

Aggressive Performance Goals Met Through Integrated Project Delivery

**A Case Study of GSA Federal Center South Complex,
Phase II - Seattle, Washington**



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AIA/CES Course Summary

This session will discuss how architects can improve their design management services as contractors push for a more active role in managing the design phase of projects through Virtual Design and Construction using BIM model; and how ambitious performance, cost and delivery goals were met through a heightened level of integration throughout the accelerated design-build process of a new District Headquarters for the U.S. Army Corp. of Engineers in Seattle, Washington.



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AIA/CES Learning Objectives

1. Learn LEAN thinking, including set based design and target value design strategies. Learn to apply a rigorous technical, analytic and research-based approach to design and decision making to arrive at best value solutions.
2. Understand the heightened level of team integration and new models of knowledge sharing, through the accelerated design-build competition and project delivery process.
3. Identify best practices for achieving aggressive building performance, cost and project delivery objectives.
4. Discover how an integrated building weaves interdependent systems to achieve a net result greater than the sum of individual systems.



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Webinar Schedule

75 min. - Eastern Standard Time (EST)

1:00 - 1:15 pm

Welcome, General Comments, and Introductions

Stephen Hagan & Jeffrey Ouellette

1:15 - 2:00 pm

Case Study: GSA Federal Center South Complex, Phase II -
Seattle, Washington

Jack Avery, Sellen Construction

Todd Stine AIA, LEED AP BD+C, ZGF Architects

Stephen Hagan, FAIA, US GSA

2:00 - 2:15 pm

Q & A



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Aggressive Performance Goals & IPD

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Aggressive Performance Goals & IPD

Who is TAP?



David Scheer
Chair - 2012



Kimon Onuma
Chair - 2013



Calvin
Kam



Stephen
Hagan



Kristine
Fallon



Tony
Rinella

Active Past Chairs



Brian
Skripac



Jeffrey
Ouellette



Karen
Kensek



Luciana
Burdi



Marty
Doscher



Mike
Kenig



Pete
Evans



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Aggressive Performance Goals & IPD

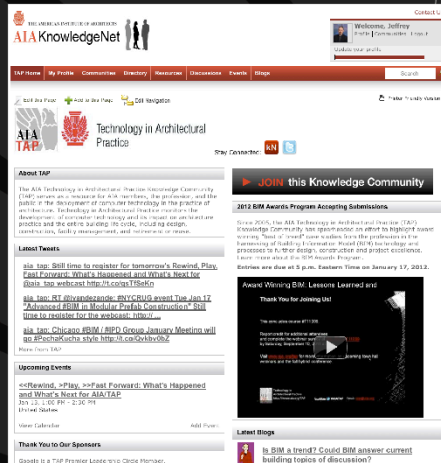
Coming Up...

- **Monthly TAP Webinars**
 - March 09: *BIM For Small Projects II*
 - April 13: *Interoperability Series*
 - May 16: *TAP@ AIA2012 - DC*
- **AIA BIM Awards**
 - Judging: Monday, February 13, 2012
 - BIMForum, San Antonio, April 25th
- **TAP Workshop @ AIA National Convention (DC)**
- **Local TAP**
- **BIM Curriculum**
- **Stay Tuned...**



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Aggressive Performance Goals & IPD

Joining the TAP Revolution

ask not only
“What can TAP do for you?”
but also,
“What can I do for TAP?”



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Aggressive Performance Goals & IPD

TAP Committees

- **BIM Awards**

- Stephen Hagan
- Marty Doscher
- Pete Evans

- **Communication**

- Jeffrey Ouellette
- Brian Skripac

- **Education**

- David Scheer

- **Research**

- Karen Kensek
- Luciana Burdi

- **Events**

- Tony Rinella
- Kimon Onuma

- **Local Discussion Groups**

- Brian Skripac
- Mike Kenig

- **Membership/Volunteers**

- David Scheer

- **Sponsorship**

- Stephen Hagan
- Jeffrey Ouellette
- Calvin Kam



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Todd

Welcome



Todd

Introduce



Project Overview

Theme: Architect, contractor, owner all have design aspirations that exceed performance incentive

- Recovery Act Design Build Process
- Site and Design Objectives
- Meet Schedule, Price, and Performance

GSA ZGF Sellen AIA TAP FASTER FORWARD 2011

Todd



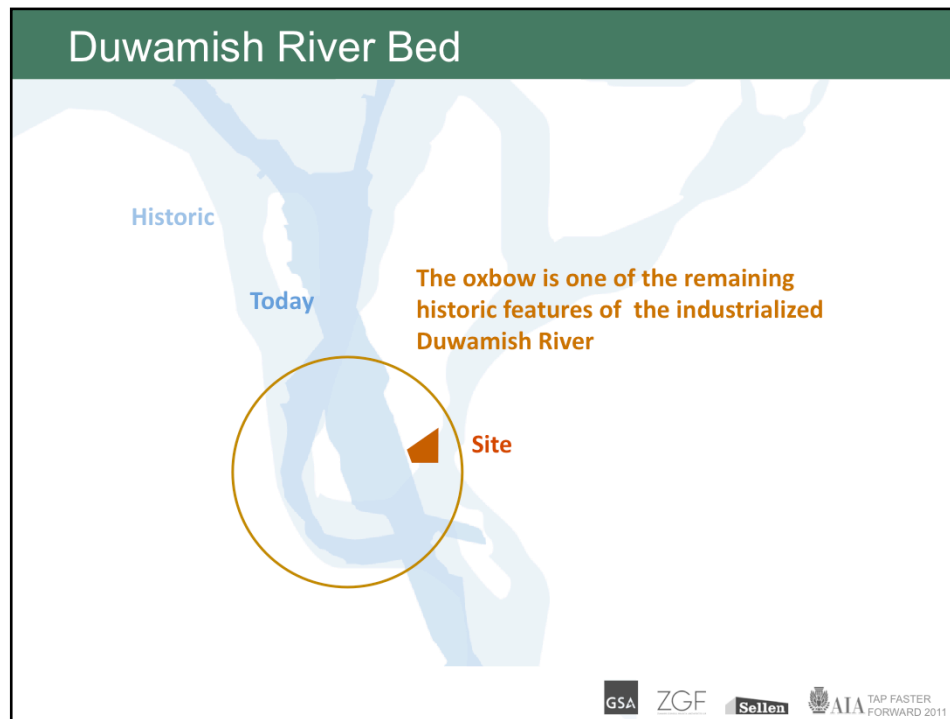
Todd, Jack

- As part of the Recovery Act, solicitation issued in Fall of 2009 for Design –Build teams to submit qualifications for 175,000 s.f. modernization of an existing warehouse on the Federal Center South campus in Seattle, to house the Seattle District USACE.
- Sellen and ZGF have been working together since the early 1990s on several large Microsoft projects – Sellen asked ZGF to design their new headquarters – ZGF asked Sellen to build-out our new offices
- Larger team including kpff engineers and Flack +Kurtz mechanical and electrical engineers
- Phase II of the solicitation consisted of an 18 week design competition against two other teams resulting in schematic level design that guaranteed performance and budget.



Todd, Jack

- After award, the integrated project team grew to include mechanical and electrical subcontractors as well as the reclaimed timber subcontractor.
- Mechanical subcontractor brought on in design-assist role wherein they actually produced the construction drawings, but Flack+Kurtz remained as the engineer of record
- Electrical subcontractor brought on as typical design-build entity.



Todd

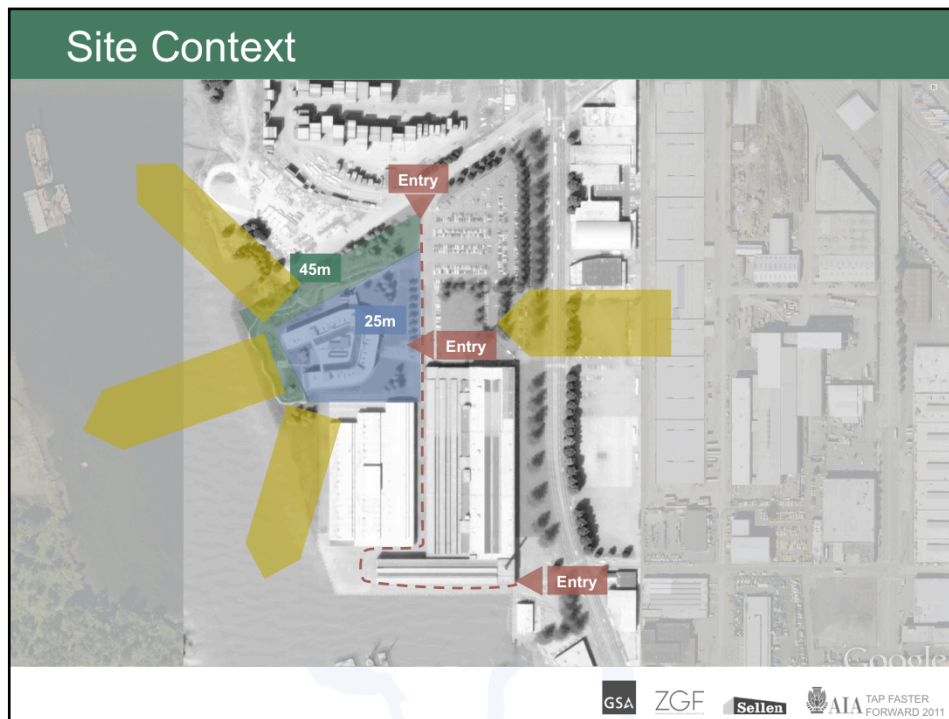
AUTOMATIC ANIMATION – ONE CLICK ONLY!

- The site for the project is located along the Duwamish Waterway just south of downtown Seattle. The original waterway meandered considerably, but the Army Corps dredged it and straightened it out in the early 1900s in order to promote commerce.
- The site was originally part of the Duwamish Tidal Basin, which not only provided inspiration for the design solution, but also posed significant challenges for the buildings's foundations



Todd

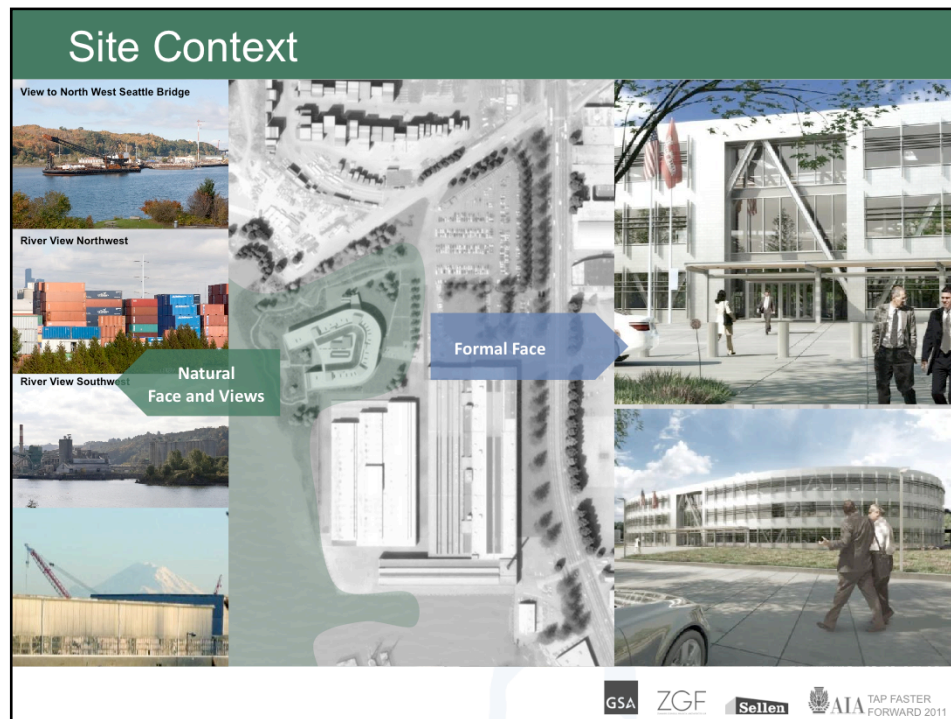
- The existing Federal Center South Campus contains two primary buildings
- The 1201 building, originally built by Ford Motor Company as a assembly plant in the 1930's, was, in its day, its own form of Recovery Act, and has been converted to office space where the Corps is currently located.
- The 1202 building was built in the 1940's, and was used by Boeing to build missiles for WWII, and we discovered, was later used as a morgue.
- The 1202 building is the warehouse originally slated for "modernization".
- Our site is the northwest corner of the campus, made possible by demolishing the north half of the 1202 building.



Todd

AUTOMATIC ANIMATION – ONE CLICK ONLY

- With the Army Corps as the tenant, the building had to comply with the Department of Defense anti-terrorism requirements including setback distances from vehicular traffic

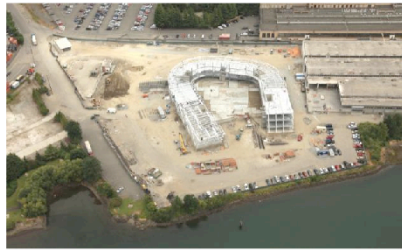
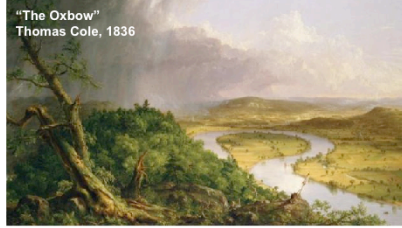


Todd

- The siting of the building, along with the required setbacks, offered the opportunity to create two faces to the building that respond to both its formal and natural context.

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



Todd, Jack

21st Century Workplace

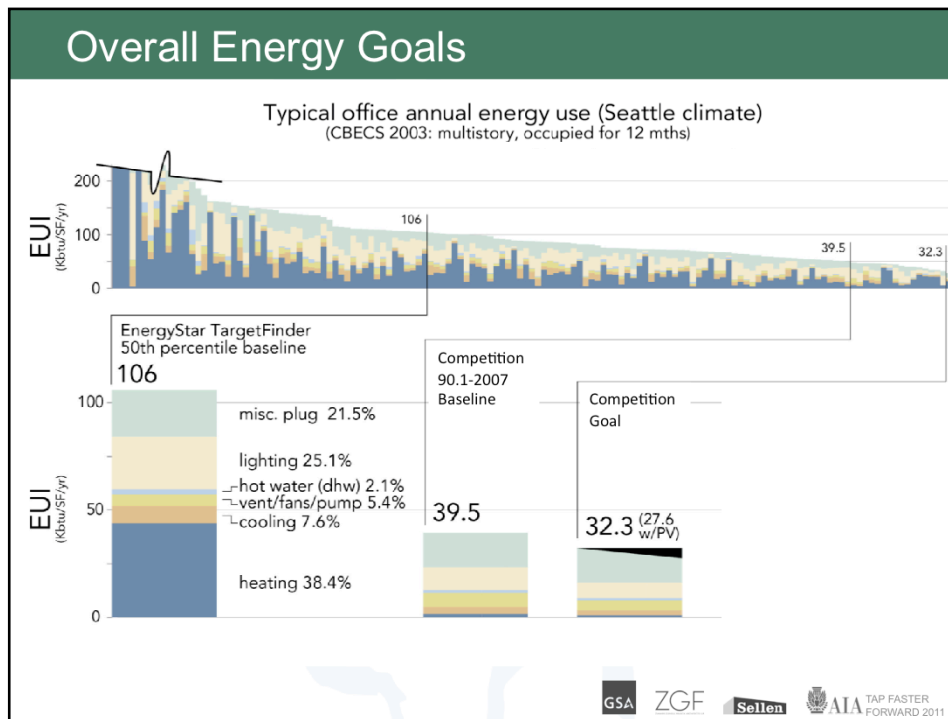
Create a sense of place
Enhance collaboration and identity
Reduce silos
Provide connectivity
Support generational work styles
Air quality
Daylight and connection to nature
Thermal comfort



GSA ZGF Sellen AIA TAP FASTER FORWARD 2011

Todd

- The design solution embodies a significant culture shift that is being implemented by the leadership of the Seattle district of the Corps.



Todd, Chris

- One of the primary goals of the Recovery Act is to create High Performance Green Buildings that establish new performance standards for the marketplace.
- ASHRAE 2007 Baseline = 2030 60%, 30% better than that ~70%
- Competition Brief: 2/3 Efficiency, 1/3 PV's (\$\$\$)
- Better, more integrated way?
 - More money for design, quality.
 - Lower EUI > "Net Zero Ready"

High Performance Green Building

LEED Gold minimum

Employ **integrated approach** to meet sustainability goals

30% reduction in energy usage compared to ASHRAE 90.1-2007

Install advanced meters for electricity, natural gas, and water

Install **solar thermal hot water system** (integrated approach determined not cost effective)

Plan for **on-site renewable energy** systems

Reduce **indoor potable water** use by at least 20%

Reduce **outdoor potable water** use by at least 50%

Manage 95th **percentile rain event** onsite through infiltration

Provide occupancy and **daylight sensors**

Pre-occupancy flush-out

Salvage, recycle, or reuse at least 50% of construction and demolition waste



Chris, Jack

- Minimum Performance Checklist
- Energy 1 of many H.P. criteria
- LEED Gold, and many credits above and beyond...
 - Advanced metering (H₂O, too)
 - Solar hot water

Energy Independence and Security Act



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.*



Jack, Tom

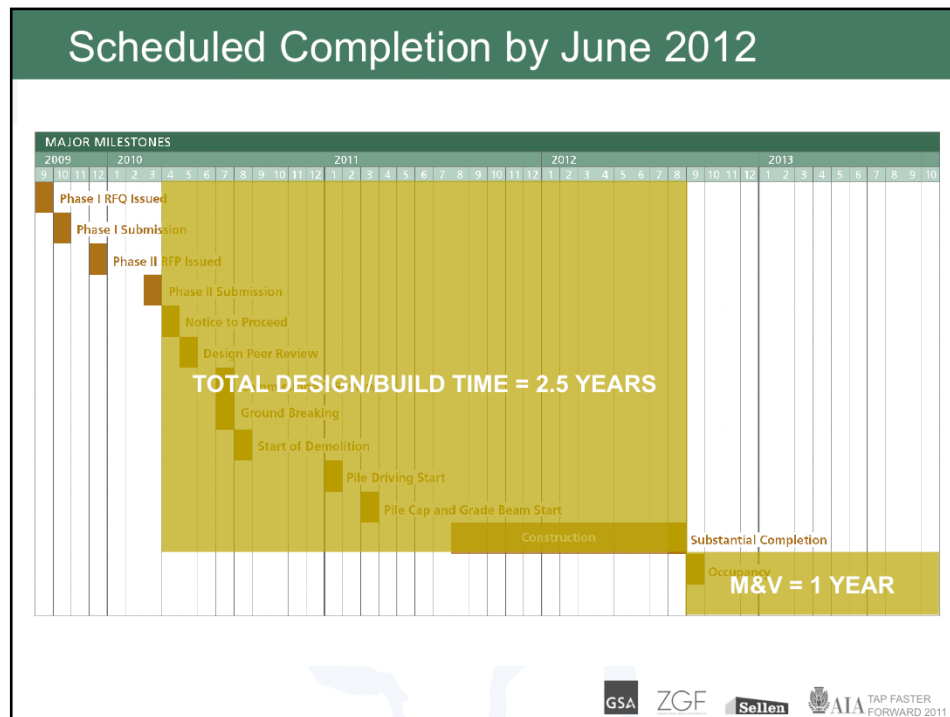
GSA FCS example of the EUI target built into the RFP and the contract with M&V.

In order to help clients achieve their goals we need to focus on an integrated design process.

Proposed Betterments

- Geothermal Heat Pump System
- Laminated Glass Skylight at Atrium
- Triple Glazing at Perimeter
- Solar PV Array
- White Capsheet on Roof
- Solar Thermal Hot Water Heating
- Enhanced Lighting Controls
- Rainwater Capture and Reuse
- Smart Building Technology
- Energy Dashboard
- LEED Platinum

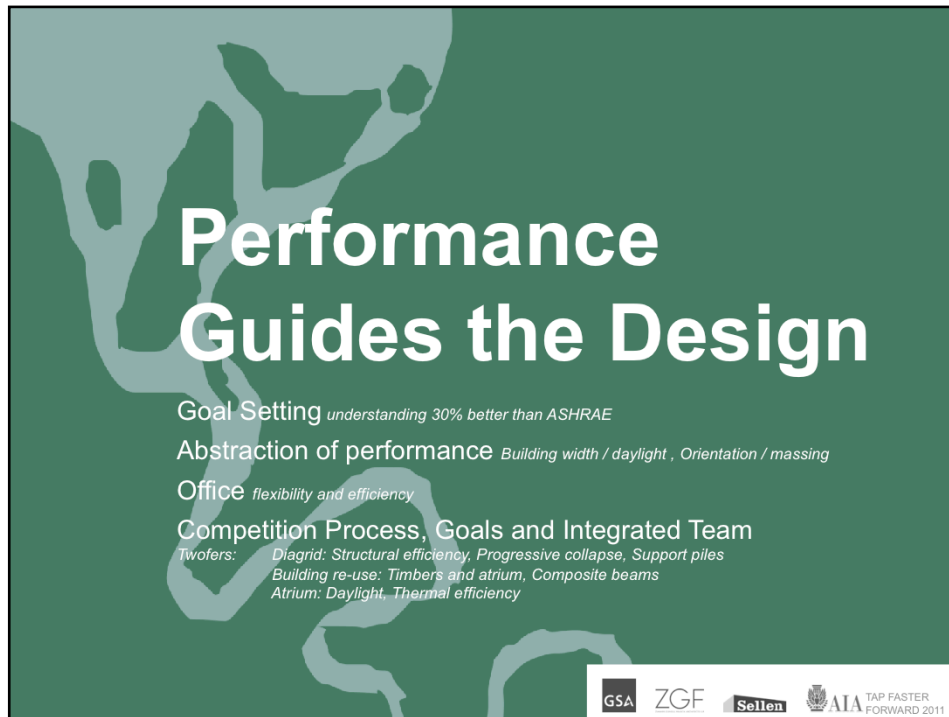




Todd, Jack

AUTOMATIC ANIMATION – ONE CLICK ONLY!

- Original Schedule
- Very aggressive, particularly since we had had minimal client input during the design competition
- Design-build has reduced the overall schedule by 1 to 2 years when compared to a conventional GSA design-bid-build procurement.



Performance Guides the Design

Goal Setting *understanding 30% better than ASHRAE*

Abstraction of performance *Building width / daylight , Orientation / massing*

Office *flexibility and efficiency*

Competition Process, Goals and Integrated Team

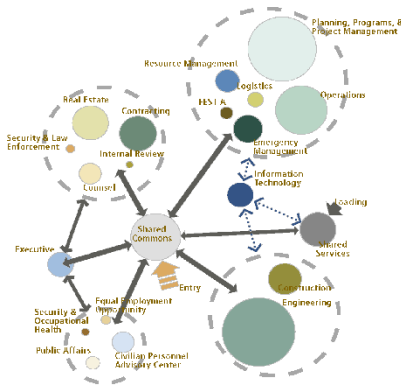
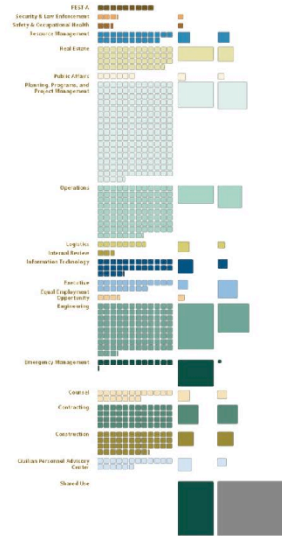
Twoofers: *Diagrid: Structural efficiency, Progressive collapse, Support piles*
Building re-use: Timbers and atrium, Composite beams
Atrium: Daylight, Thermal efficiency

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Todd

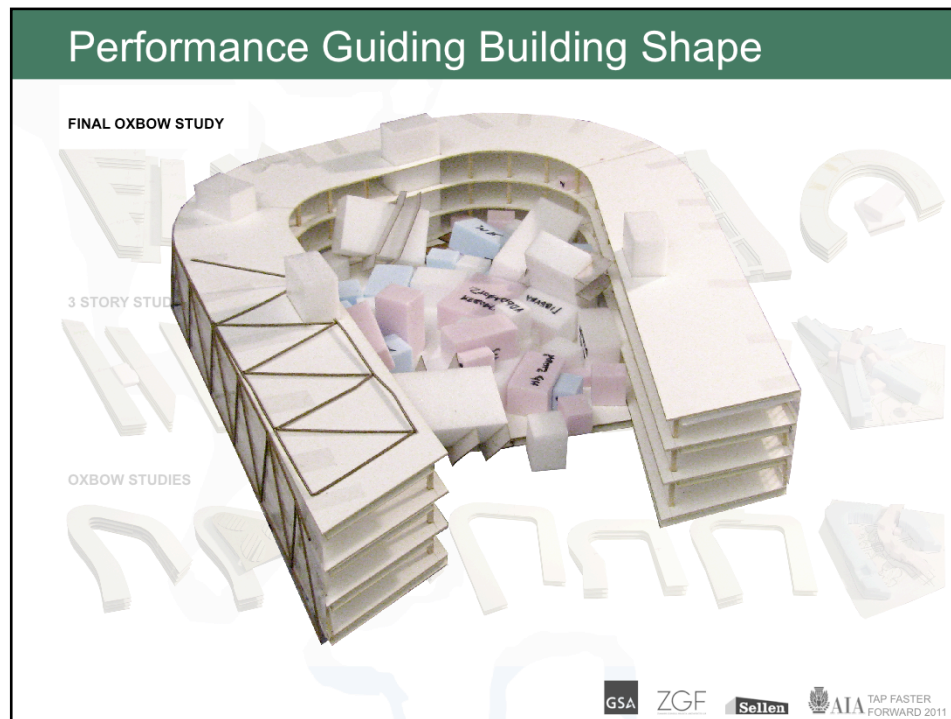
USACE Program Analysis

PROGRAM BY DEPARTMENT



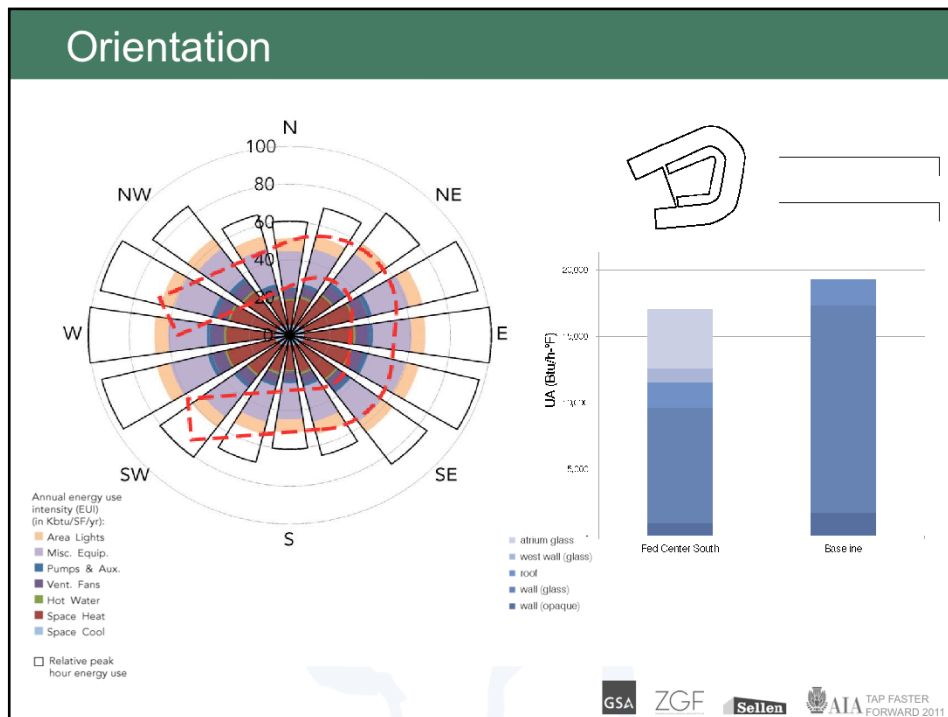
Todd

- Army Corps program
- Major departments governed
- Pulled out meeting spaces from individual departments into the Commons



Chris

AUTOMATIC ANIMATION – ONE CLICK ONLY



Chris

- Designers faster than engineers/modelers
- Generic Energy Rose (EQUEST)
- Go Daylight optimized rotated
 - Annual Energy Use
 - Peak = Equipment cost
- Tweak evolving atrium scheme
- UA benefit vs. Bar Building
 - Envelope = Heat loss, Energy = Money

3 Story Configuration

Optimizes site available for security setbacks

Maximizes open campus green space

Provides storm water management opportunities



GSA ZGF Sellen AIA TAP FASTER FORWARD 2011

Todd, Chris

- Three stories triggered progressive collapse requirements

The Collaborative Workplace

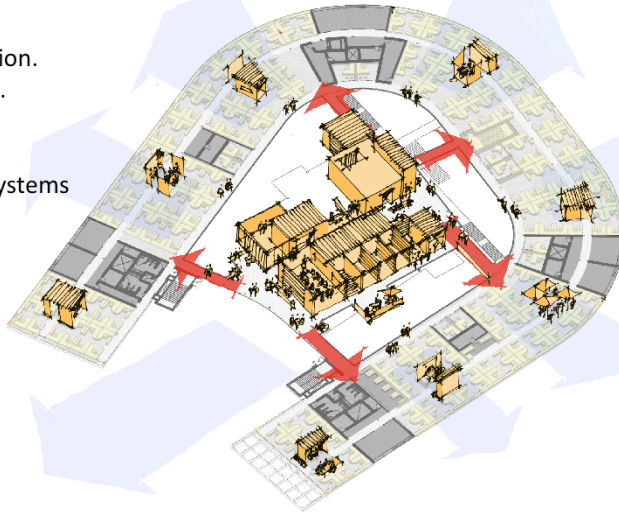
Flexibility. Efficiency. Daylight.
Unified. Open.

Interaction. Collaboration.
Central and convenient.

No "Silos".

Optimize Mechanical Systems

Builds Community



GSA

ZGF

Sellen

AIA

TAP FASTER
FORWARD 2011

Todd, Chris

Building Block of Workplace Design

Allows Various Tenant Layouts
 Maximizes Efficient 8 x 9 Workspaces
 Optimize Daylighting and Transparency
 Optimize Visual Connections

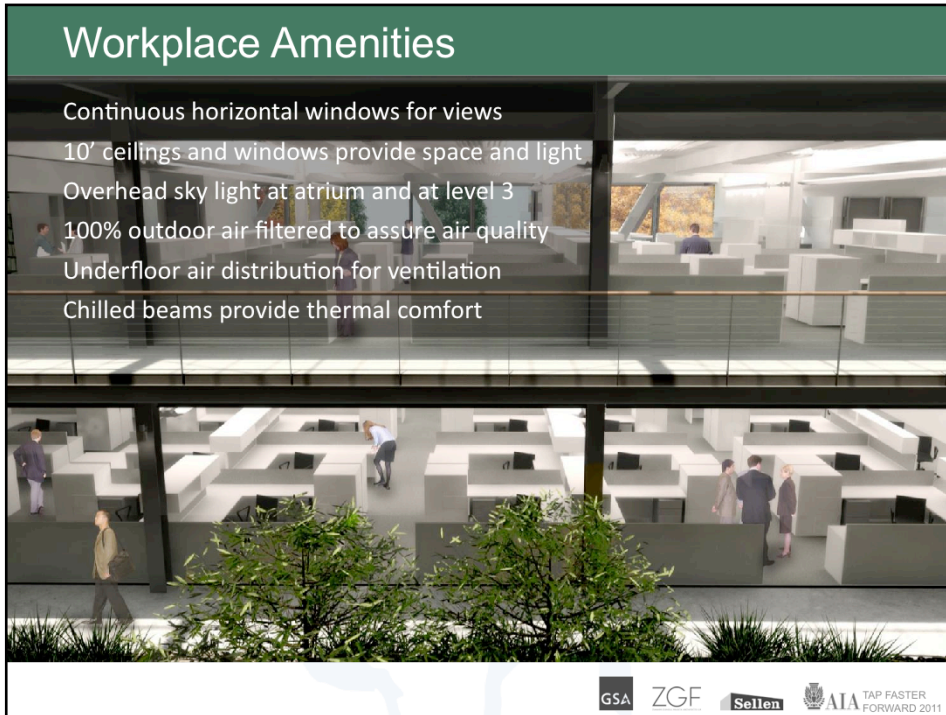


Todd, Chris

- The bar of the Oxbow is 60 foot wide with 22 foot structural bays along the length to maximize access to views and daylight, and to right-size the office area for the typical workstation.

Workplace Amenities

Continuous horizontal windows for views
10' ceilings and windows provide space and light
Overhead sky light at atrium and at level 3
100% outdoor air filtered to assure air quality
Underfloor air distribution for ventilation
Chilled beams provide thermal comfort



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Todd

Atrium Strategies

- Landscape connects to site
- Workspace open to daylighting views
- Efficient envelope ratio
- Ventilation pathways



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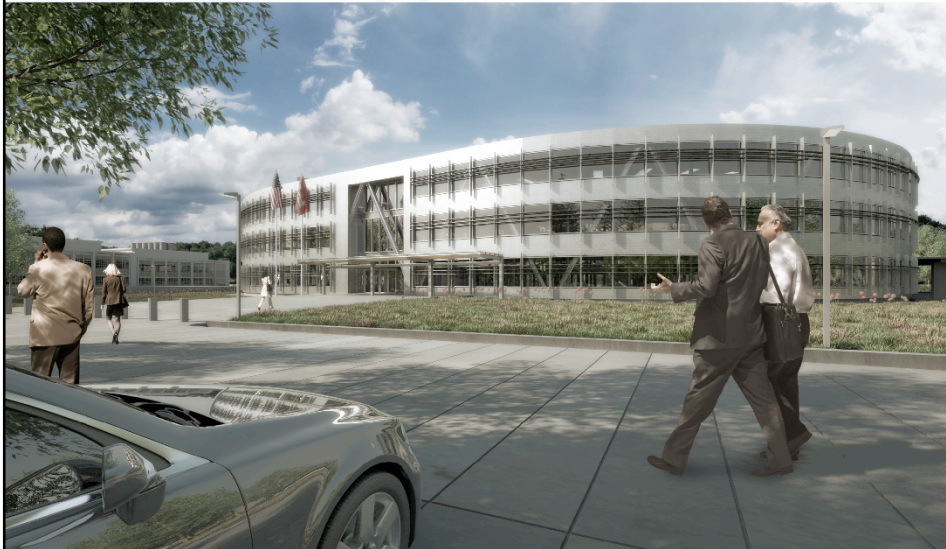
Todd

Interior Environment



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Exterior Expression



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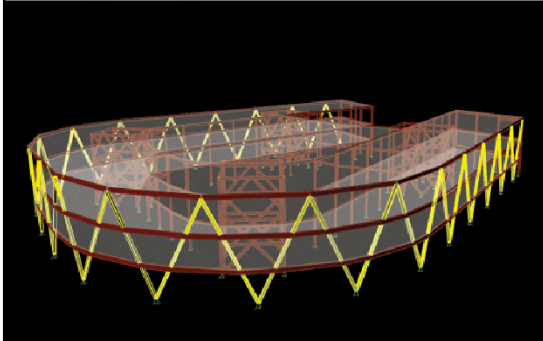
Structural Design

Diagrid System

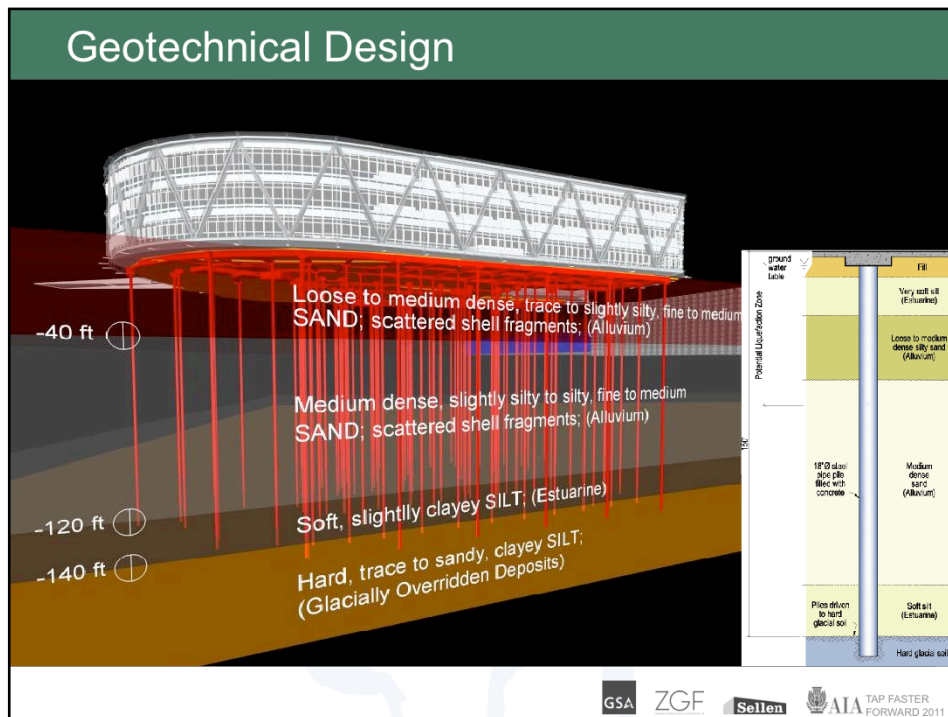
- Carries gravity loads
- Contributes to the lateral force resisting system
- Serves as progressive collapse system → truss action

Level One Floor System

- Grade Beams supported by piles assure stability in any soils condition

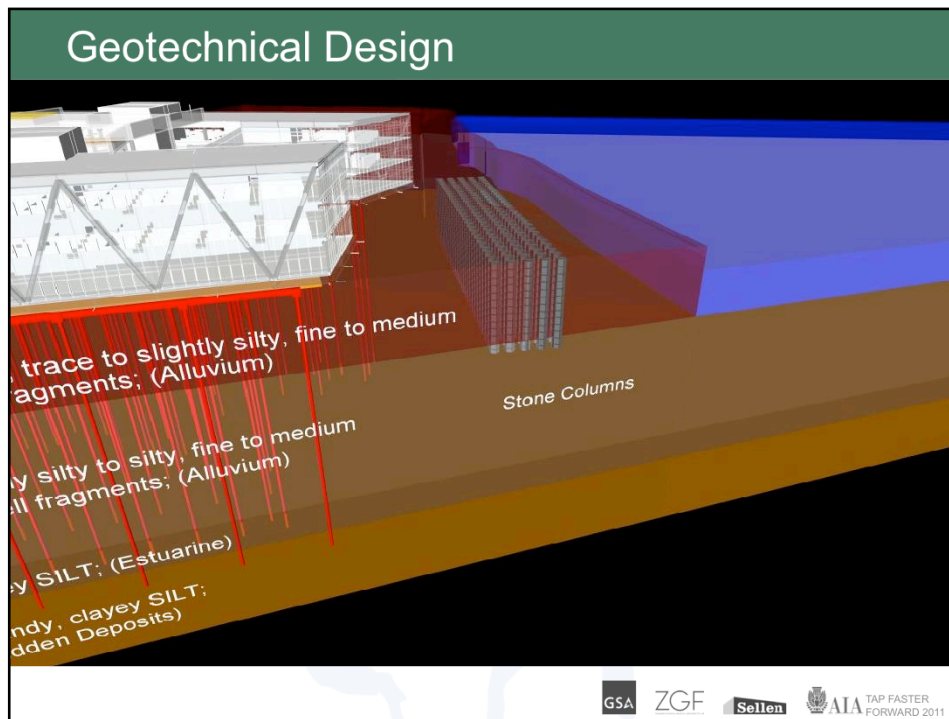


Jack, Todd



Jack, Todd

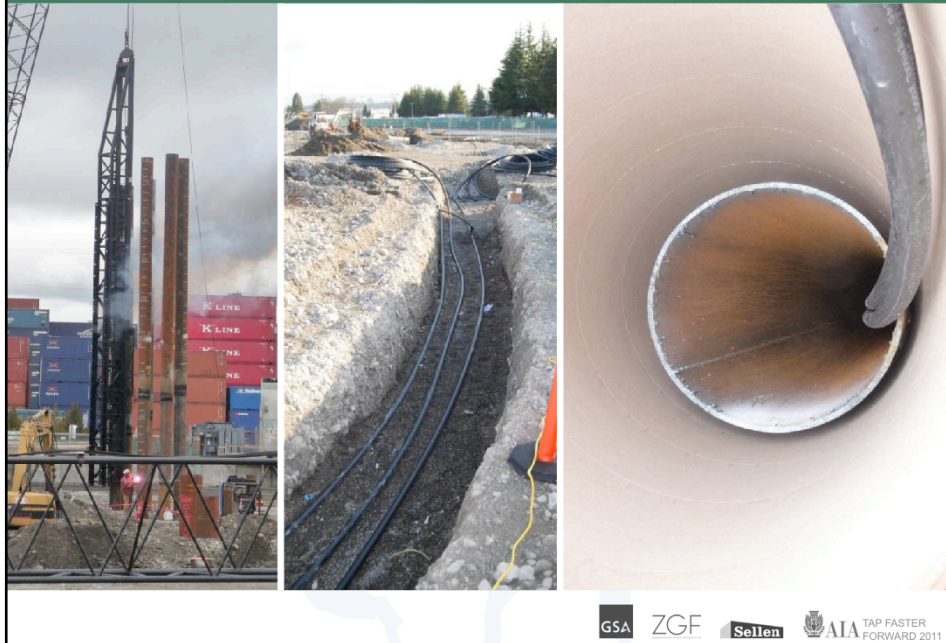
- DEEP PILES extend through the silty and sandy soils to bear on firm Glacial Till... depth of till at 160' deep on average;
- Provides a ROCK-SOLID foundation for the new building, overcoming the risk of soil liquefaction during a seismic event.
- In addition, the ground level floor is supported not by a slab-on-grade, but by interconnected GRADE BEAMS; so it can also remain unaffected even in the event of soil liquefaction event.



Jack, Todd

- In this case, loose, liquefiable soils can be modified to increase the soil's resistance to liquefaction and slope instability.
- The use of stone columns is a ground improvement technique where stones displace or replace weak soils using either an electrical or hydraulically actuated, cylindrical vibrating probe
- Stone columns along the western edge of the site stabilize the soil to mitigate the potential for lateral spreading
- liquefaction-induced settlement could range from nearly 1.5 feet to more than 5 feet in the vicinity of the proposed building

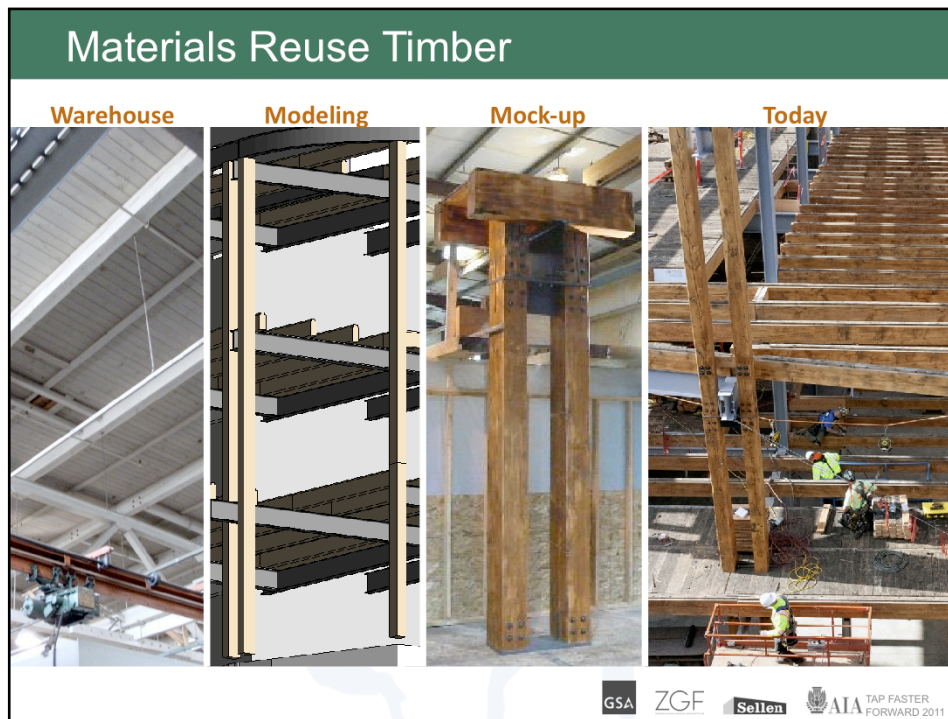
Energy Piles



GSA ZGF Sellen AIA TAP FASTER FORWARD 2011

Jack

- Piles on average 160 feet deep.
- Test piles utilized to determine if geothermal wells would further enhance performance of the building.



Todd, Jack

- Started with an assessment of the yield that could be harvested from the existing warehouse
- Modeling used throughout design to not only develop the aesthetic, but to continually crosscheck sizes and quantities to ensure that the use matched the harvest
- Demolition involved careful dis-assembly in order to ensure the maximum yield
- Existing paint only milkwash, was easily removed via hand-planning and water-jetting to create a rich patina finish
- Erection process has been referred to be akin to “working with tinker toys”



Todd, Jack

- Over 200,000 board feet of timber and decking has been re-claimed for use in the building.
- Composite wood beams introduced in order to match number of purlins required with available timber.
- Additional lumber has been re-purposed to create concrete formwork, as well as other temporary uses during construction.
- Re-use of lumber has resulted in over 99% recycle rate of construction waste

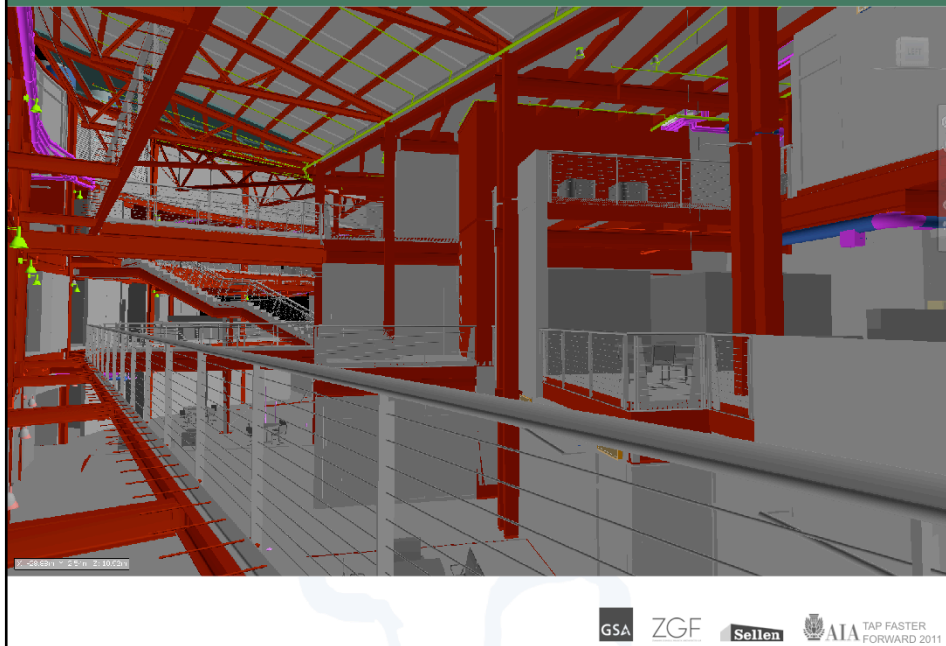
Materials Reuse



Jack, Todd

- Gordon R. Plume Timber Company, who worked with Sellen on the house for a certain software mogul in the Seattle area, provided valuable expertise in grading the timbers and fabricating them for their new use.
- This view shows the architectural rendering.....

Materials Reuse



Jack, Todd

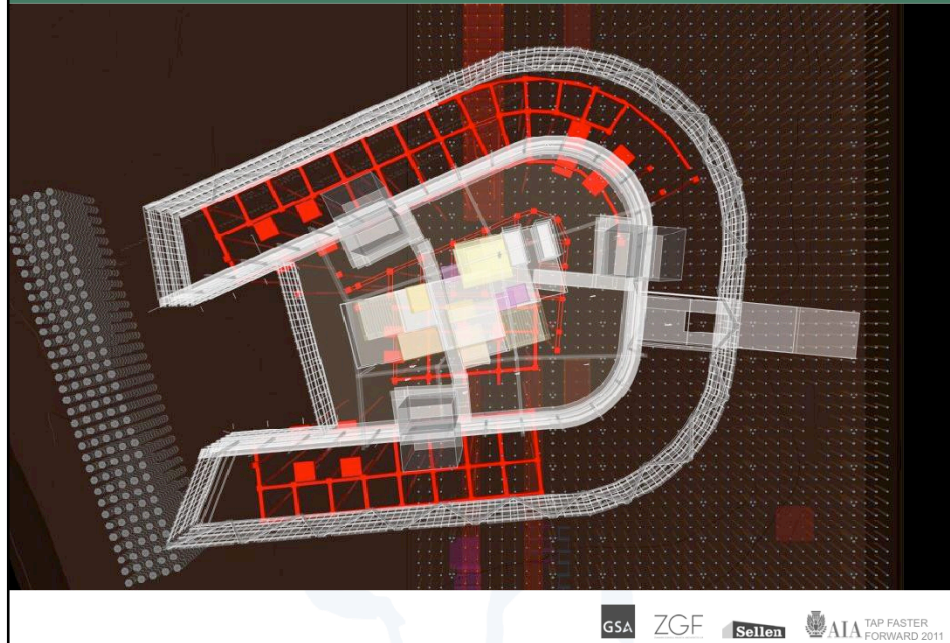
- This view is from the MEP model illustrating the integration of piping and ductwork with the exposed structure.

Materials Reuse



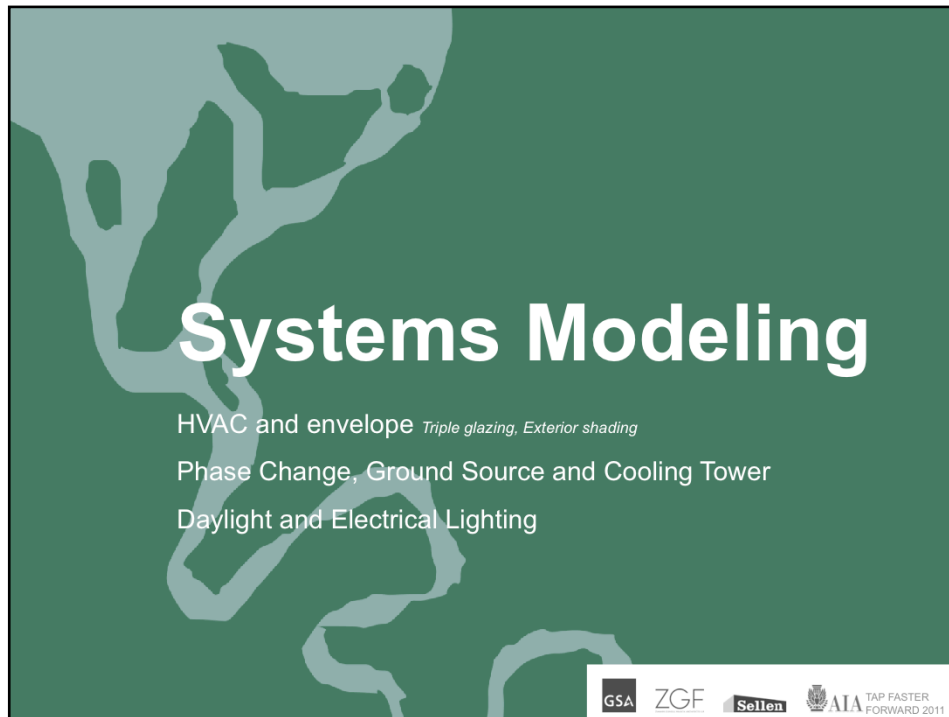
- Jack, Todd
- The same view under construction

Materials Reuse

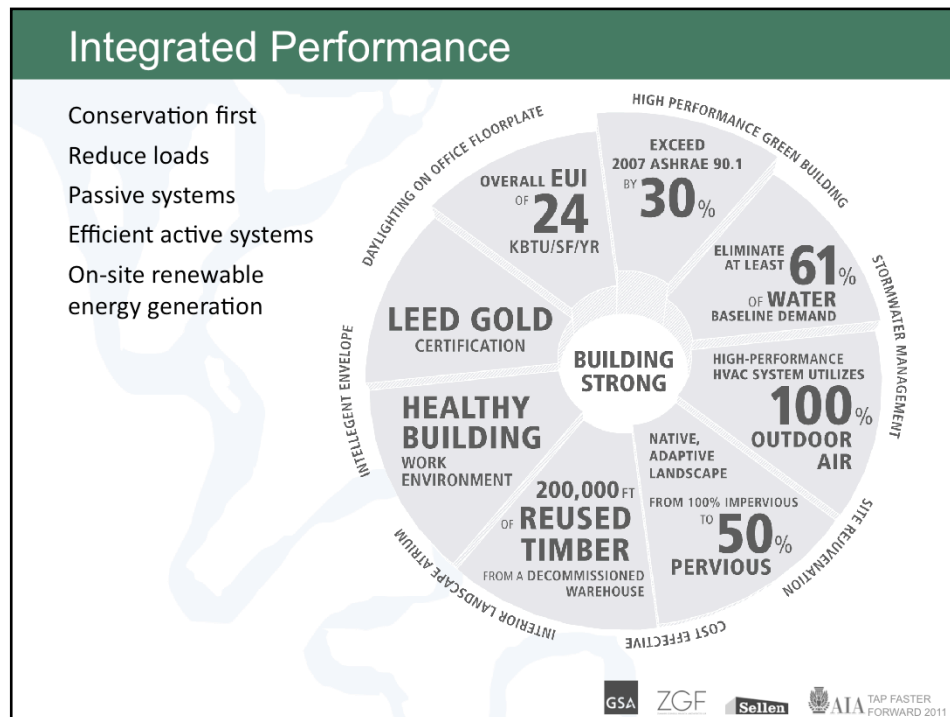


Jack

- Existing timber piles, 16" in diameter, and 40 foot long, extend the full length of the 1202 building at 8'-0" on center
- Building was sited to minimize the number of timber piles that needed to be removed.
- In the end, only 55 piles had to be removed, and these piles are being re-used as site benches and for construction means and methods.
- The remaining piles provide additional soil densification.

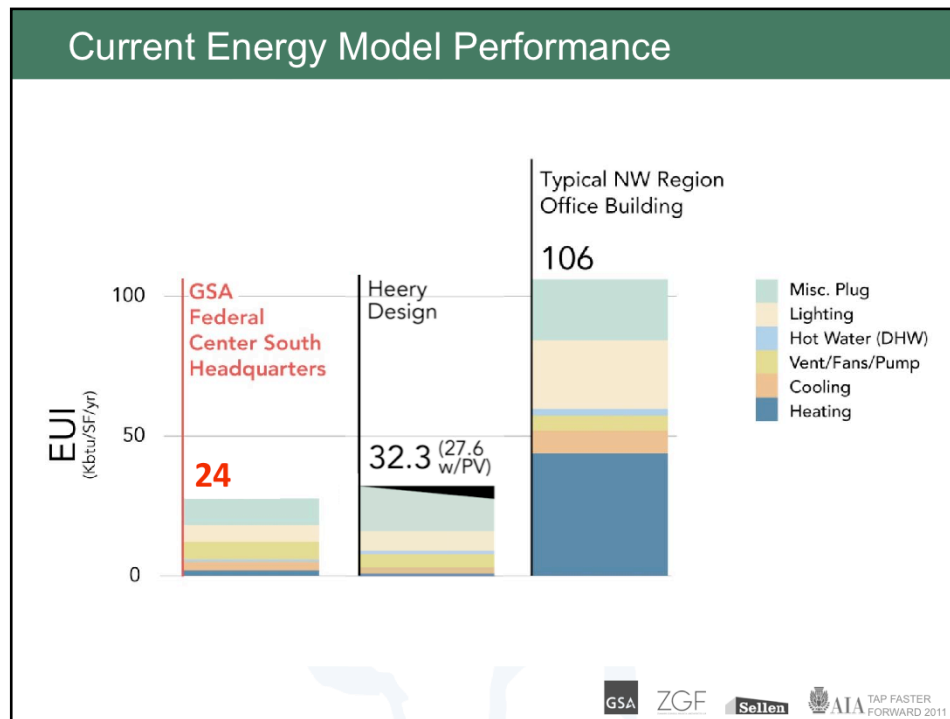


Todd, Chris



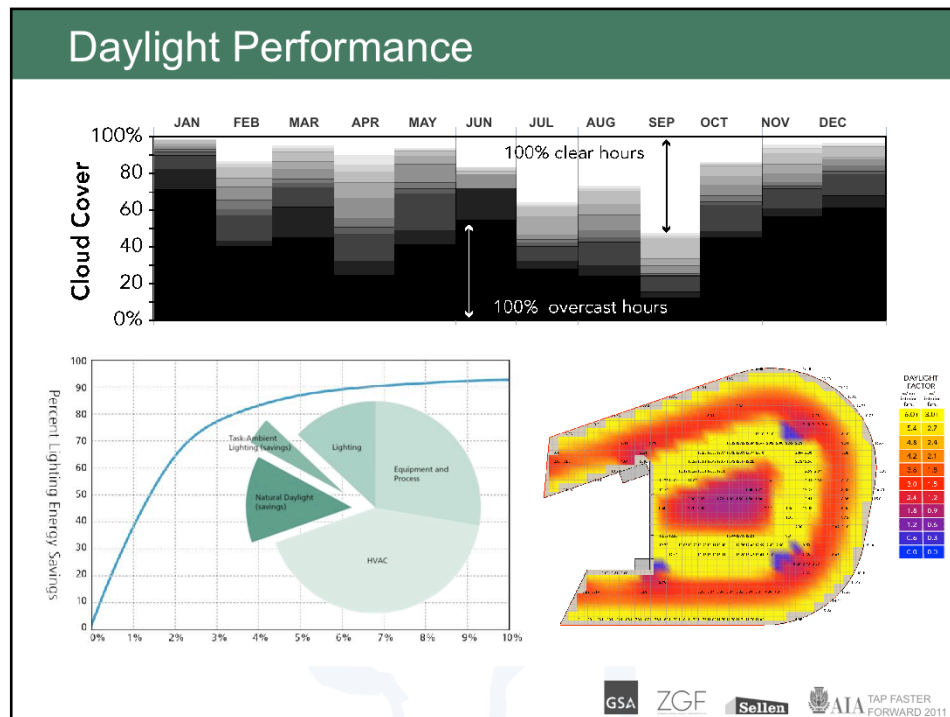
Charles

- Explain how we hit these goals
 - Primary Energy
 - With integrated design
 - Achieving quality in Architectural design
 - Indoor environment



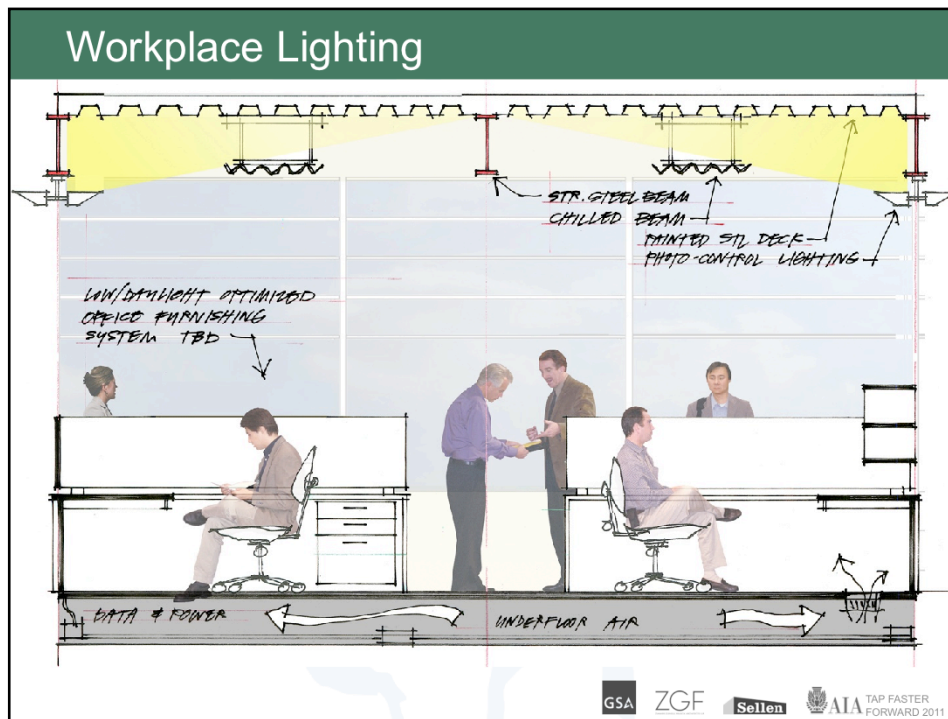
Charles

- Current Prediction
 - 24 EUI 77% vs CBECS, 40% vs ASHRAE
- Heat & Cool – Miniscule
 - Efficient Systems
 - Heat (Pump) Recovery & Redistribution
- Hot Water – small, but less energy by using heat pumps & ASTE Heat Recovery
- Lighting



Chris

- Seattle – Predominantly overcast , fairly clear summer
- Target – D.F ~ 3 in office



Chris, Todd

- Direct/indirect lighting fixtures
- Structural Module of 22'
- Achieve goals of 25 fc
- Installed LPD of 0.7



Chris, Jack, Todd

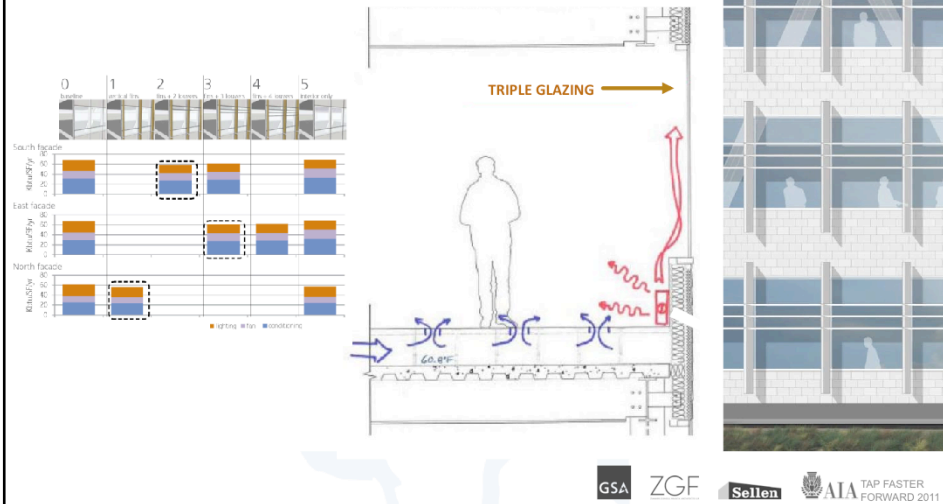
- Sellen introduced Barcol-Air to the west coast.
- Energy wave...
- Chilled beams “sails”
- Decouple vent + H/C
- Water 327 x vs Air
- Low velocity vent in UFAD
- Barcol Air

Orientation-Specific Envelope

Daylight orientation

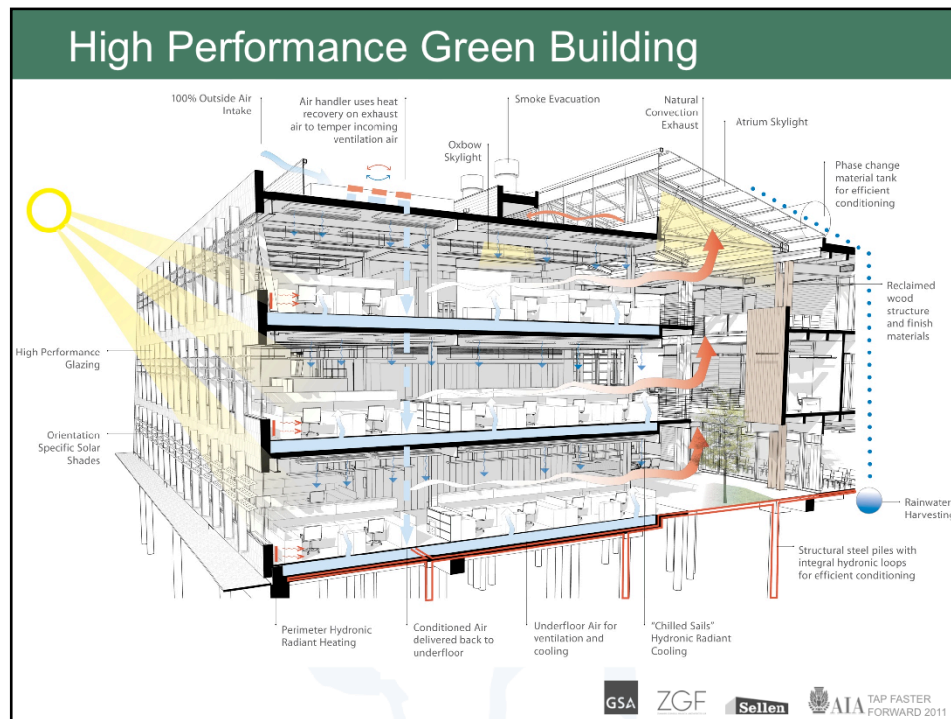
River orientation: natural

Campus orientation: formal



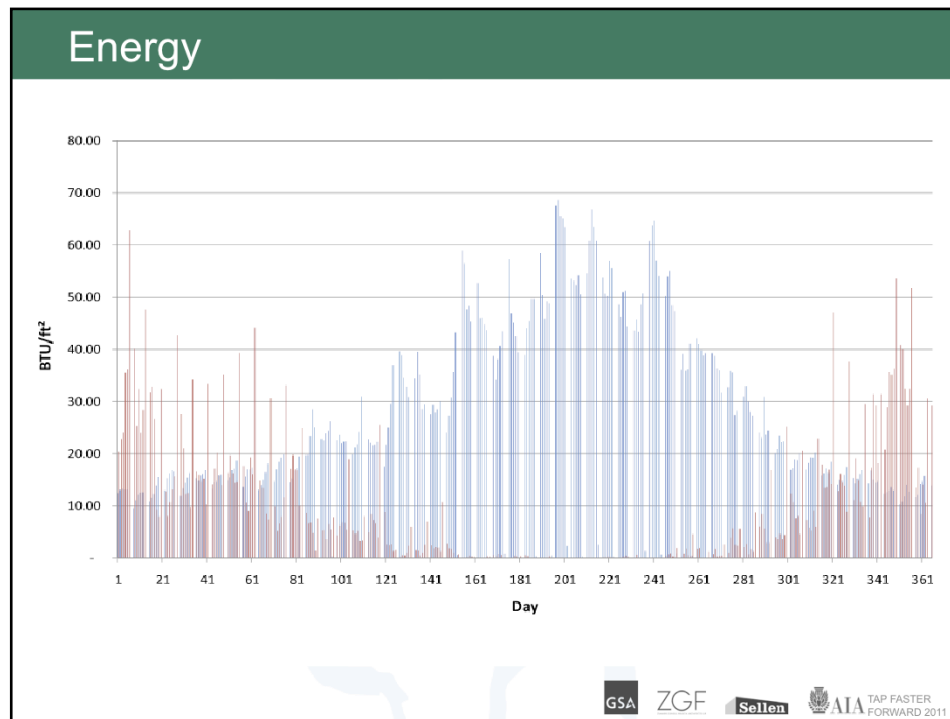
Chris

- Dev of Env in concept w/HVAC
 - What performance criteria to meet goal?
- Original goal: Heating – No separate perimeter system
 - Considered triple glazing, separated high temp plenum
 - But: Higher cost, less comfort (1%) HRS
 - And *lower energy performance ultimately, per hydronic ???
- Cooling: Limit C.B density to...Orientation specific shading NW – V, E, S



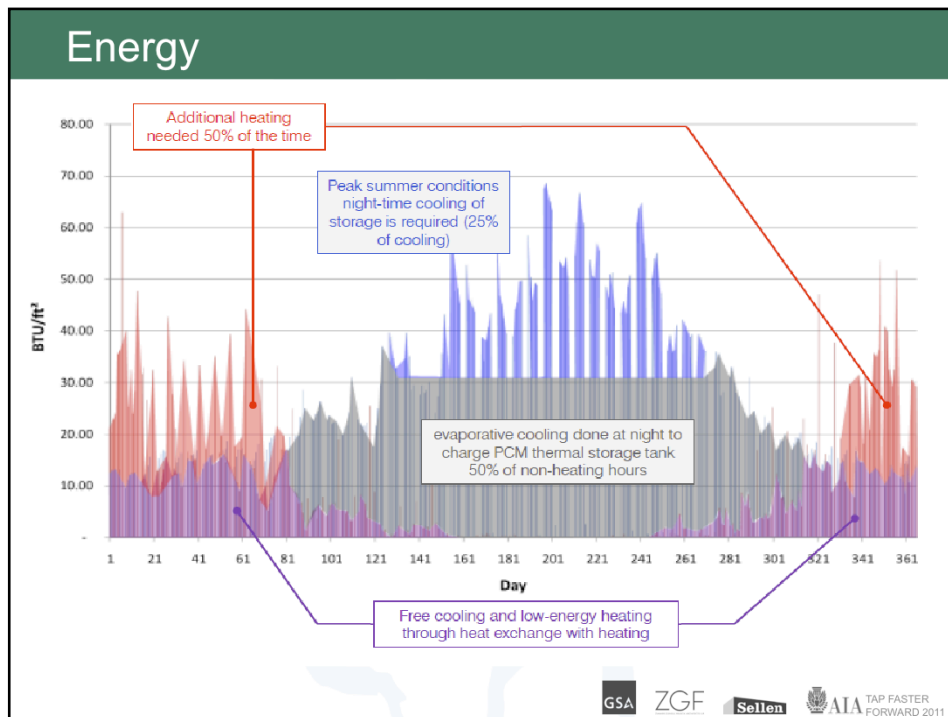
Charles, Jack, Todd

- **Building orientation, High windows & Skylights maximize daylighting ; External Shading controls heat gain**
- **High Performance Glazing enhances energy efficiency as well as Blast Protection**
- **Energy use reduced by 30%**
- **100% Outdoor Filtered Air for Ventilation.**
- **Healthy Underfloor Air Dist. System**
- **High efficiency WaterSense fixtures save water**
- **LEED GOLD Certification**
- **Building Form and Skin designed to aid in air flow**
- **Stormwater is actively managed on-site with surface detention & conveyance**
- **Thermal Storage provides maximum efficiency for HVAC system - Radiant cooling assures thermal comfort while saving energy.**
- **During the design competition explored a number of high performance strategies that ultimately had to be set aside in order to meet an initial budget. These were presented as "Betterments" to GSA, that they could incorporate into the project if additional funding became available. GSA embraced this concept and collaborated with design-build team to incorporate geothermal wells, rainwater harvesting, and a glass skylight.**
- **Atrium – Air handlers (5)**
 - Smoke exhaust – enable mixed construction
 - Exposed steel & wood
- **H.R./HX**
- **2 other systems for base heat source**
 - P.C.
 - GSHP



Chris

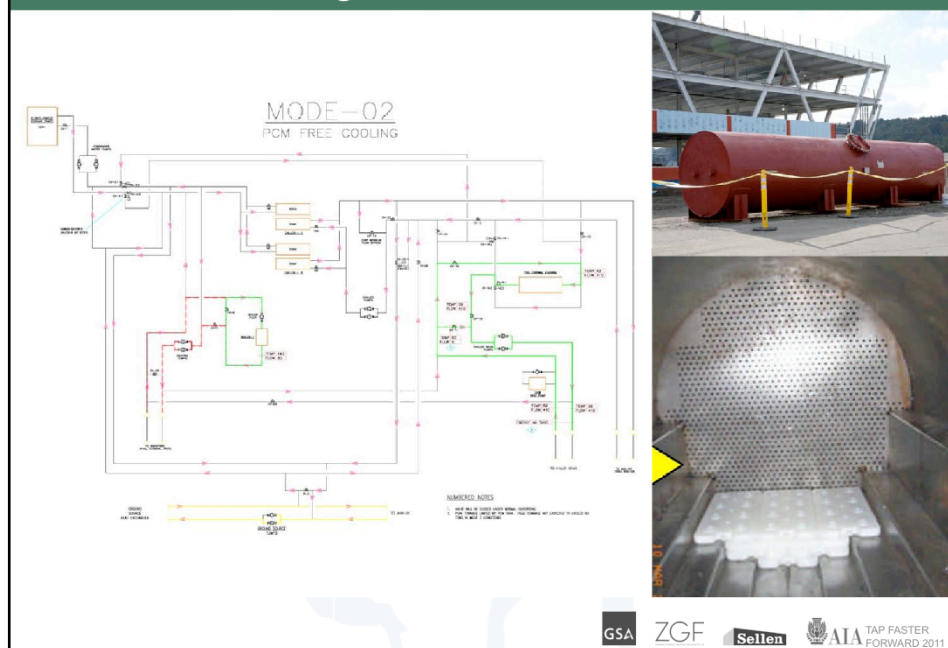
- Loads for annual simulation (F+V, B.E.)
- Heat load reduced through HX
- Sim H+C
- Cooling – sign period peaks



Chris

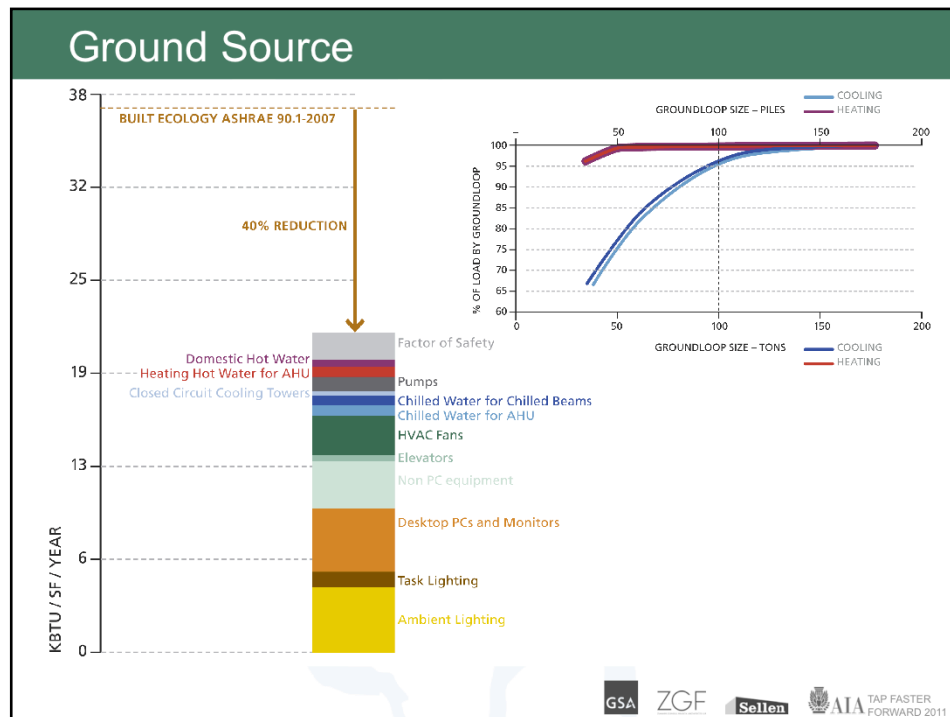
- ??? – where can we move energy ???
 - Heat interior > Perimeter (Hydronu
 - Monitoring warmup vs. day cooling (storage)
 - Capacity to do a lot of cooling at night in Seattle (typical < 60F ???)

Thermal Storage



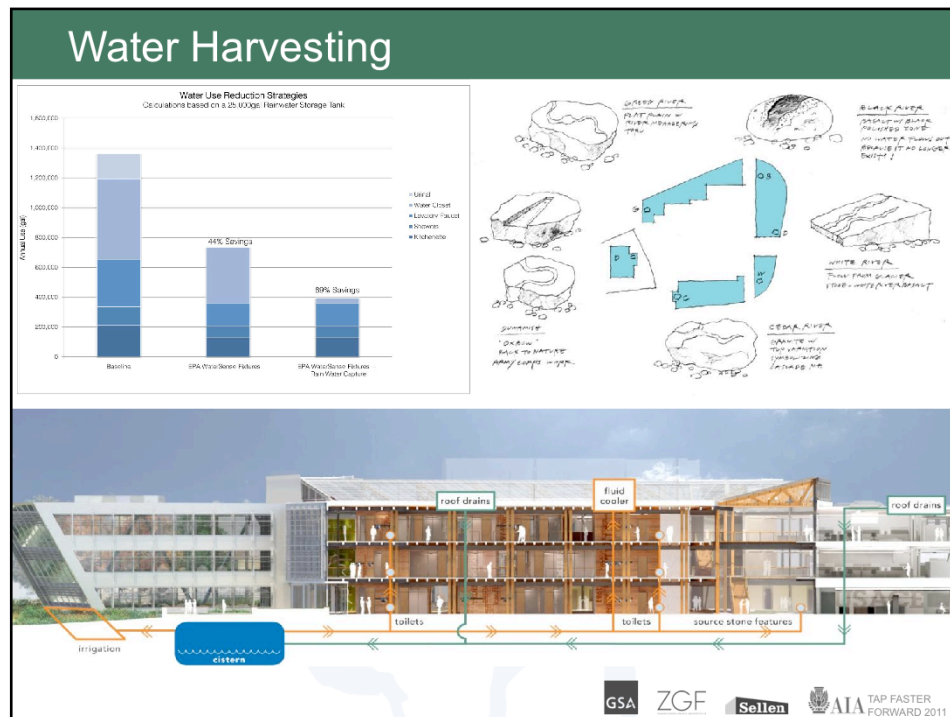
Chris, Jack

- PCM tank – capacity for 50% of cooling solving storage problem
- Melting/freezing point 55F
 - Base Temp.
 - Superfast GSHP – limited capacity renewable daily



Chris, Jack

- Early comp concept was GSHP integrated design, but more costly than PCM
- Essentially same as PCM
- Not in Project – more cost duplicate, only got small 7% better
- Additional Betterment \$, Reduce cooling tower (1/2)



Todd, Jack

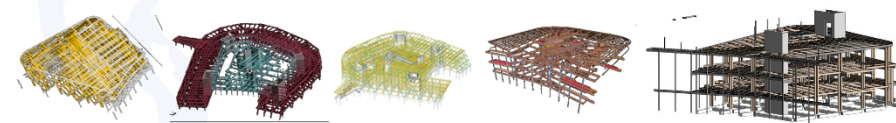
- 25,000 gallon cistern captures rainwater from all of the roofs
- Rainwater used for grey water at toilets and cooling tower make-up, as well as for irrigation
- In addition the rain water, after ozone treatment, is pumped back to the atrium water feature consisting of source stones representing the four tributary rivers that feed into the Duwamish, as well as the Duwamish past and present.

Model Integration Lessons

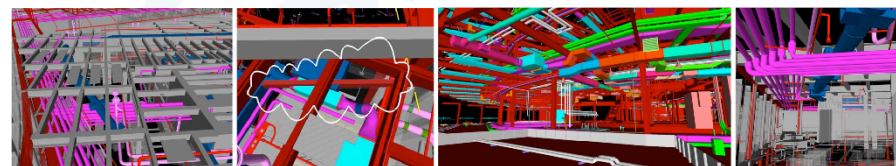
ARCHITECTURAL



STRUCTURAL



MECHANICAL



Todd

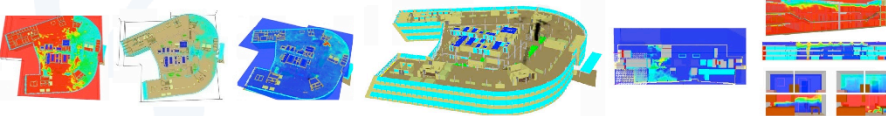
- Architectural models – architectural team very green in terms of use of Revit. Only one master user at the start of the project. After early frustration, team grew to prefer Revit over AutoCAD. Team particularly excelled at generating presentation graphics. Team underestimated the effort required to extract good quality 2D construction documents from the model.
- Structural model – many versions:
 - ZGF - Revit
 - Kpff - Revit
 - Sellen wood - Revit
 - MKE, steel detailing – Steel detailing program
- Mechanical – utilized CADduct not easy to share files with Revit – utilized Navisworks for 3D coordination throughout the design and documentation process but unable to import mechanical systems into architectural and structural models

Model Integration Lessons

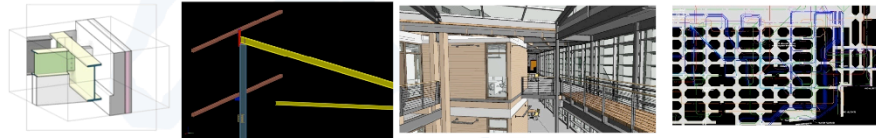
LIGHTING



SMOKE / CFD ANALYSIS



DETAILING



Todd

- Lighting, studies for both daylighting and artificial lighting
- Smoke/CFD: Entire building is an atrium, smoke modeling required to simulate ability to exit the building safely in the event of a significant terrorist event. CFD modeling utilized to assure that condensation will not occur on chilled sails
- Detailing: wood structure as well as the fact that the structure is exposed throughout created unique detailing situations that required their resolution via 3D modeling

Create and Test New Products

Through collaborative efforts, the team created and tested three new sustainable products utilized in the building and ready for the market.

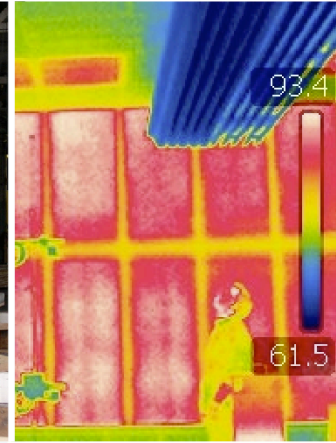
Steel Shingles



Composite Beams

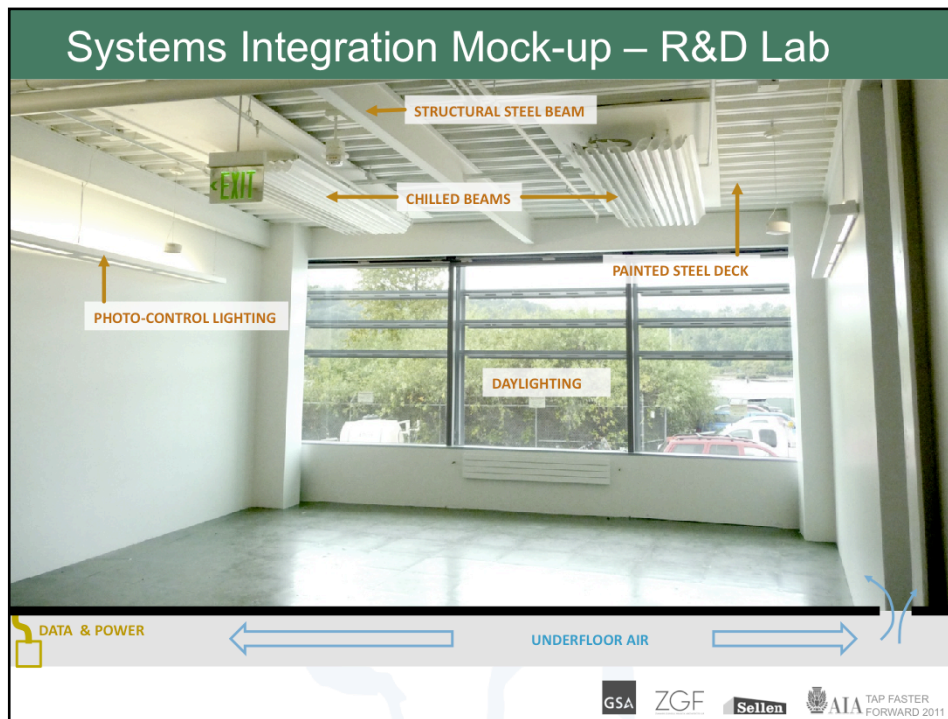


Chilled Sails



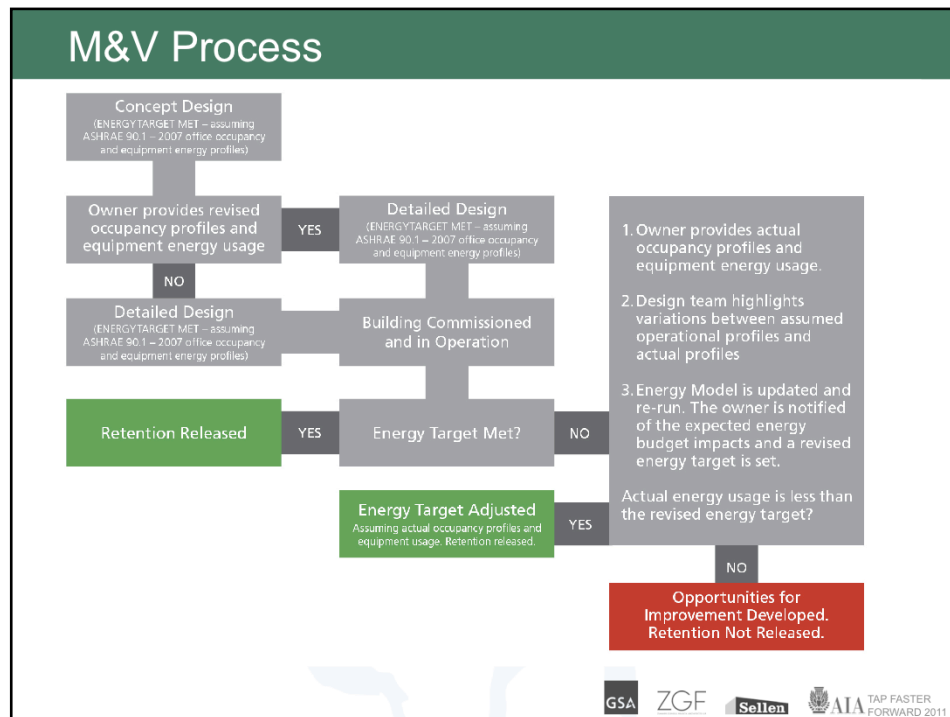
Jack, Todd

- Design-build process allowed the introduction of innovative semi-custom systems to be developed for the building, all of which have the ability to be utilized on future projects
- New vertical shingle design, now part of the manufacturer's standard line
- First use of composite wood beams in the U.S.
- New chilled sail design – with perforations, actually performs better than anticipated – also now becoming part of manufacturer's standard line of products.



Todd, Jack

- Although integration of systems thoroughly examined via 3D modeling, the actual execution still presented some unknowns.
- Built full-scale mock-up of one bay of the Oxbow.
- Every trade that participated in this R&D lab has changed their means and methods as a result.
- Design-build process allowed an additional opportunity for the trades to learn how to put the building together in a practice run.



Chris, Jack

- Metering requiring far exceeds that required to meet LEED M&V requirement.

General Contractor:
SELLEN CONSTRUCTION COMPANY

Architect:
ZGF ARCHITECTS LLP

Sustainability Lead:
SELLEN SUSTAINABILITY

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.
TUAZON ENGINEERING
HART CROWSER & 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
MILLENNIUM TILES, LLC
NORTH SHORE SHEET METAL
WALTERS & WOLF
SESSLER
R.W. RHINE, INC.
BARCOL-AIR
LUTRON
LITECONTROL

AN Integrated Team
ACHIEVES
Performance +
Time + Cost + Quality

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Jack, Todd

AUTOMATIC ANIMATION – ONE CLICK ONLY



The End



Todd

Introduce

Aggressive Performance Goals & IPD

The End.

THANK YOU!!



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