Sustainability Through Reuse:
A Case Study of Reclaimed Wood and Energy Efficiency

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
When designing the new Federal Center South – Building 1202, a new 209,000-square-foot office building in Seattle, WA, the General Services Administration (GSA) faced a dilemma. An existing, 1940s-era heavy timber-framed warehouse still occupied the site, and demolition would potentially negate sustainability goals desired for the new building. This presentation, given from the perspective of the project architect, focuses on the innovative resolution to that challenge—showing how 300,000 board feet of lumber from the existing building were integrated into the new home of the U.S. Army Corps of Engineers. This LEED Platinum and AIA/COTE Top Ten Green Plus project utilized reclaimed wood both as exposed structure and finish while meeting the stringent performance requirements of the GSA’s Design Excellence Program.
1. Identify sustainability goals achieved through the use of reclaimed wood framing and decking.

2. Explore the aesthetic and structural capabilities of reclaimed wood finishes and framing.

3. Describe how innovative hybrid systems such as composite wood beams were utilized to minimize material mass and optimize available reclaimed wood.

4. Discuss the project’s energy-efficiency goals and the role that a performance-oriented contract played in measurement and verification to ensure the goals were met.
Agenda/Outline

- Project Requirements
- Performance Guides the Design
- Optimized Systems
- Integrated HVAC
- Timber Reclamation
- Biophilic Design
- Lessons from Integrated Process
- Post Occupancy
Project Requirements
Key Design Objectives

- Reflect USACE mission
- Optimize site amenities
- Solidify site and soil conditions
- Assure air quality
- Create a modern 21st century workplace
- Achieve 30% energy reduction
- Re-use 1202 materials

“The Oxbow”
Thomas Cole, 1836
Overall Energy Goals
The Energy Independence and Security Act

Section 433, Federal Building Energy Efficiency Standards requires that all new federal buildings and major renovations meet the energy performance standards of the 2030 Challenge beginning in 2010.

Design-Build Contract Language:

M&V and Warranty Period Verification. The Government will retain a pre-determined amount of dollars from the overall contract award during performance evaluation. Release of payment for this withheld amount will be contingent upon final confirmation that the energy performance standards for the facility (i.e. actual BTU/GSF saved) have been achieved as verified by the M&V and Warranty Period testing to be conducted within 365 days from final completion. The basis for the pre-determined amount shall be equal to .5% of the proposed construction price. Offeror shall calculate the amount and enter it into CLIN 0005 of the Pricing Schedule.
Performance Guides the Design
The oxbow is one of the remaining historic features of the industrialized Duwamish River.
Optimizing Performance and Building Shape
Surface Area and Orientation
3 Story Configuration

Optimizes site available for security setbacks
Maximizes open campus green space
Provides storm water management opportunities
The Collaborative Workplace


No “Silos”

Optimize Mechanical Systems

Optimize Structural

Builds Community
Optimized Daylight

80 ft
- Daylight Zone (2 x 15°)
- Non-Daylit Zone (asymmetrical on atrium side)
- Daylight Zone (15°)

Electric light savings: 22% with 3rd floor skylights: 48%

70 ft
- Daylight Zone
- Non-Daylit Zone
- Daylight Zone

27% - 51%

60 ft
- Daylight Zone
- Non-Daylit Zone
- Daylight Zone

33% - 55%
Daylight Performance

Point of Diminishing Returns

Cloud Cover

Daylight Factor (percent available outdoor ambient illumination)
Predicted Lighting Load

Typical Office Building
CBEC regional average

106

Final Design Predicted Performance

20.3 EUI

EUI Kbtu/SF/yr

- Miscellaneous Plug
- Lighting
- Hot Water (DHW)
- Vent/Fans/Pump
- Cooling
- Heating

Diagram showing energy use intensity (EUI) for typical and final design performances, with a focus on lighting.
Orientation-Specific Envelope
Diagrid Expression
Integrated HVAC
Modeled Annual Heating and Cooling Loads
Decoupled Ventilation and Conditioning

AIR DUCT  WATER PIPE

1 : 327

Flow Cross Section Ratio
Underfloor Concepts / IAQ

Figure 7: CFD Results - 2nd floor underfloor plenum

Figure 8: CFD Results - Building Section (North-South)

- Temperature in the occupied zone are comfortable - between 75°F and 77°F
- Temperature change across the body is less than 1°F

The supply air temperature at the underfloor air highway take-off is 84.4°F. As the supply air travels across the underfloor to the diffuser, it increases in temperature by a maximum of 6°F. As is evident in Figure 8, this thermal decay isn’t significant enough to cause discomfort.

Consistent temperature in the ground floor plenum

Air supplied at the underfloor air highway take-offs
Thermal Storage: Phase Change Material
Geotechnical Design

Loose to medium dense, trace to slightly silty, fine to medium
SAND; scattered shell fragments; (Alluvium)

Medium dense, slightly silty to silty, fine to medium
SAND; scattered shell fragments; (Alluvium)

Soft, slightly clayey SILT; (Estuarine)

Hard, trace to sandy, clayey SILT;
(Glacially Overridden Deposits)
Ground Source

Point of Diminishing Returns
Energy Piles: A Realized Opportunity
Energy Use of Federal Center South Design

- Backup heating provided by ground source heat pumps
- Peak summer load provided by ground source heat pumps
- Evaporative cooling done at night to charge PCM thermal storage tank 50% of non-heating hours
- Free cooling and low-energy heating through heat exchange with heating
High Performance Green Building
Heating and Cooling Loads

- **Typical Office Building**: Average EUI is 106 Kbtu/SF/yr.
- **Final Design Predicted Performance**: EUI is 20.3 EUI.

The diagram shows the distribution of energy use across different categories such as miscellaneous plug, lighting, hot water (DHW), vent/fans/pump, cooling, and heating.
Timber Reclamation
Original Warehouse
Heavy Timber Salvaged

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Total: 2133
Timber Design
Timber Design
Timber and Decking Harvesting
Reclaimed Decking
Timber Grading and Certification
Composite Beam Testing/Lag Screws and Conduit in Slab

- Reduced structural material needs by 20-30%
- First use of composite wood beams in the United States
Materials Timber Reuse

Warehouse  Modeling  Mock-up  Under Construction
Twist, Crook, and Bow
Timber Erection
Timber Erection
Timber Erection
Reclaimed Decking
Reclaimed Wood Detailing
Reclaimed Wood Detailing
Reclaimed Decking Horizontal and Vertical Use
Commons Cladding and Handrail
Reclaimed Wood Handrails
Timber for Bridges and Stairs
Communicating Stairs
Communicating Stairs
Communicating Stairs
Ground Floor “Bridges”
Ground Floor “Bridge” Detail
Executive Suite
Executive Suite
Entry Lobby Desk and Ceiling
Entry Canopy
Reclaimed Wood as Canvas
Reclaimed Wood as Canvas
Reclaimed Wood as Canvas
Reclaimed Wood as Canvas
Reclaimed Wood as Canvas
Reclaimed Driftwood
Reuse Existing Piles
Pile Harvesting
Biophilic Design
Biophilia

The goal of biophilic design is to create places imbued with positive emotional experiences, enjoyment, pleasure, interest, fascination, and wonder, that are the precursors of human attachment to and caring for place.

Using inspiration from both the local natural environment and vernacular cultural expressions to create a sense of place is critical to the success of biophilic design.

Judith Heerwagen

Primary Tenets of Biophilic Design:

- Nature Contact, Actual and Analog
- Prospect and Refuge
- Heraclitian Motion
- Change and Resilience
- Variations on a Theme
- Multi-Sensory
- Discovered Complexity
- Transformability and Multiple Use
Biophilic Design: Nature Contact, Actual and Analog
Biophilic Design: Prospect and Refuge
Biophilic Design: Heraclitian Motion
Biophilic Design: Variations on a Theme
Biophilic Design: Multi-Sensory
Water Flow

STORMWATER FACTS
8.8-acre site was 100% hardscape and is now 34%
Retains the 95th Percentile Rainfall event
Approx. 99% of runoff naturally treated
Facilities include 39,000 SF of rain gardens, bioretention facilities, 1.170-ft filter strips and a bioxwale.
Water Harvesting

Water Use Reduction Strategies

Calculations based on a 25,000 gal rainwater storage tank.

- 40% Savings
- 60% Savings

[Diagram showing water flow and harvesting systems]

[Diagram of a building with labeled systems: roof drains, fluid cooler, toilets, and water features]
Cedar and Duwamish River Source Stones
Lessons from an Integrated Process
Design-Build Team Collaboration

Architect:
ZGF ARCHITECTS LLP

General Contractor:
SELLEN CONSTRUCTION COMPANY

Design Consultants:
KPFF CONSULTING ENGINEERS, INC.
WSP FLACK + KURTZ/BUILT ECOLOGY
SITE WORKSHOP LLC
STUDIO SC
LERCH BATES
ROLF JENSEN & ASSOCIATES, INC.
HINMAN CONSULTING ENGINEERS, INC.
The GREENBUSCH GROUP, INC.
TUASON ENGINEERING
HART CROWSE & ASSOCIATES, INC.
LANE COBURN & ASSOCIATES, LLC
MCKINNEY ASSOCIATES
OTTO ROSENAU & ASSOCIATES, INC.

Key Subcontractors:
The G.R. PLUME COMPANY
UNIVERSITY MECHANICAL CONTRACTORS
SEQUOYAH ELECTRIC, LLC
PATRIOT FIRE PROTECTION
MILLENIUM TILES, LLC
NORTH SHORE SHEET METAL
WALTERS & WOLF
SESSLER
R.W. RHINE, INC.
BARCOL-AIR
LUTRON
LITECONTROL
DEAMOR GLASS SKYLIGHTS
Model Integration Lessons

Architectural

Structural

Mechanical
Model Integration Lessons

Lighting

Smoke / CFD Analysis

Detailing
Systems Integration Mock-up – R&D Lab

- Structural Steel Beam
- Chilled Beams
- Painted Steel Deck
- Photo-Control Lighting
- Daylighting

Data & Power

Underfloor Air
Exterior Wall Prefabrication
Create and Test New Products

Vertical Shingles  Pendant Light Fixtures  Chilled Sails
Project Delivery Schedule

TOTAL DESIGN/BUILD TIME = 2.5 YEARS

M&V = 1 YEAR
Aerial Views: Construction to Completion

Existing Site

August 2011

October 2011

December 2011

March 2012

October 2012
Integrated Design

EUI 25.74 KBTU/SF/YR

LEED GOLD CERTIFICATION

HEALTHY BUILDING WORK ENVIRONMENT

200,000 FT² OF REUSED TIMBER FROM A DECOMMISSIONED WAREHOUSE

stormwater management

high-performance hvac system utilizes 100% outdoor air

native, adaptive landscape

site revegetation

cost effective

interior landscape atrium

building strong

high performance green building

exceed 2007 ASHRAE 90.1 by 40%

eliminate at least 61% of water baseline demand

daylighting on office floorplate

energy efficient envelope
**Project Scorecard**

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<thead>
<tr>
<th>Category</th>
<th>Points Earned</th>
<th>Total Points</th>
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<td>Water Efficiency:</td>
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<td>Materials &amp; Resources:</td>
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<td>Innovation in Design:</td>
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<td>Regional Priority:</td>
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Post Occupancy
Occupant Satisfaction Survey – CBE

Lighting

Which of the following controls do you have over the lighting in your workspace? (check all that apply)
- Light switch
- Light dimmer
- Window blinds or shades
- Desk (task) light
- Name of the above
- Other:
- None of the above

How satisfied are you with the amount of daylight in your workspace?
- Very Satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

How satisfied are you with the amount of electric light in your workspace?
- Very Satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

How satisfied are you with the glare in your workspace?
- Very Satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

Overall, does the lighting quality enhance or interfere with your ability to get your job done?
- Enhances
- Satisfactory
- Neutral
- Interferes

Glare

Please rate your level of discomfort from all of the potential sources of glare below.

Glare from windows
- Not Perceivable
- Slightly
- Moderate
- Intolerable

Glare from electric lights
- Not Perceivable
- Slightly
- Moderate
- Intolerable

Daylight reflecting on your computer screen
- Not Perceivable
- Slightly
- Moderate
- Intolerable

Electric light reflecting on your computer screen
- Not Perceivable
- Slightly
- Moderate
- Intolerable

Glare from bright vertical surfaces (i.e. walls and partitions)
- Not Perceivable
- Slightly
- Moderate
- Intolerable

Other Sources of Glare (please specify)
- Not Perceivable
- Slightly
- Moderate
- Intolerable

Source(s) of Glare:

Survey Progress...
Pre-Occupant Satisfaction Survey

CBE Occupancy Survey Results

- Overall Building
- Thermal Comfort
- Acoustic Quality
- Air Quality
- Office Layout
- Office Furnishings
- Cleanliness
- Lighting

- CBE Benchmark Average
- Federal Center South PROE
Occupancy

Original Workplace Conditions

21st Century Workplace
Occupancy

Original Workplace Conditions

21st Century Workplace
Tenant Education – Change Management

e-Blasts

Self-Guided Building Features Tour
M + V Tracking Tool
M + V Tracking

JANUARY FAN ENERGY
3.670 kWh adjustment

- Interpolated AHU 1-4
- Metered AHU 1-4
- Modeled AHU 1-4

[kW]

[Data intervals]
OVERNIGHT HEATING ISSUES
Earlier in the year there was excessive overnight energy usage, particularly unnecessary gas usage in the first few months of the year. This issue has been eliminated and the building operates with a rather consistent electrical baseload overnight of which, about 1/3, is tenant plug load consumption.
*Plug loads were the only significant adjustment since May.
M + V Tracking

<table>
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<tr>
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<th>Performance Through September</th>
<th>Forecasted Year End Adjusted Performance</th>
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<td>33.9</td>
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<tr>
<td>Fully Adjusted Energy</td>
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<td>25.8</td>
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<tr>
<td>Adjusted Energy (Plug Loads Only)</td>
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<td>Targeted Energy</td>
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<td>25.74</td>
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25.74
Metered Expected in 2014!
Questions?

This concludes The American Institute of Architects Continuing Education Systems Course

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