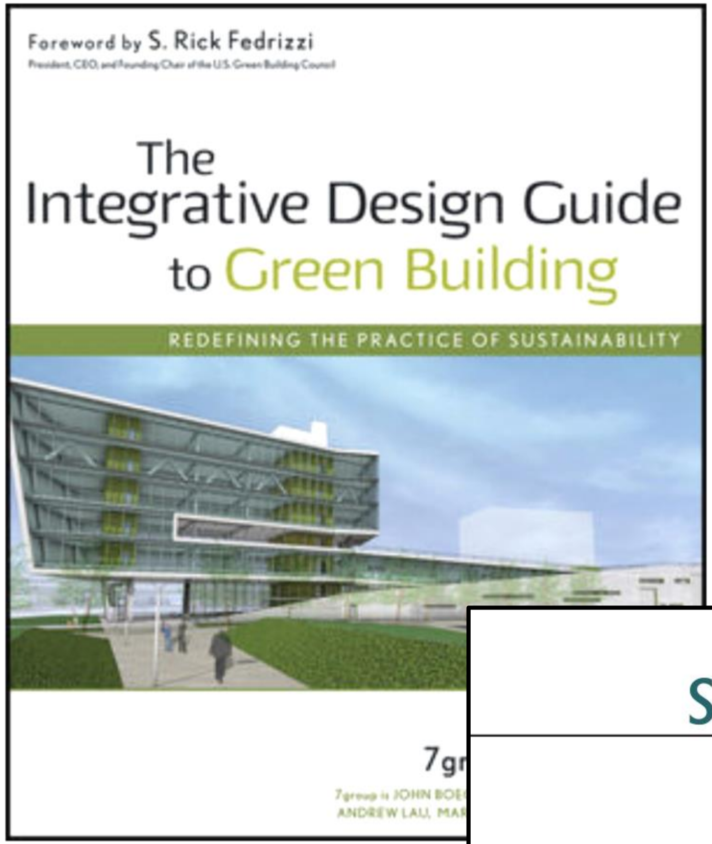
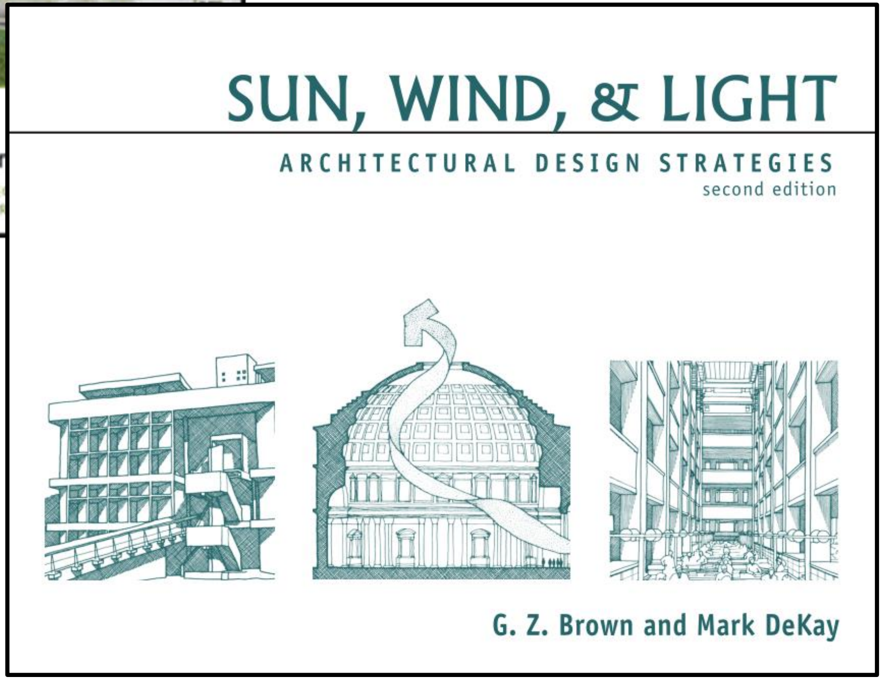
Schematic Design Phase

جلسه نهم- مبانی طراحی محیطی، نظریه ها و روشها

آبانماه 1397





Introduction

- Schematic Design Charrette
- 4th research & analysis phase: Schematic Design Phase

MENTAL MODEL

Client, design, and building teams' mind-set, attitude, and will

PROCESS

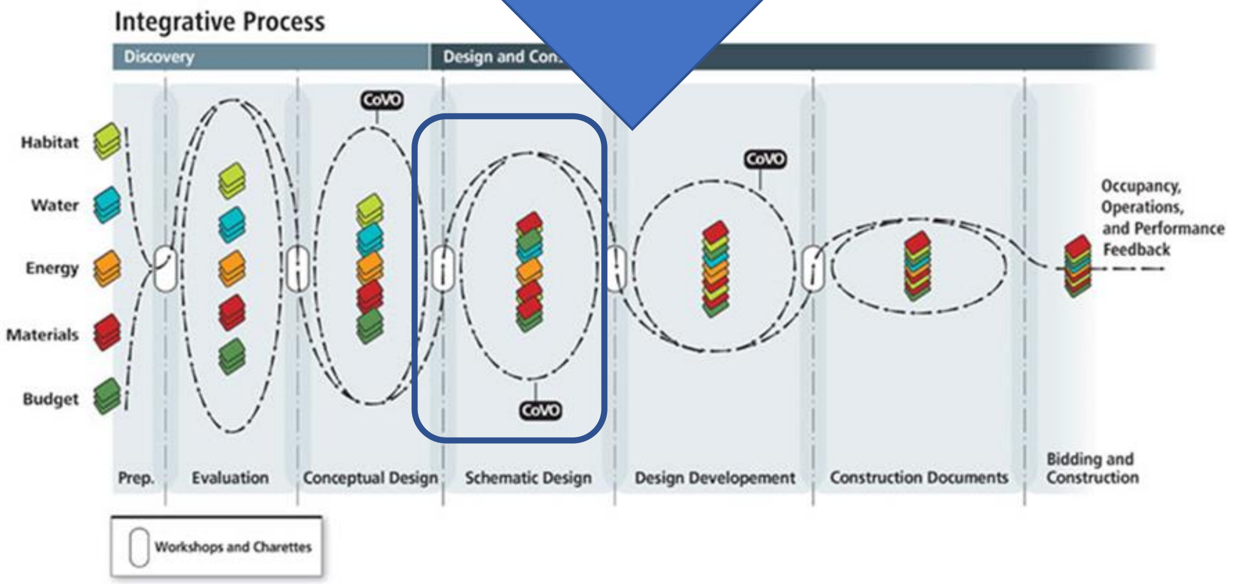
Integrated, all parties engaged-system optimization through iterative analysis

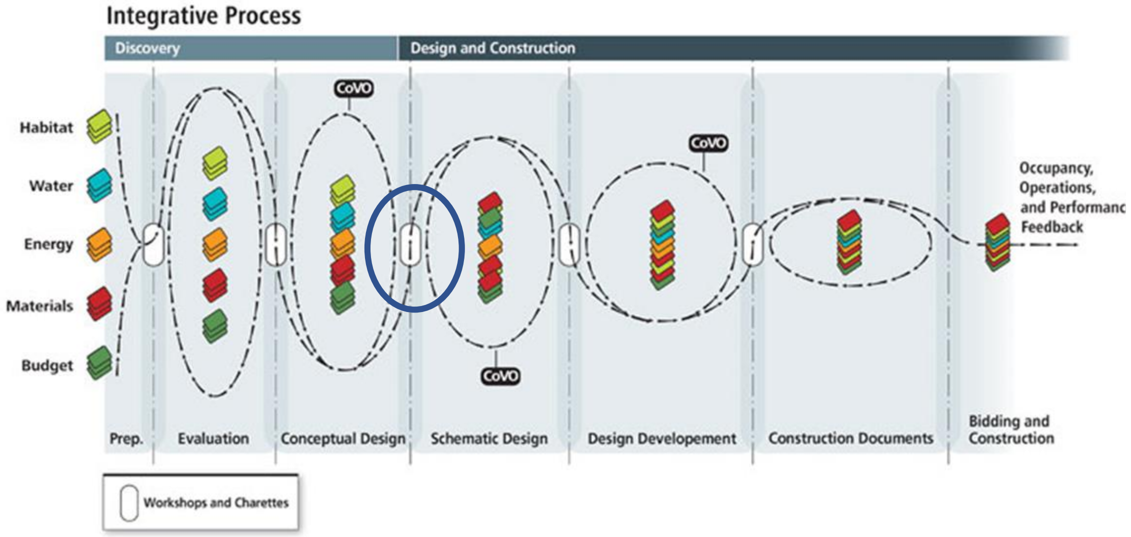
TOOLS

Metrics, benchmarks, modeling programs-analytical methods for materials and costing

PRODUCTS/ TECHNOLOGIES

Things and stuff, technologies and techniques





Workshop No. 3: Schematic Design Kickoff

Stage B.1

Workshop No. 3: Schematic Design Kickoff—Bringing It All Together (without committing to building form)

B.1.1 Workshop No. 3 Activities

- Present sketch concepts, supporting data, and discoveries from *Stage A.5* Research and Analysis
- Develop site and building configuration sketch solutions by evaluating flows and exploring interrelationships between the four key subsystems:
  - Habitat
  - Water
  - Energy
  - Materials
- Assess the realistic potential for achieving Performance Targets and review commitment to Touchstones and Principles
- Identify the systems that require more extensive cost bundling analysis, including life cycle cost impacts
- Provide time for reflection and feedback from client and team members
- Commissioning: Identify where the OPR and BOD will need refinement based upon new discoveries

B.1.2 Principles and Measurement

- Document adjustments to Performance Targets to reflect input from Workshop No. 3
- Commissioning: Adjust OPR and BOD to reflect input from Workshop No. 3

B.1.3 Cost Analysis

- Update any required integrative cost bundling templates to reflect input from Workshop No. 3

B.1.4 Schedule and Next Steps

- Refine and extend forward the Integrative Process Road Map tasks and schedule into future phases to reflect input from Workshop No. 3
- Distribute Workshop No. 3 report

Present sketch concepts, supporting data, and discoveries

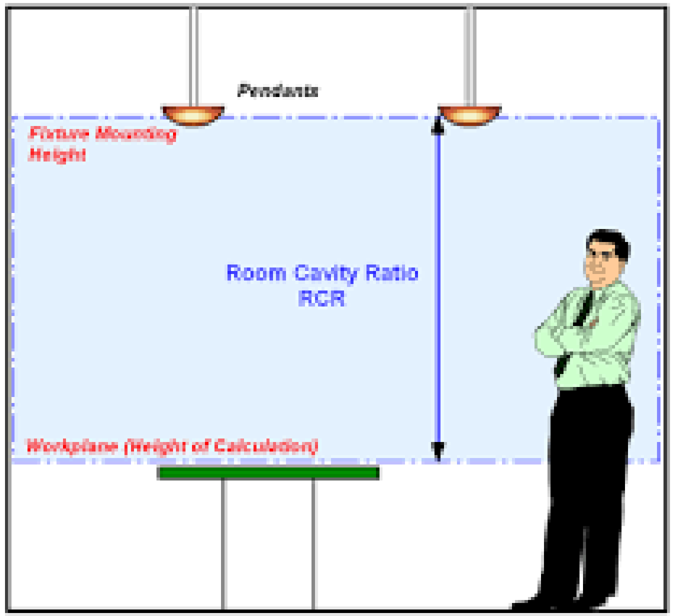
- Refined Conceptual building footprint & phasing diagram options
- Refined program data
- Site analysis
- Location & sizing options for infiltration & constructed wetlands
- Initial water balance analysis
- Potential for renewable energy supply
- Building massing option sketches with alternatives for fenestration patterns & window to wall percentages
- Energy model comparisons of the above options
- Rough sketches of initial daylighting strategies with optional configurations
- Initial LCA of core and shell material options.
- List of potential salvaged materials from the existing on-site building
- Initial draft of BOD for commissioning
- Cost bundling analysis for various combinations of EEMs
- Updated LEED assessment

Develop site and building configuration sketch solutions by evaluating flows and exploring interrelationships between the four key subsystems.

Habitat (biotic systems other than human)

- Discuss the specific roles of habitat in relation to:
  - Thermal control (wind & shading)
  - Water quality
  - Rainwater management
  - Connectivity to larger nested systems such as nearby streams
  - Habitat corridors within the larger watershed
  - Opportunities for microclimates around each side of the building to shelter and support various plants and other species

Habitat (human)

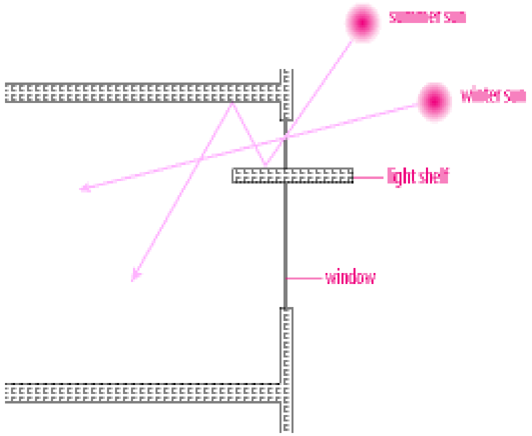


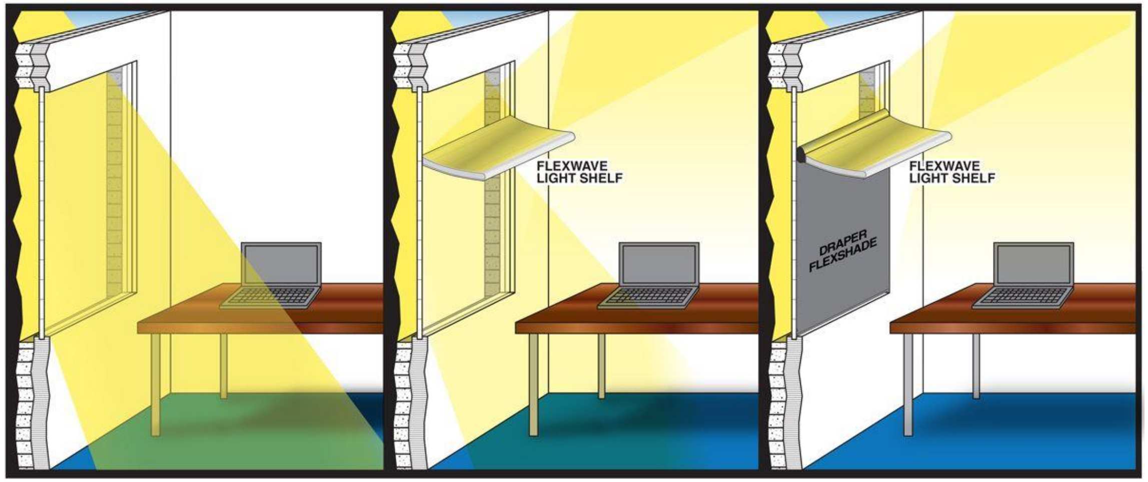
Room Section

- Determine where daylighting is important
- Which design strategies need to be pursued for daylighting
  - Window sizing and location
  - Room-cavity ratio
  - Distance to glazing
  - Orientation
  - Side lighting/top lighting / Bilateral capability

Sidelighting

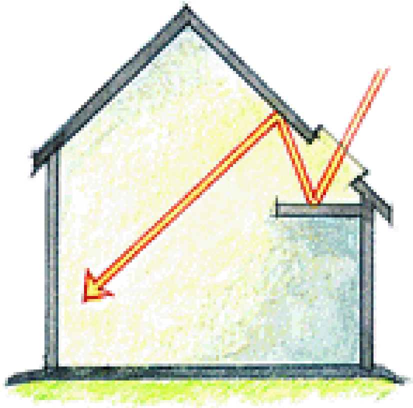
- Effective daylight penetration equates to about 1.5 times the window heat height.
- With the use of a light shelf, penetration can increase up to 2.5 times the window height.
- An initial starting point for adequate daylighting is to target approximately 15% as a glazing to-floor area ratio for spaces on the south and about 20% for those on the north.

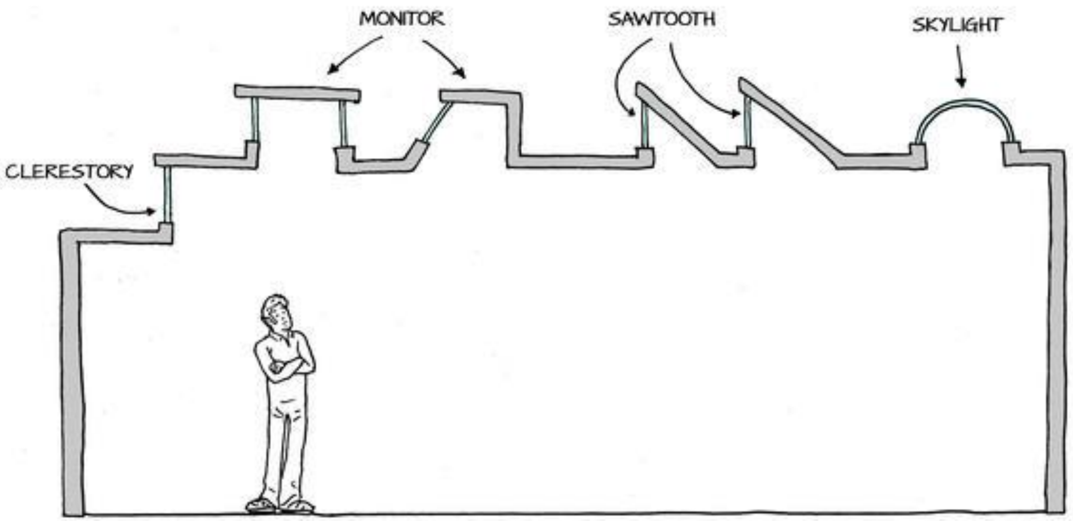




Toplighting

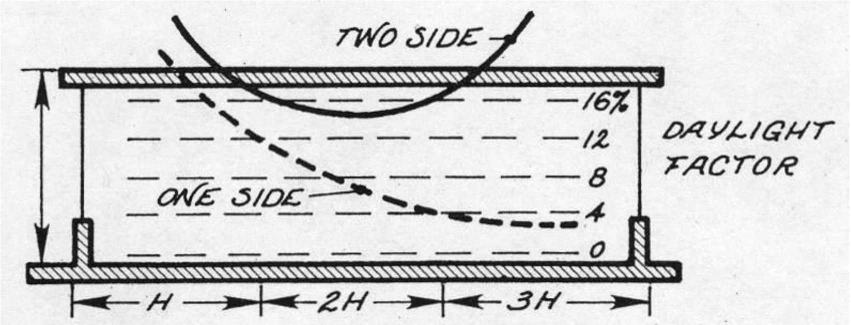
- Most effective: clerestories or roof monitors
- Use of sky light requires a special balance between lighting needs and the reduction of solar heat gain.
- An initial design starting point is to target approximately 7-10% as a glazing-to-floor area ratio for toplighting.
- Clearstories work best if they face either north or south
- If facing south, baffles or diffuse glazing might be needed to eliminate direct solar gain and glare.





Bilateral daylighting

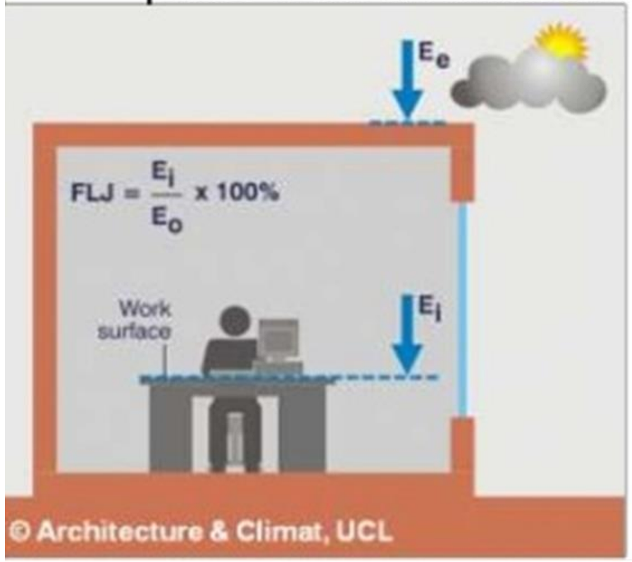
- The highest quality daylighting conditions since it balances the lighting-level distributions in the space.
- Reduces glare and high contrast ratios that can result from side-lighting alone

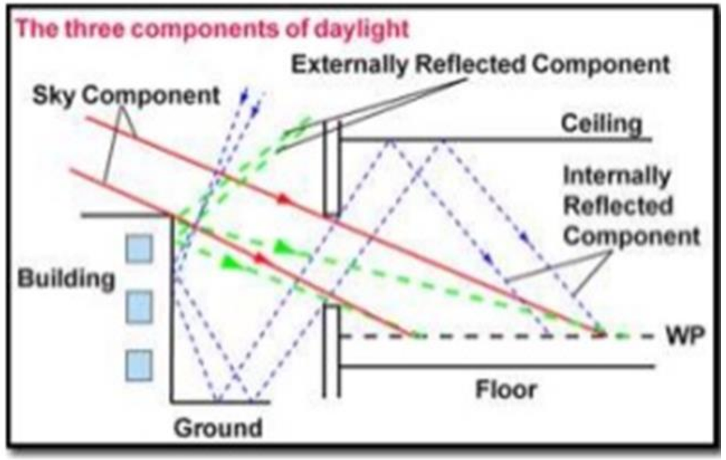


Good daylighting addresses both the quantity and quality of light. When examining issues such as glare and contrast, actual foot-candle measurements, relative values, and distribution provide a more accurate picture.

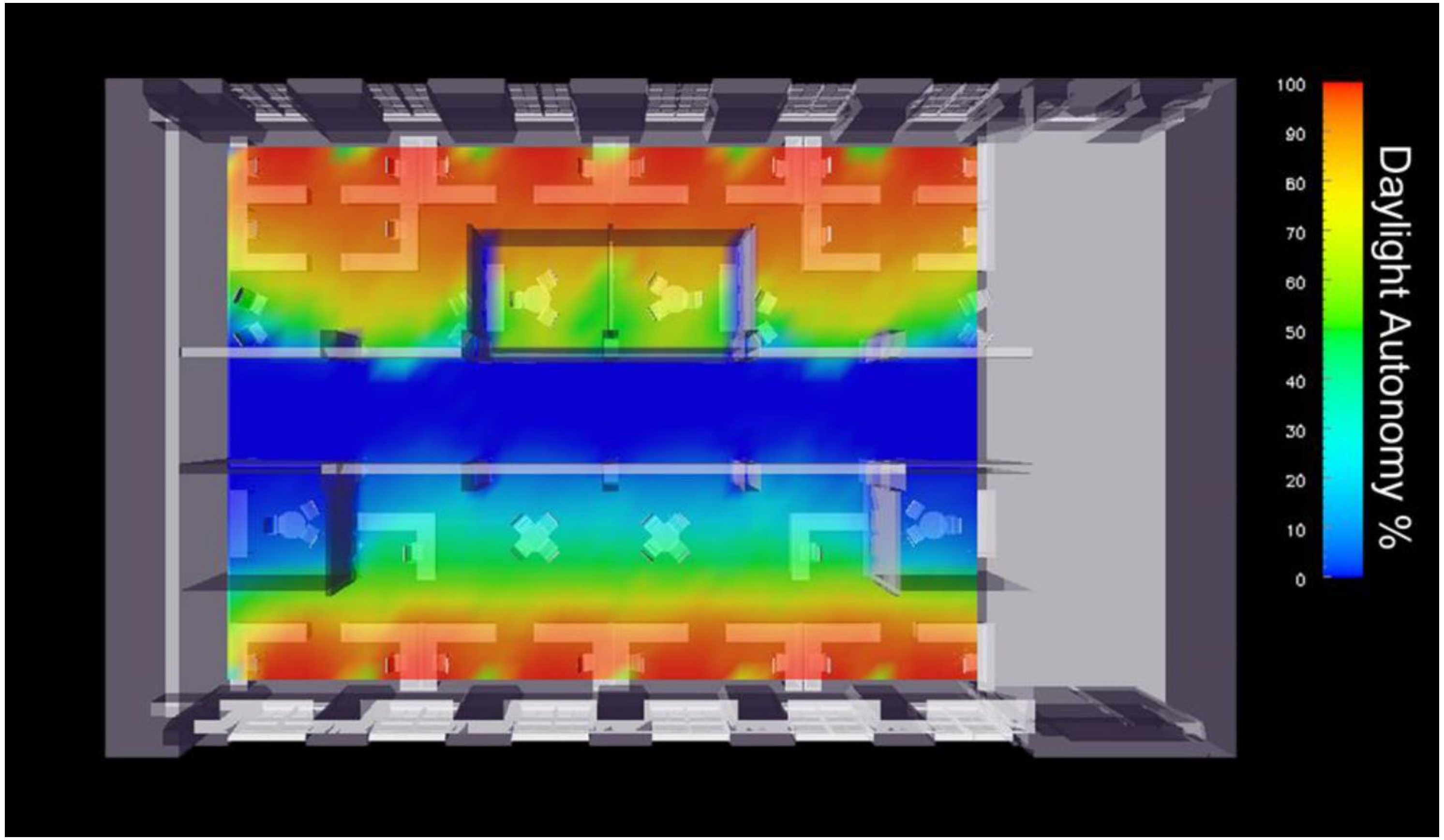
Daylight factor

- Daylight Factor is the ratio of the internal light level to the external light level
- DF=(Ei/Eo) x 100%
- E_i = illuminance due to daylight at a point on the indoors working plane
- E_o = simultaneous outdoor illuminance on a horizontal plane from an unobstructed hemisphere of overcast sky





Ei=SC+ERC+IRC



Daylight Autonomy

- Daylight autonomy is the percentage of time that daylight levels are above a specified target illuminance within a physical space or building.
- Achieving daylight autonomy requires an integrated design approach that guides the building form, siting, climate considerations, building components, lighting controls, and lighting design criteria
- Tools: SPOT

Lighting Simulation Software Tools

- Key criteria for daylighting:
  - Even distribution of light
  - Minimal glare
  - Low contrast ratio
- Tools:
  - Radiance
  - Lumen Designer
  - AGI32
  - ECOTECT
  - IES-VE
  - DYSIM

Program outputs:

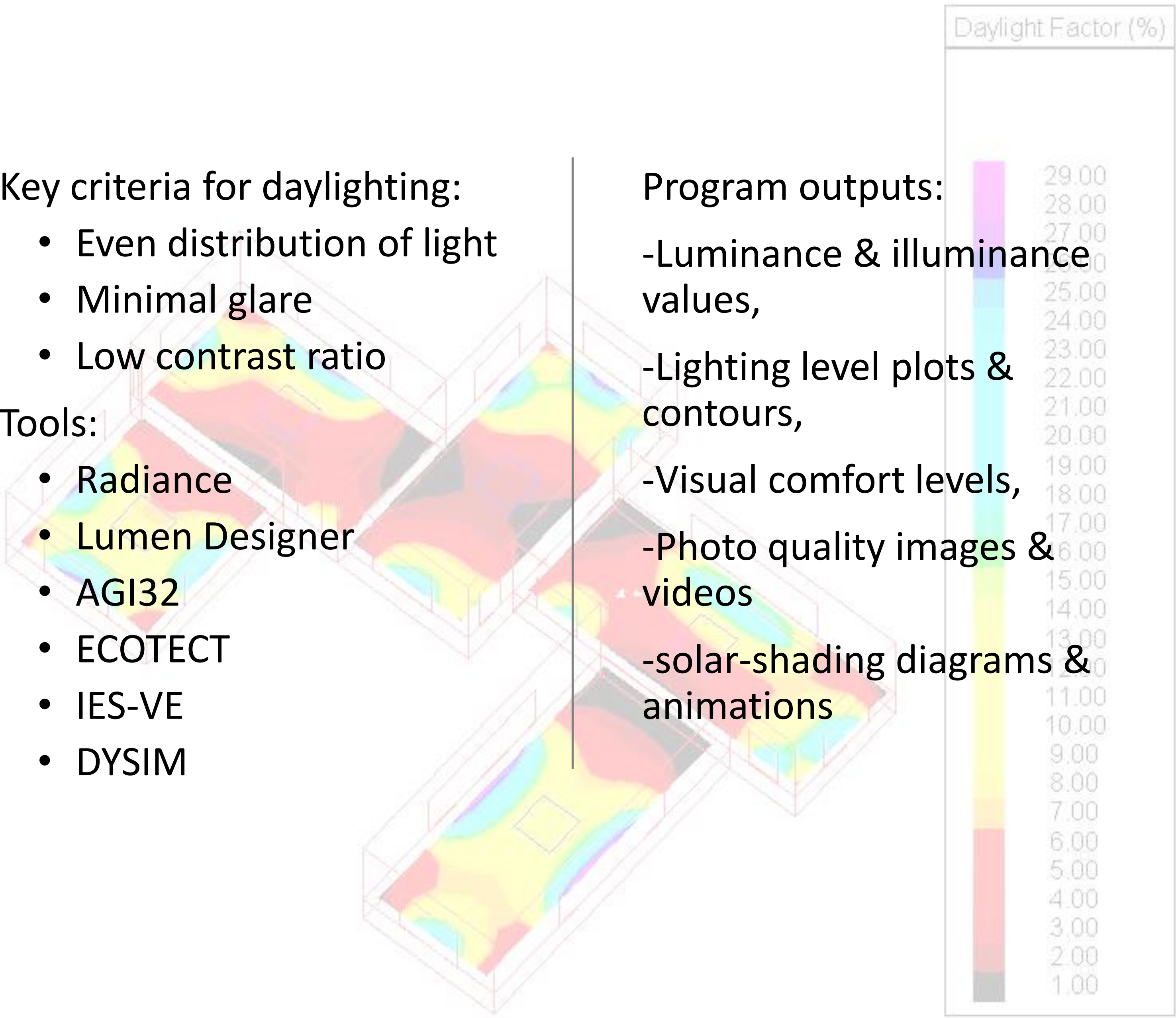
-Luminance & illuminance values,

-Lighting level plots & contours,

-Visual comfort levels,

-Photo quality images & videos

-solar-shading diagrams & animations



Water

- Evaluate integrative solutions for water conservation, water quality, and water balance strategies.
- Use water for multiple purposes as it moves through the building and the site.
- Use Technical solutions only where it is needed!

Energy-Discuss Operations

Decide on	Decide on comfort ranges and adaptive thermal comfort parameters.
Assess	Assess level of automation vs. active participation in operations.
Evaluate	Evaluate the level of sophistication of maintenance and operations staff in relation to the desired complexity of controls systems.
Identify	Identify actual occupancy schedules.
Establish	Establish criteria for determining service life of mechanical systems.
Discuss	Discuss potential local incentives, rebates, grants, and other funding sources related to energy efficiency.

Materials

- Establish structural system materials options and parameters.
- Establish building service life criteria for architectural and structural systems.
- Prioritize environmental indicators for informing LCA-based materials decisions & selections.

Other steps during Workshop No. 3

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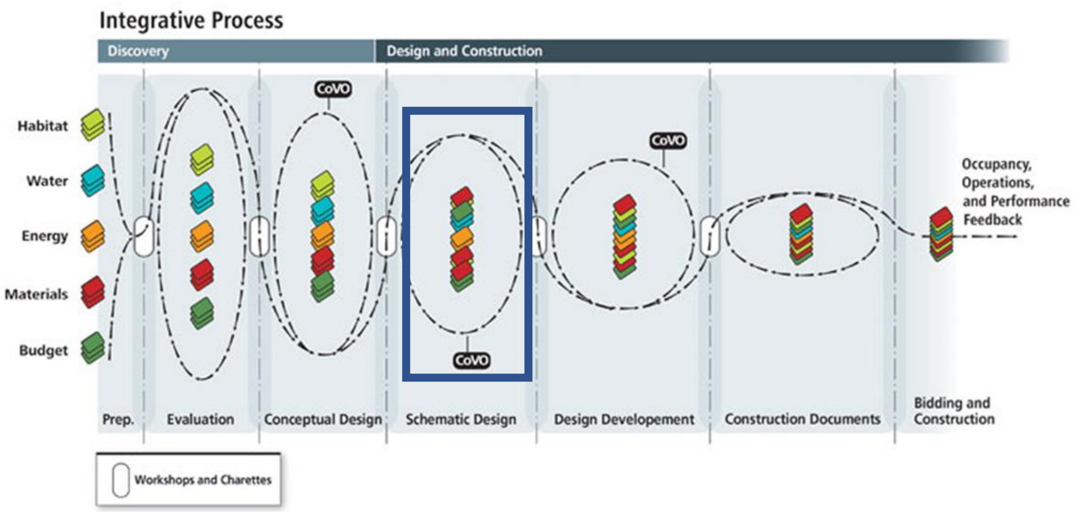
Distribute Workshop No. 3 Report

- Meeting agenda
- Lists of attendees
- Photos of activities
- Images of all sketches of proposed solutions
- Meeting notes recording additional findings, results, reflections, etc.
- Updated Metrics and Performance Targets, include updated LEED checklist (if applicable)
- Updated integrative cost-bundling template
- Process Road Map spreadsheet of schedule and tasks
- Updated OPR and BOD
- Next steps



Research & Analysis: Schematic Design

Stage B.2

Research and Analysis: Schematic Design—Bringing It All Together (and now committing to building form)

B.2.1 Research and Analysis Activities: Schematic Design

- Engage a more informed schematic design process and develop building form solutions from conceptual sketches produced in Workshop No. 3.
- Iterate, iterate, iterate, with meetings, conference calls, etc., to integrate the four key subsystems with building form
  - Habitat
  - Water
  - Energy
  - Materials

B.2.2 Principles and Measurement

- Test building performance in detail and evaluate results against Performance Targets
- Commissioning: Adjust the OPR and BOD to reflect proposed schematic design

B.2.3 Cost Analysis

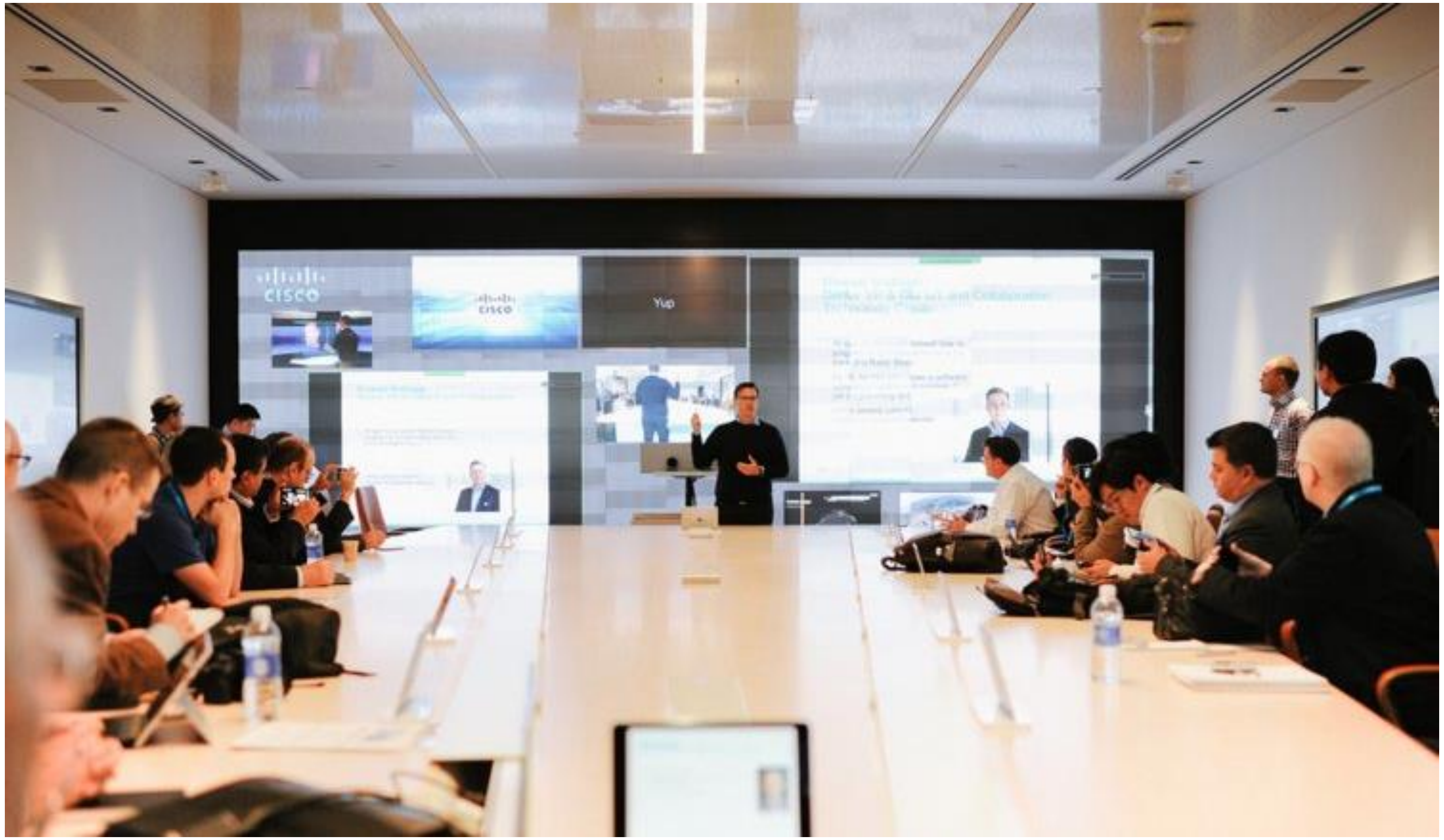
- Refine integrated cost bundling numbers to ensure that proposed schemes, systems combinations, and cost scenarios can be evaluated with increasing accuracy

B.2.4 Schedule and Next Steps

- Adjust and prepare Integrative Process Road Map for team review to include tasks and schedule impacts that have emerged from schematic design discoveries
- Prepare Agenda for Workshop No. 4

Engage a more informed schematic design process and develop building form solutions from conceptual sketches produced in Workshop No. 3.

- The architect dive headlong into developing
    - Design solutions,
    - Building form,
    - And aesthetic iterations
- The design palette enriched with a wider range of possibilities and potentialities than in a conventional process.
- Design decisions not being driven merely by building form and aesthetic considerations; rather, by performance analyses, and system interactions.



Iterate, iterate, iterate, with meetings, conference calls, etc. to integrate the four key subsystems with building form

-The success of integrating the key subsystems depends upon how much exploratory work is done previously.

-Environmentally effective design solutions require very quick cycles of iteration between the key systems in the project to explore their interrelationships.

-These issues are addressed at interim meetings, within and across disciplines.

-The sessions are informed by using various tools.

-As integrative solutions are developed, the dividing lines between the four key subsystems begin to blur.

Habitat (biotic systems other than human)

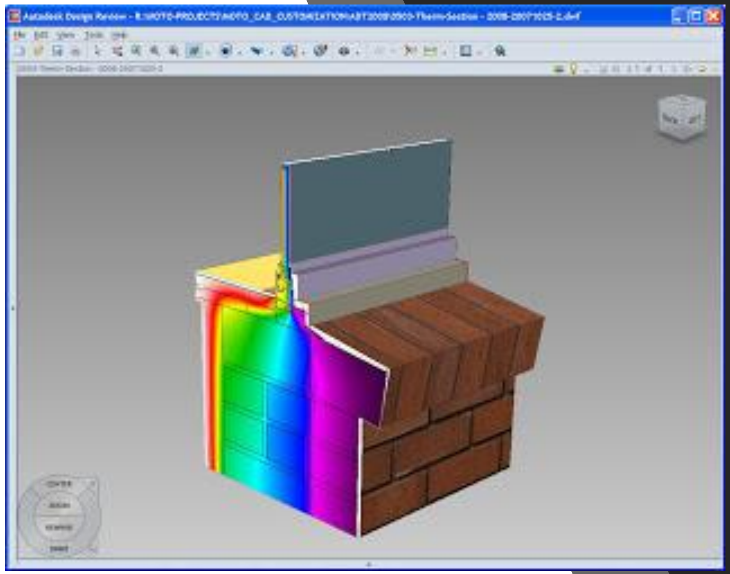
Explore strategies and components that promote habitat and biodiversity in ways that also can be synthesized with other systems, such as rainwater, wastewater, energy, etc.

Example: Green roofs, Earth sheltered buildings

Habitat (human)

- Explore interrelationships between indoor environmental systems and components that impact human health, performance, productivity, and quality of life.
- Use of Solar path finder tools or software programs such as SketchUp and ECO-TECTS

Thermal Comfort Analysis



- Determine final comfort settings and parameters
- Determine the level of individual control
- Begin to examine the effects of issues related to the interaction of HVAC system components.
- Thermal analysis modeling- Tools: TRNSYS
- Evaluating Specific envelope configurations to determine heat-transfer effects for:
    - Identifying thermal bridging => identifying potential issues related to condensation, moisture problems, cold surfaces, and heat loss
- Tools: WINDOW & THERM 5.2

Ventilation Analysis

- Determine the location(s) of outside air intakes and coordinate with roof material selection.
- CFDs: model airflow, heat transfer, & thermal comfort

Software packages: Fluent, Design Builder

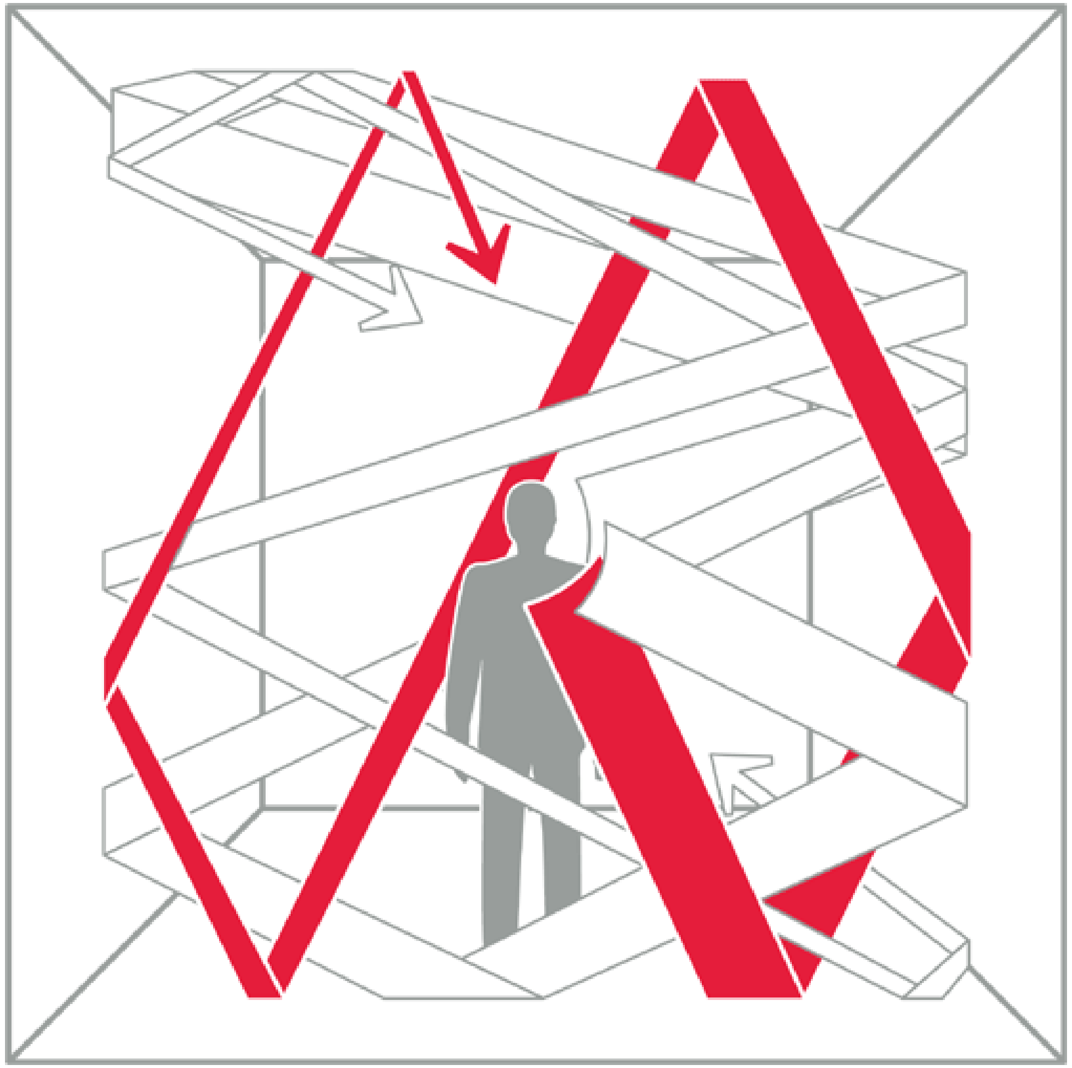
- Pollutant source control:

Elimination of cross-contamination: explore ways to reduce exhaust duct runs & fan capacity by grouping or stacking such spaces.

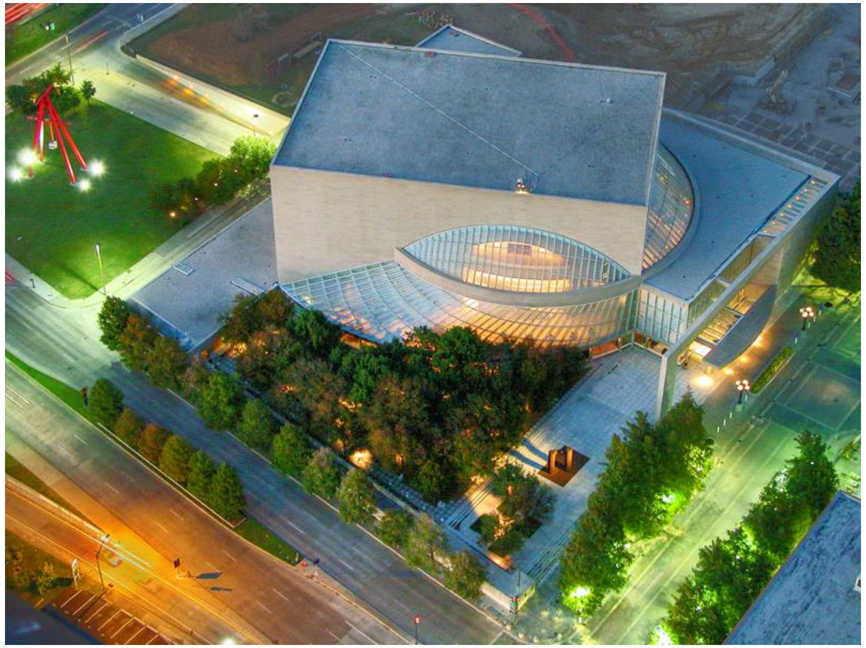
Acoustics

Identify acoustical properties and performance targets' impacts on:

- Scale & Form of rooms
- Architectural configuration
- HVAC system components,
- Materials selection
- Electro Acoustics systems

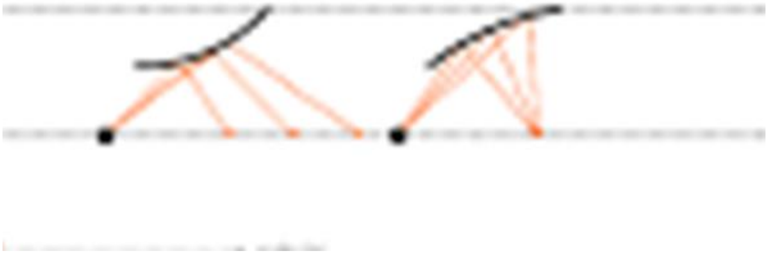


Acoustics- scale & form: opportunities for integration



- Acoustically superb buildings: Radical insight into the geometry
- The most cost-effective way to control noise:

Location



Acoustics- Materials: Opportunities for integration

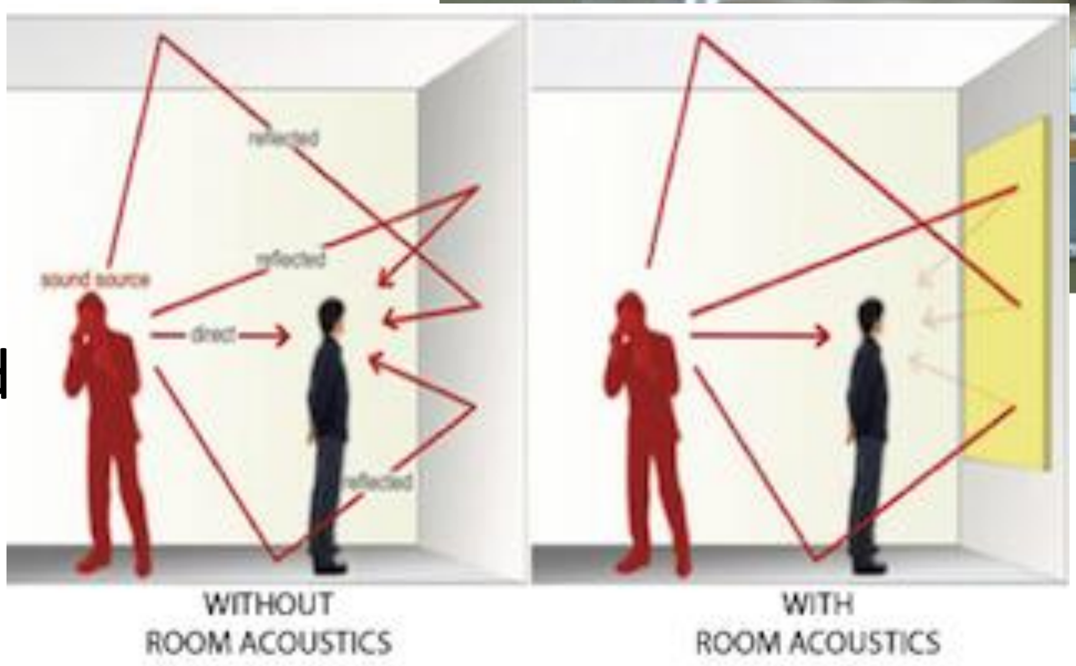
Materials affect sound by:

- Absorbing/barrier to sound
- Reflecting/scattering sound

The most common acoustical treatment:

A suspended ceiling:

Acoustic tiles to reflect light, hid unsightly structure, and control excessive reverberation.



Acoustics- Mechanical & Electrical systems: Opportunities for integration

- Surfaces with an acoustic function such as acoustic “clouds” can help in distributing air; architectural aesthetics,
- White noise from air-distribution can contribute to speech privacy.
- Supplying air from below & returning it high:

- quitter,

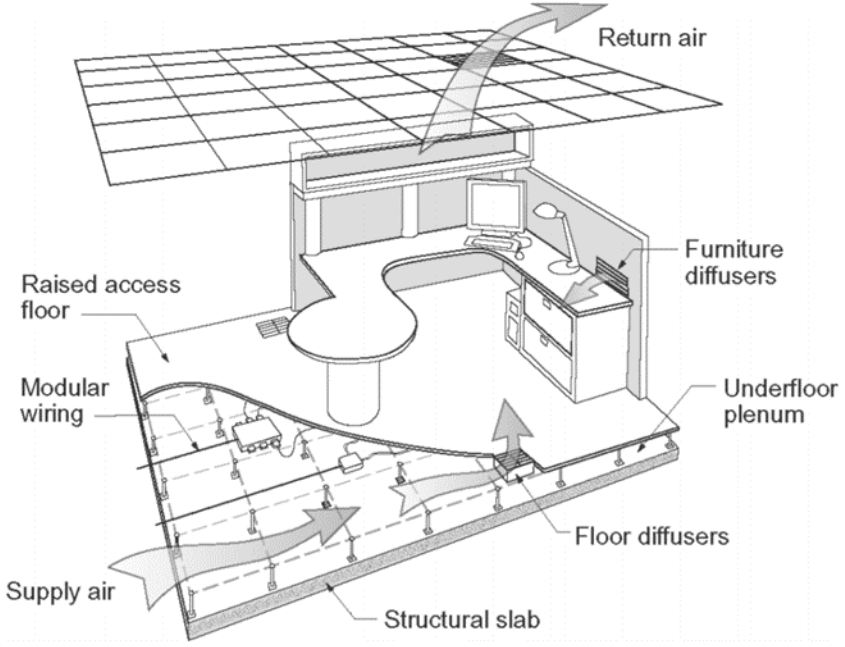
- Individual user control,

- more versatility

- more energy efficient,

- removes contaminants from the air.

- Reduced floor to floor height



Water

- Reducing water demand via low-flow fixtures- can reduce demand to 50%
- For flushing toilets, irrigation, and groundwater recharge use:

-cooling system condensate water,

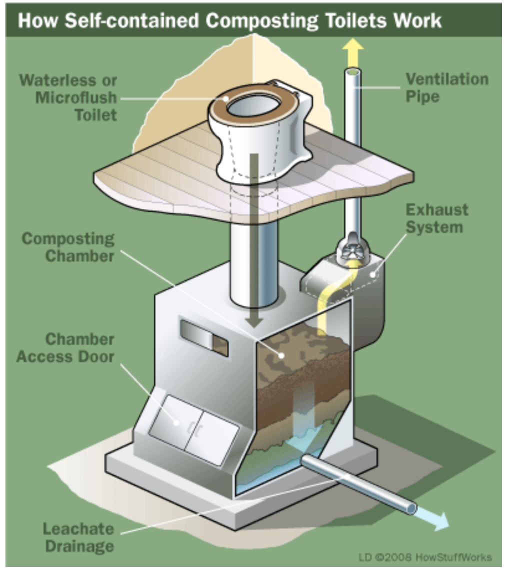
-graywater,

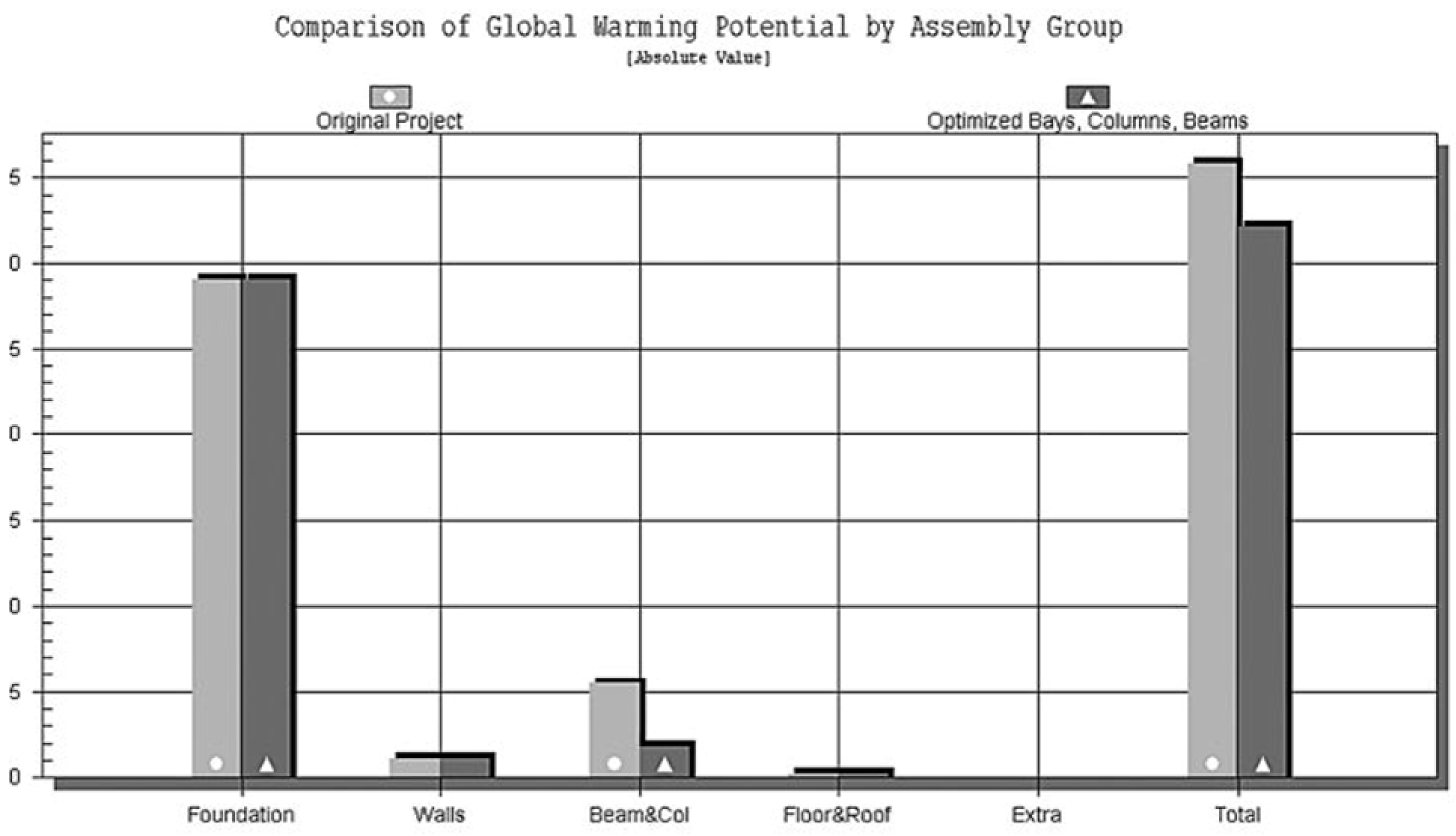
-captured rainwater

- Explore treatment of wastewater from toilets in constructed wetlands (could be recirculated back into the building)

-Where the larger hydrological loop is being considered low-flow toilets may not be desirable!

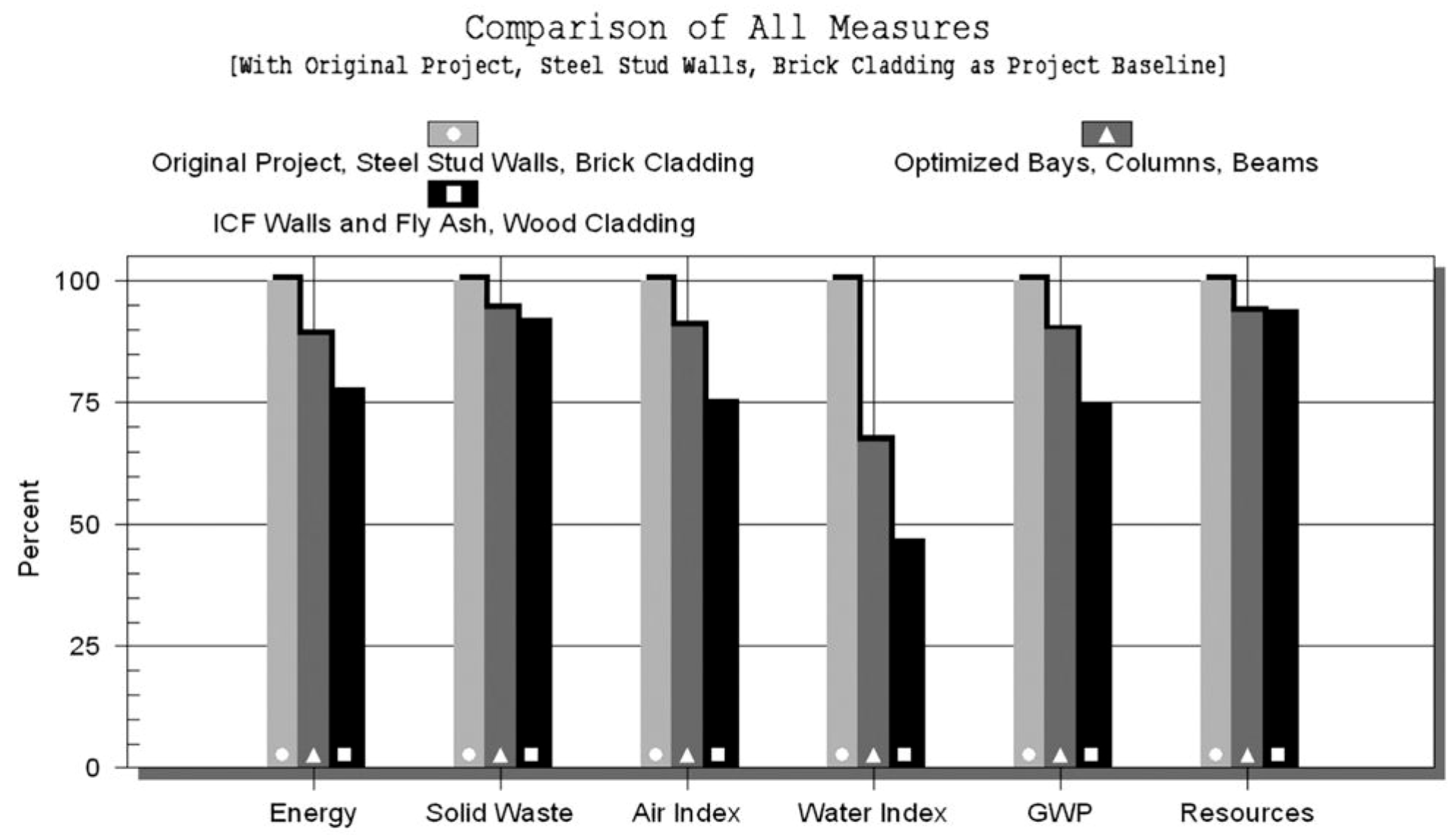
- Consider using composting toilets!





Materials

- Review comparisons of assembly options (based on LCA analysis)
- Review the largest impacts by building assembly and seek opportunities for reducing impacts.
- Review all opportunities to optimize sizing for bay-spacing, columns and beams, floor, and roof decks.
- Consider all structural innovations that reduce material needs.



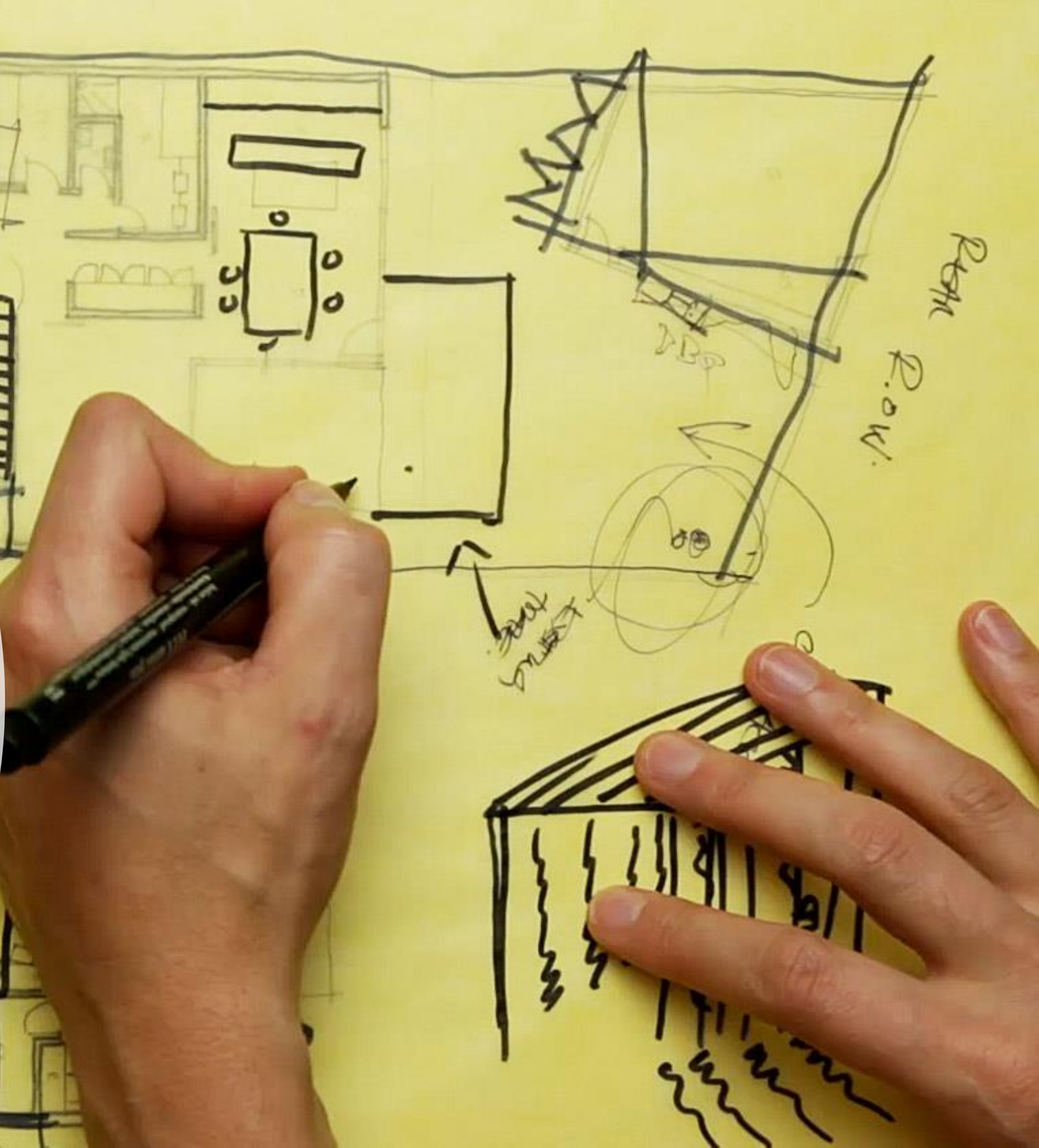
Comparison of All Measures
[With Original Project, Steel Stud Walls, Brick Cladding as Project Baseline]
Original Project, Steel Stud Walls, Brick Cladding
Optimized Bays, Columns, Beams
ICF Walls and Fly Ash, Wood Cladding
Percent
100
75
50
25
0
Energy
Solid Waste
Air Index
Water Index
GWP
Resources

Cost Analysis

- Refine integrated cost bundling numbers to ensure that proposed schemes, systems combinations, and cost scenarios can be evaluated with increasing accuracy
- Cost bundling approach vs. line item approach

Prepare Agenda for Workshop No. 4

- The scope of possible design solutions is narrowed down to a single architectural solution, with possible variations.
- All MEP and other systems are evaluated in parallel with architectural solutions.
- Agenda for workshop No. 4 can be more focused on presenting holistic solutions/ finalizing major design decisions.



Questions to Consider for writing the Reflections:

WHAT DID YOU LEARN FROM THE DESIGN CHARRETTE CONDUCTED ON YOUR STUDIO PROJECT? HOW DO YOU THINK IT CAN BE IMPROVED?

Preparation Reading for Next Class:

Subject:

Design Development & Construction Documentation Phase in IDP process