What if? A Case for a Multifamily Prescriptive Path

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PCA

Who We Are

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PCA

Agenda

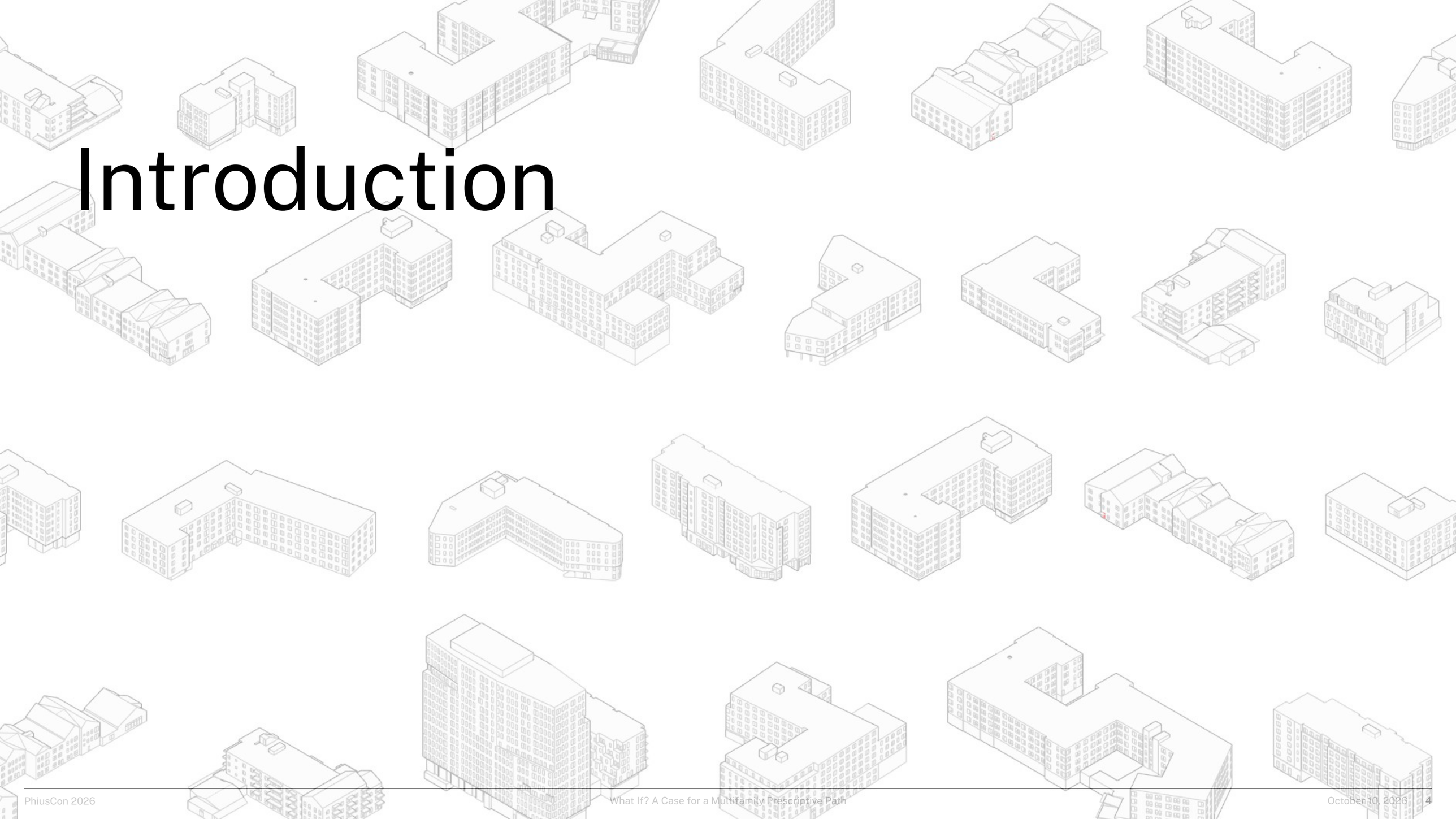
Introduction

Survey of industry professionals and Phius staff

Project analysis

Where we go from here

Introduction



Initial Curiosity

The Motivations:

- Demand for an **easier entry point** to Phius
- Need for **time savings** in the design and review process for already established practitioners
- **Observed patterning** in our portfolios of work

Initial Questions:

- Is there a case to be made for a multifamily prescriptive path?
- Are there trends across our multifamily passive buildings that could inform a streamlined prescriptive standard?

Scope and Process

What this study is:	What this study is not:
• A **survey** of practitioners and Phius staff to understand interest in and concerns around a multifamily prescriptive path • An **observational analysis** of common traits across multifamily passive projects • A set of **initial recommendations** based on the above for future compliance path updates	• A draft prescriptive path • A lobbying effort to pressure Phius into creating a prescriptive path • A denunciation of energy modeling

Performance Path

Phius Project Certification Timeline

Feasibility Study

Project Registered

Schematic Design

Design Development

Construction Documents

Design Certification

Building Permit

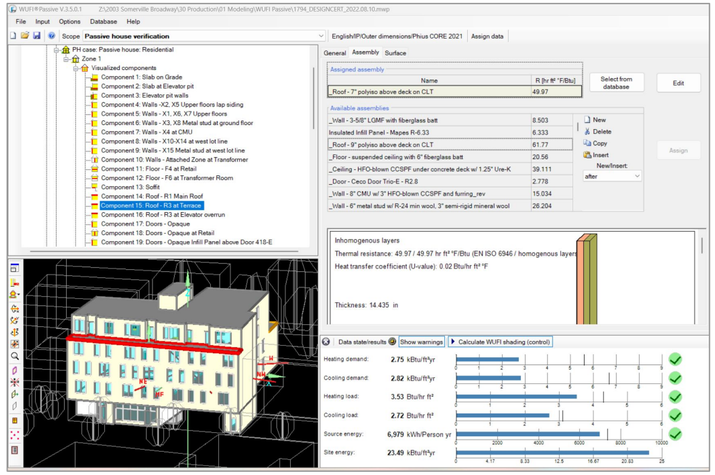
Onsite Review

Construction Administration

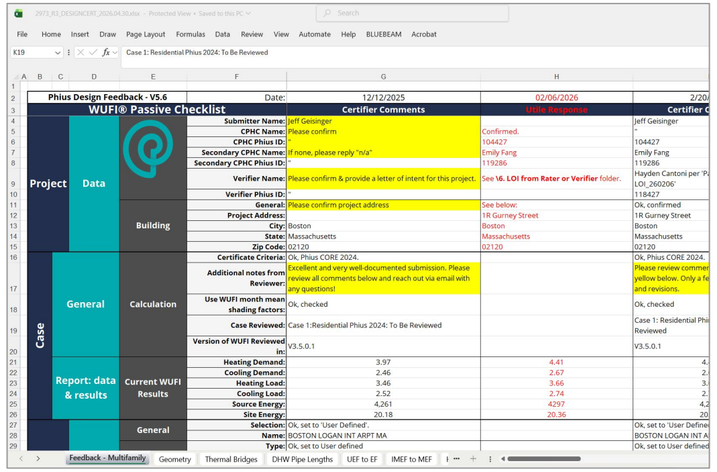
Final Certification

Certificate of Occupancy

Energy Modeling



Phius Design Review



Single Family Prescriptive Path

Prescriptive Requirements

Dimensional

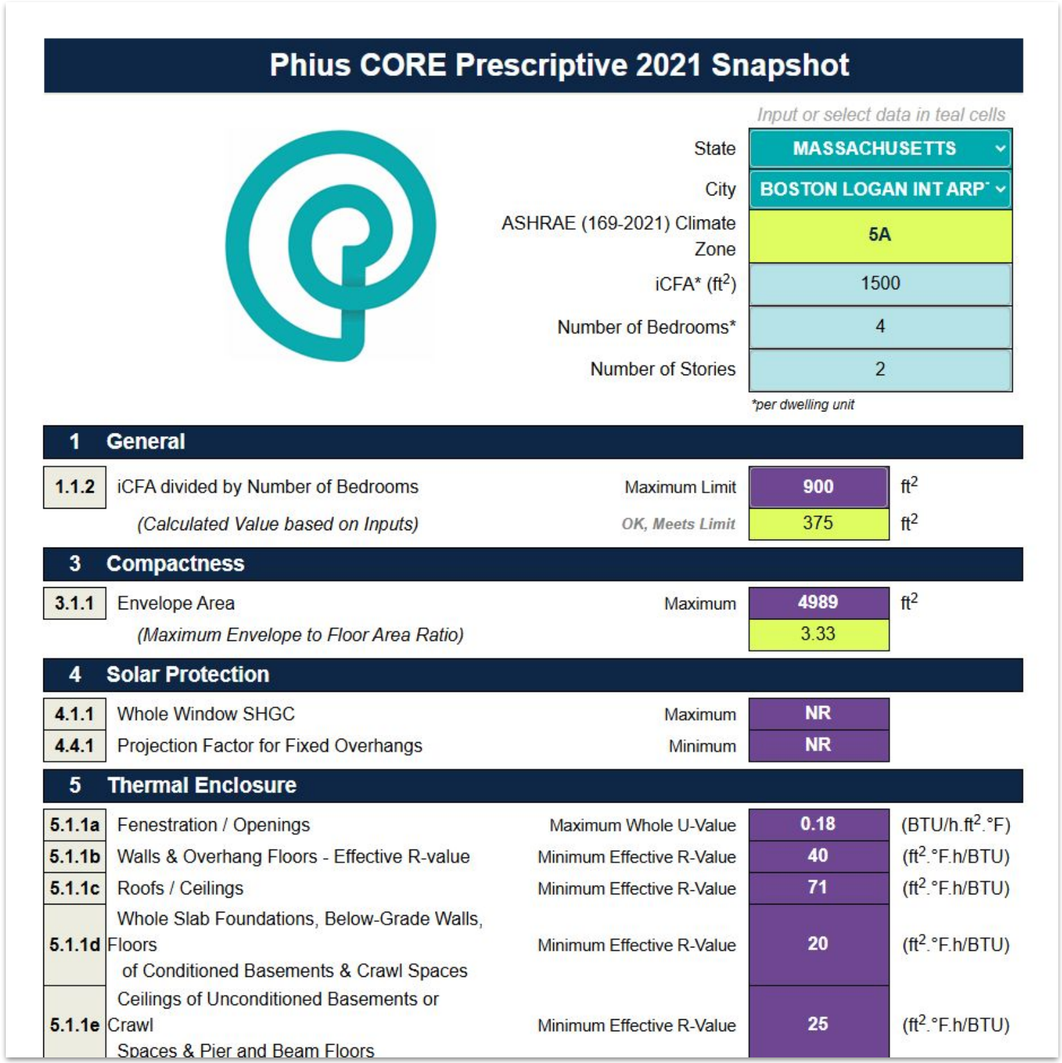
- Compactness (envelope area to floor area ratio) and bedroom density limits

Thermal Envelope

- Envelope: component limits or UA calculation
- No thermal bridging / R-10 everywhere
- Blower door test limit of 0.04 CFM/sf of enclosure

Mechanical Systems

- Ventilation efficiency minimums
- Heating/cooling COP minimums
- No fossil fuel combustion
- Domestic Hot Water: ENERGY STAR UEF or EF
- Laundry and appliances based on ENERGY STAR
- Lighting: ENERGY STAR top quartile



Phius CORE Prescriptive 2021 Snapshot

Input or select data in teal cells

State	MASSACHUSETTS
City	BOSTON LOGAN INT ARP
ASHRAE (169-2021) Climate Zone	5A
iCFA* (ft^2)	1500
Number of Bedrooms*	4
Number of Stories	2

**per dwelling unit*

1 General				
1.1.2	iCFA divided by Number of Bedrooms	Maximum Limit	900	ft^2
	(Calculated Value based on Inputs)	*OK, Meets Limit*	375	ft^2
3 Compactness				
3.1.1	Envelope Area	Maximum	4989	ft^2
	(Maximum Envelope to Floor Area Ratio)		3.33	
4 Solar Protection				
4.1.1	Whole Window SHGC	Maximum	NR	
4.4.1	Projection Factor for Fixed Overhangs	Minimum	NR	
5 Thermal Enclosure				
5.1.1a	Fenestration / Openings	Maximum Whole U-Value	0.18	(BTU/h.ft^2.°F)
5.1.1b	Walls & Overhang Floors - Effective R-value	Minimum Effective R-Value	40	(ft^2.°F.h/BTU)
5.1.1c	Roofs / Ceilings	Minimum Effective R-Value	71	(ft^2.°F.h/BTU)
5.1.1d	Whole Slab Foundations, Below-Grade Walls, Floors of Conditioned Basements & Crawl Spaces	Minimum Effective R-Value	20	(ft^2.°F.h/BTU)
5.1.1e	Ceilings of Unconditioned Basements or Crawl Spaces & Pier and Beam Floors	Minimum Effective R-Value	25	(ft^2.°F.h/BTU)

Survey

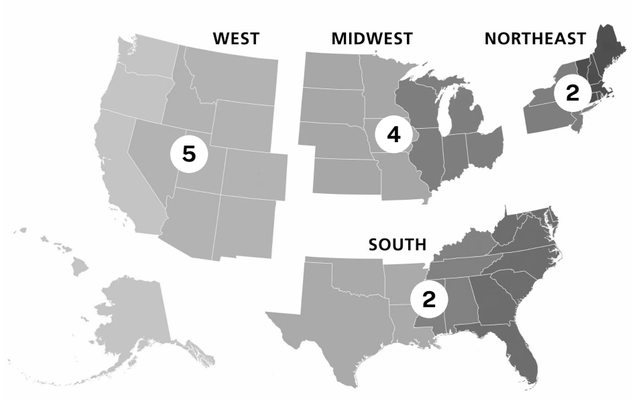
Overview and Goals

Reviewers

Single Family Professionals

MA Multifamily Professionals

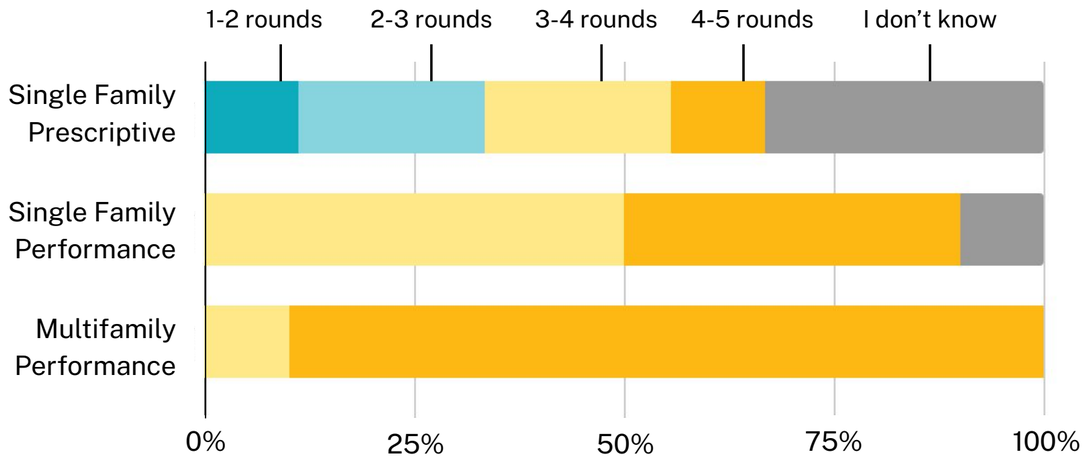
Who We Surveyed



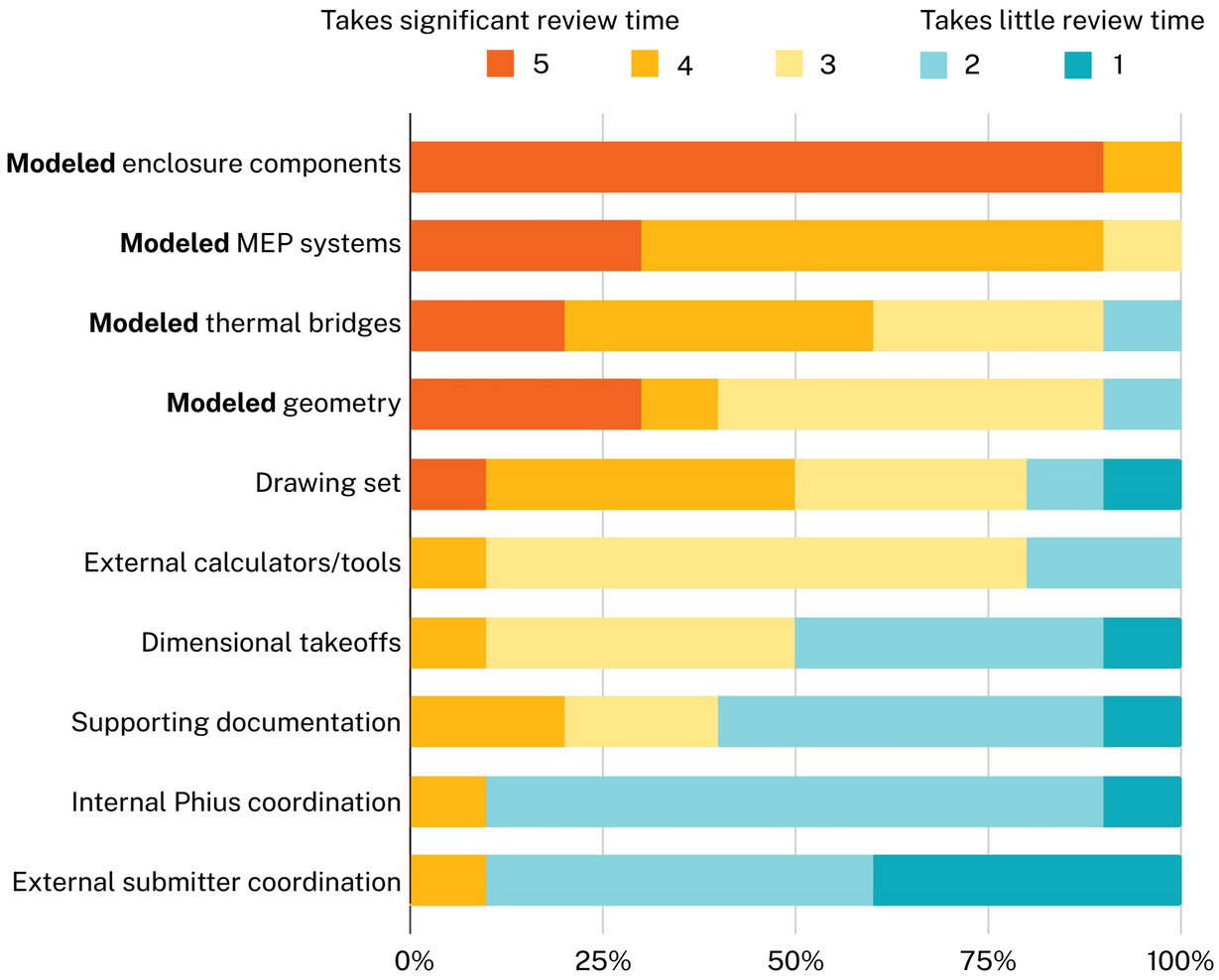
Survey	Phius Review Staff	Professionals with Prescriptive Path Experience (Single Family)	CPHCs in Massachusetts (Multifamily)
Goals	• Understand experience with prescriptive path review • Identify time-consuming aspects of MF project review	• Hear pros/cons of existing prescriptive path	• Identify pros/cons of performance path process • Gauge interest in potential MF prescriptive path
Assumptions	Reviewers + practitioners (SF) would find prescriptive faster/easier		Multifamily CPHCs would have varied interest in a MF prescriptive path
Respondents	10 reviewers	8 out of 30 (Two non-CPHCs)	36 out of 70

Reviewer Survey

Rounds of review for design certification



Review tasks according to amount of time spent (Multifamily projects)



Reviewer Survey - Things We Heard

Inherent to any multifamily certification path

> *The review time for all of these [performance path] items is **highly variable and dependent** on CPHC **organization and experience level**.*

> *Enclosure, component, and system review take the longest because **larger projects** have more details, components, and systems to review.*

Note: Any emphasis in the respondents' quotes were added by presenters

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Thermal bridge models submitted by CPHCs

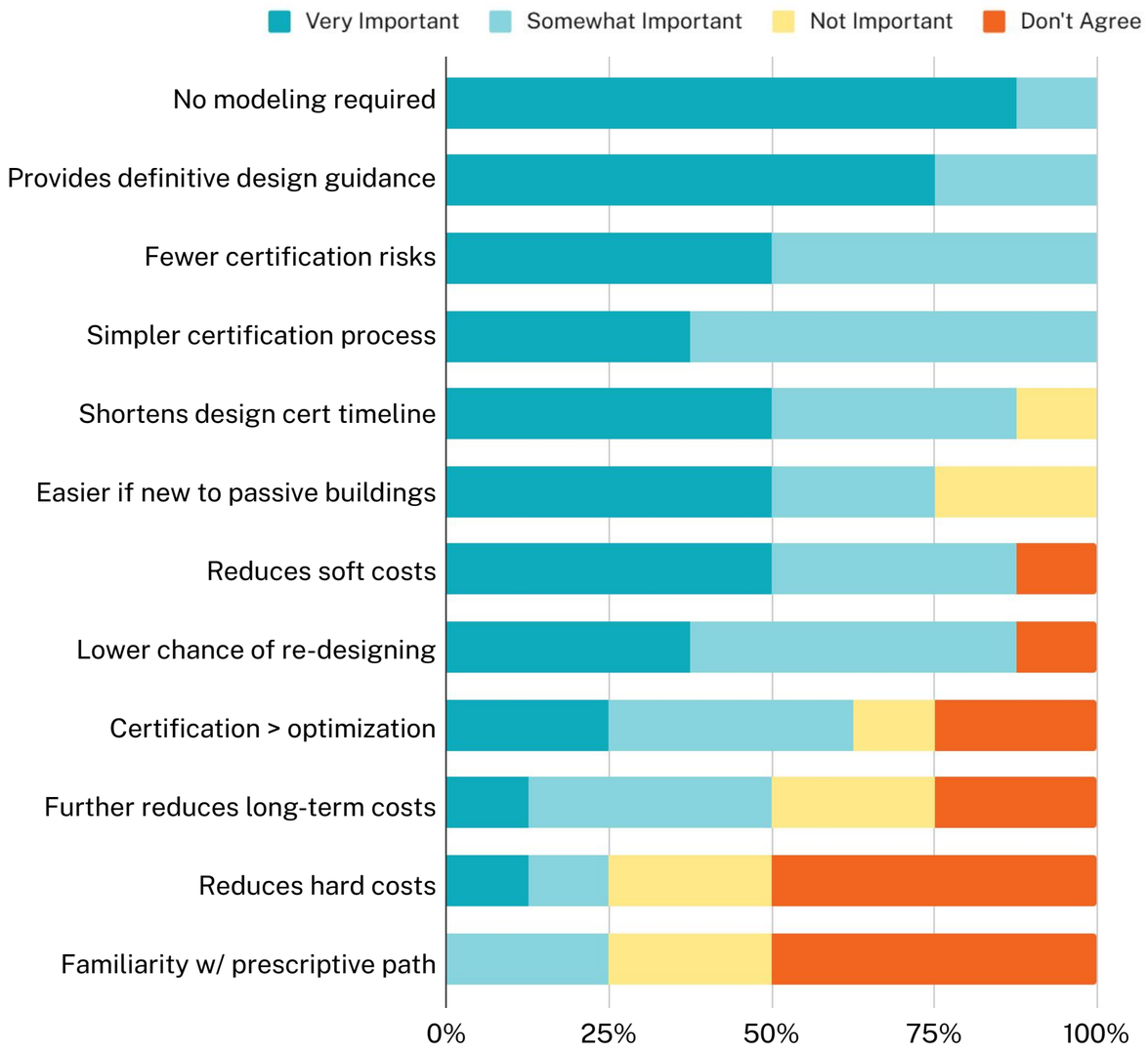
> *Thermal bridge review is a **complete crapshoot** most of the time. It often takes nearly as long to review a thermal bridge calculation as it would to run the analysis myself.*

> *Some teams provide 20+ TB calculations which takes an **abundance of time to review**...*

Note: Any emphasis in the respondents' quotes were added by presenters

Single Family Survey

Reasons professionals recommend **Phius <u>Prescriptive</u>** over Phius Performance

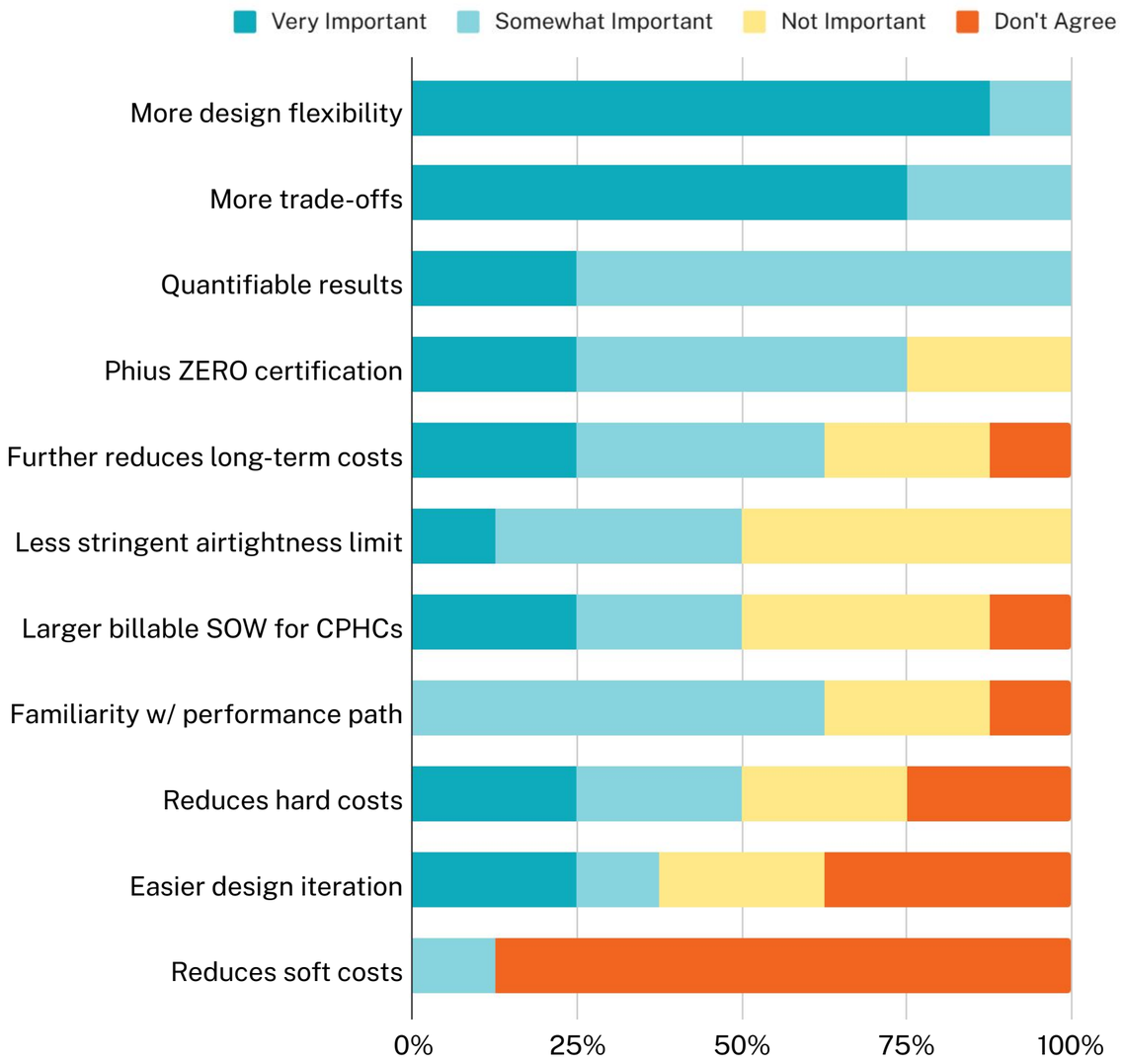


> *The Prescriptive method simplifies the certification process… and **makes entry into doing a PH certified project easier** for those on the fence.*

> *Since we were new and there is **only one certified consultant in our state**, prescriptive seemed like the best choice.*

Single Family Survey

Reasons professionals recommend **Phius <u>Performance</u>** over Phius Prescriptive

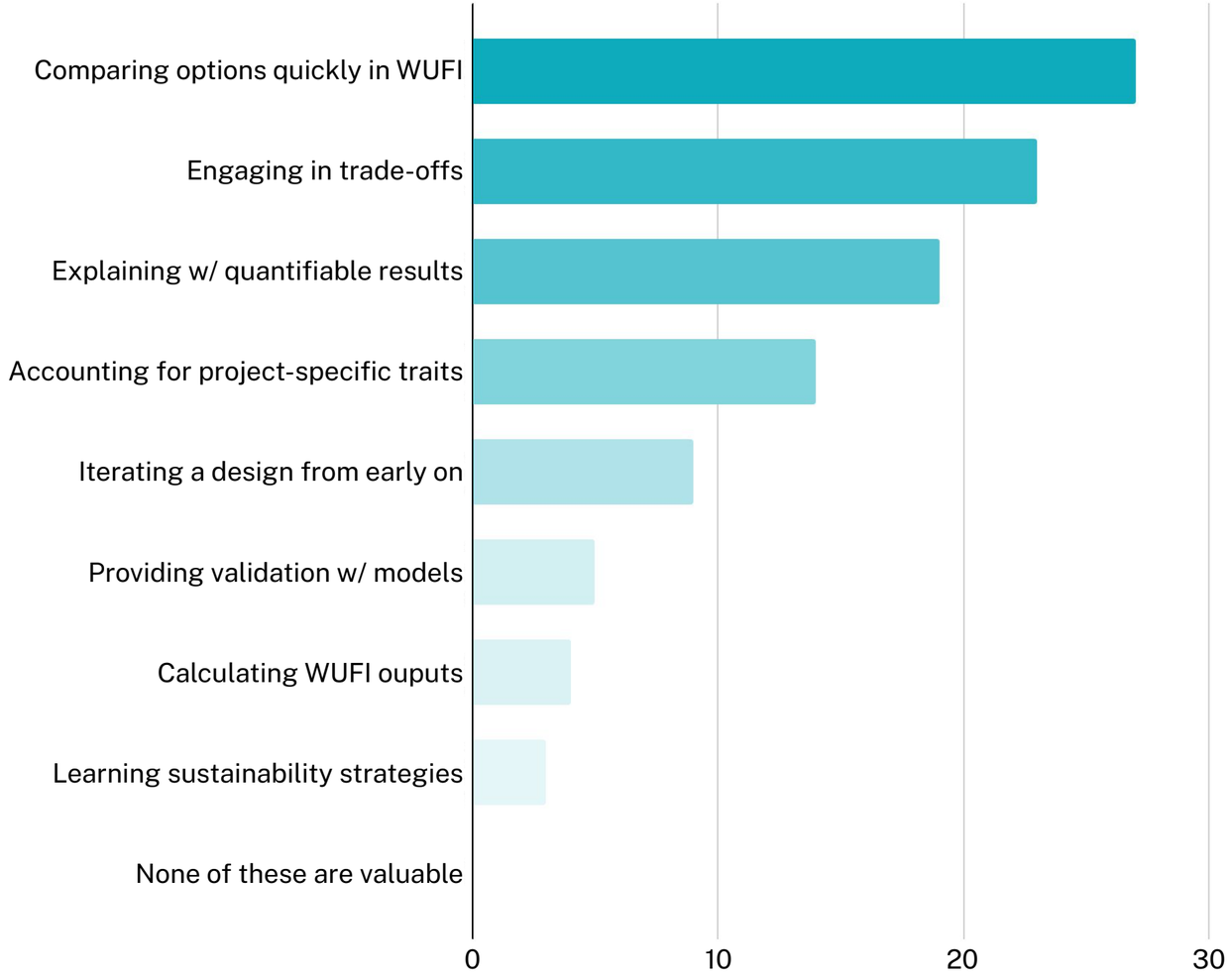


> *Prescriptive path is good for basic shapes and simple buildings.* ***Anything else should go for performance****.*

> *...At ~4,000 ft2 of wall area that's $3,720 savings in just 1" of insulation.... You* ***stack a few simple equations*** *like that and it's very easy to justify performance path.*

Massachusetts Multifamily CPHC Survey

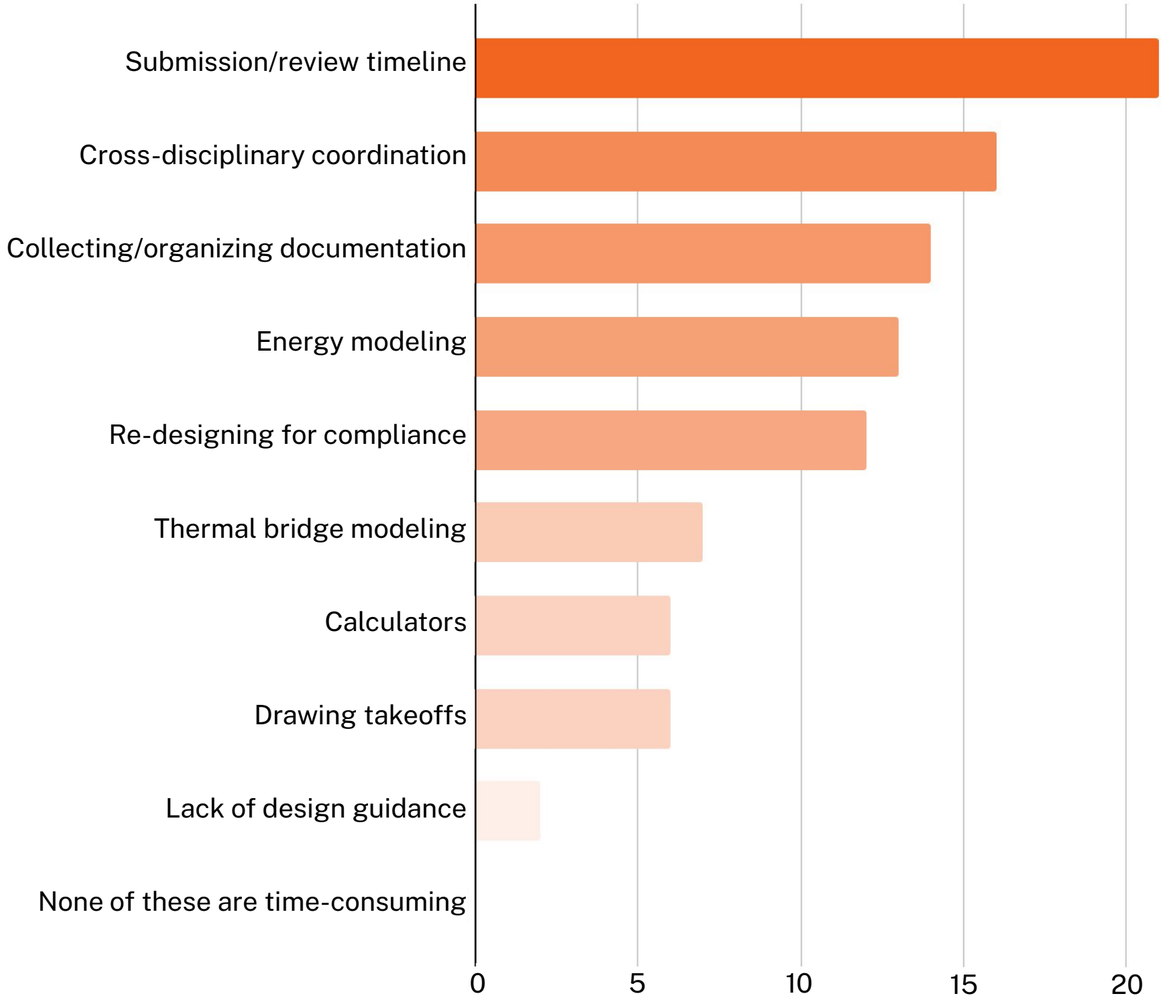
Valuable aspects of Performance Path



> *Owners want to meet the requirements at the **lowest cost** and **modeling and expertise are invaluable** in achieving that goal.*

Massachusetts Multifamily CPHC Survey

Time-consuming aspects of Performance Path

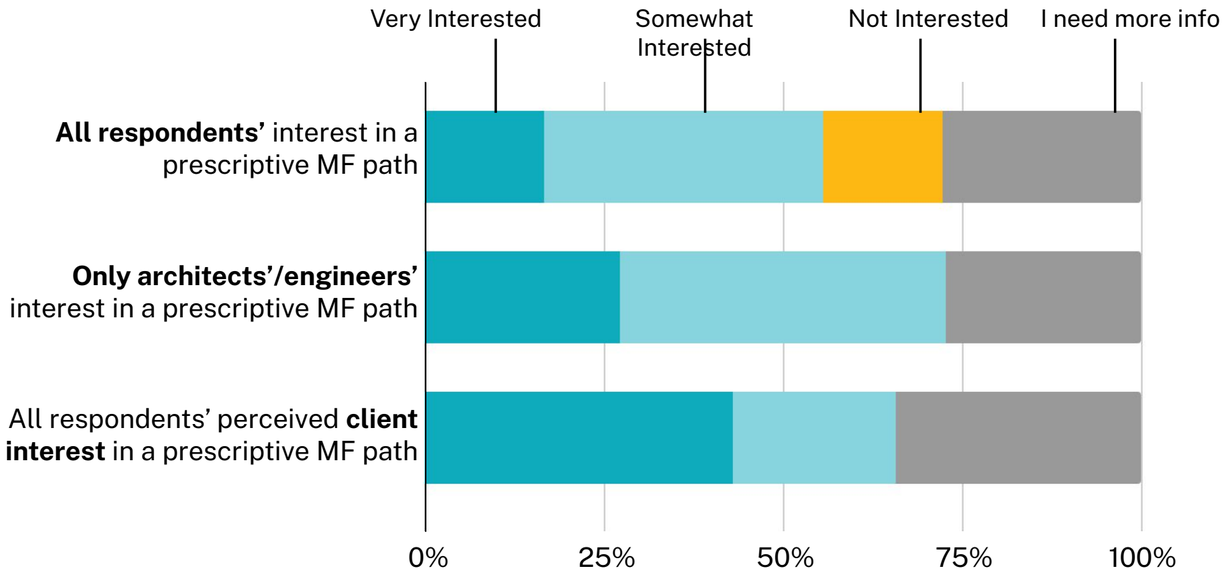


> *Only real annoyance is being asked to analyze conditions or provide additional detail on a model where it **clearly isn't going to move the needle and the model is comfortably below the targets.***

> *The **level of scrutiny** on minute details these days is proving to be **exhausting** for both us, the design team and the construction team.*

Massachusetts Multifamily CPHC Survey

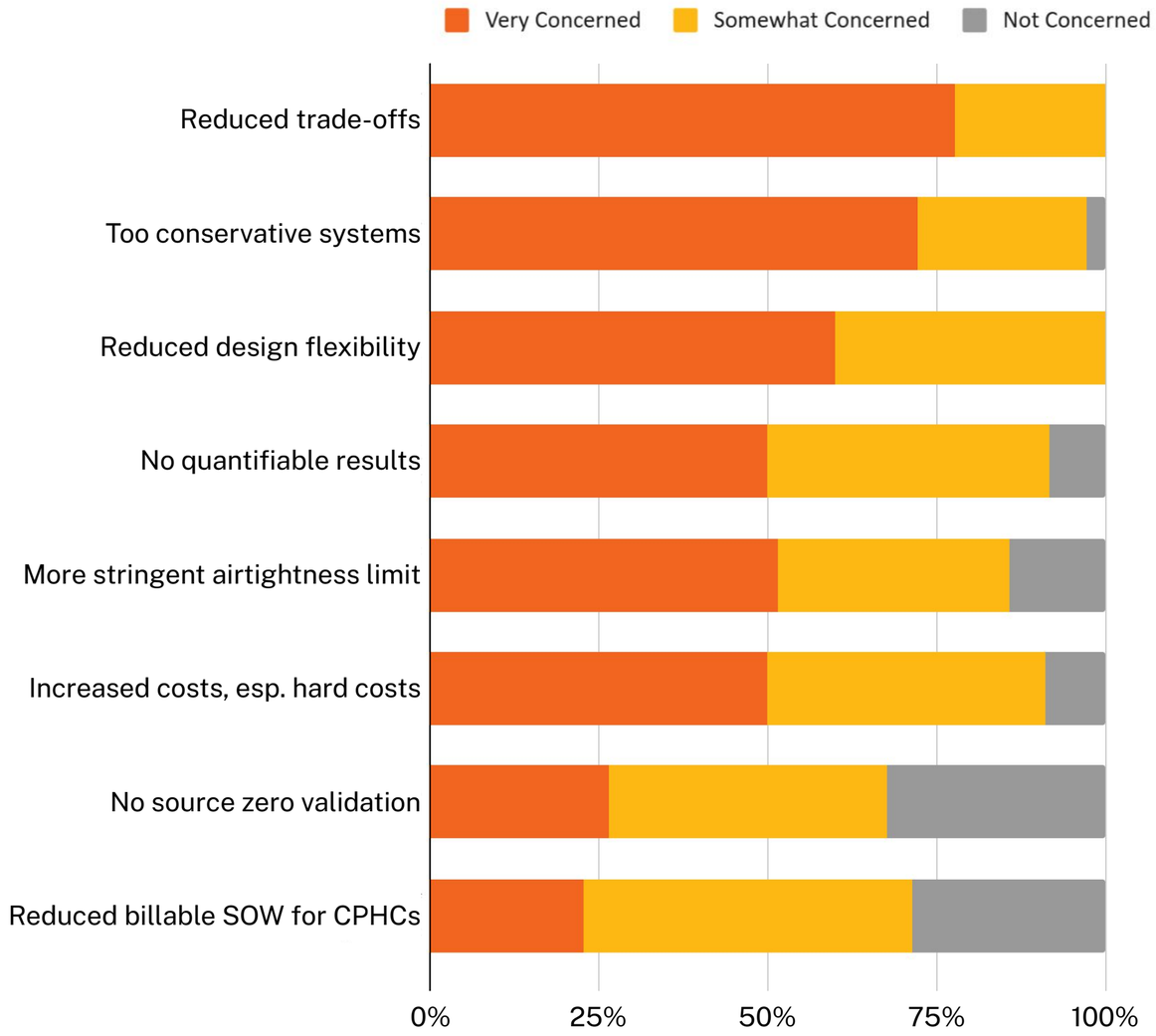
Interest in a multifamily prescriptive path



> *I do think that **small** [multifamily] buildings… could **greatly benefit** from a prescriptive pathway as long as it is not overly prescriptive and conservative.*

Massachusetts Multifamily CPHC Survey

Concerns over a multifamily prescriptive path



> *The risk with any Prescriptive approach is they tend to be **more conservative** than a modeled pathway...*

> *I really don't want to see our **creativity and freedom constrained**.*

Massachusetts Multifamily CPHC Survey

Suggestions we heard

> *Regardless of whether a prescriptive path is introduced, I believe there should be **changes made to the performance process** to reduce uncertainty, time, and cost.*

Massachusetts Multifamily CPHC Survey

Suggestions we heard

> *Regardless of whether a prescriptive path is introduced, I believe there should be **changes made to the performance process** to reduce uncertainty, time, and cost.*

> *A **prescriptive approach to [thermal bridge] mitigation** would be welcomed as it would reduce modeling time and uncertainty.*

> *I'd like to see an effort to develop a **standardized set of assembly derations** to develop a "worst-case" WUFI model...*

> *A **standard TB library** that can be used for modeling would be great...*

Survey - What We Found

Confirmed SF prescriptive path is faster and simpler

- Prescriptive path reduces review rounds
- Prescriptive path provides an easier point of entry due to no modeling requirements and definitive design guidance
- Prescriptive path is more limiting and may not promote design optimization

Confirmed some interest for a MF prescriptive path, esp. smaller buildings

- Concerns over prescriptive path being limiting and disallowing design optimization

Existing performance path could be streamlined

- Many multifamily CPHCs suggested ways to reduce modeling time in current performance path

Thermal bridge submissions can take a disproportionate amount of review time

Project Analysis

Initial assumptions: Our pattern of regular Phius-compliant strategies could lead to prescriptive guidelines

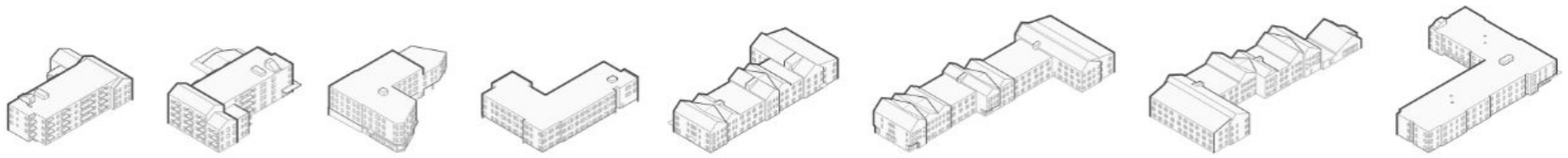
Project selection

Methodology

Analysis

- Envelope
- Thermal bridging
- MEP systems

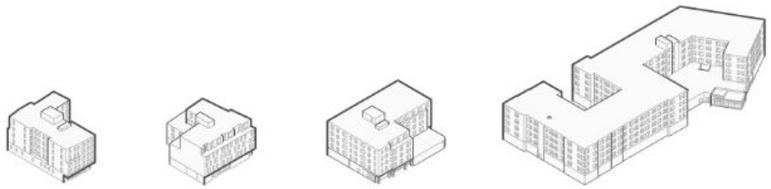
Project Selection



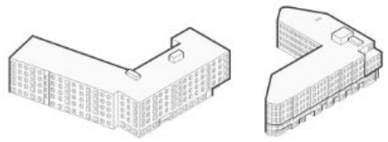
Type V

Low Rise (3 to 4 stories)

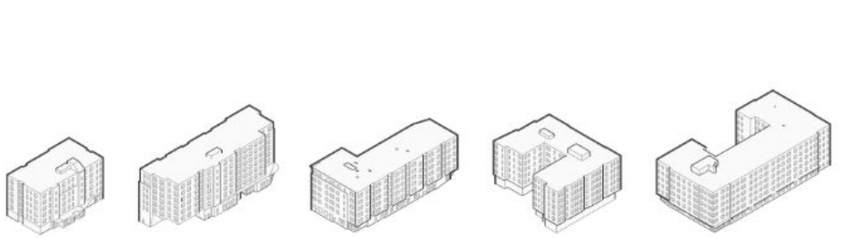
Number of Projects	**25**
Architect (Utile / PCA)	**60% / 40%**
Weather station (Boston Logan / Other MA)	68% / 32%
Cert. status (Design Certified / Certified)	68% / 32%
Market sector (Affordable / Market Rate / Mixed Income)	72% / 12% / 16%
Phius standard (2018, 2021, 2024)	16% / 48% / 36%
% of projects within 5% buffer of Space Conditioning metric (any)	24%
% of projects within 5% buffer of Source Energy metric (excl. solar)	36%



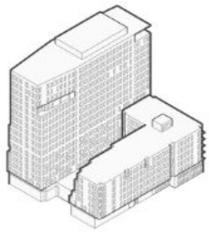
Type V over I



All Type III



Type III over I



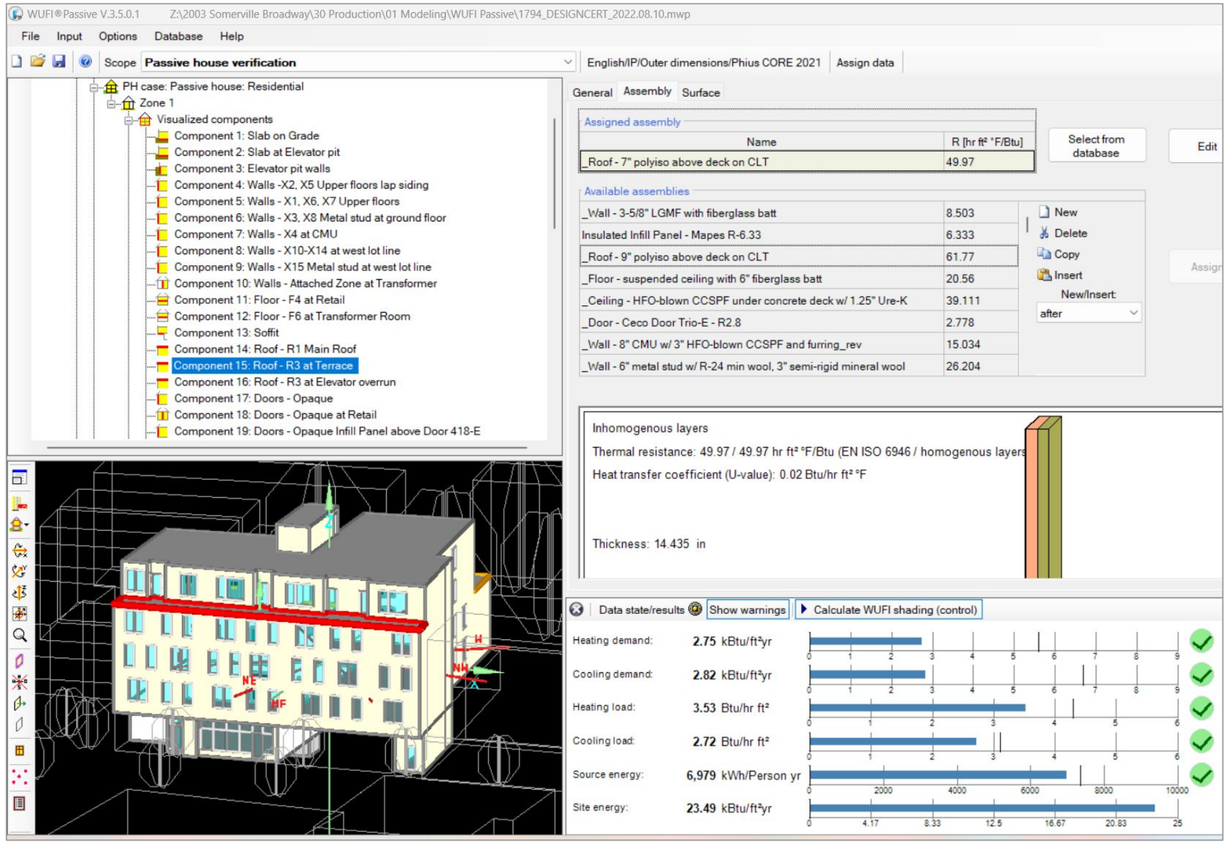
Type I (Tower)

Podium Mid Rise (5 to 7 stories)

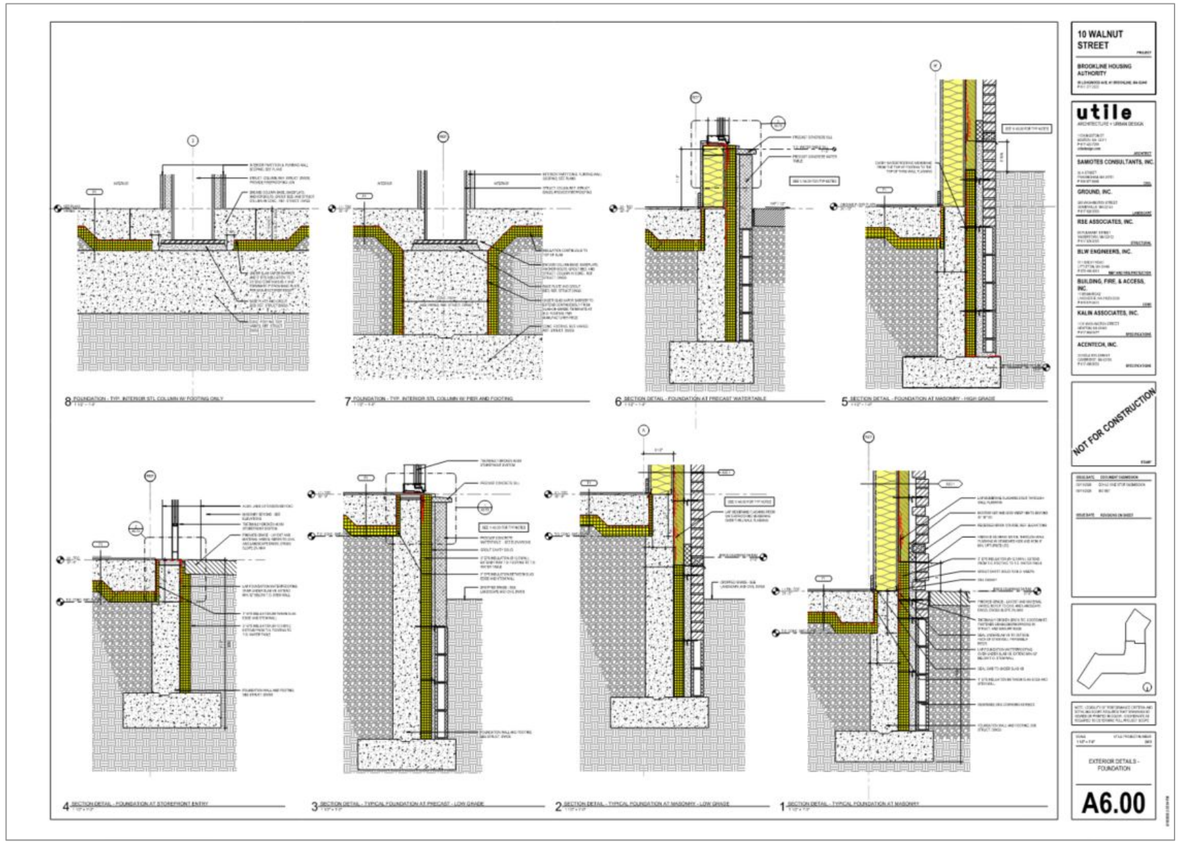
High Rise

How We Collected Data

WUFI Passive and THERM models, calculators



Construction drawings and architectural knowledge of projects

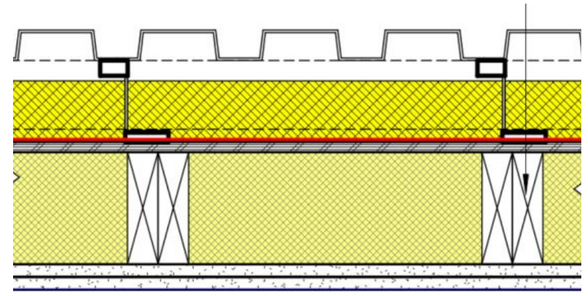


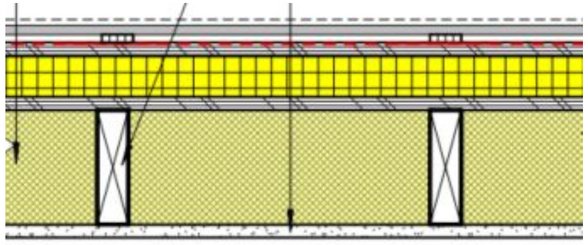
\+ MA multifamily CPHC survey responses on envelope

Above Grade Walls (Wood Construction)

100% 2x6 Studs

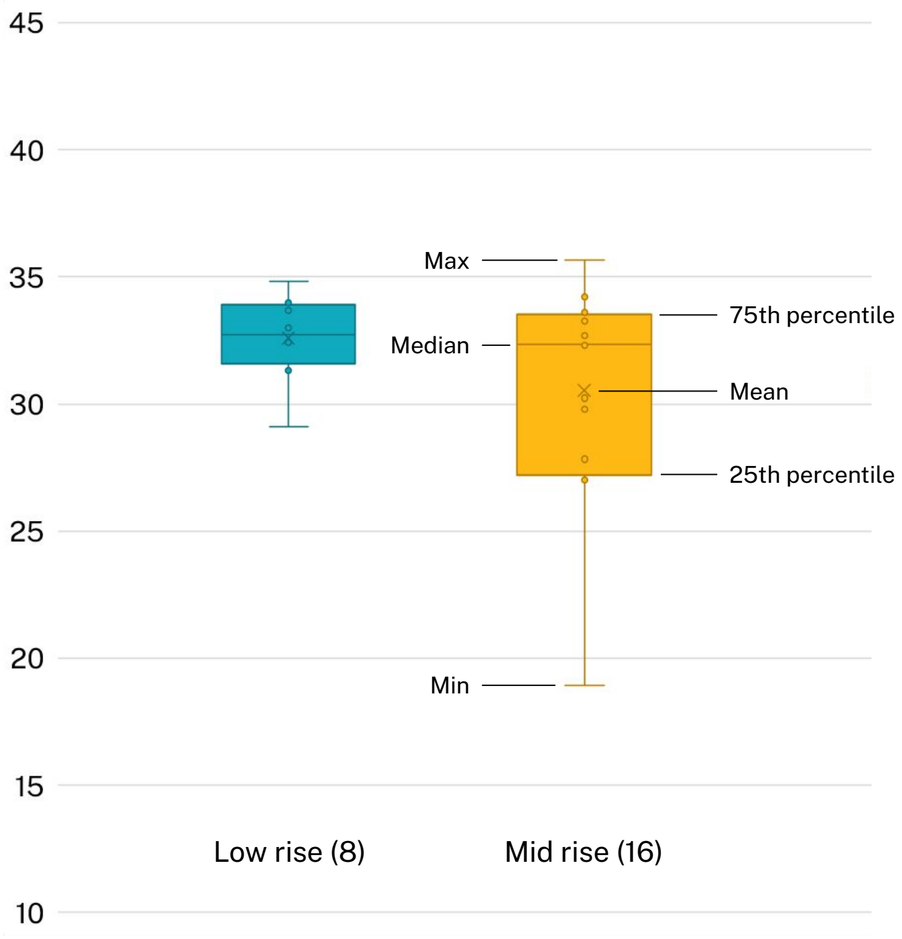
Insulation type	% of projects
Continuous Insulation*	
Mineral wool	**72%**
Polyiso board	16%
Insulated sheathing	12%
*Depths varied from 2” to 3”	
Cavity Insulation	
Blown fibrous insulation (cellulose or fiberglass)	**72%**
Batt insulation (mineral wool or fiberglass)	24%
Empty	4%





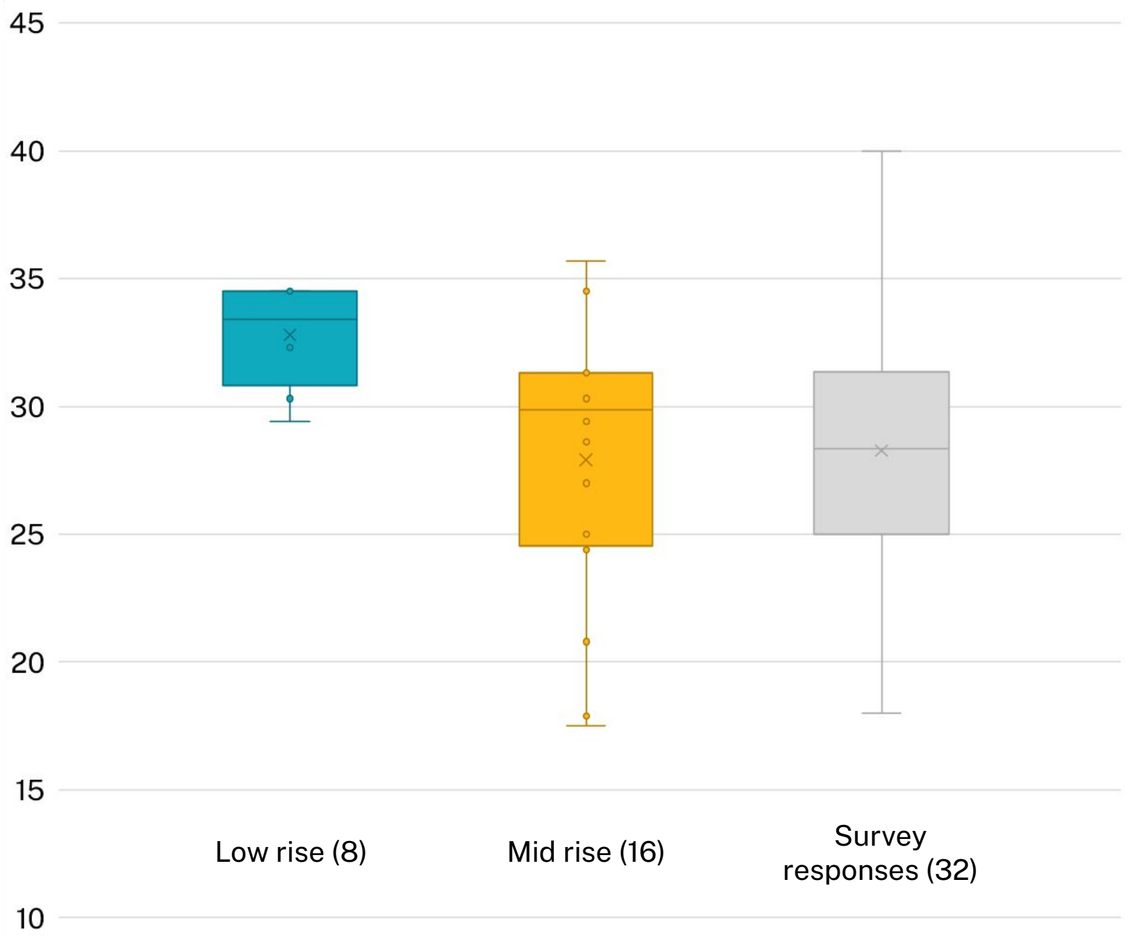
Above Grade Walls - Effective R-values

Wood Framed Walls Only



Overall Wall

Area-weighted across all wall construction types



Note: The single high rise has been excluded for clarity, unless otherwise noted

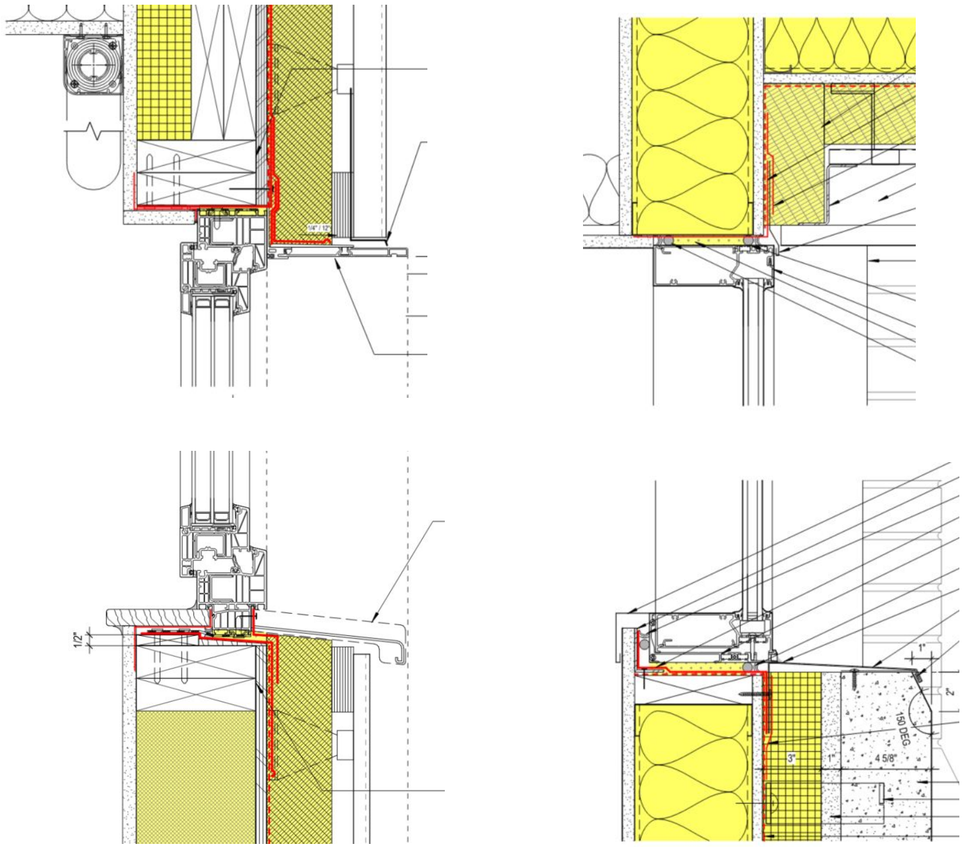
Windows

Punched Windows	% of projects
uPVC, triple-glazed (median U-0.16)	**96%**
Fiberglass, triple-glazed	4%

Storefront*	
Aluminum, double-glazed (median U-0.39)	**68%**
Aluminum, triple-glazed (curtain wall)	4%
Fiberglass, triple-glazed	4%

*Storefront only represented an average of 2% of the overall glazing on our projects

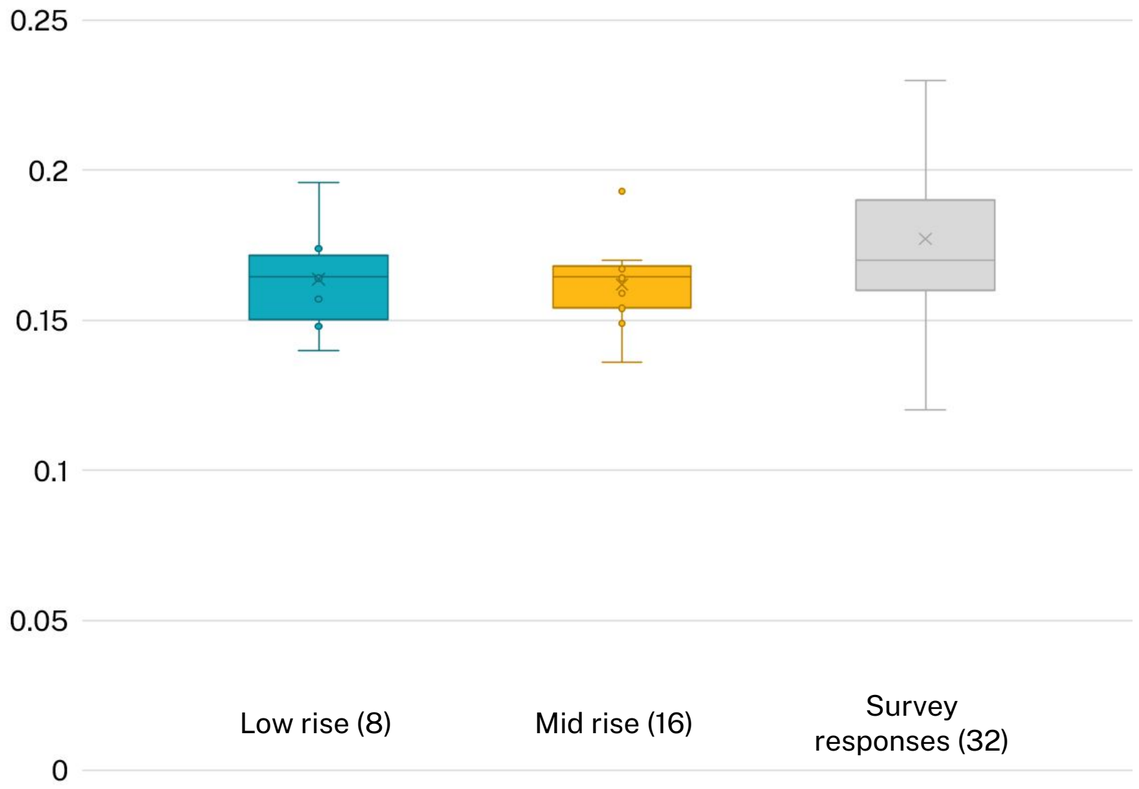
Solar Heat Gain Coefficient (SHGC)	
SHGC (median at center-of-glass: 0.39)	–



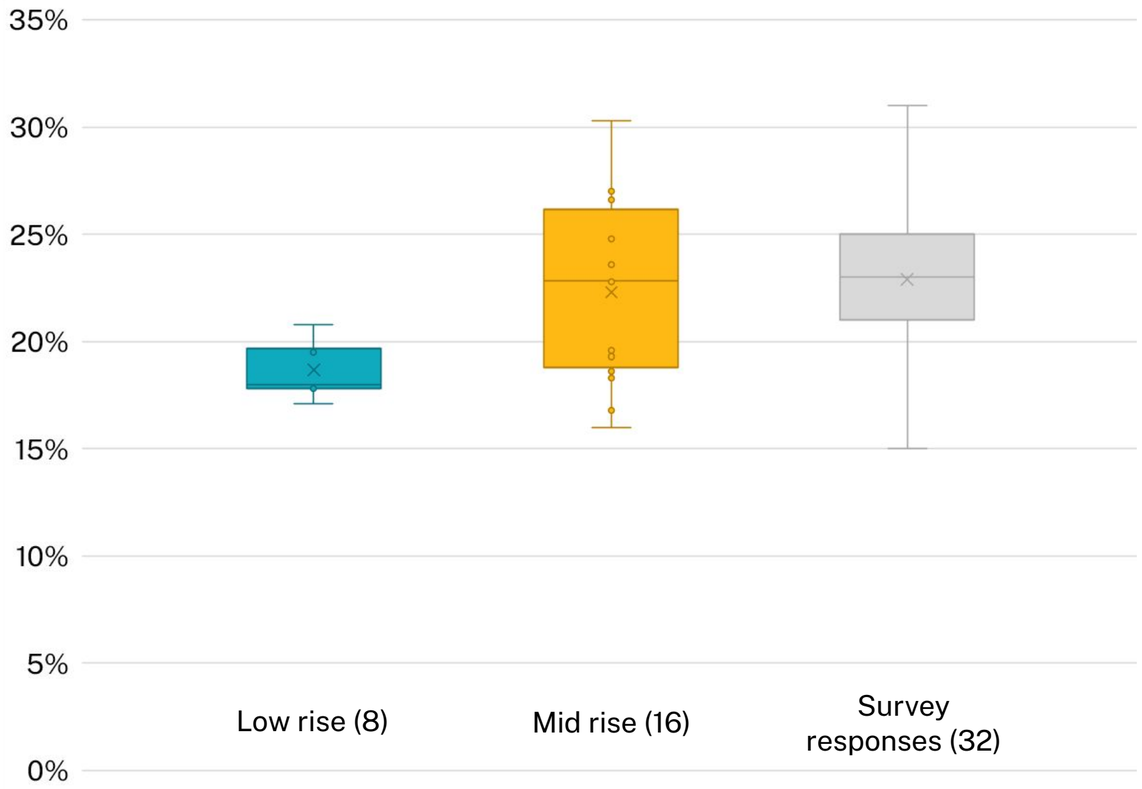
Windows

Punched Window U-value Ranges

Area-weighted across operable and fixed



Window-to-Wall Ratio (WWR) Ranges



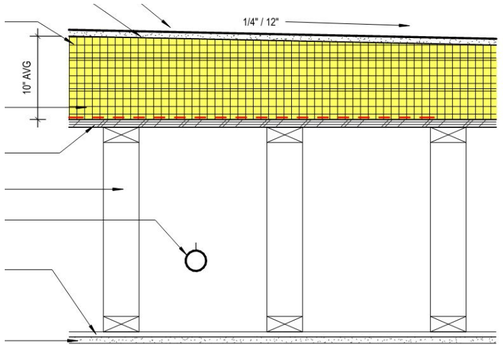
> *Punched window U values seem **fairly standardized across all projects***
>
> — Multifamily survey respondent

Note: Any outliers for survey responses have been removed for clarity, unless otherwise noted

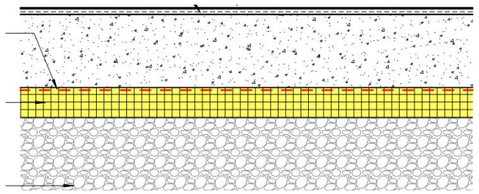
Horizontal Assemblies

Roofs	% of projects
Polyiso above deck (5” to 11”)*	**100%**
Hybrid rigid above, batt or spray below	20%

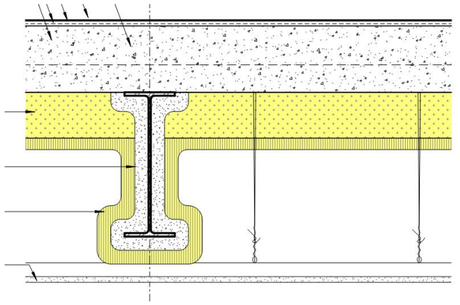
*Median fastener deration was 13.9% (mild steel) for v2021 and newer projects, vs. 35% default deration



Slabs	
Rigid insulation under slab on grade (2” to 5”)	**88%**
Foam glass aggregate under slab	12%

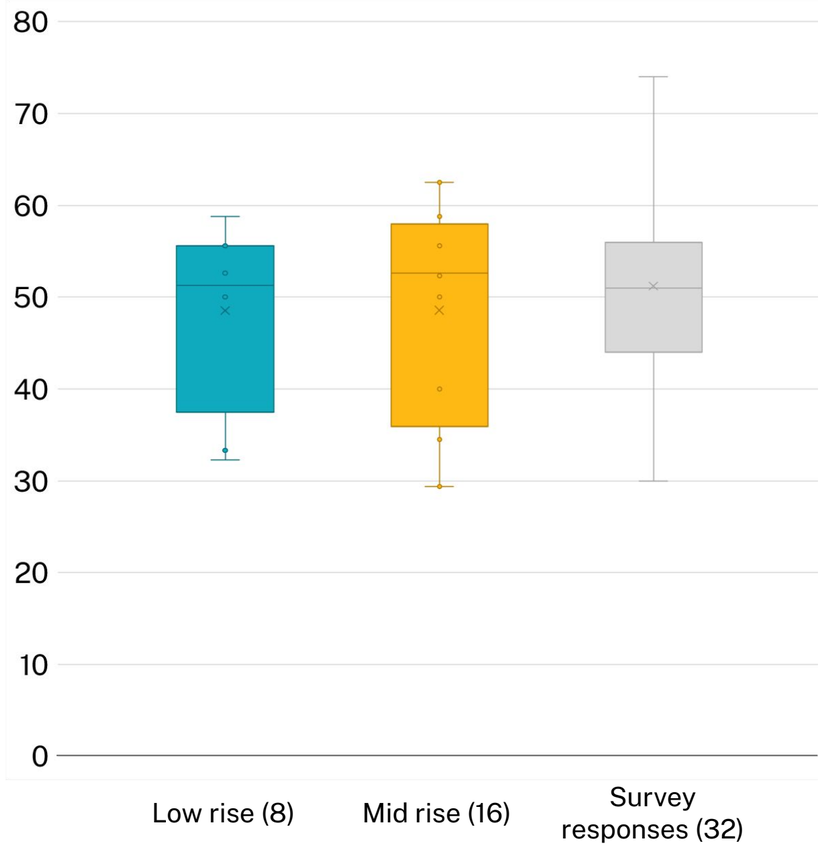


Floors over garage	
CCSPF against deck w/ cellulose spray	**56%**
EPS concrete sandwich	28%
Mineral wool under trusses	8%

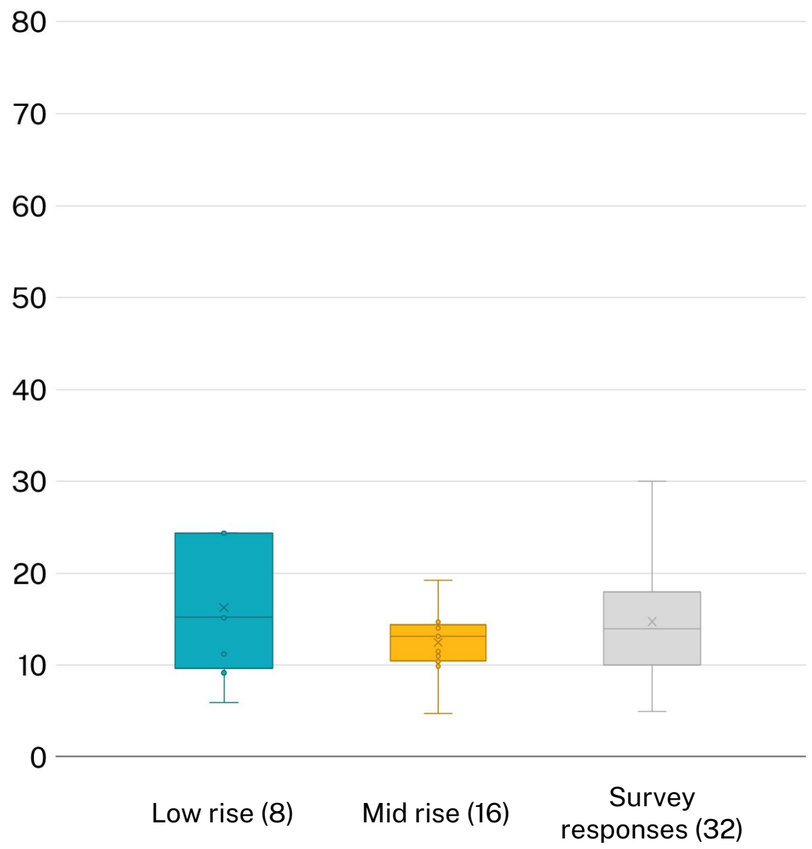


Horizontal Assemblies - Effective R-values

Roof



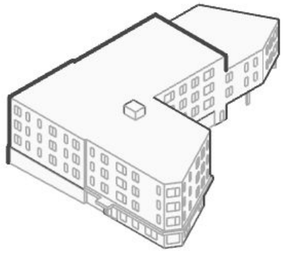
Slab



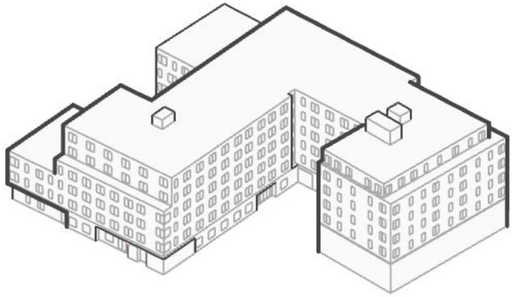
Exterior Floor

Compactness Ratio

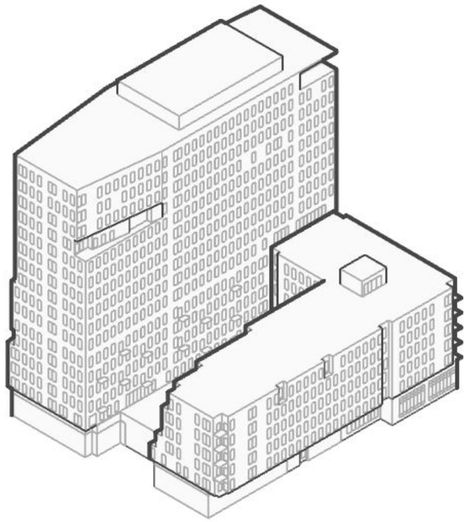
Enclosure Area / Interior Conditioned Floor Area (iCFA)



Enclosure / iCFA = **1.26**



Enclosure / iCFA = **1.00**



Enclosure / iCFA = **0.69**

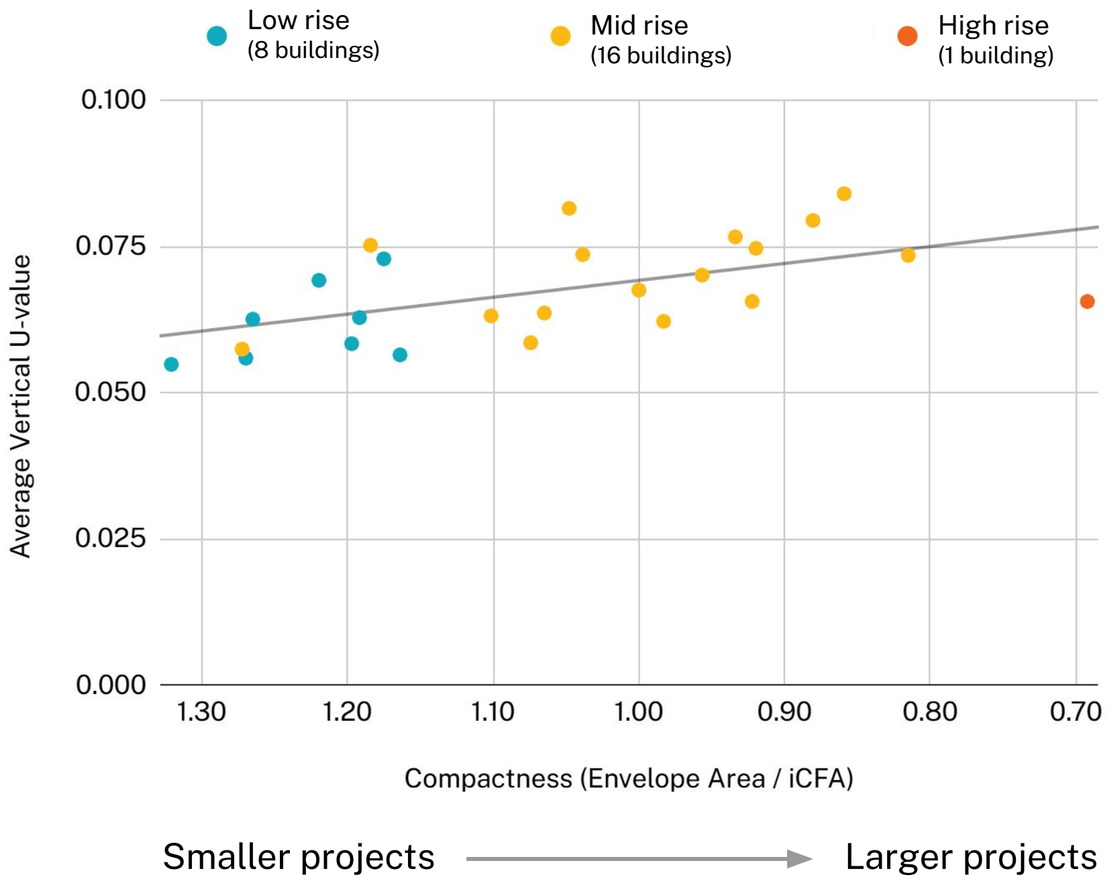
Smaller projects
More surface area to floor area

Larger projects
Less surface area to floor area

Area-Weighted U-Values (Pre-Thermal Bridging)

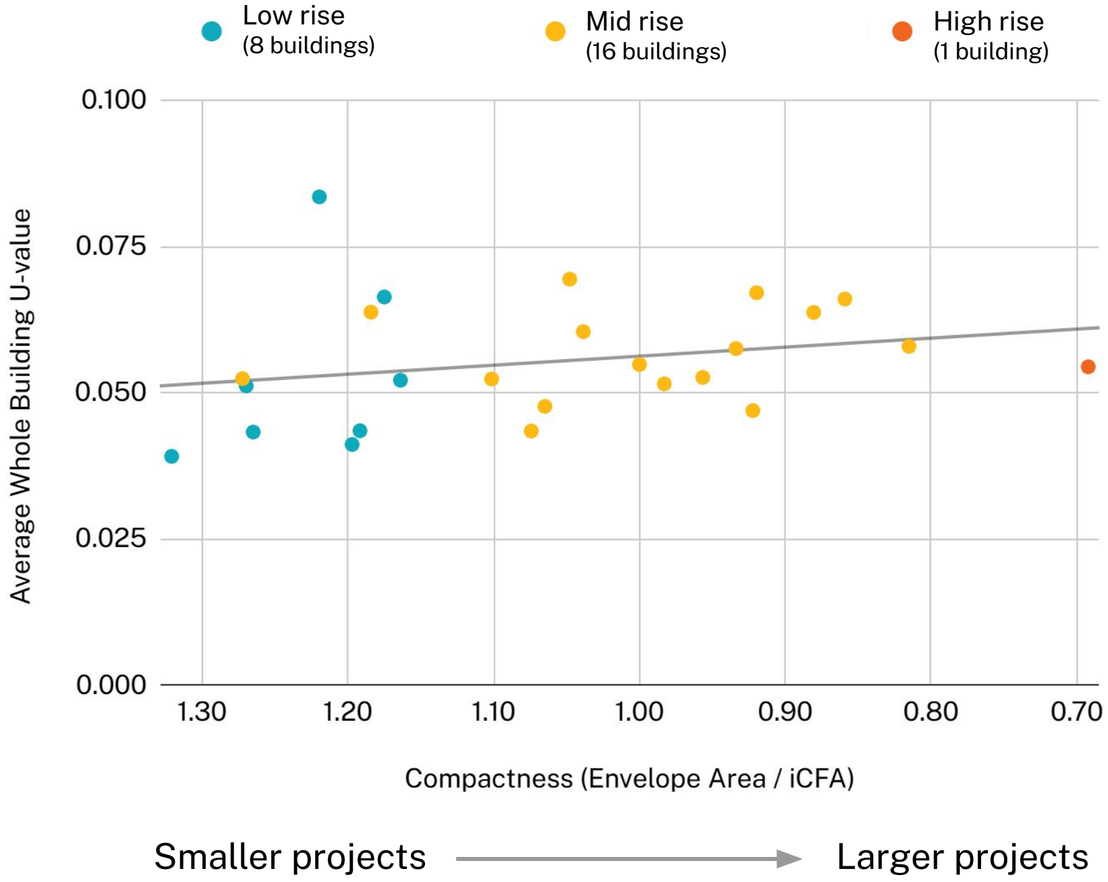
Vertical U-value v. Compactness

Walls and glazing



Smaller projects → Larger projects

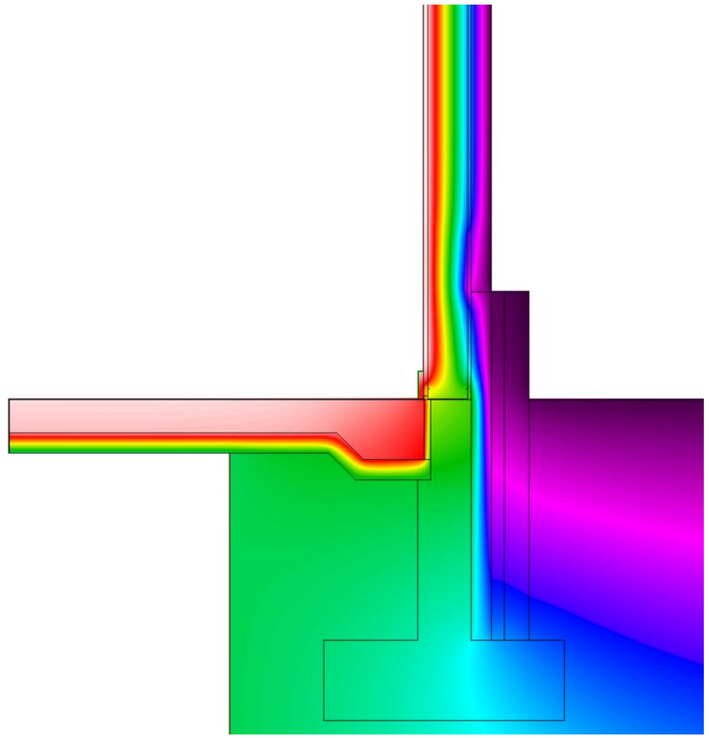
Whole Building U-value v. Compactness

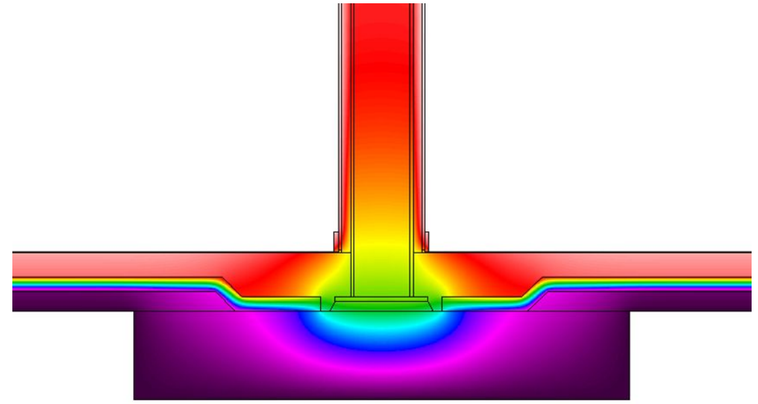


Smaller projects → Larger projects

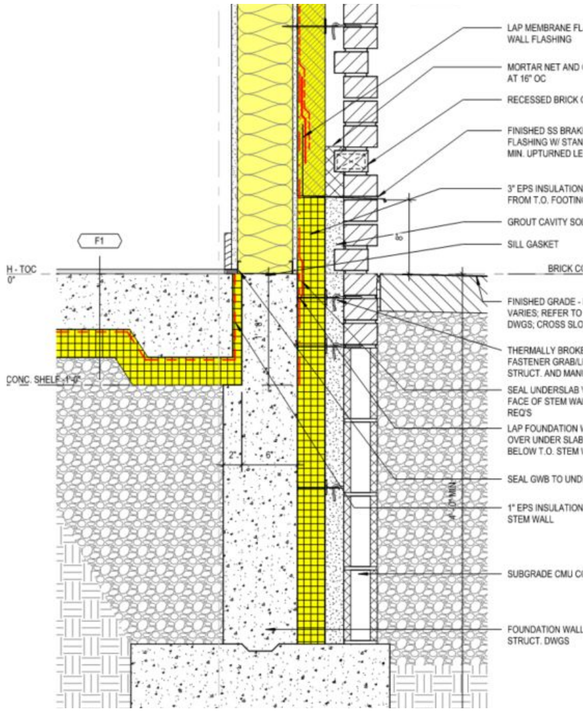
Thermal Bridges

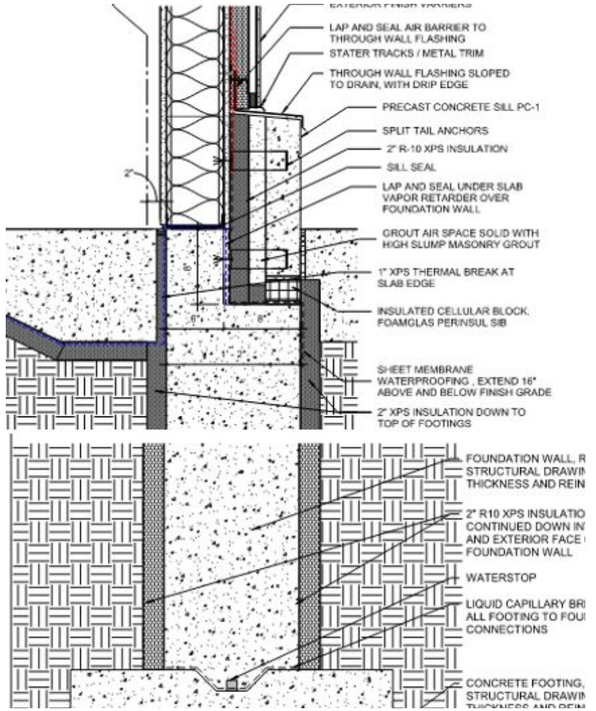
Perimeter	% of projects
Foundation at slab edge	**88%**
Door sill	16%
Ambient	
Steel beam at soffit	36%
Steel at exterior wall	28%
Steel column to beam	28%
Steel beam at garage	28%
Concrete deck to podium	12%
Balcony connection	8%
Interior Footing	
Steel column at interior footing	40%
Bearing wall at interior wall footing	20%

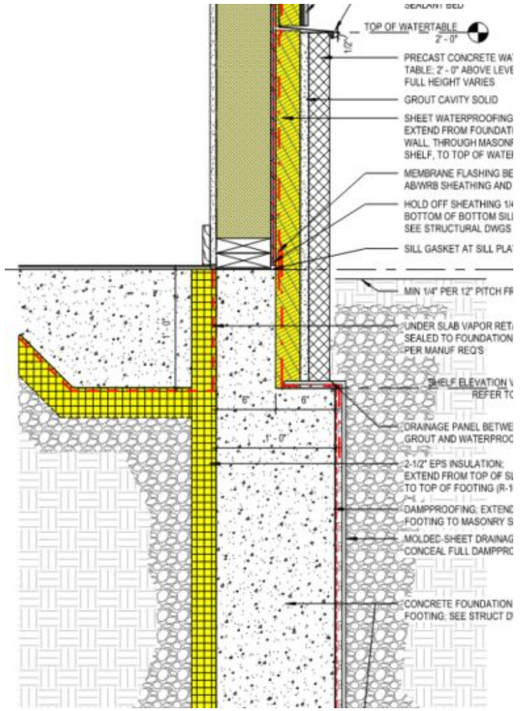




Thermal Bridges - Foundation Wall at Slab Edge



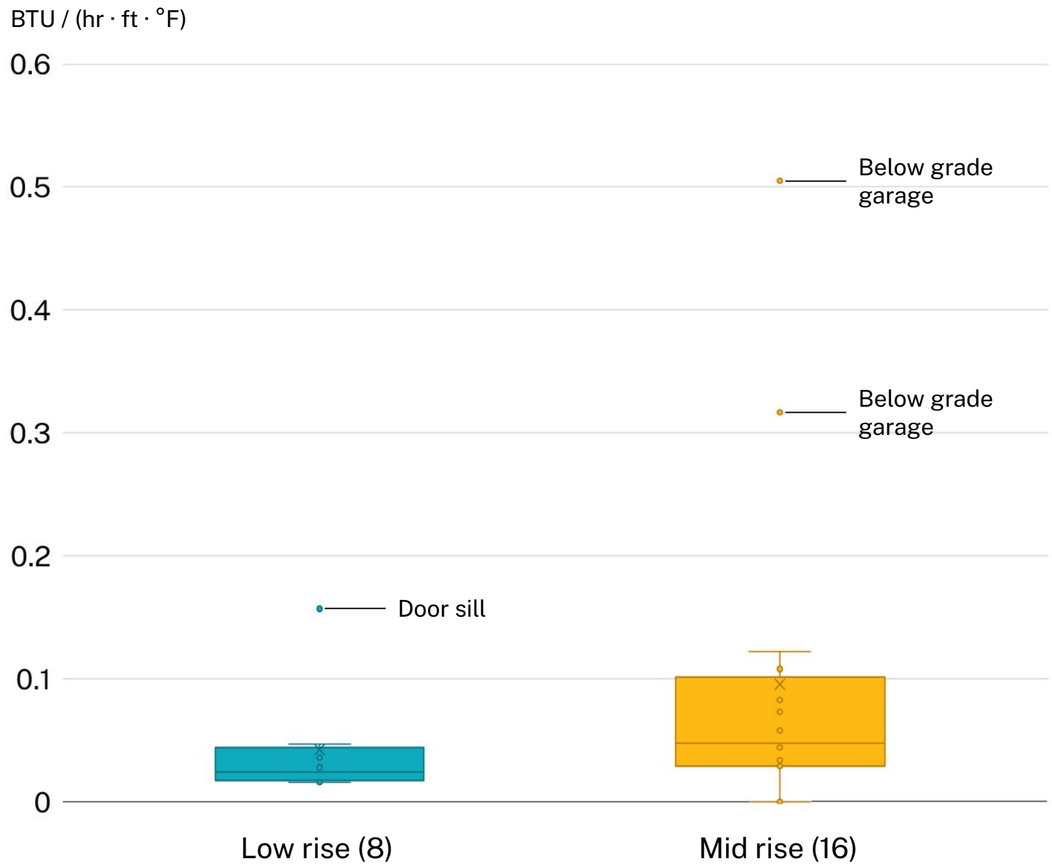




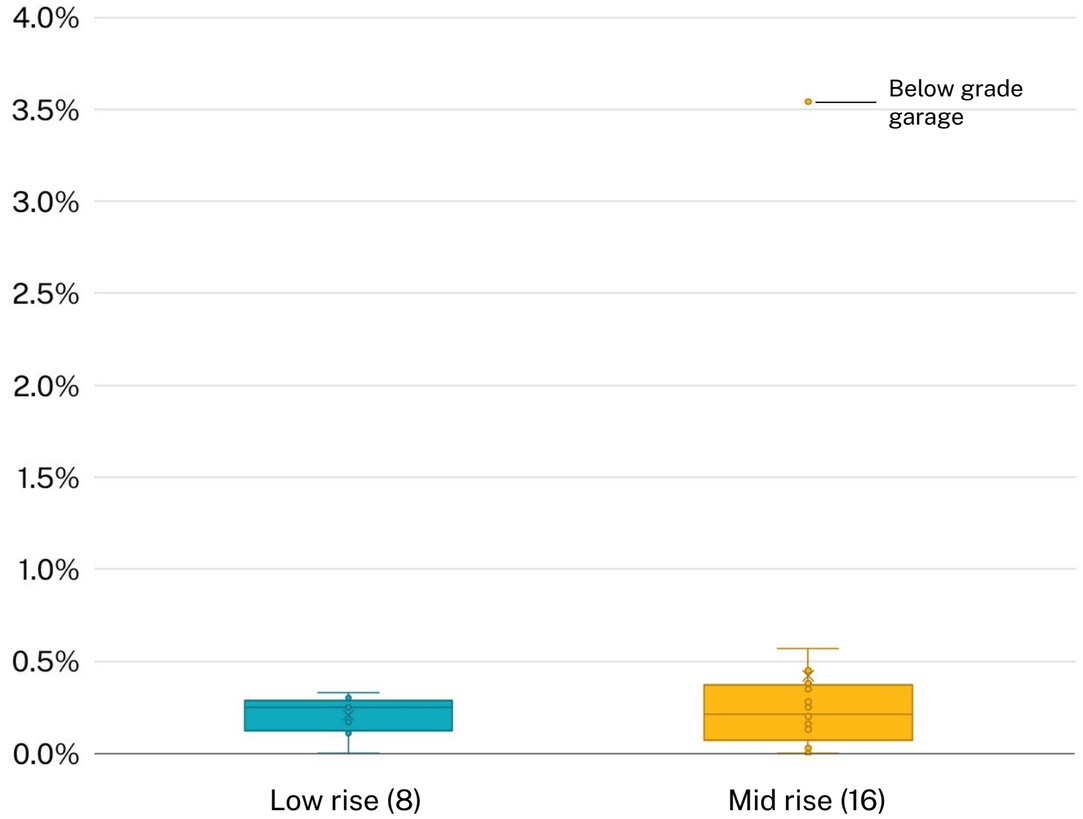
Rigid insulation position	**Outside (48%)**		**Combined (33%)**		**Inside (19%)**	
Wall framing above	Wood (3)	Metal (7)	Wood (3)	Metal (3)	Wood (2)	Metal (2)
Psi-value range (Btu/hr-ft-F)	0.016 - 0.02	0 - 0.07	0.02 - 0.04	0.03 - 0.18	0.03 - 0.05	0.06 - 0.65
Psi-value median	0.02	0.03	0.03	0.12	0.04	0.36

Thermal Bridges - Foundation

Weighted Average Perimeter Psi-values

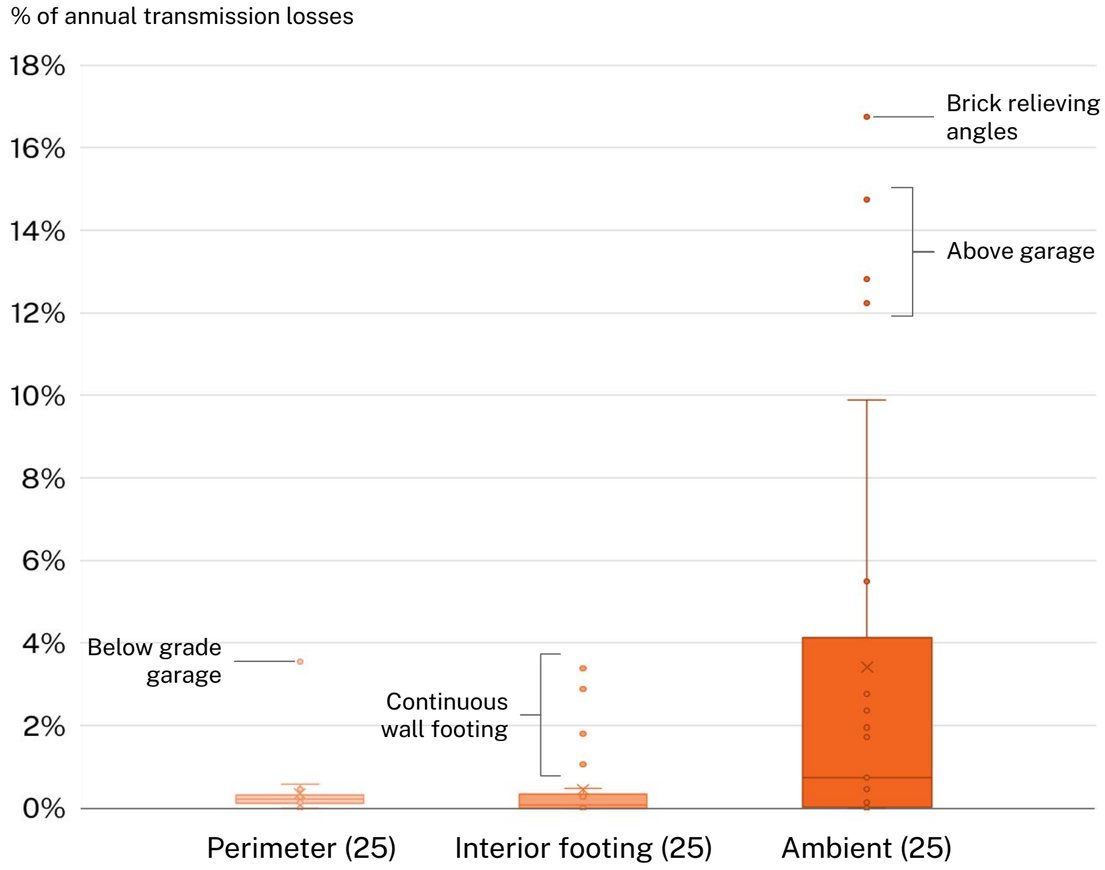


% of Annual Transmission Losses from Foundation TB's

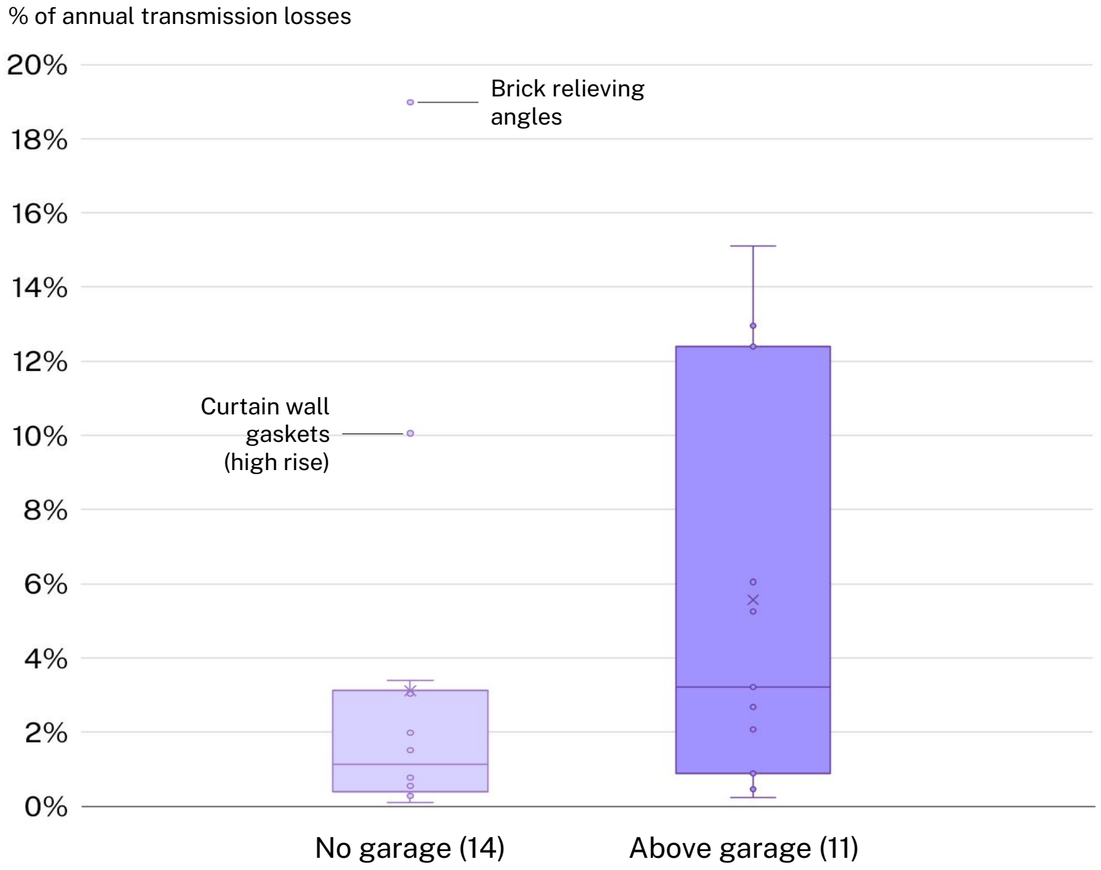


Thermal Bridges

Impact of Thermal Bridges on All Projects



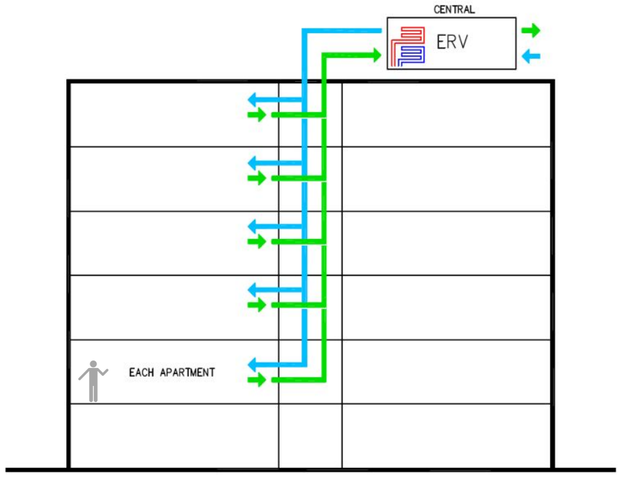
Effect of Garage on Thermal Bridging



Note: Results include data from the single high rise

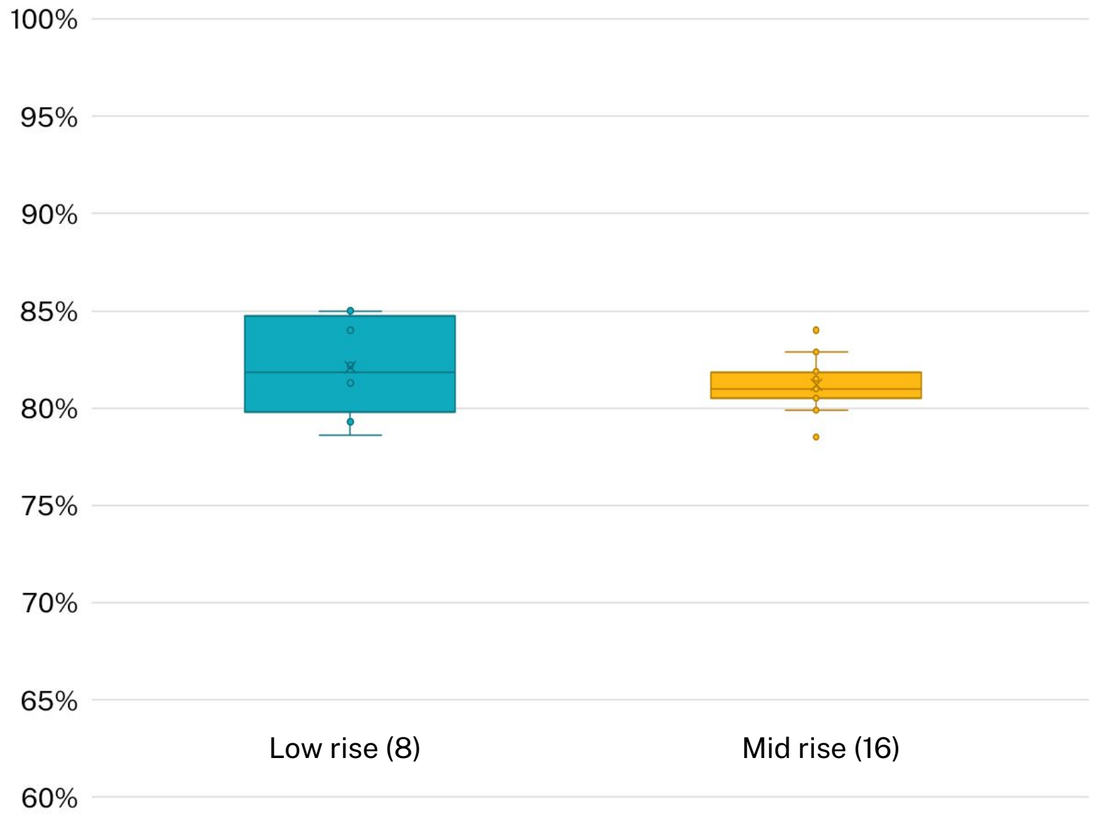
Mechanical Equipment

ERV Configuration	% of projects
Outside, Centralized	92%
Inside, Individual	8%
Heating/Cooling	
ASHP, VRF	60%
ASHP, 1:1 Split	36%
Condenser loop w/ WSHP	4%
Water Heating	
Central HPWH	48%
Central Gas	36%
Individual Elec. Resistance	12%
Individual HPWH	4%

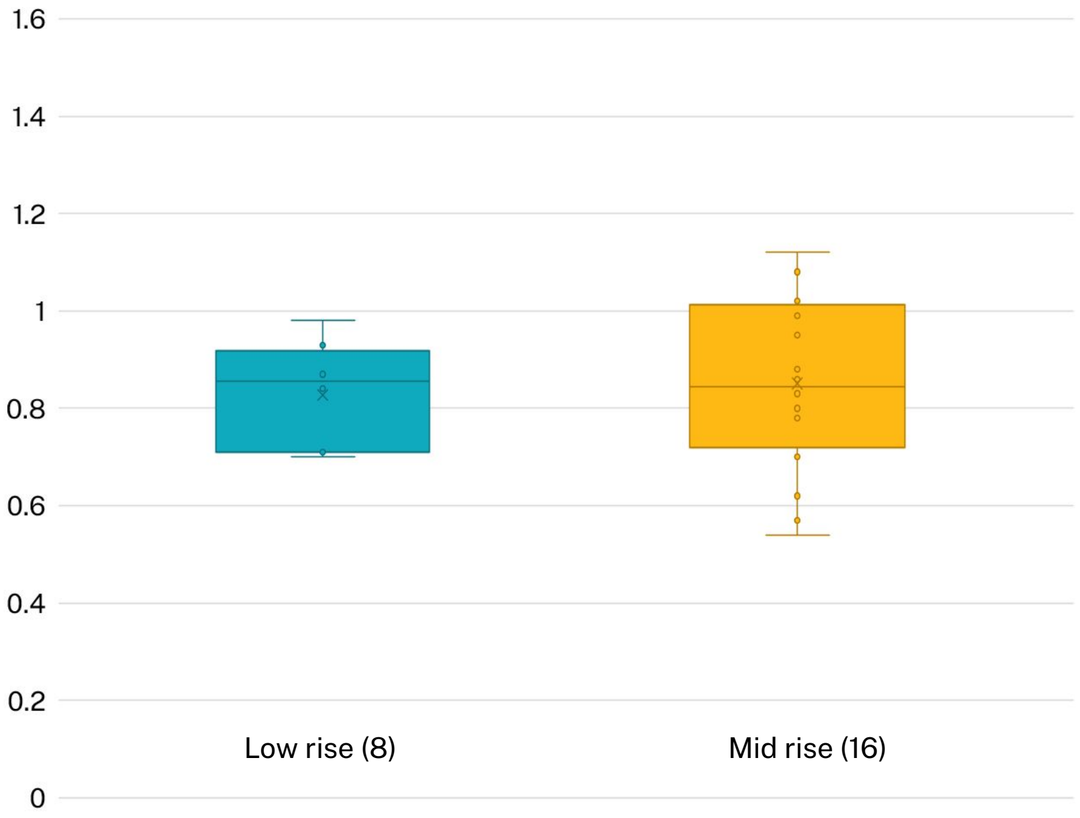


Energy Recovery Ventilation

Sensible Recovery Efficiency

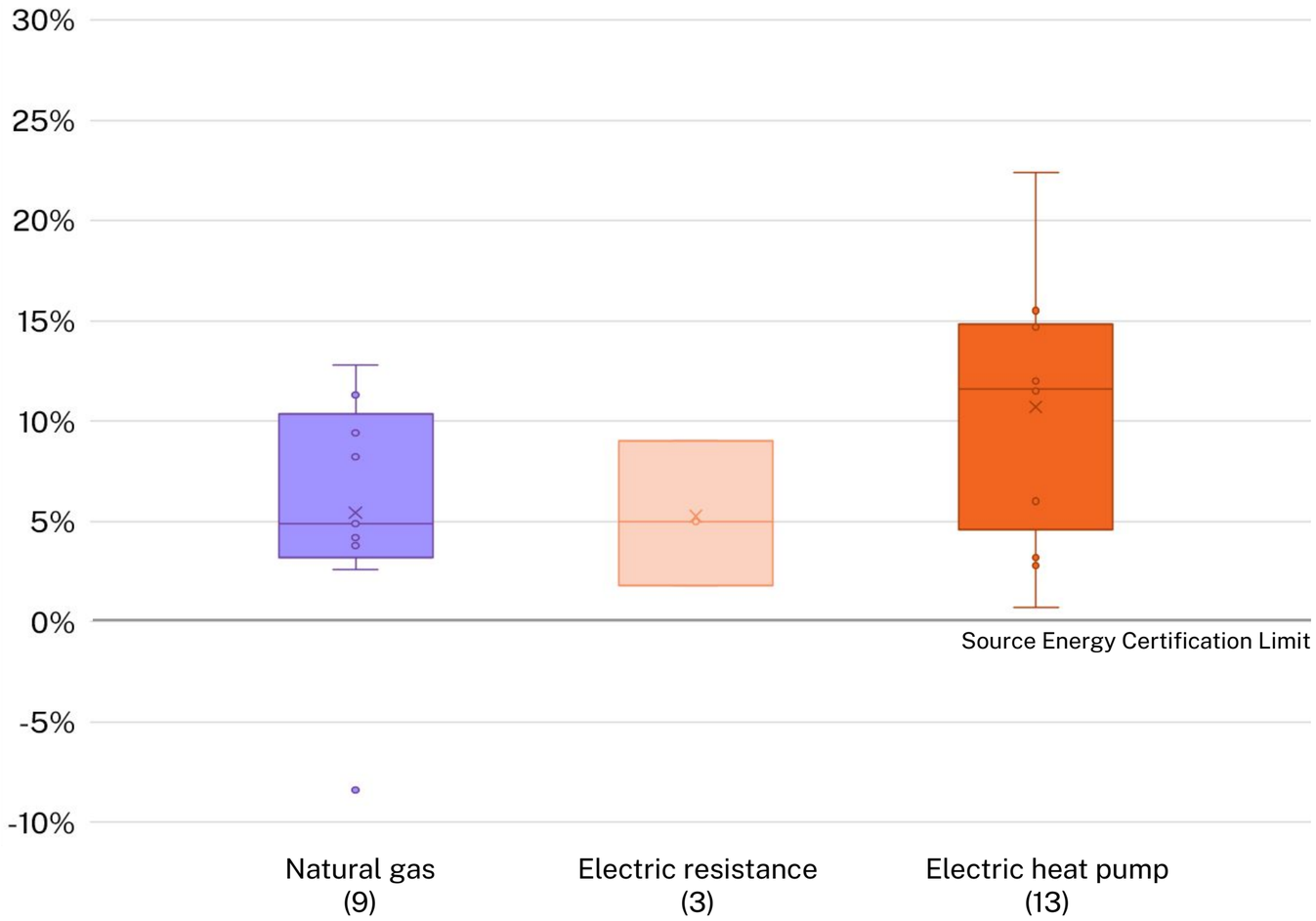


Electric Efficiency (W/cfm)



Water Heating

Source Energy Buffers (Before Renewables) by DHW System



> *Electric resistance DHW **usually needs PV**.*
>
> — Multifamily survey respondent

Note: Results include data from the single high rise

Project Analysis - What We Found

Project scale matters

- Low rise projects had commonalities for walls, window-to-wall ratio, and foundation psi values
- Enclosure U-factors trend with project scale (even though horizontal assembly performance varied)
- All projects shared consistency in some things, e.g. glazing and ventilation performance

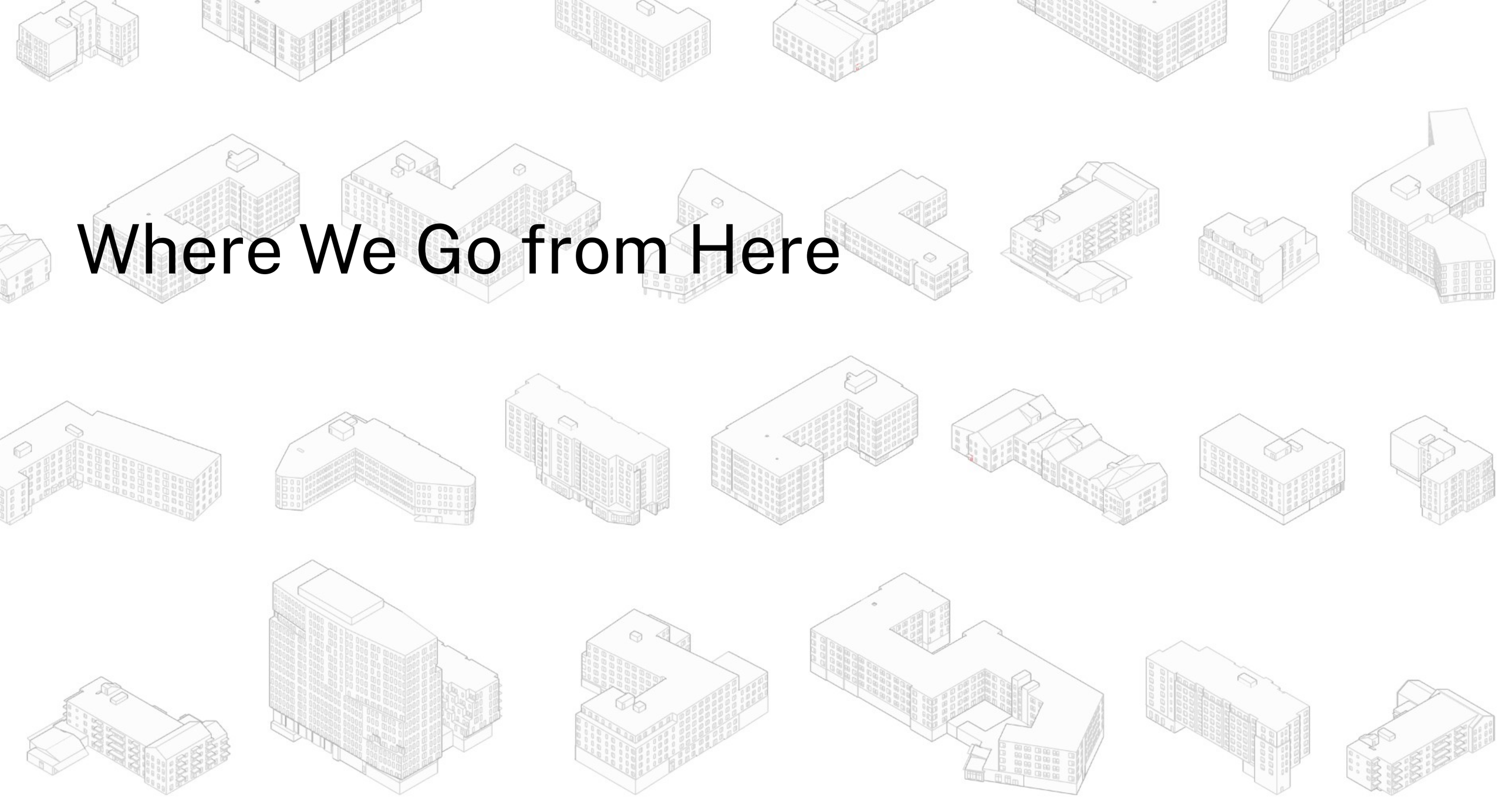
Some thermal bridges matter more than others

- Foundation TB's contribute relatively little to overall enclosure transmission losses
- Projects w/ garages had more varied thermal bridging and impact on overall performance

Water heating system often determines Source Energy buffer

- Gas or ER DHW closer to Source Energy limits

Where We Go from Here



What We Learned

	Initial assumptions	What we learned
Survey	Practitioners (SF) + reviewers would find prescriptive faster/easier	**Confirmed assumptions about time savings** **Universal concern over prescriptive being too limiting**
	Multifamily CPHCs interest in prescriptive	**Many multifamily CPHCs suggested ways to streamline the current performance path**
Project Analysis	Our pattern of regular Phius-compliant strategies could lead to prescriptive guidelines	**Project scale matters** **Some things we have to model have much more impact than others**

What We Learned

Prescriptive

Early design guidance
Low barrier to entry
Shorter certification timeline

Performance

Decision-making freedom
More in-depth CPHC involvement
Customization and trade-offs

Two Opportunities

Prescriptive

Early design guidance
Low barrier to entry
Shorter certification timeline

Performance

Decision-making freedom
More in-depth CPHC involvement
Customization and trade-offs

Incremental Expansion of the Prescriptive Option

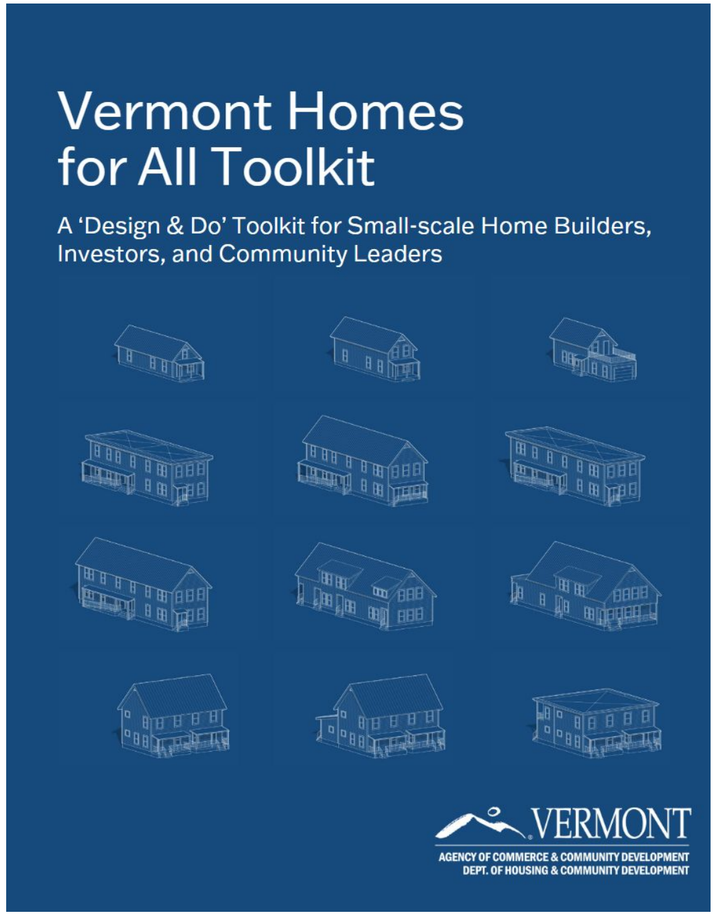
- Start with smaller buildings, where there is need for easier entry to Phius
- Avoid overly conservative limits, incorporate sliding scale

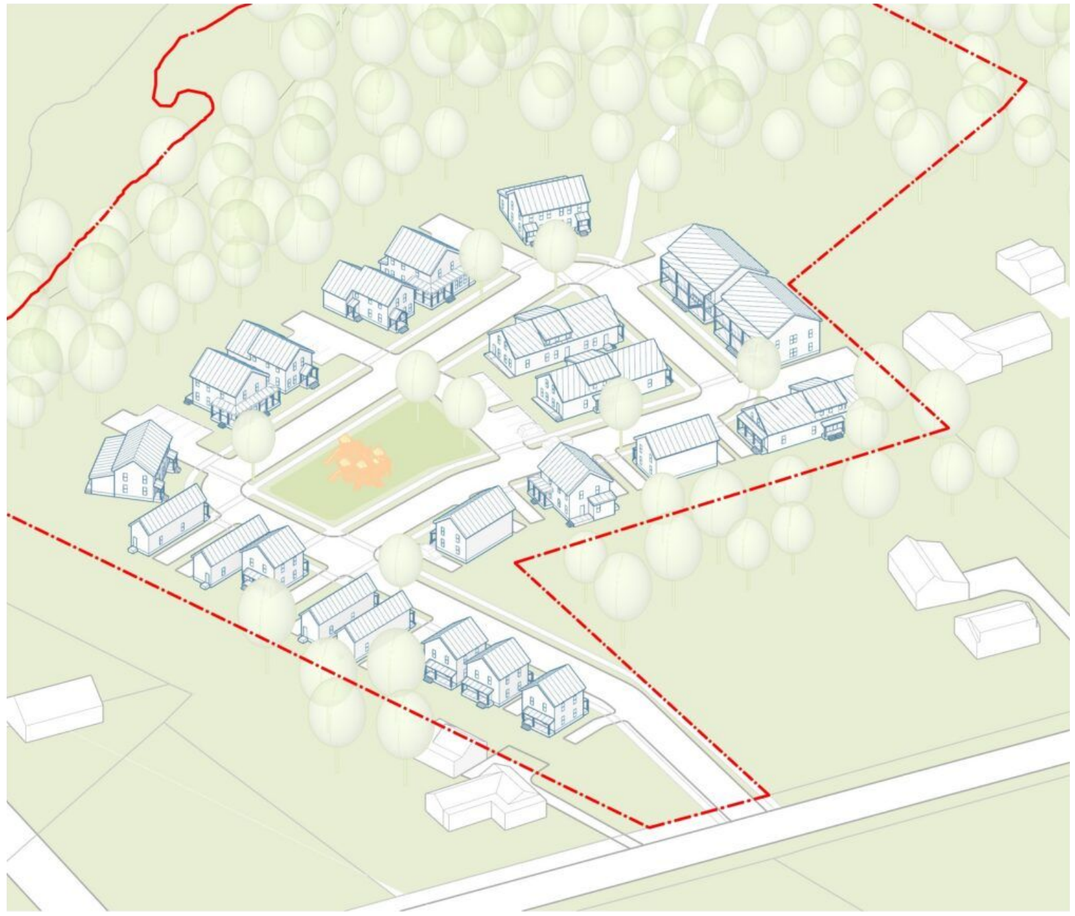
Streamlining the Multifamily Performance Path

- Targeted simplifications of existing modeling and review process
- Standardized details based on expanded project research

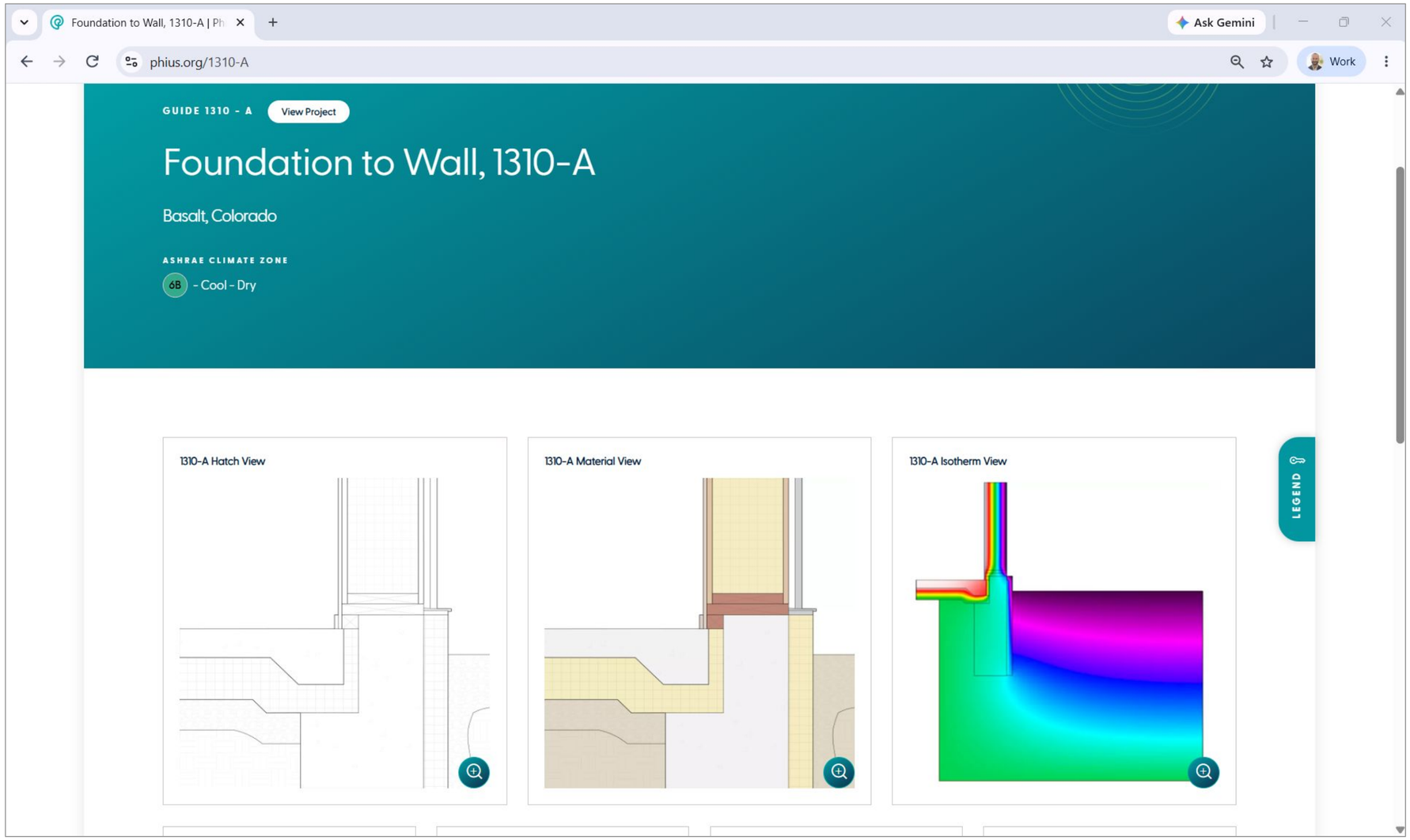
Future Multifamily Prescriptive Option

Smaller multifamily / missing middle housing





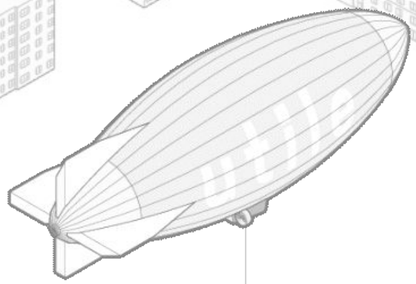
Streamlining the Multifamily Performance Path



Initial Recommendations

Component	Recommendation	Incremental Expansion of the Prescriptive Path	Streamlining the Performance Path
Enclosure	**Consider smaller multifamily eligibility for prescriptive**	☐	
	Put enclosure performance limits on a sliding scale (e.g. compactness) and maintain UA trade-off	☐	
	Conduct further study of certified projects in comparable climates to avoid overly conservative limits	☐	
Thermal bridges	**Expand detail library to include pre-approved foundation thermal bridges, assembly derations**	☐	☐
	Projects with garages may need potential scope limitation, further study		
Mechanical systems	**Electric Resistance DHW may need potential scope limitation or PV tradeoff, along with further study**		
	Calibrate ventilation and other system performance limits based on further project study	☐	

Thank You!



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