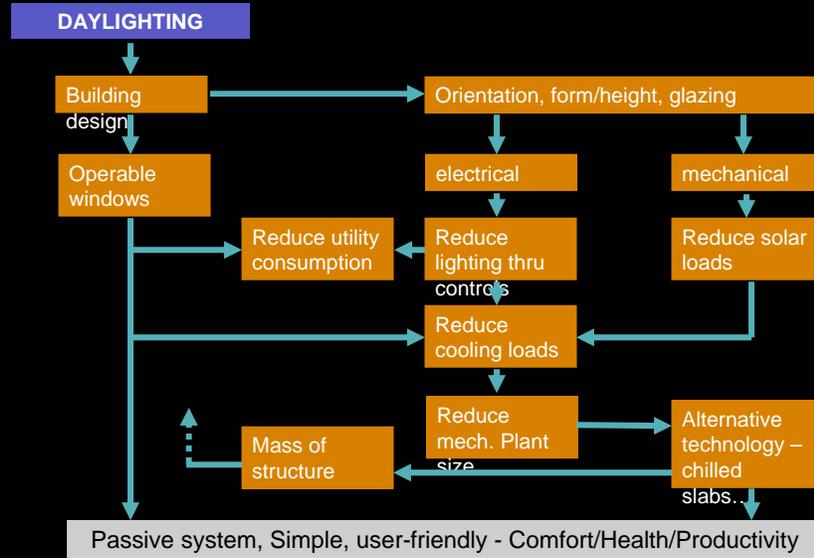
Charlottetown GOCB



Massing Options

Case Study

Charlottetown GOCB



Case Study

Charlottetown GOCB



Case Study

Charlottetown GOCB

TECHNIQUES

- Building Envelope
- Neutralize the Perimeter
- Local Source Materials
- Natural Ventilation
- Site Selection



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Case Study

Charlottetown GOCB

TECHNIQUES

- Site Selection
- Building Orientation
- Daylighting
- Neutralize Perimeter
- Rainwater Harvesting
- Renewable Energy

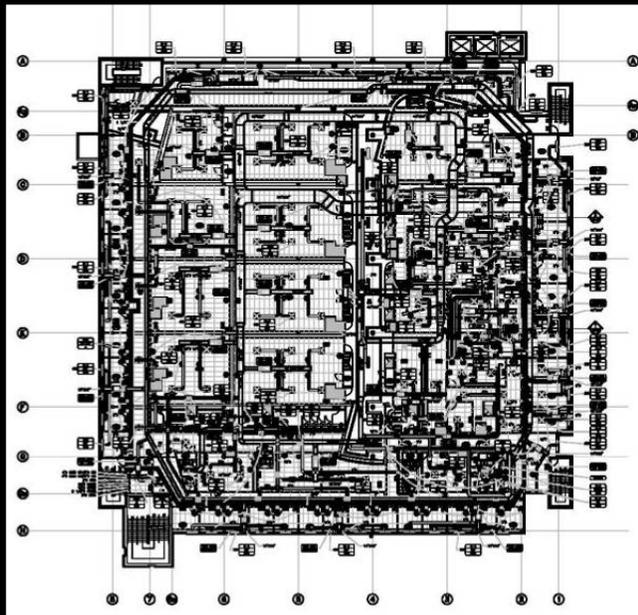
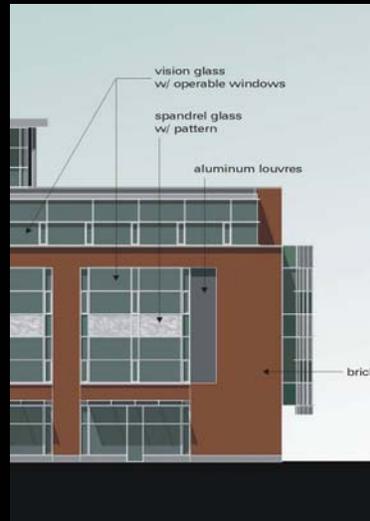


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Case Study

Charlottetown GOCB

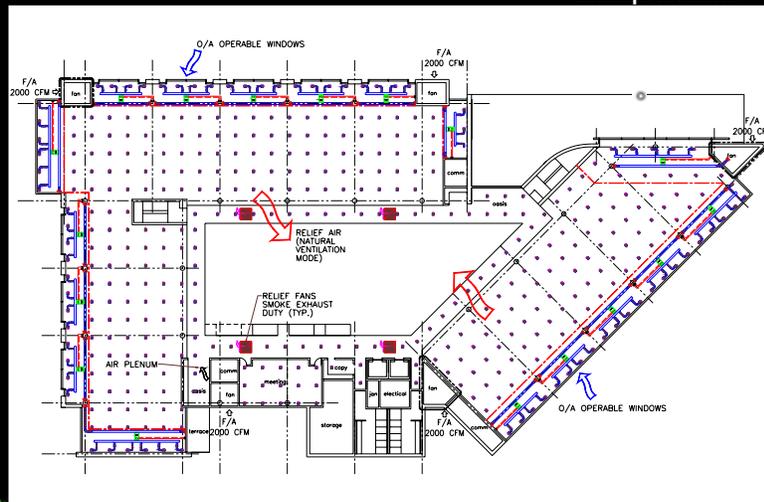


THE TRADITIONAL SYSTEM

System Intensive

UFAD + Radiant Slab SYSTEM

Envelope Intensive

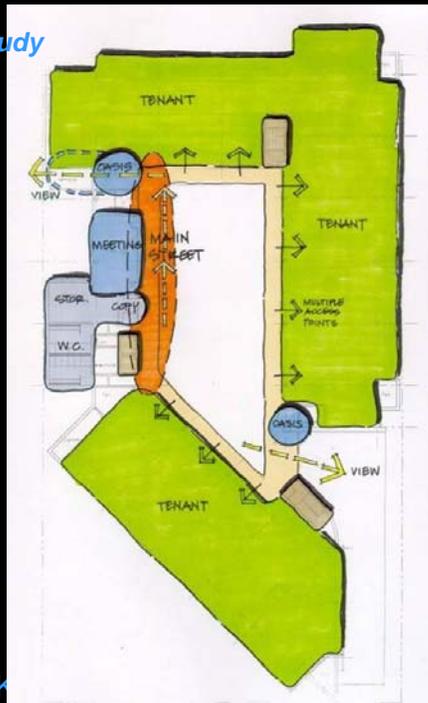


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Case Study

Charlottetown GOCB



Interior Relationship Diagram

HOK



Case Study

Charlottetown GOCB



Case Study

Charlottetown GOCB

Atrium – Town Centre



TECHNIQUES

- Dynamic Thermal Storage
- Stratification
- Natural Ventilation
- Lighting Levels
- Daylighting



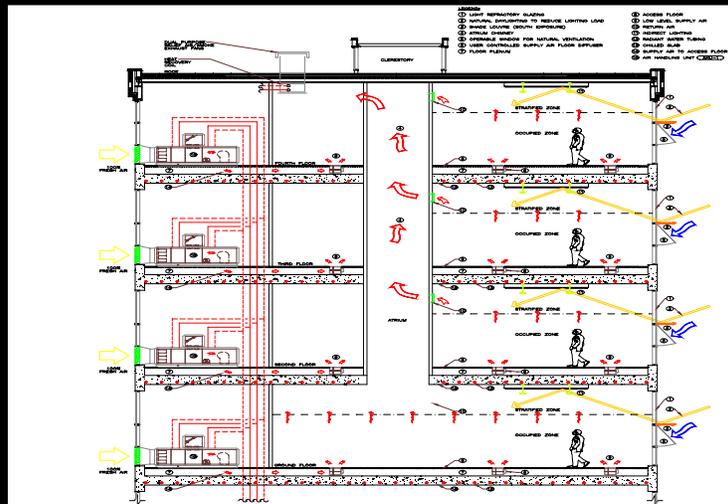
Case Study

Charlottetown GOCB



Case Study

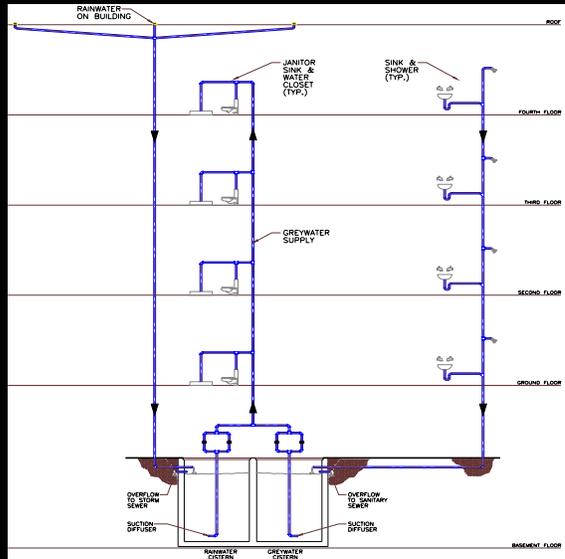
Charlottetown GOCB
Atrium – Mechanical System



Case Study

Rainwater / Grey Water
Piping Schematic

Charlottetown GOCB



Case Study

Charlottetown GOCB



Case Study

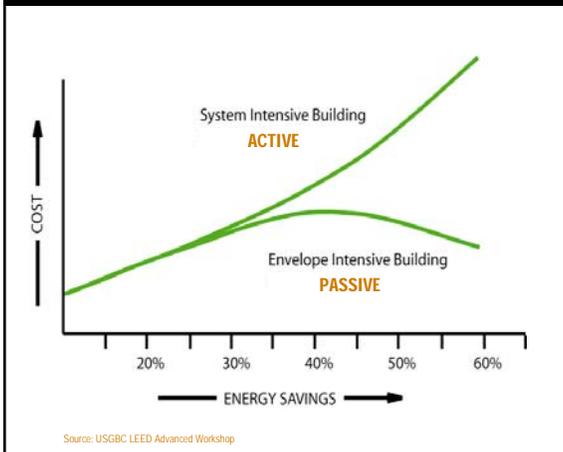
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COST & PERFORMANCE



System Intensive

- Additive process
- Linear
- Reactive

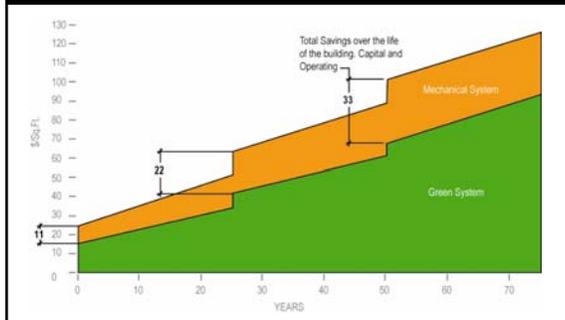
Envelope Intensive

- Reductive process
- Cyclical
- Anticipatory

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COST & PERFORMANCE



Minimization through innovation makes sense

- environmentally
- socially
- economically

- Conventional Mechanical System
- Green Mechanical System

75 Year Life Cycle	Conventional Mechanical System	Green Mechanical System
Capital Cost.....	\$25.00 per sq. ft.....	\$15.00 per sq. ft.
Yearly Maintenance Cost.....	\$1.00 per sq. ft.....	\$0.75 per sq. ft.
Replacement Cost (every 25 Years)....	50% of original Capital Cost.....	50% of original Capital Cost

Case Study

Charlottetown GOCB

- Who** The integrated Team = **TEAMING**
designers, consultants, owners, users, commissioning, contractor
- When** As early in the process as possible = **TIMING**
essential for goals and integration to have any value
- Where** clients are requesting it
PWGSC, Manitoba Hydro, Toronto District School Board ...
- What** Goals + Metrics = **TRACKING**
agree on them and use them consistently throughout = **TENACITY**
- Why** The triple bottom line
adds quality and long term value to any project

Is sustainable design simply a collection of best practices that reduce environmental burden, or **is it fundamental to the process of design?**



Life Safety Analogy

... transformed design practice

Sustainability and Integrated Design

Now

... market advantage

Soon

... market necessity

