
BILTMORE
phius
PRO FORUM

SUSTAINABLE COMFORT

Best Practices: Building an Integrated Team

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About SCI

- Consulting
  - High Performance Design + Architectural Design
  - Existing buildings
  - HERS Rating and Verification
- Property Management
- Construction
- Development

Outline

- **What is integrative project delivery?**
  - General principles
  - Who is part of the team
    - Phius Team Roles
- **IPD at various stages of a Passive House project**
  - Diagnosis and Sales
  - Feasibility Study
  - Design Development
  - Construction
- **Questions?**

WHAT IS INTEGRATED PROJECT DELIVERY?

Integrated Project Delivery

Understanding the types of project delivery methods

1. Design- Build (DB)
2. Design-Bid-Build (DBB)
3. Construction Manager at Risk (CMAR)
4. **Integrated Project Delivery (IPD)**
5. Public-Private Partnership (P3)
6. Construction Manager Multi-Prime (CMMP)

Conventional Design Process

- Involves team members only when essential.
- Less time, energy, and collaboration in the early stages, but more time spent on the latter end.
- More decisions made by fewer people.
- Linear process.
- Systems often considered in isolation.
- Limited or constrained optimization.
- Diminished opportunity for green building and resilient synergies.
- Emphasizes upfront costs
- Typically finished upon construction
- Higher potential for cost overruns, delays, and change orders.

Integrated Design Process

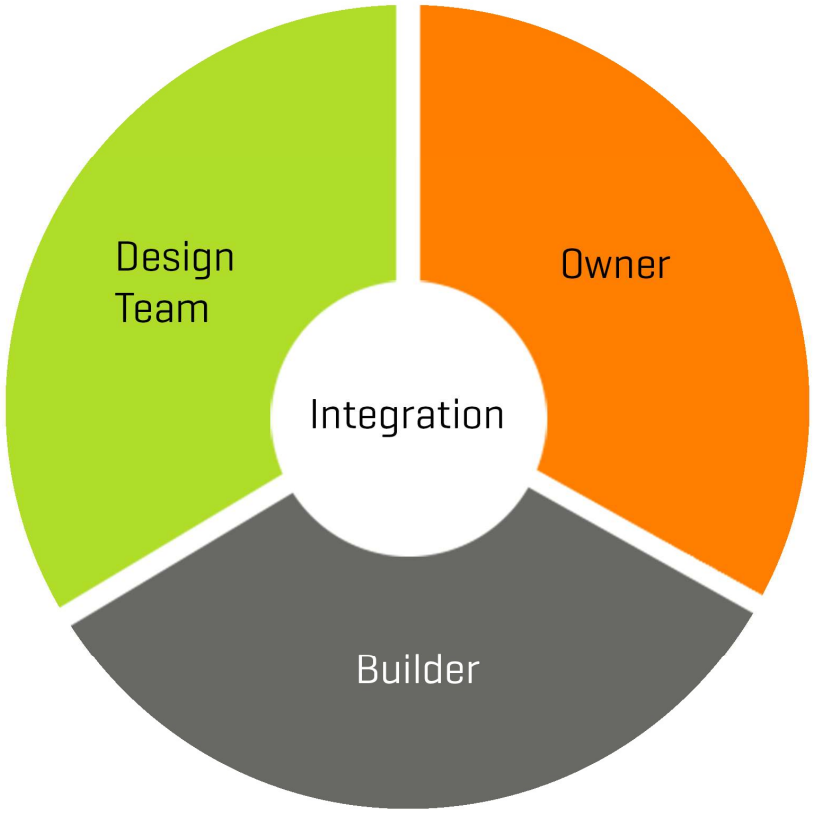
- Inclusive from the outset
- Front-loaded time and energy, but far less time spent later on during the project.
- Decisions influenced by a broad team.
- Iterative process.
- Whole-systems thinking.
- Allows for full optimization.
- Maximizes opportunity for green building and resilient synergies.
- Utilizes life-cycle costing.
- The process can continue through post-occupancy.
- Planning/iterative process minimizes costs overruns, delays, and change orders

Integrated Project Delive

American Institute of Architects (AIA) Definition:

Integrated Project Delivery (IPD) integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all participants. The goals of IPD are to **optimize project results**, increase **value to owners, reduce waste,** and **maximize efficiency** through all phases of design, fabrication, and construction.

IPD principles can be applied to a variety of contractual arrangements. IPD teams can include members beyond the owner, architect, and contractor. In all cases, integrated projects are uniquely distinguished by **highly effective collaboration** between the owner, the prime designer, and the prime constructor, **beginning at early design** and continuing through project handover.



AIA Guide to IPD: https://www.aia.org/sites/default/files/2023-11/ipd_guide.pdf

Integrated Project Delivery

IPD and Sustainability

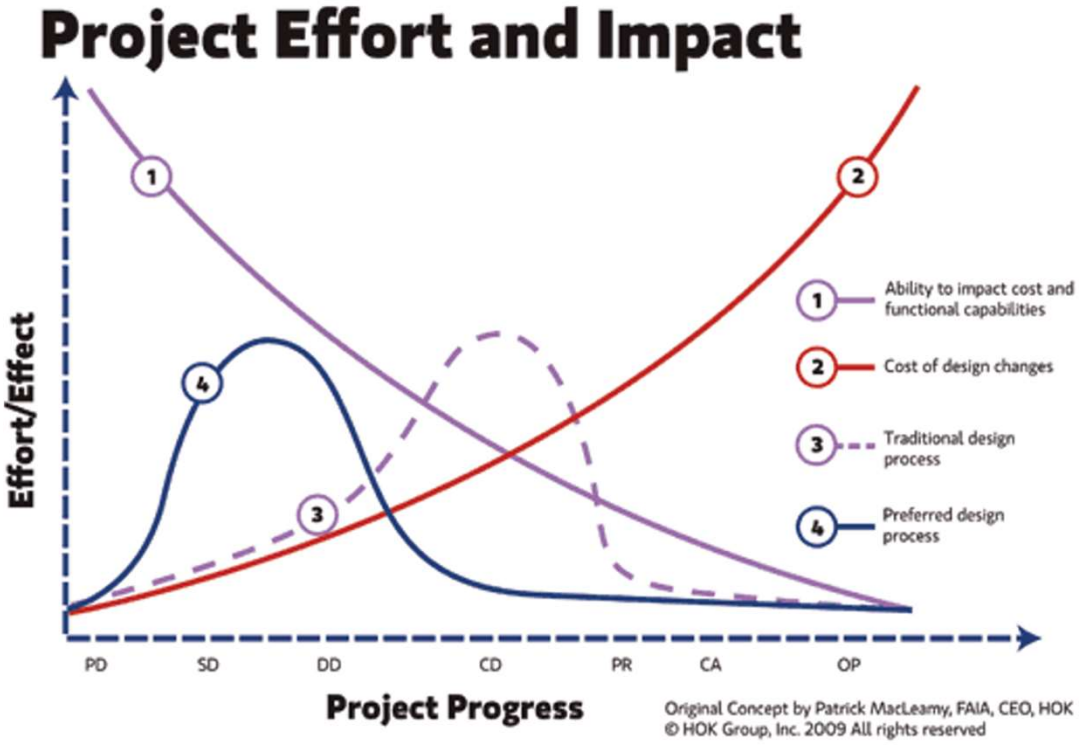
An integrated design process can result in a project that:

- Increases the opportunity to achieve more aggressive sustainability goals
- Optimizes energy efficiency and incorporates alternative energy solutions
- Recognizes and plans for synergies between green building and resilient design
- Moves beyond minimizing environmental impacts to creating positive, regenerative impacts on the environment
- Maximizes cost effectiveness

NJ GREEN BUILDING MANUAL

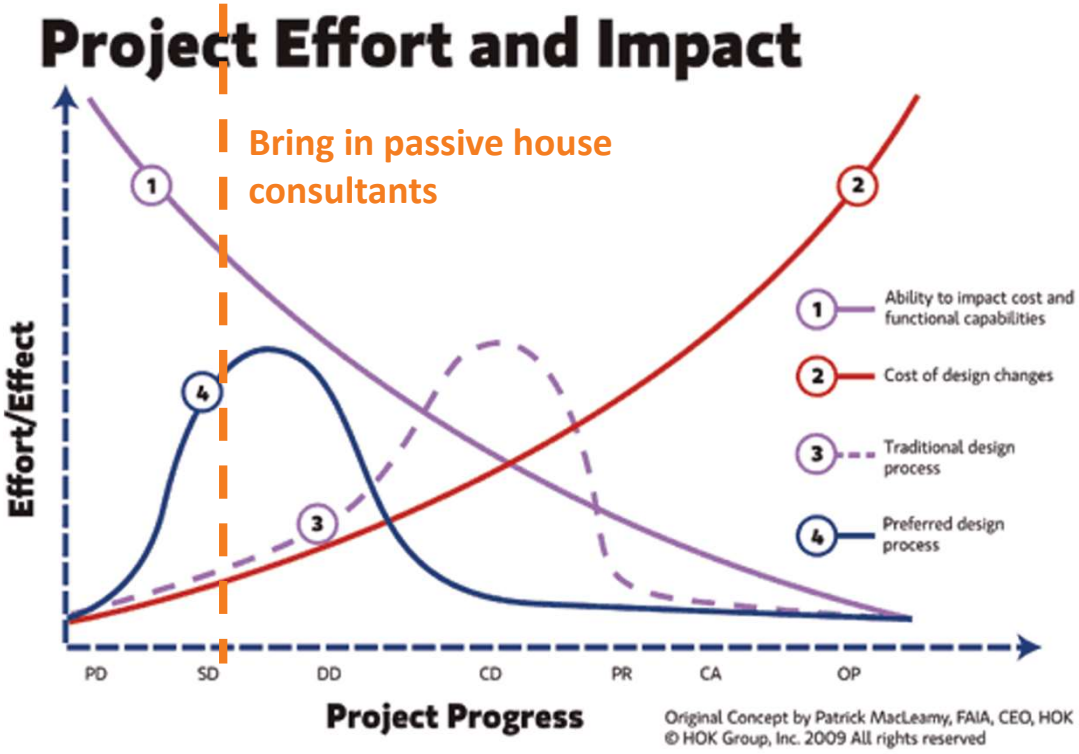
NJ Green Building Manual: https://greenmanual.rutgers.edu/nr-integrated-design-process/

Project Effort and Impact



Original Image from AIA

Project Effort and Impact



Original Image from AIA

Phius Roles

- Client or Project Owner
- Project Submitter
- Phius Certified Consultant: CPHC®
- Phius Certified Builder: CPHB
- Phius Certified Rater/ Verifier
  - Rater: required on Single-family projects
  - Verifier: required for non-residential and multifamily projects

Expanded Passive House Project Team Roles

- Owner
- Architect
- Builder
- Rater/Verifier
- CPHC
- **Funding Agency**
- **Sustainability Consultant**
- **Owner's rep**
- **MEP Engineer**
- **Landscape Architect**
- **Structural Engineer**
- **Interior Designer**
- **Property MGMT**
- **Utility Company**
- **Municipality**
- **Solar Provider**

Photo by fauxels

DePaul Pan-American Square, Buffalo, NY

DEPAUL SWBR CHRISTA CONSTRUCTION SUSTAINABLE COMFORT ME ENGINEERING C&S COMPANIES

West Side Homes, Buffalo, NY

PUSH BUFFALO
PEOPLE UNITED FOR SUSTAINABLE HOUSING

STIEGLITZ SNYDER ARCHITECTURE

CHRISTA CONSTRUCTION

eco_logic STUDIO

Pathfinder Engineers & Architects

NEW YORK STATE | NYSERDA

SUSTAINABLE COMFORT

625 West Ave

- 15 Units
- iCFA 17,044 ft2
- GSHP Space Cond. & DHW.
- Phius 2018 Almost Certified
- Source Zero

146 Rhode Island

- 4 Units
- iCFA 4,612 ft2
- ASHP and HPWH
- Phius 2018 Certified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“What creates the difference between a frustrating project and a fulfilling project? Everyone we’ve talked to mentions **education**, alignment around **purpose**, **reduced ego**, and **clear direction.**”

-Bill Reed, Regenesis Group

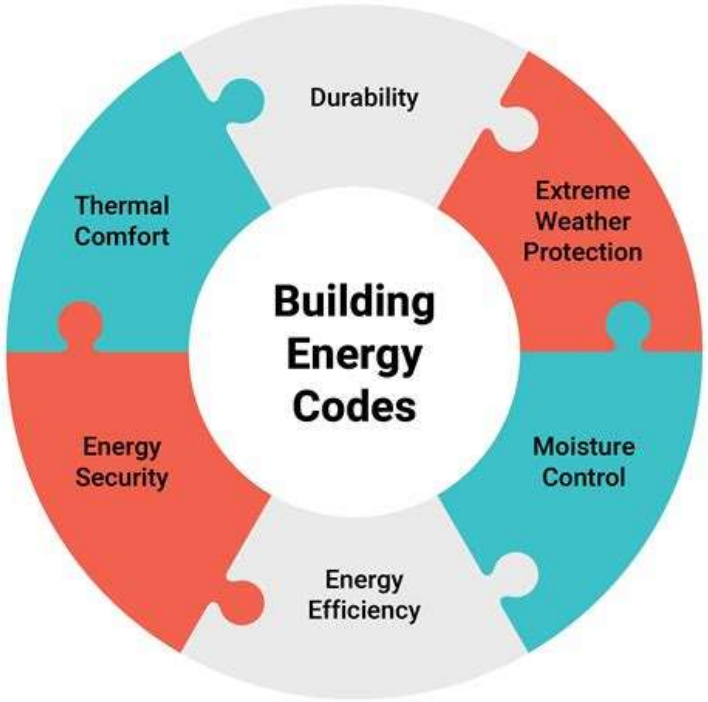
IPD at Various Stages of A Passive House Project

- Diagnosis and Sales
- Sales to Design Handoff
- Feasibility Study
- Design Development to Design Certification
- Design to Construction Handoff
- Construction Kick-off / Contractor Orientation
- Construction and Verification Phase
- Project Closeout

Diagnosis and Sales

Diagnosis

https://codes4climate.efficiencycanada.org/wp-content/uploads/2021/04/C4C_BuildingEnergyCodes.png



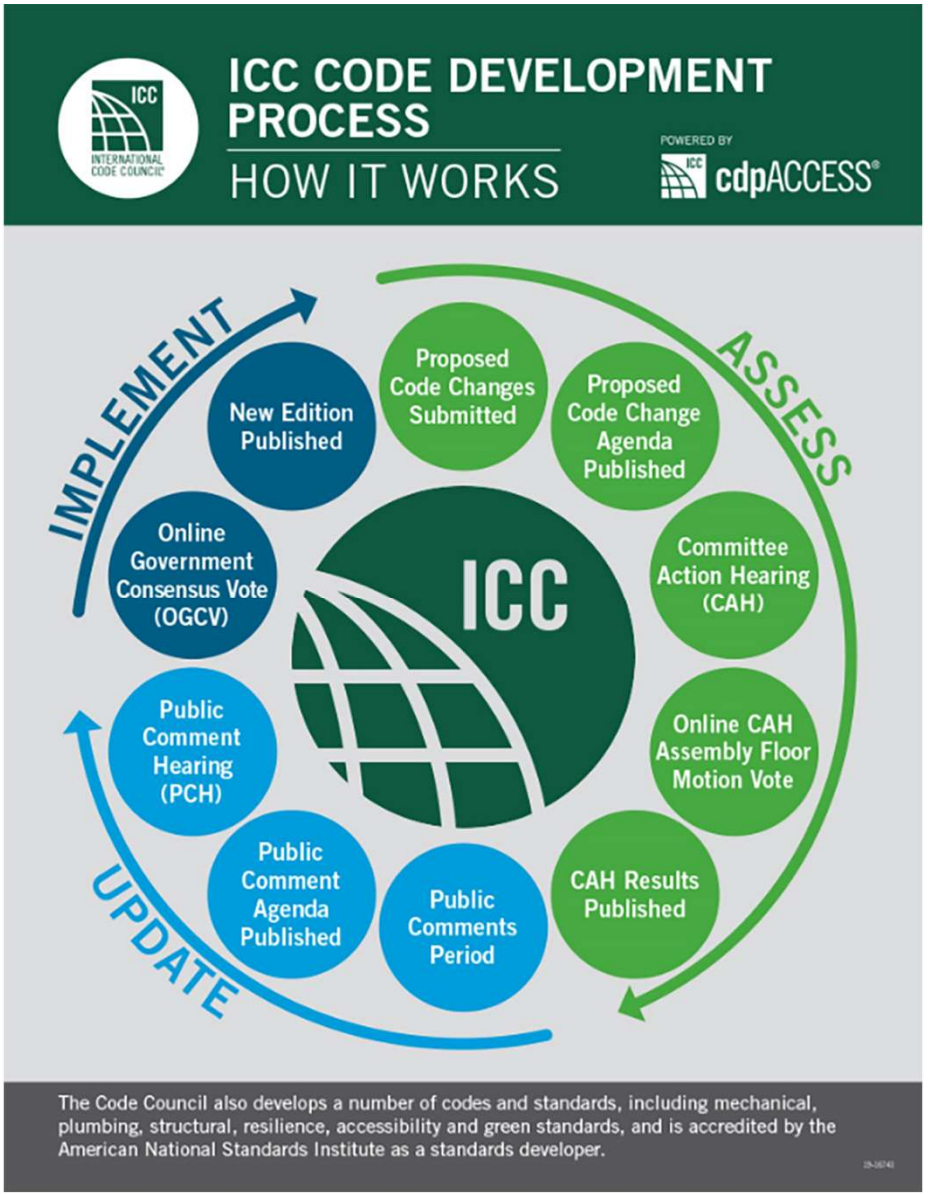
https://en.pimg.jp/014/783/796/1/14783796.jpg

Diagnosis

- Energy codes
  - Requirement vs Want
- Available incentives
  - Larger incentives associated with Phius
- Funding opportunities/requirements
  - Competitive points are offered with Phius certification
  - Loan interest saving
- Project Type and complexity
  - DER/Existing vs New Construction
  - Multifamily vs Townhome/8-plex
- Overall goals
  - Lower operating cost

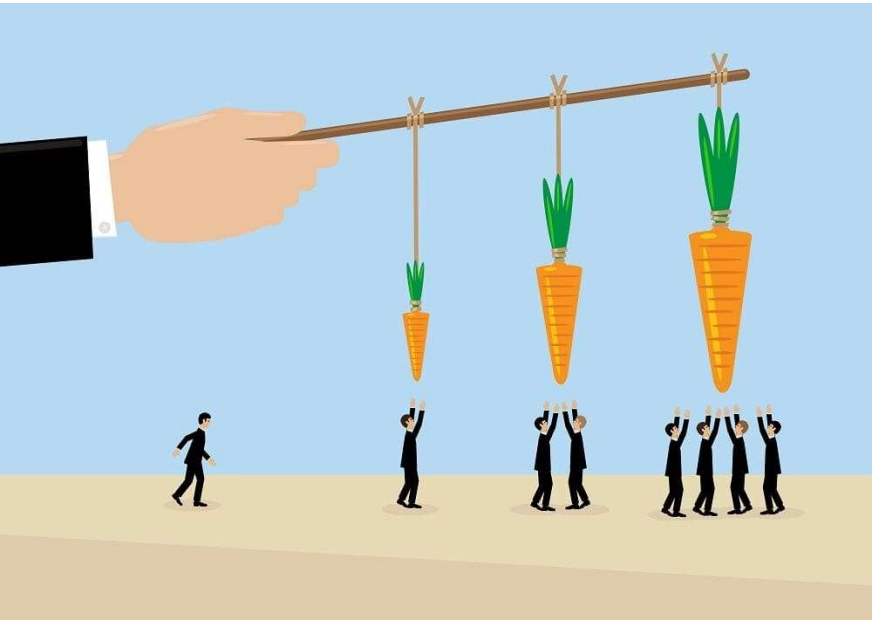
https://www.istockphoto.com/photos/magnifying-glass-building

Energy Code


ICC CODE DEVELOPMENT PROCESS
HOW IT WORKS
POWERED BY cdpACCESS®
IMPLEMENT
ASSESS
UPDATE
New Edition Published
Proposed Code Changes Submitted
Proposed Code Change Agenda Published
Committee Action Hearing (CAH)
Online CAH Assembly Floor Motion Vote
CAH Results Published
Public Comments Period
Public Comment Agenda Published
Public Comment Hearing (PCH)
Online Government Consensus Vote (OGCV)
ICC
The Code Council also develops a number of codes and standards, including mechanical, plumbing, structural, resilience, accessibility and green standards, and is accredited by the American National Standards Institute as a standards developer.

Incentives

Aligning Energy Efficiency Program Objectives with State Policy Goals



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Savings through energy efficiency

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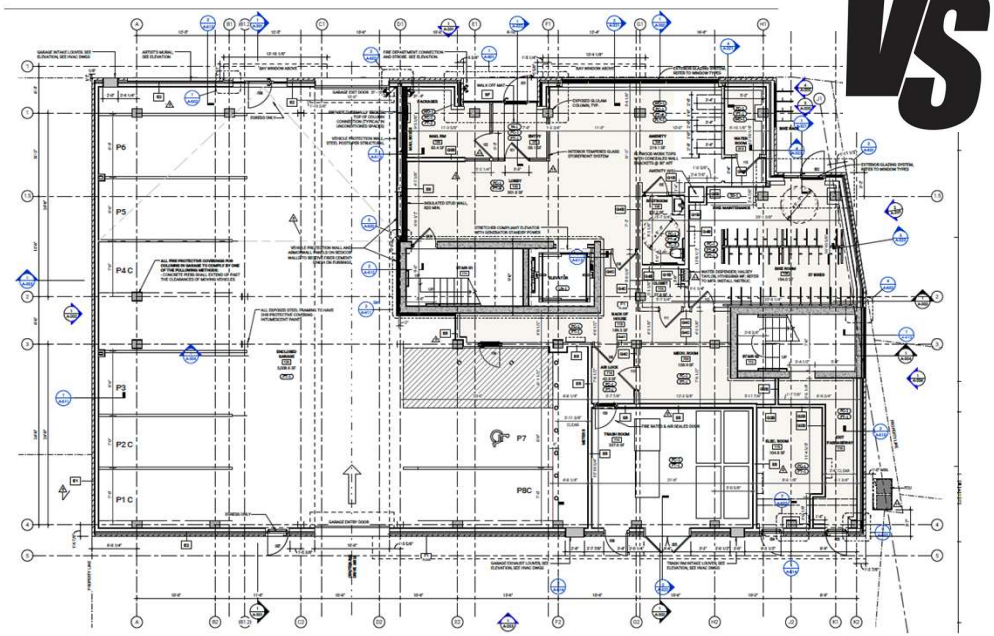
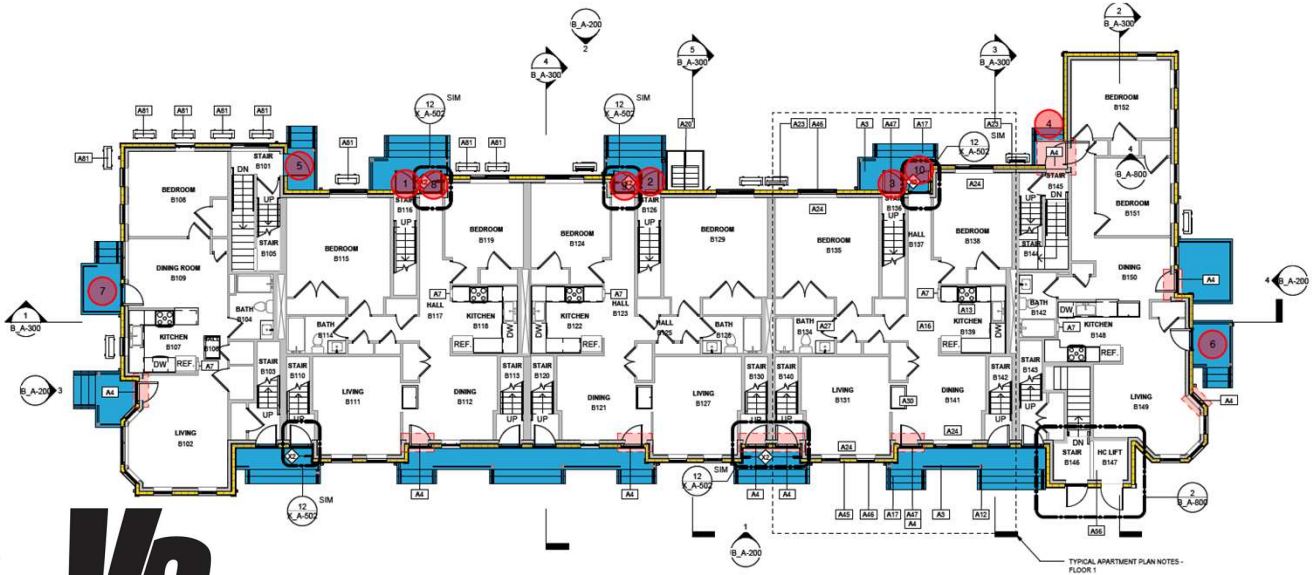
Scope of Work

- Passive House
  - Design
    - Feasibility
    - Building complexities
    - Team experience
  - Verification
    - Testing complexities
    - Building readiness
      - Mid-point testing
      - General contractor support

Testing Plan



Vs

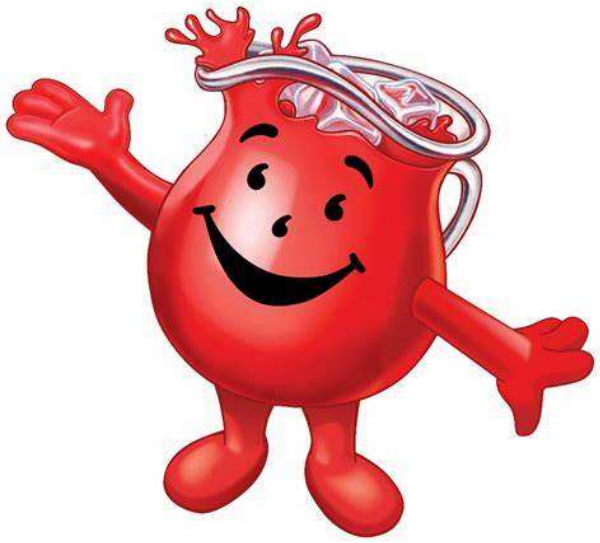


Sales to Design Handoff

- Assemble internal team
  - CPHC
  - Verifier
  - Project Manager
- Connect / assemble external team
  - Verifier
  - GC should have someone on staff with Phius training/previous PH experience
- Information transfer
  - Co-requisites
  - Additional green programs
  - Additional mandatory regulations

Credit: iStock, Richvintage

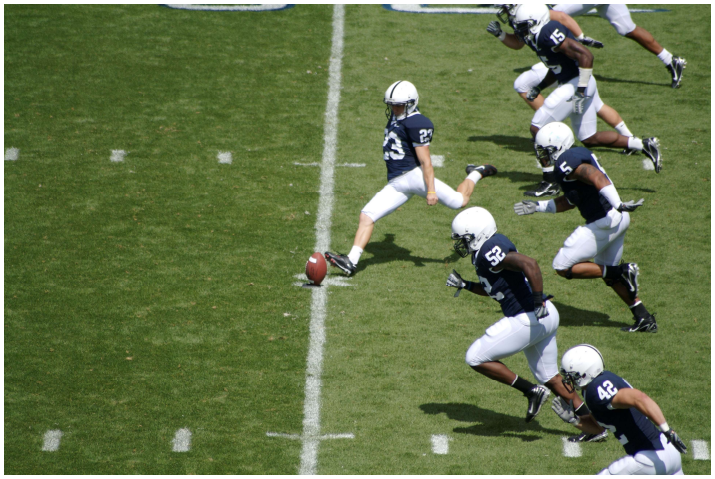
Who drank the Kool-Aid?



- Owner is passionate vs checking a box on an incentive program
- Contractor wants to do things the way they've done it for 30 years vs has their CPHB and is excited about the challenge
- MEP has experience from previous PH project vs thinks it's just an annoying added burden
- The team has worked together on previous projects
  - Lather rinse repeat – why it does not always work.

Kick-off Meeting

- Listen and Educate
- Talk in more detail (generic) about PH requirements.
  - Provide starting point for assembly R-values and system efficiencies
  - Keep ducts short & insulation
  - DHW distribution
  - Overall expectations about window performance
  - Make sure they fully understand air leakage requirements and potential challenges
- A time to listen for feedback and owner preferences
  - Provides context for feasibility study
  - Kitchen range exhaust, DHW, Duct ventilation



Examples of Owner Non-Negotiables

- Won’t do central HP DHW and do not like unitary HP units.
- Want individual ERV’s so in each independent unit for homeowner. MOH program
- IAQ concerns and will not install recirculating range hoods.
- Must have large windows due to marketability.
- Property MGMT. must be able to access ERV units from exterior to change filters. Unwilling to enter each unit.
- Do not want to change one ERV filter per unit = Semi Central approach
- Looking to contain costs and not install PV.

Feasibility Study

Feasibility Study

What will it take to make this project a successful passive house project?

- Study the design and perform energy modeling for preliminary results.
- Compile findings and recommendations into a report and meet with the project team to review.
- Meet with the entire design team meeting to review. Includes ownership/development, design and any other consultants.
- Takes place during the SD phase, sometimes even earlier.
- More info supplied to CPHC means more impactful report.
- Mass Save through ICF requires the review meeting as part of the incentive.

Information Requirements for Feasibility Study

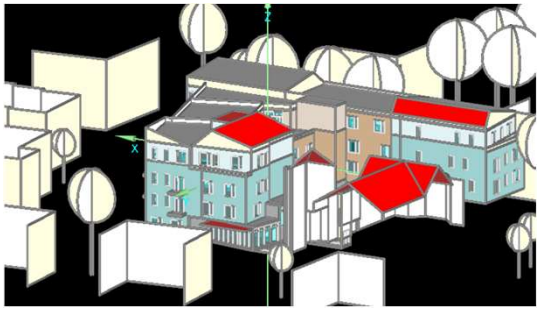
GOOD	BETTER	BEST
Minimum Required	More Accurate Results	Most Accurate Results
Site plans showing building location and orientation	Plans showing parking stall quantities and proposed EV spaces	Roof plans showing proposed equipment and PV locations
Building floor plans showing room use (ex. bedroom, kitchen, office), quantities, and locations	MEP equipment specifications and/or preferences	MEP plans showing equipment locations, plumbing supply piping and ductwork layouts
Exterior building elevations showing window and door locations, material changes, and any shading canopies	Window and door schedules indicating exact sizes and preferred manufacturers	Window and door specifications noting center of glass U-value and SHGC, frame U-values, and psi-value
Building sections showing building height and wall areas below grade	Foundation, slab, floor, wall, and roof assembly types	Proposed connection details at exterior locations (ex. walls to foundation and slab, parapet wall and roof connection)

Feasibility Study

Feasibility Study

What does the report include?

Target and Occupancy Overview



Building Information	
Dwelling Units	49
Occupants	101
Conditioned Floor Area (iCFA)	39,349.7
Envelope Area	54,632.1
Air Tightness Whole Building Testing	0.060 CFM50/ft2

Heating/Cooling Targets	
Annual Heating Demand	5.5 kBtu/ft2yr
Annual Cooling Demand	6.2 kBtu/ft2yr
Peak Heating Load	4.2 Btu/ft2hr
Peak Cooling Load	3.0 Btu/ft2hr
Source Energy	5100 kWh/person.yr

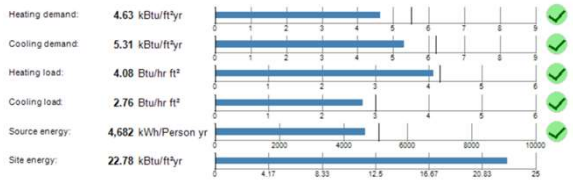
Additional Compliance Programs

- EPA Indoor AirPLUS
- Energy Star Homes
- DOE Net Zero Energy Ready Homes
- Mass Save Incentives

Modeling Results

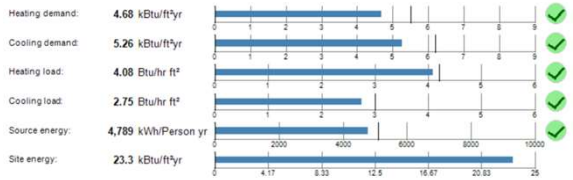
Option 1:

Geothermal Heating & Cooling



Option 2:

VRF Heating & Cooling

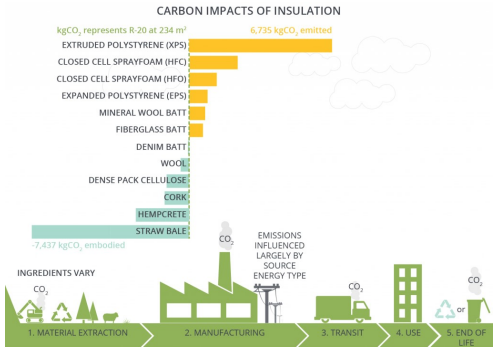


Feasibility Study

What does the report include?

Alternate Products – Environmental Impact

	PROS	CONS
Polyisocyanurate: Aged R-value ~ R-6 per inch, vapor impermeable	Highest R-value per inch	Vapor closed, retains water
Extruded Polystyrene (XPS): R-5 per inch, vapor semi-permeable	High R-value/inch	High global warming potential
Graphite Polystyrene (GPS): R-5 per inch, vapor semi-permeable	EPS with improved R-value, source locally	Less common
Expanded Polystyrene (EPS): R-4 per inch, vapor semi-permeable	Best option for foam insulation	Lower R-value
Rockwool: R-4 per inch, vapor permeable, fire resistant	Hydrophobic, not petroleum based	Cost
Wood Fiberboard: R-3.6 per inch, vapor semi-permeable	Natural Material, Positive carbon sequester	Thicker wall, availability



Exterior Insulation for R-12 Exterior	
Thickness Required	**Type (R per Inch)**
2"	Polyisocyanurate (R-6)
1.5”	XPS / GPS (R-5)
3”	EPS (R-4)
3”	Rockwool (R-4)
4”	Wood Fiberboard (R-3)

Potential Challenges

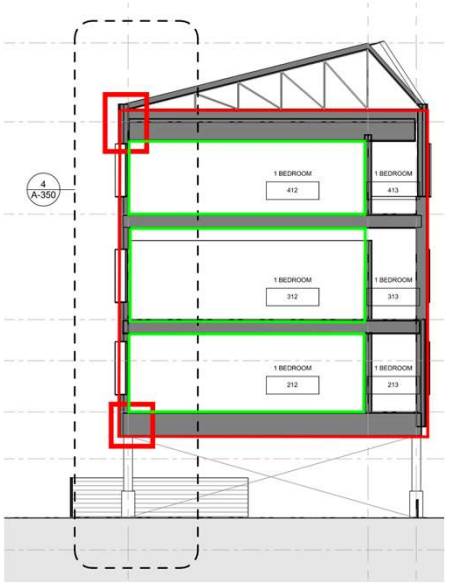
Potential Thermal Bridges

- Foundation to wall transition
- Wall to roof transition
- Siding attachments (Brick Ties)
- Canopy attachments
- Roof drains
- Equipment curbs
- Roof insulation fastening system

Additional detailing required for thermal-bridge-free construction

Thermal and air control boundary – 0.06 CFM/ft2 @50PA

Compartmentalization boundary – 0.3 CFM/ft2 @50PA

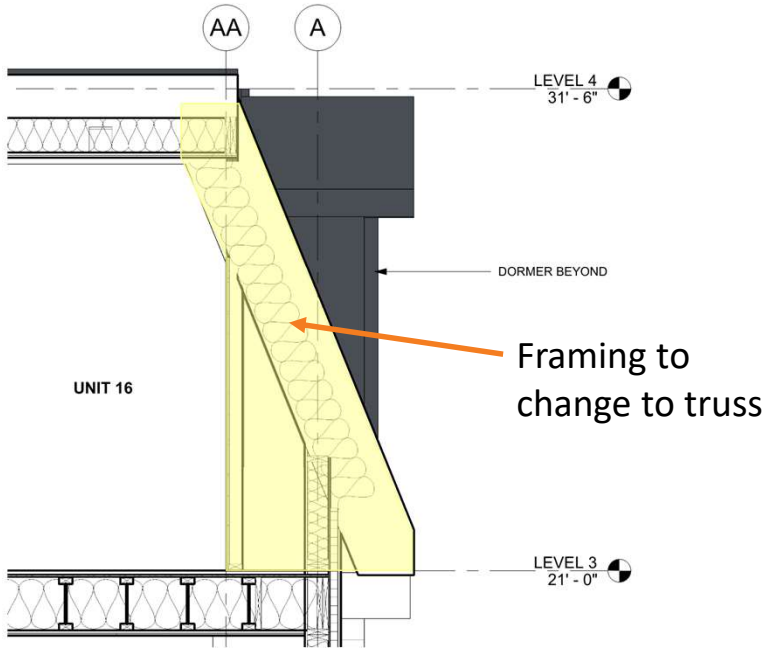


Feasibility Study – Discussion Points

Mansard Roof

Project Rendering

Location



Roof Connection Detail

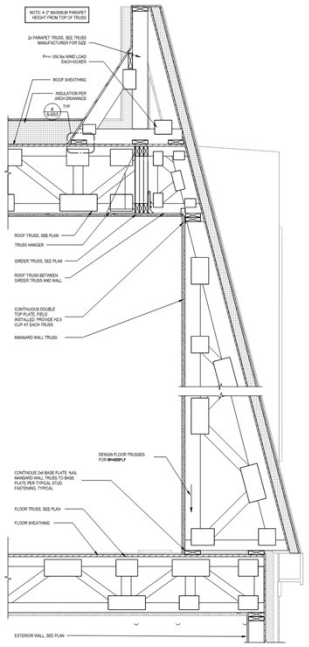
Images from Co-Everything LLC

Feasibility Study – Discussion Points

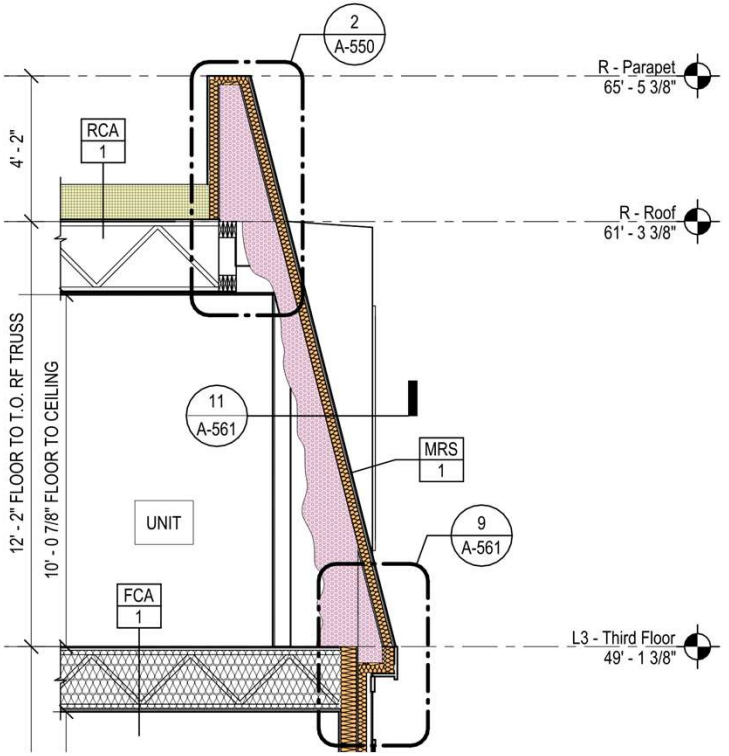
Mansard Roof

Determined low emitting closed cell spray foam would be the path of least resistance.

Continuous, filled smaller voids, ease of install, less moisture concern.



Detail before insulation



Detail after insulation

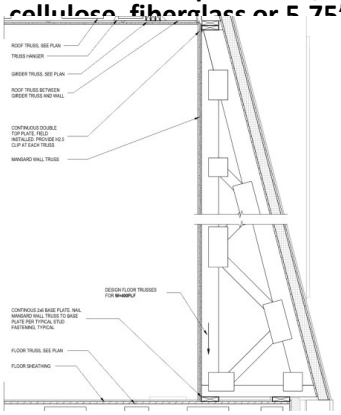
Images from Cube 3

Feasibility Study – Discussion Points

Mansard Roof

The Report

Roof Assembly ratio. Exterior insulation = R-4/inch x 3 = R-12
Exterior must be >35% whole roof = R-35 roof.
Cavity = R-23 max before additional exterior insulation is required-3.3/inch = ~7" mineral wool, cellulose, fiberglass or 5.75" of R-4 timberbatt



Mansard Roof Trusses

- Filling the interior cavity with insulation will require additional exterior insulation.
- Using net and blown insulation along the exterior will create a service cavity.

Moisture Control (Zone 5)

- Confirm whether any roofs will be vented
- Unvented roof: Outer air-impermeable insulation value >35% of total roof R-value. Option A will need more exterior insulation.

<u>The Discussion During Review</u>

- No service cavity needing sprinkler protection – fire engineer said eliminate it
- Sustainability consultant wanted to eliminate it
- Arch – required for city approval, neighborhood, historic look blending into landscape
- CPHC – consider moisture control guidelines when selecting materials

Decision was to fake the mansard outboard of a more typical vertical wall. Could be challenges with fastening through exterior insulation creating thermal bridges or condensation risks.

Still awaiting the final detail

Feasibility Study – Discussion Points

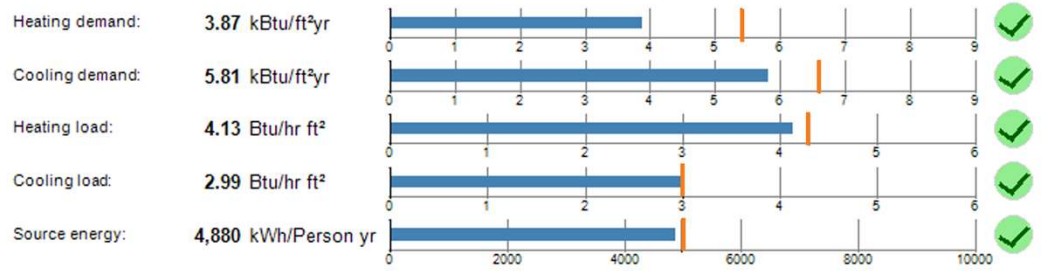
Barely-Passing Model

Project team used a design-certified project as a guide
This project performed differently – there's no "one-size fits all" assembly and equipment selection for passive house

Initial modeling results were very tight

Our findings indicate that targets are tight for the heating and cooling load as well as the source energy. At this early stage we recommend a 10% buffer on all targets.

Our primary recommendation is to strategically reduce the window sizes and/or quantity.



Images from Monte French Design Studio

Feasibility Study – Discussion Points

Barely-Passing Model

Options discussed to improve the WUFI model performance

Windows - Reduction in Quantity and/or Height
- Challenged with the site shading from surrounding buildings and a larger amount of glazing (heat loss, minimal gain)
- Modeled three window size options to illustrate the impact
- Larger glazing desired for real estate value in small SF units

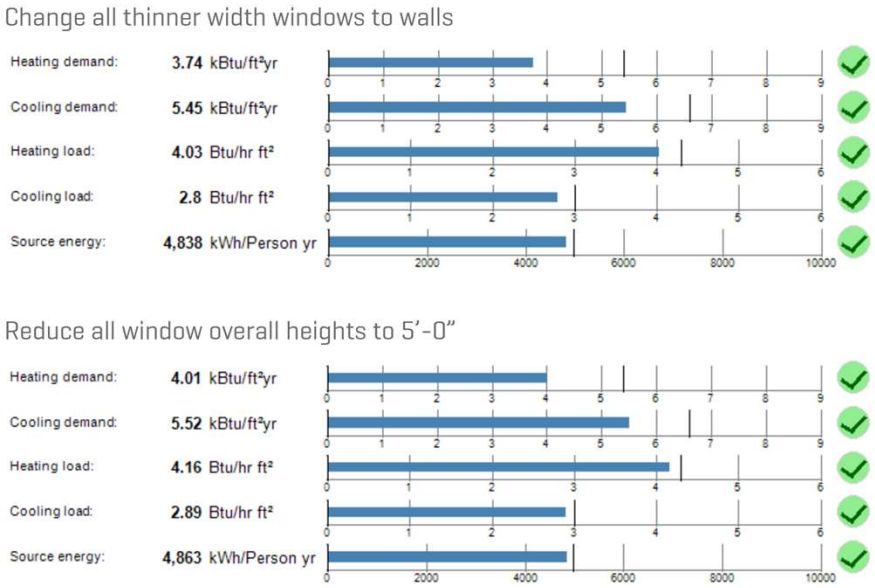
Water Heating - HPWH vs Electric Resistance
- Performance impact
- Higher initial costs for HPWH
- Livability – HPWHs produce cold air and can be noisy
- Electric resistance increases the source energy usage
- Mass Save weigh-in on rebates for HPWH

ERV – Central vs Unitary
- Central system could help get windows desired by the team
- Cost for central higher for development
- Central would require more work from maintenance (condos)

Feasibility Study – Discussion Points

Barely-Passing Model

Modeling results for 2 options



Although both of these options have reduced the cooling load, the buffer is not the 10% that is recommended at this stage.

We recommend continuing to reduce the window area.

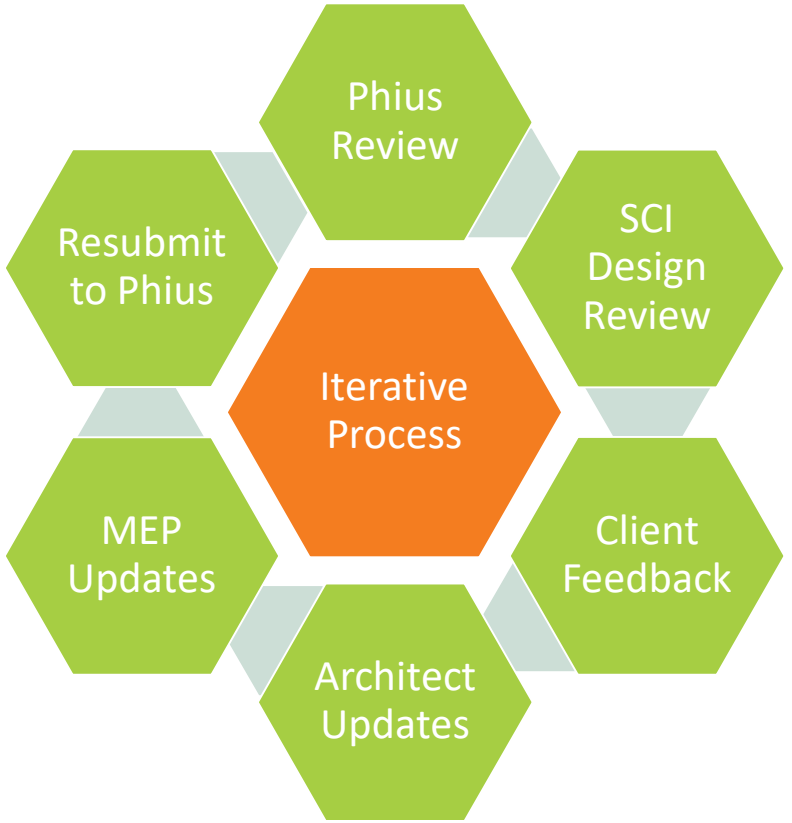
Still having discussions with the team.
Reduced the glazing even more and film windows for lower SHGC to reduce cooling needs.

Design Development

Design Development

Highlights

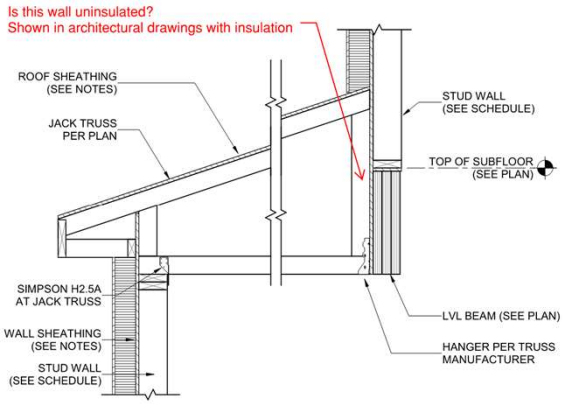
- Register with Phius early
  - Red-Flag Review if needed
- Understand and communicate review cycle to set expectations
  - Phius Project Flow Outline
- Formal Design Review by SCI
  - Includes CPHC, Verifier/Rater – if both
  - Corequisite Program Review
  - Plan and program checklist review
- Iterative Process
  - Heavy communication between all disciplines as details are developed

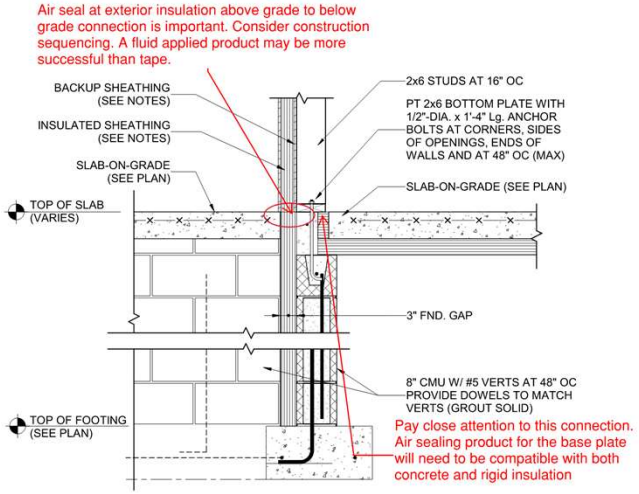


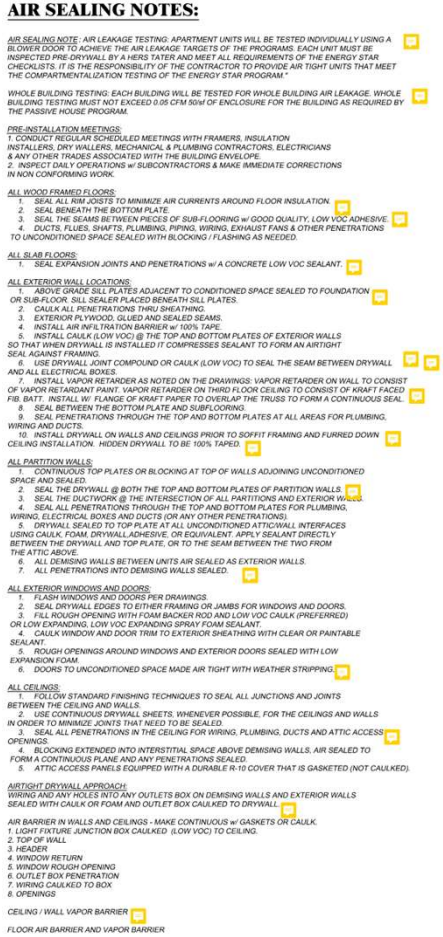
Design Development

Design Review

- Clear communication to the design team
- Detailed drawing review leads to success







AIR SEALING NOTES:

AIR SEALING NOTE: AIR LEAKAGE TESTING: APARTMENT UNITS WILL BE TESTED INDIVIDUALLY USING A BLOWER DOOR TO ACHIEVE THE AIR LEAKAGE TARGETS OF THE PROGRAMS. EACH UNIT MUST BE INSPECTED PRE-DRYWALL BY A HERS TATER AND MEET ALL REQUIREMENTS OF THE ENERGY STAR CHECKLISTS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE AIR TIGHT UNITS THAT MEET THE COMPARTMENTALIZATION TESTING OF THE ENERGY STAR PROGRAM.

WHOLE BUILDING TESTING: EACH BUILDING WILL BE TESTED FOR WHOLE BUILDING AIR LEAKAGE. WHOLE BUILDING TESTING MUST NOT EXCEED 0.05 CFM 50/sf OF ENCLOSURE FOR THE BUILDING AS REQUIRED BY THE PASSIVE HOUSE PROGRAM.

PRE-INSTALLATION MEETINGS:
1. CONDUCT REGULAR SCHEDULED MEETINGS WITH FRAMERS, INSULATION INSTALLERS, DRY WALLERS, MECHANICAL & PLUMBING CONTRACTORS, ELECTRICIANS & ANY OTHER TRADES ASSOCIATED WITH THE BUILDING ENVELOPE.
2. INSPECT DAILY OPERATIONS w/ SUBCONTRACTORS & MAKE IMMEDIATE CORRECTIONS IN NON CONFORMING WORK.

ALL WOOD FRAMED FLOORS:
1. SEAL ALL RIM JOISTS TO MINIMIZE AIR CURRENTS AROUND FLOOR INSULATION.
2. SEAL BENEATH THE BOTTOM PLATE.
3. SEAL THE SEAMS BETWEEN PIECES OF SUB-FLOORING w/ GOOD QUALITY, LOW VOC ADHESIVE.
4. DUCTS, FLUES, SHAFTS, PLUMBING, PIPING, WIRING, EXHAUST FANS & OTHER PENETRATIONS TO UNCONDITIONED SPACE SEALED WITH BLOCKING / FLASHING AS NEEDED.

ALL SLAB FLOORS:
1. SEAL EXPANSION JOINTS AND PENETRATIONS w/ A CONCRETE LOW VOC SEALANT.

ALL EXTERIOR WALL LOCATIONS:
1. ABOVE GRADE SILL PLATES ADJACENT TO CONDITIONED SPACE SEALED TO FOUNDATION OR SUB-FLOOR. SILL SEALER PLACED BENEATH SILL PLATES.
2. CAULK ALL PENETRATIONS THRU SHEATHING.
3. EXTERIOR PLYWOOD, GLUED AND SEALED SEAMS.
4. INSTALL AIR INFILTRATION BARRIER w/ 100% TAPE.
5. INSTALL CAULK (LOW VOC) @ THE TOP AND BOTTOM PLATES OF EXTERIOR WALLS SO THAT WHEN DRYWALL IS INSTALLED IT COMPRESSES SEALANT TO FORM AN AIRTIGHT SEAL AGAINST FRAMING.
6. USE DRYWALL JOINT COMPOUND OR CAULK (LOW VOC) TO SEAL THE SEAM BETWEEN DRYWALL AND ALL ELECTRICAL BOXES.
7. INSTALL VAPOR RETARDER AS NOTED ON THE DRAWINGS: VAPOR RETARDER ON WALL TO CONSIST OF VAPOR RETARDANT PAINT. VAPOR RETARDER ON THIRD FLOOR CEILING TO CONSIST OF KRAFT FACED FIB. BATT. INSTALL W/ FLANGE OF KRAFT PAPER TO OVERLAP THE TRUSS TO FORM A CONTINUOUS SEAL.
8. SEAL BETWEEN THE BOTTOM PLATE AND SUBFLOORING.
9. SEAL PENETRATIONS THROUGH THE TOP AND BOTTOM PLATES AT ALL AREAS FOR PLUMBING, WIRING AND DUCTS.
10. INSTALL DRYWALL ON WALLS AND CEILINGS PRIOR TO SOFFIT FRAMING AND FURRED DOWN CEILING INSTALLATION. HIDDEN DRYWALL TO BE 100% TAPED.

ALL PARTITION WALLS:
1. CONTINUOUS TOP PLATES OR BLOCKING AT TOP OF WALLS ADJOINING UNCONDITIONED SPACE AND SEALED.
2. SEAL THE DRYWALL @ BOTH THE TOP AND BOTTOM PLATES OF PARTITION WALLS.
3. SEAL THE DUCTWORK @ THE INTERSECTION OF ALL PARTITIONS AND EXTERIOR WALLS.
4. SEAL ALL PENETRATIONS THROUGH THE TOP AND BOTTOM PLATES FOR PLUMBING, WIRING, ELECTRICAL BOXES AND DUCTS (OR ANY OTHER PENETRATIONS).
5. DRYWALL SEALED TO TOP PLATE AT ALL UNCONDITIONED ATTIC/WALL INTERFACES USING CAULK, FOAM, DRYWALL ADHESIVE, OR EQUIVALENT. APPLY SEALANT DIRECTLY BETWEEN THE DRYWALL AND TOP PLATE, OR TO THE SEAM BETWEEN THE TWO FROM THE ATTIC ABOVE.
6. ALL DEMISING WALLS BETWEEN UNITS AIR SEALED AS EXTERIOR WALLS.
7. ALL PENETRATIONS INTO DEMISING WALLS SEALED.

ALL EXTERIOR WINDOWS AND DOORS:
1. FLASH WINDOWS AND DOORS PER DRAWINGS.
2. SEAL DRYWALL EDGES TO EITHER FRAMING OR JAMBS FOR WINDOWS AND DOORS.
3. FILL ROUGH OPENING WITH FOAM BACKER ROD AND LOW VOC CAULK (PREFERRED) OR LOW EXPANDING, LOW VOC EXPANDING SPRAY FOAM SEALANT.
4. CAULK WINDOW AND DOOR TRIM TO EXTERIOR SHEATHING WITH CLEAR OR PAINTABLE SEALANT.
5. ROUGH OPENINGS AROUND WINDOWS AND EXTERIOR DOORS SEALED WITH LOW EXPANSION FOAM.
6. DOORS TO UNCONDITIONED SPACE MADE AIR TIGHT WITH WEATHER STRIPPING.

ALL CEILINGS:
1. FOLLOW STANDARD FINISHING TECHNIQUES TO SEAL ALL JUNCTIONS AND JOINTS BETWEEN THE CEILING AND WALLS.
2. USE CONTINUOUS DRYWALL SHEETS, WHENEVER POSSIBLE, FOR THE CEILINGS AND WALLS IN ORDER TO MINIMIZE JOINTS THAT NEED TO BE SEALED.
3. SEAL ALL PENETRATIONS IN THE CEILING FOR WIRING, PLUMBING, DUCTS AND ATTIC ACCESS OPENINGS.
4. BLOCKING EXTENDED INTO INTERSTITIAL SPACE ABOVE DEMISING WALLS, AIR SEALED TO FORM A CONTINUOUS PLANE AND ANY PENETRATIONS SEALED.
5. ATTIC ACCESS PANELS EQUIPPED WITH A DURABLE R-10 COVER THAT IS GASKETED (NOT CAULKED).

AIRTIGHT DRYWALL APPROACH:
WIRING AND ANY HOLES INTO ANY OUTLETS BOX ON DEMISING WALLS AND EXTERIOR WALLS SEALED WITH CAULK OR FOAM AND OUTLET BOX CAULKED TO DRYWALL.

AIR BARRIER IN WALLS AND CEILINGS - MAKE CONTINUOUS w/ GASKETS OR CAULK.
1. LIGHT FIXTURE JUNCTION BOX CAULKED (LOW VOC) TO CEILING.
2. TOP OF WALL
3. HEADER
4. WINDOW RETURN
5. WINDOW ROUGH OPENING
6. OUTLET BOX PENETRATION
7. WIRING CAULKED TO BOX
8. OPENINGS

CEILING / WALL VAPOR BARRIER

FLOOR AIR BARRIER AND VAPOR BARRIER

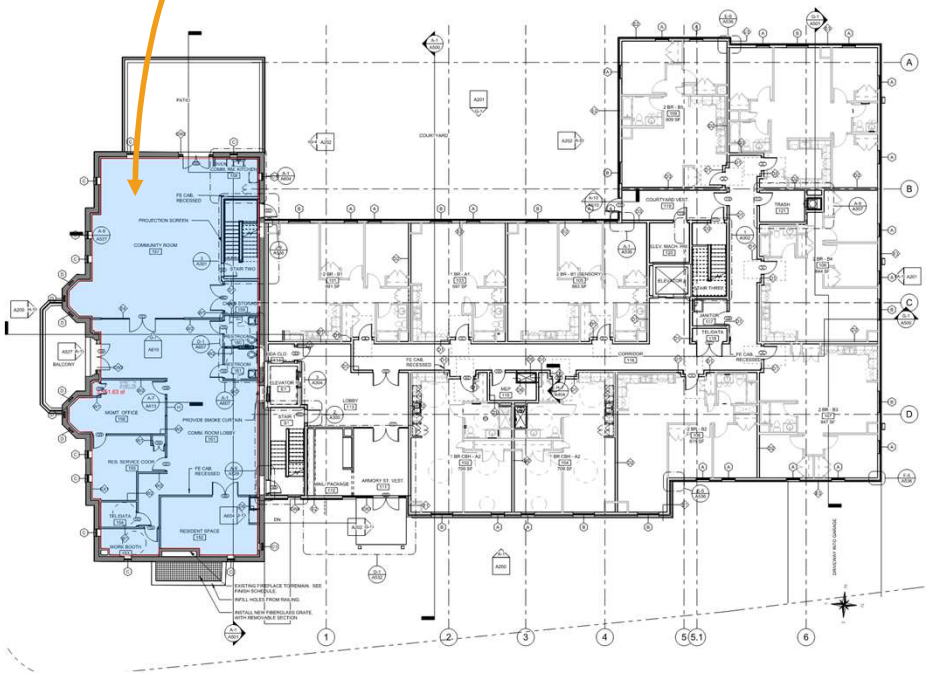
Design Development

Design Certification Process

- Contact Phius with questions
- There can be surprises, so include a healthy buffer early on

Historic Reuse with New Construction

Historic Reuse Area Outside Passive House Boundary



Include energy usage for support spaces outside the passive house boundary

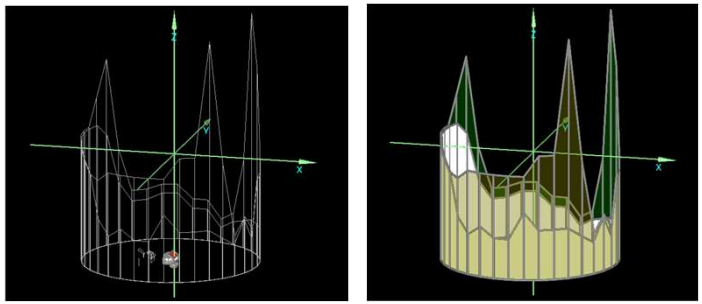
Rendering from Davis Square Architects

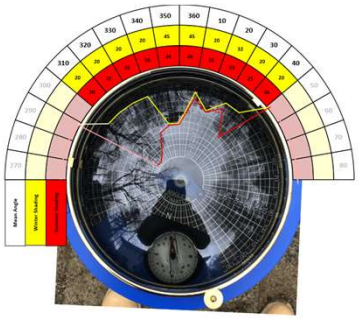
Design Development

Strong Relationships Drive Success

- Project Roles – Architect, CPHC, Verifier, and CPHB all by SCI
- Fast responses with so many in one company
- Needed detailed shading for passing model
  - Solar pathfinder method for shading
- Request add multiple windows
  - Studied outcome of various models
- Multiple changes during design (even into construction)

Wufi model with Summer and Winter Shading





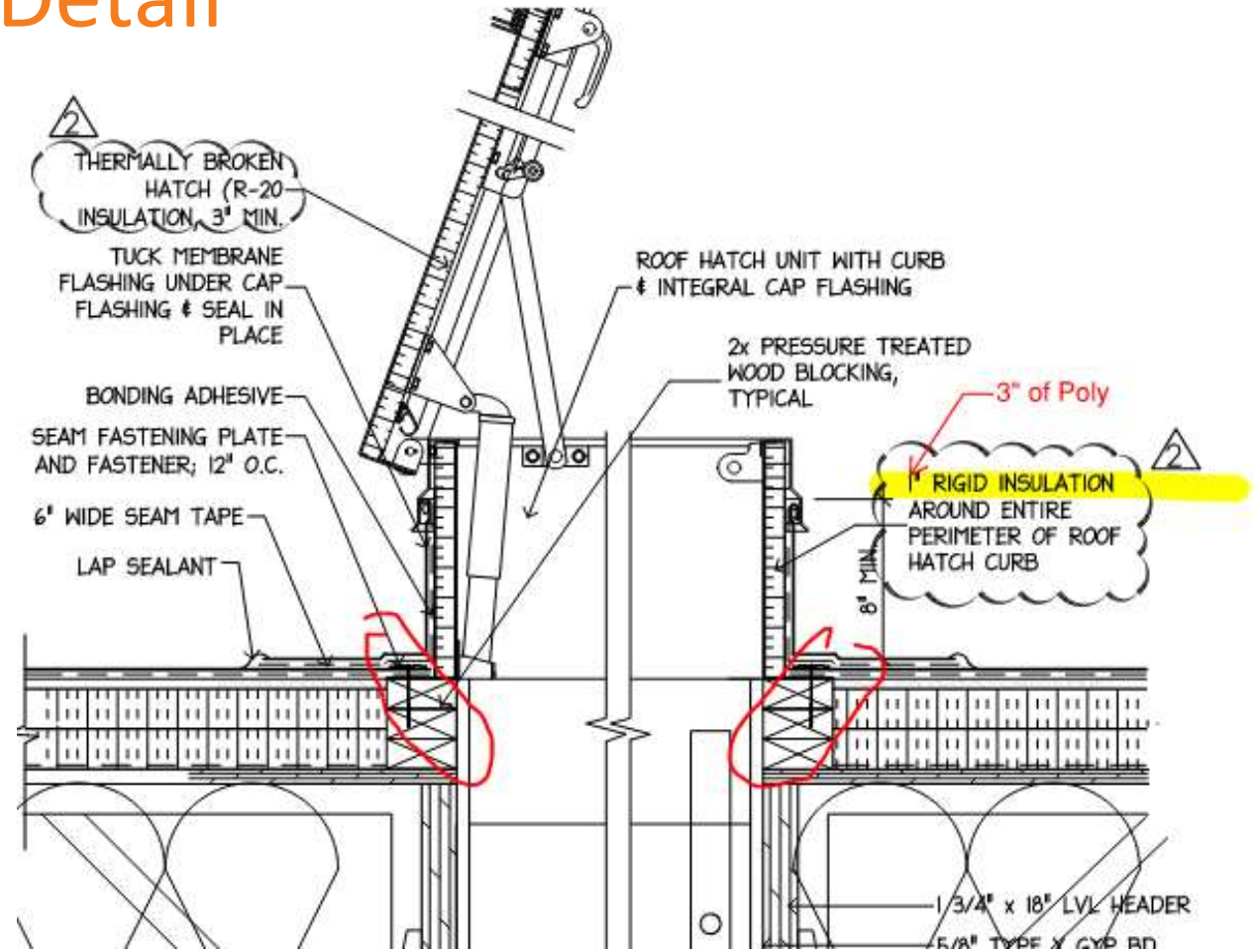
Solar Pathfinder for Modeling Shading

Construction

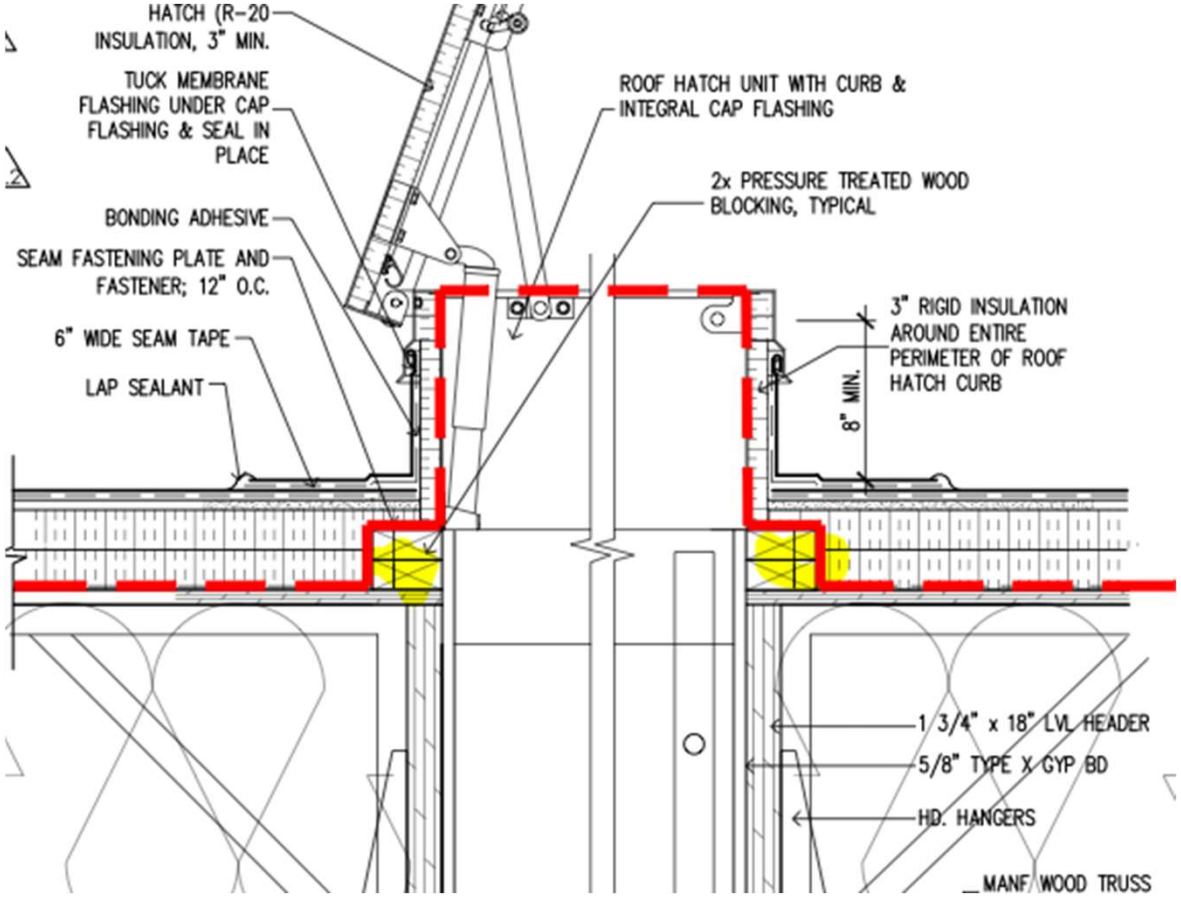
Design to Construction Handoff – CPHC perspective

- Setting up the verifier for success
- Dedicated meeting walking though plans to discuss important features
- Chance to review project players
- Timelines
- High-level goals
- Concerns – pitfalls. intimate knowledge of specific features we want to get right.
- Clarify what submittals the CPHC needs to see.

Original Detail

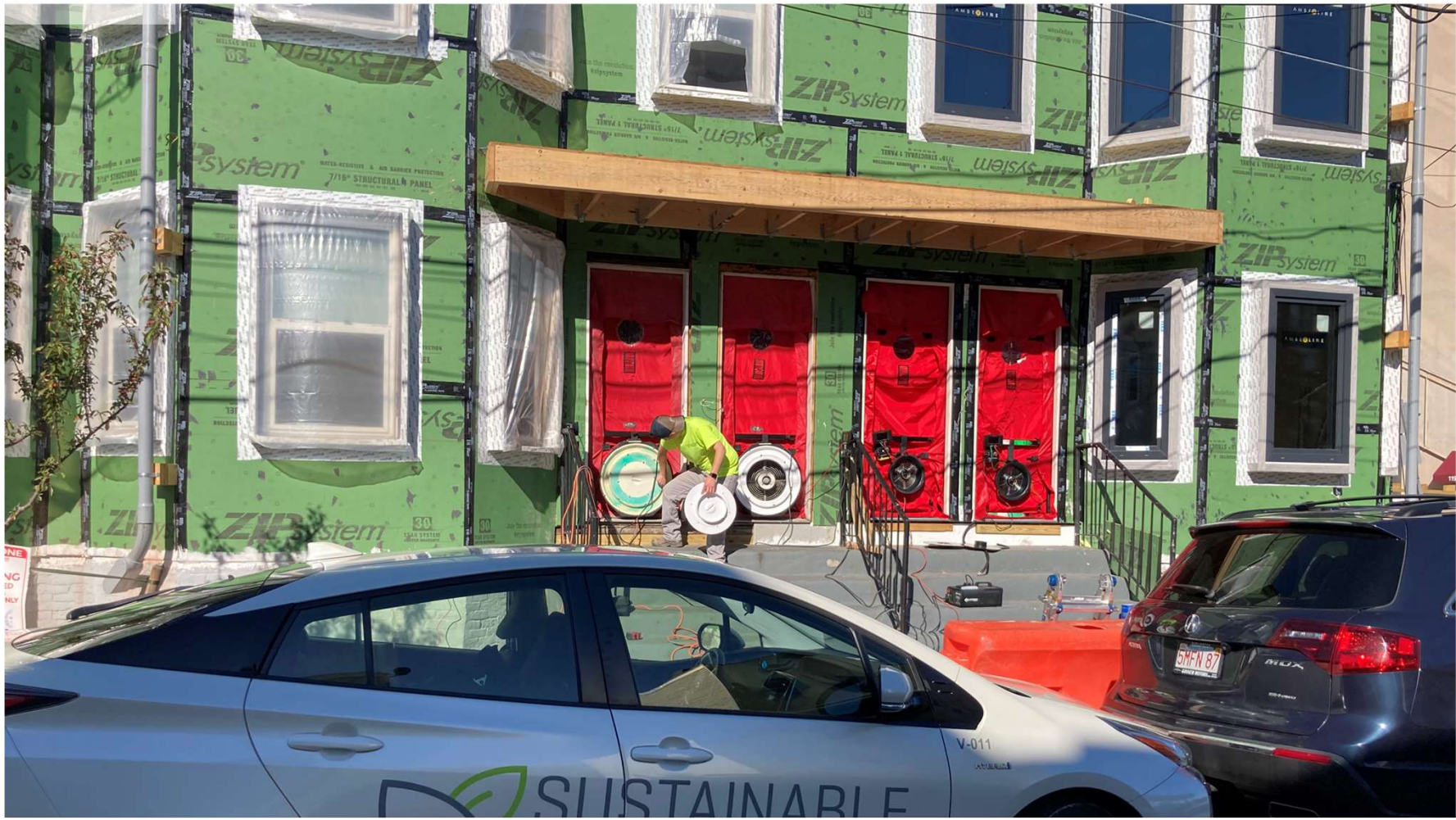


Improved Detail



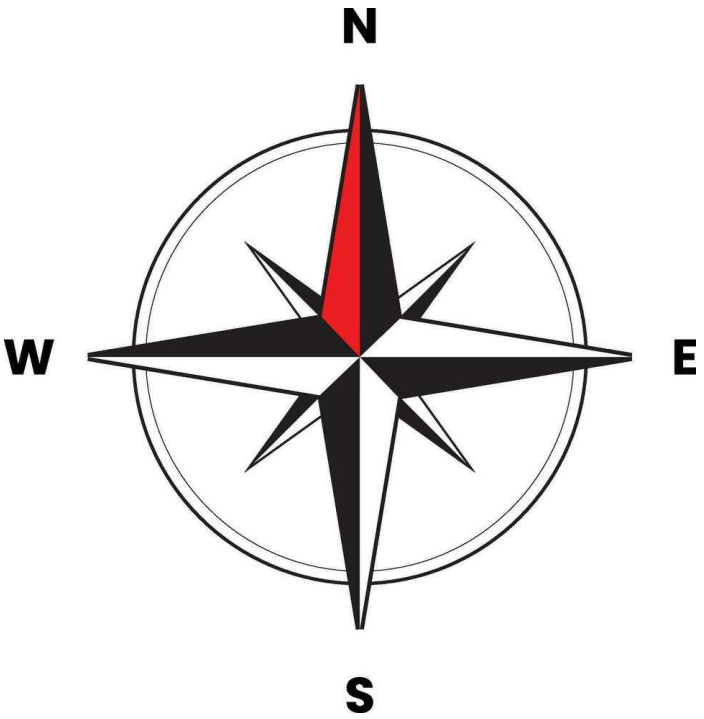
Reality

Verification



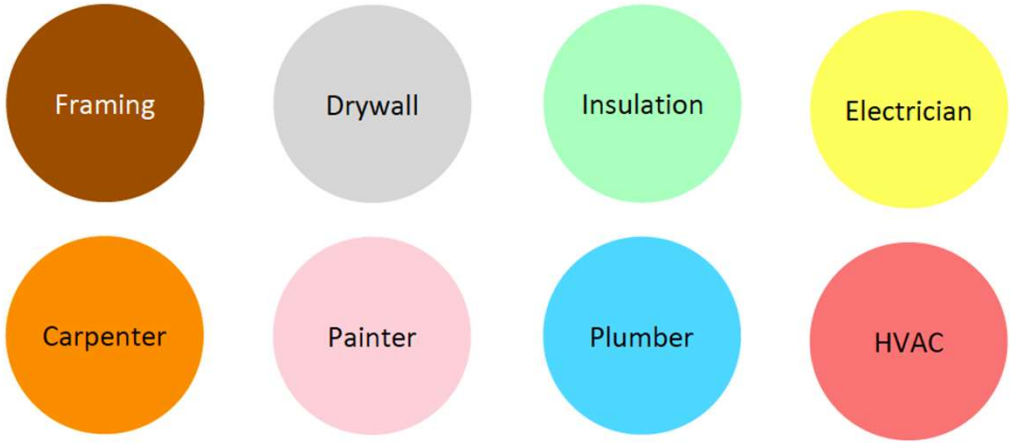
Contractor Orientation

- Bring Integrative process on-site
- Purpose is to take design team vision, comments and all the hard work and internalize it with the construction team. The shared goal is passive house!
- Review all specific design details as it relates to Phius. Bring everything from the design to construction handoff
- Review co-requisite programs
- Discuss building readiness and the testing plan



Contractor Orientation

- Who should be there?
  - Most trades have a role in the success of Phius
  - Site super, MEP's, drywaller, roofer, framer, insulation, even structural
  - Also, the Architect
- Assigning the Air Boss
- Setup communication
  - Site reports
  - Issue escalation
  - Testing coordination



Verification

- Submittal review for co-requisite programs
- Executing the Mid-point
  - Develop mid-point testing plan that provides clarity around building readiness
- Provide Education
  - Construction kick-off meetings and what is reviewed.
  - What are folks sharing with us? Be a good listener.
- Interaction between Verifier and CPHC
  - Finding issues in the field that would impact the WUFI model. (ex: longer ventilation ductwork, higher/lower U/SHGC values, thermal bridges and missing walls)

Design Changes During Construc

- Each party has their responsibility
  - CPHC - Phius compliance & building science
  - Arch – Signoff
  - GC – Buildability
  - Verifier – Compliance with co-requisites
  - Subs – Estimate costs & perform additional work
  - Owner – Design & cost approvals
- GC/Architect will know to reach out to CPHC
- May need to run additional therm calcs
- Importance of a call vs email to fully understand implications

Install Coordination

Air Tightness Testing

Final Verification

Additional Verification

- Hot Water Distribution
- Ventilation Flow Rates
- Ventilation wattages
- Final equipment efficiencies

Guiding Factors of IPD

- Early Involvement of Key Participants
- Early Goal Definition
- Open Team Communications
- Mutual Trust and Respect
- Mutual Benefit and Reward
- Collaborative Innovation and Decision Making
- Appropriate Technology
- Organization and Leadership

“Collaboration is not a substitute for accountability”

-AIA Guide

SUSTAINABLE COMFORT

Thank you! Any questions?

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