Welcome to the waiting room. We'll begin shortly.

Reminder: Today's webinar will be recorded and shared with attendees.

Welcome

Cornelia Wu

Senior Manager,

Codes and Standards

Things to Note

- This webinar is being recorded
- In NEEP's ongoing effort to improve accessibility to both our work and events, we have enabled the closed captioning, the control to disable this feature is located in the lower right corner
- The slides and recording will be sent to all attendees
- All lines will remain on mute—please type in your questions in the Q&A at any time
- Chat will be available for comments, discussion, and collaboration
- Antitrust statement: Participants shall comply with competition law requirements and shall not enter into any discussion, activity or conduct that may violate any applicable competition law

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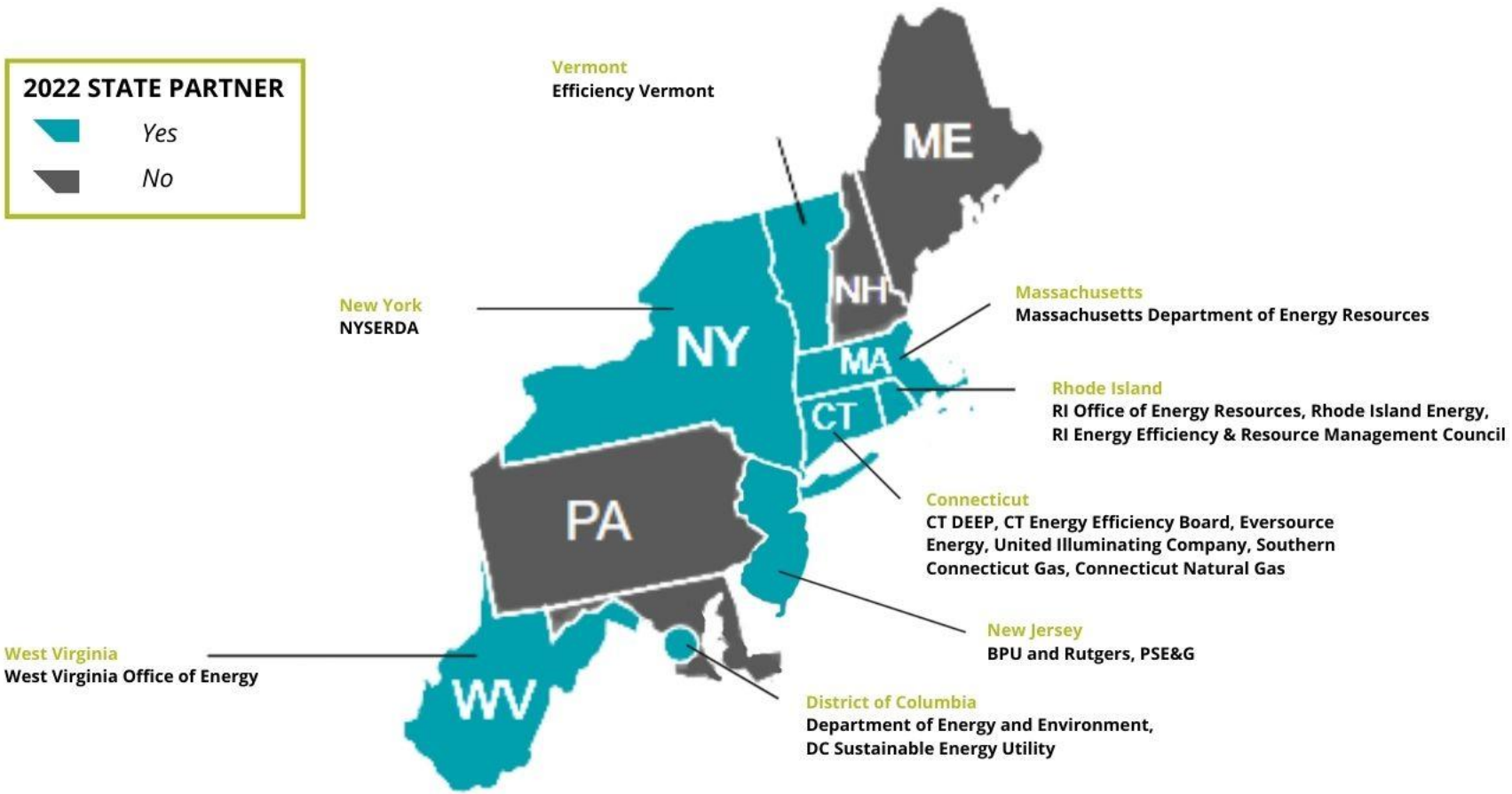
U.S. DEPARTMENT OF
ENERGY

Northeast Energy Efficiency Partners (NEEP)

State Partnerships

NEEP works closely with our State Partners on the successful application of policies, programs, and technologies, and brings knowledge of what strategies work (and don't work) to advance the state's and region's clean energy goals.



NEEP Summit 2023 is in a Few Weeks!

RVI and Off-Site Construction

Cornelia Wu

Senior Manager,

Codes and Standards

RVI and Off-Site Construction

Funding

This off-site construction and Remote Virtual Inspections (RVI) project is funded by the United States Department of Energy (U.S. DOE)

RVI and Off-Site Construction

Definitions

Off-site construction is a construction method where some components of a building are put together at an off-site factory and later assembled at the building site. Some form of on-site construction is always necessary. Off-site construction methods include pre-cut lumber, panelized walls, and modular components.

- It does not include manufactured (HUD) housing, which is subject to separate federal regulations.

Remote Virtual Inspections (RVI) are an inspection method that allows inspectors to use technology to conduct inspections without needing to be physically present at the building site.

- This can be particularly useful for off-site construction, but can also be used for solely on-site construction.
- The COVID-19 pandemic limited ability to perform onsite inspections due to social distancing requirements. As a result, there became an increased need for RVI .

Remote Virtual Inspections

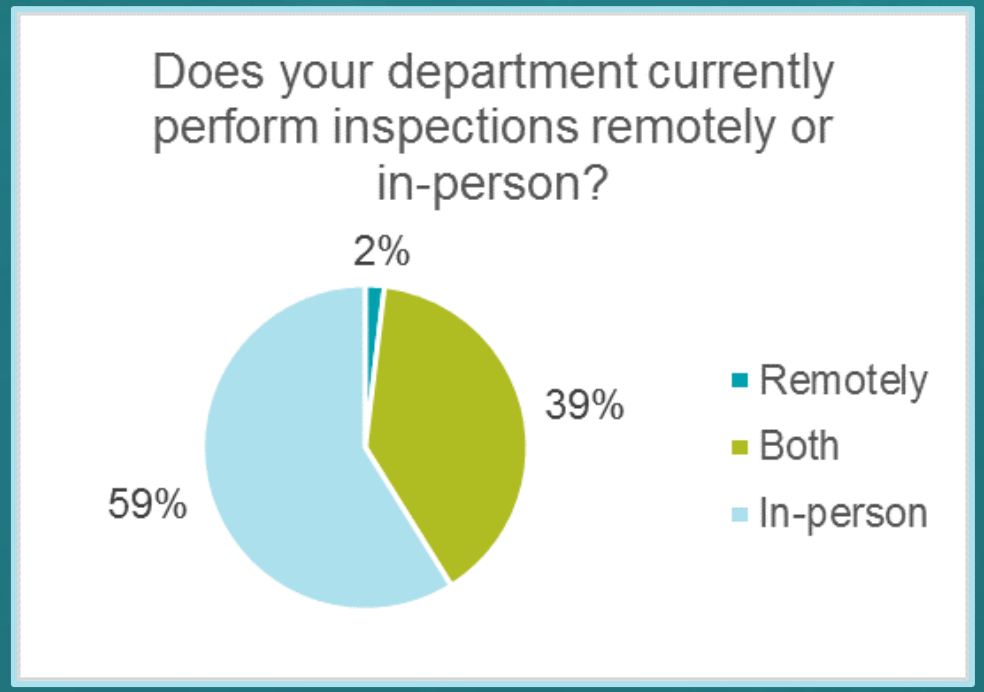
Survey

A joint survey was conducted in 2021 by the project team in collaboration with the International Code Council (ICC), targeting responses from code officials and contractors. More about the survey is summarized in a brief found on our project webpage:

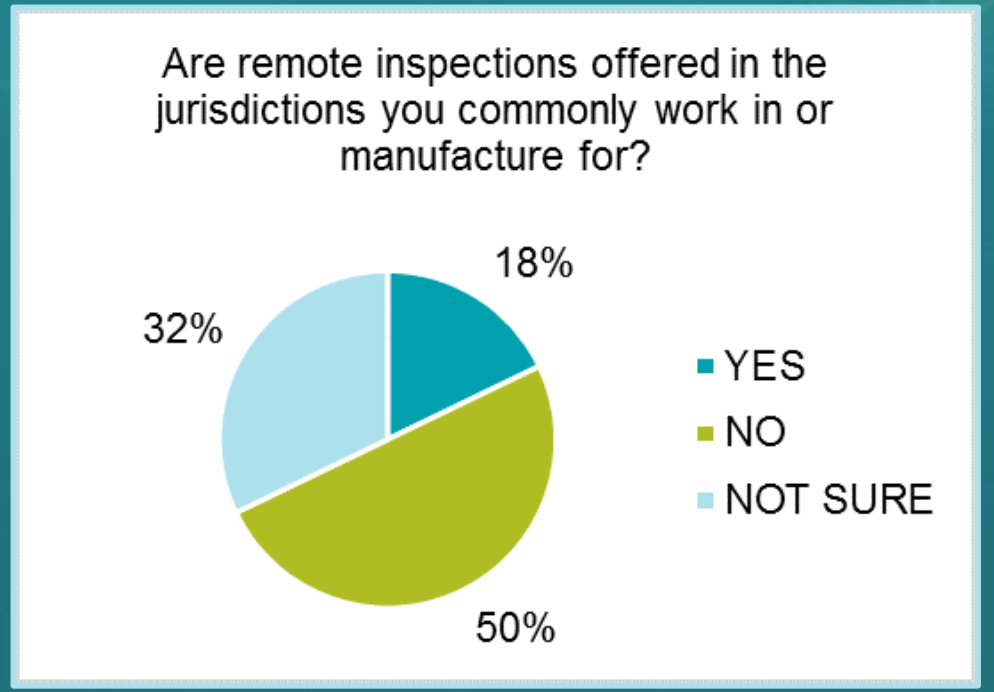
https://neep.org/building-energy-codes-and-appliance-standards/prefabricated-construction-and-remote-virtual

Remote Virtual Inspections

Survey



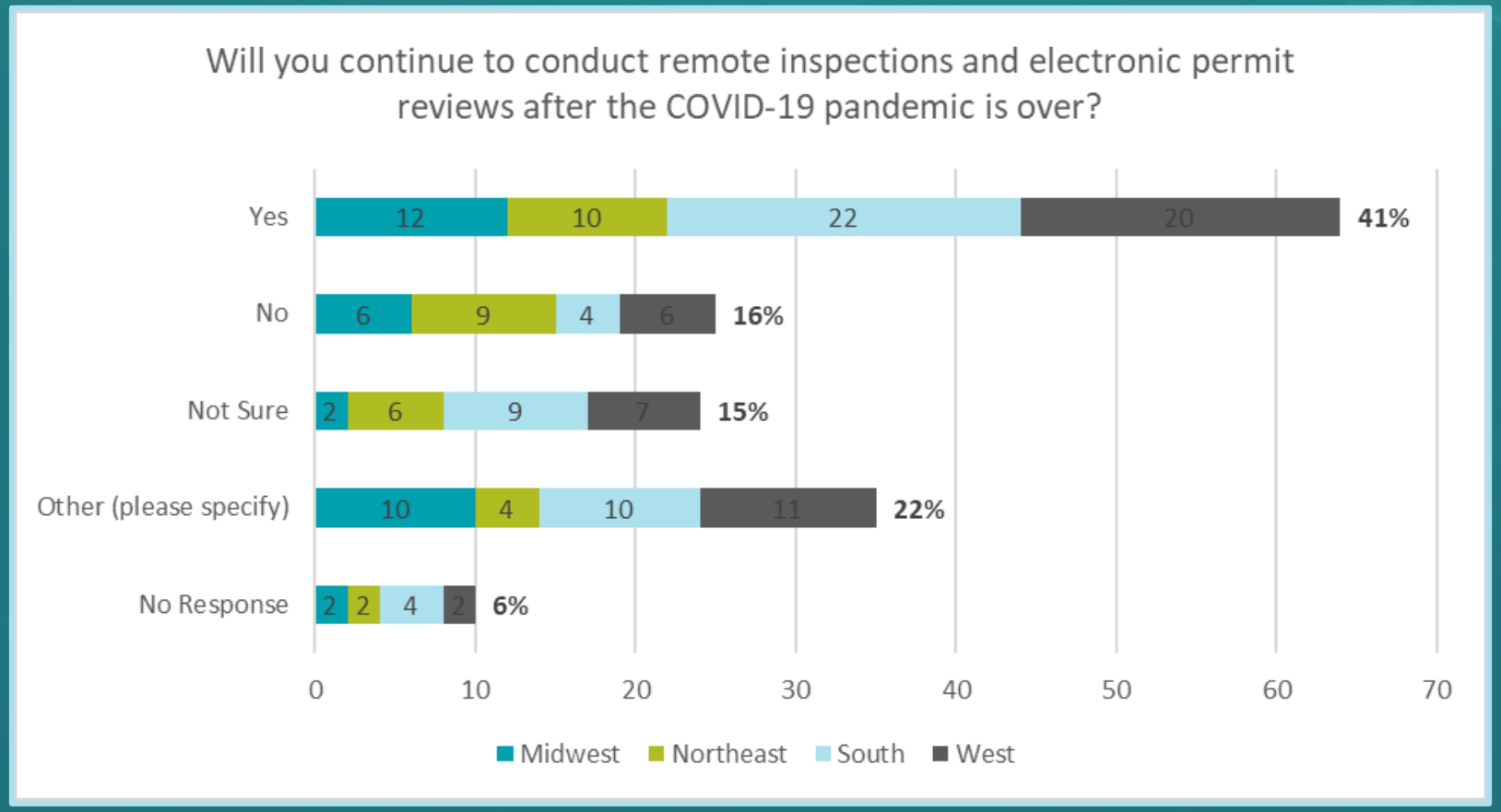
Survey of jurisdictions



Survey of contractors

Remote Virtual Inspections

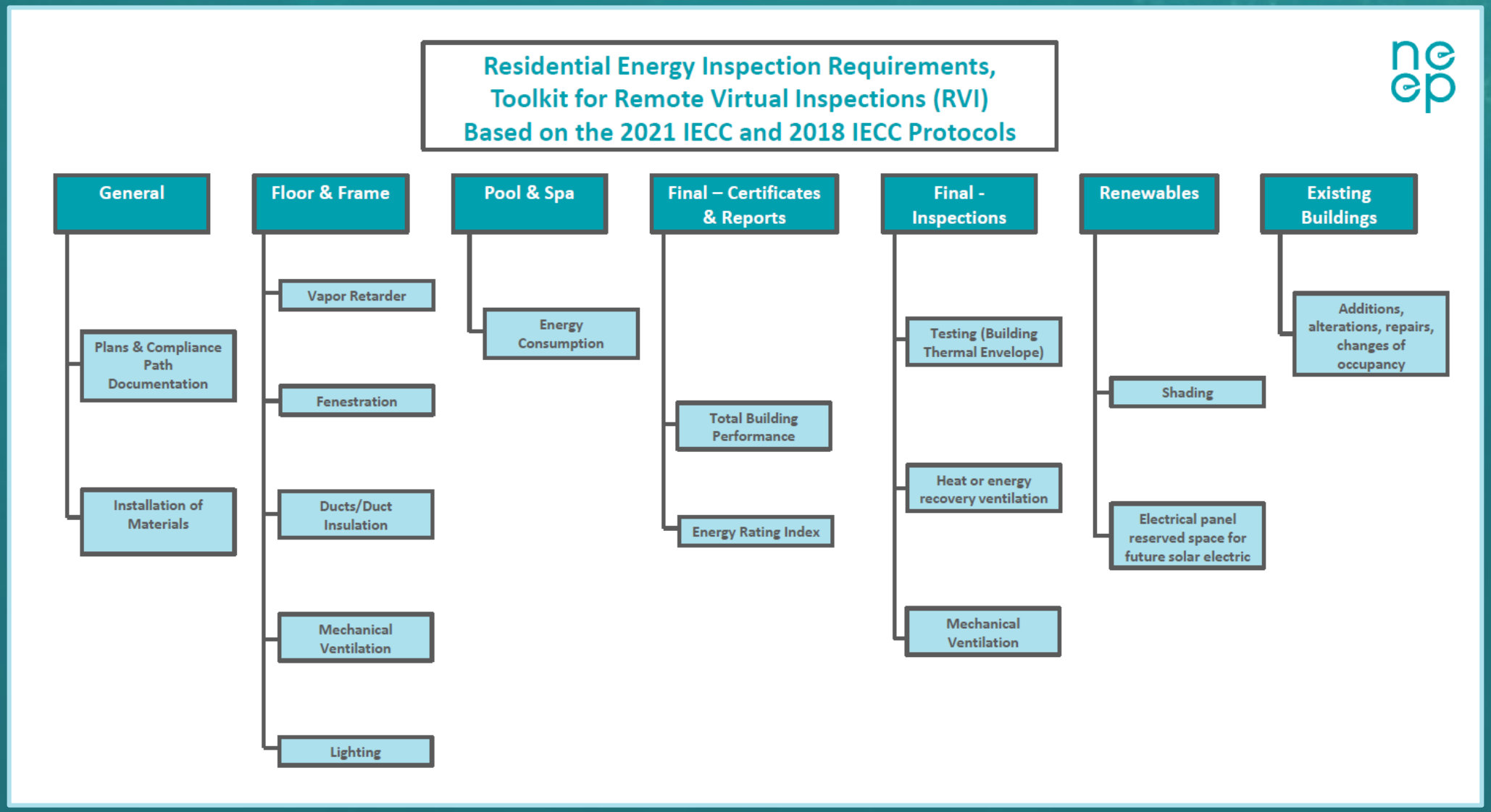
Survey



Survey of jurisdictions

Remote Virtual Inspections Toolkit

International Code Council (ICC), based on 2021 IECC and 2018 IECC Protocols



Off-Site Construction

Introduction

Efficiencies

- Fabricated in a facility under controlled conditions
- Components for many buildings and homes are built together in a single factory
- Work at building site and factory can proceed simultaneously

Challenge

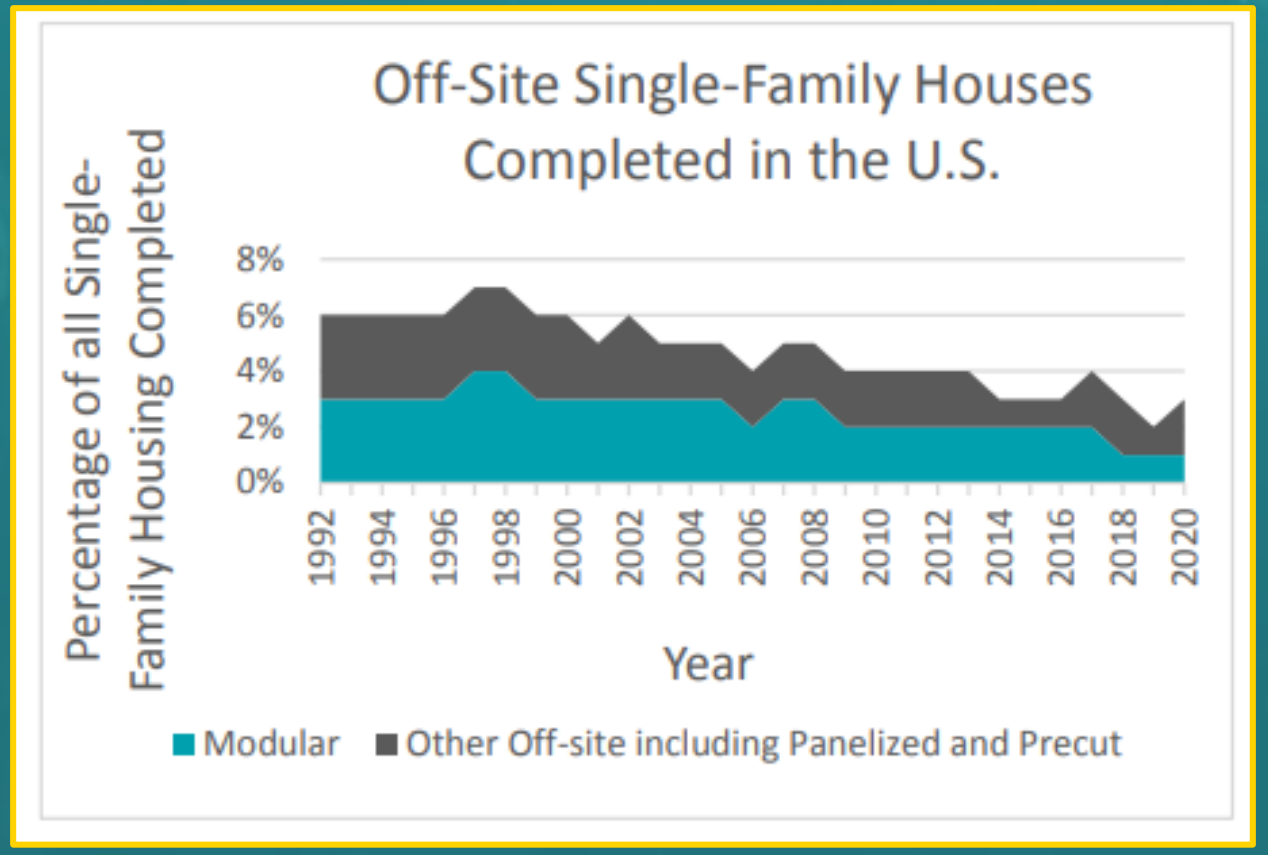
- Factory is often in a different jurisdiction/state than the authority having jurisdiction (AHJ), which is local to the job site.

A Solution

- Under these conditions, AHJs often hire third-party inspectors to visit the factory. Alternatively, they can use RVI (with or without the use of third-party inspectors).

Off-Site Construction

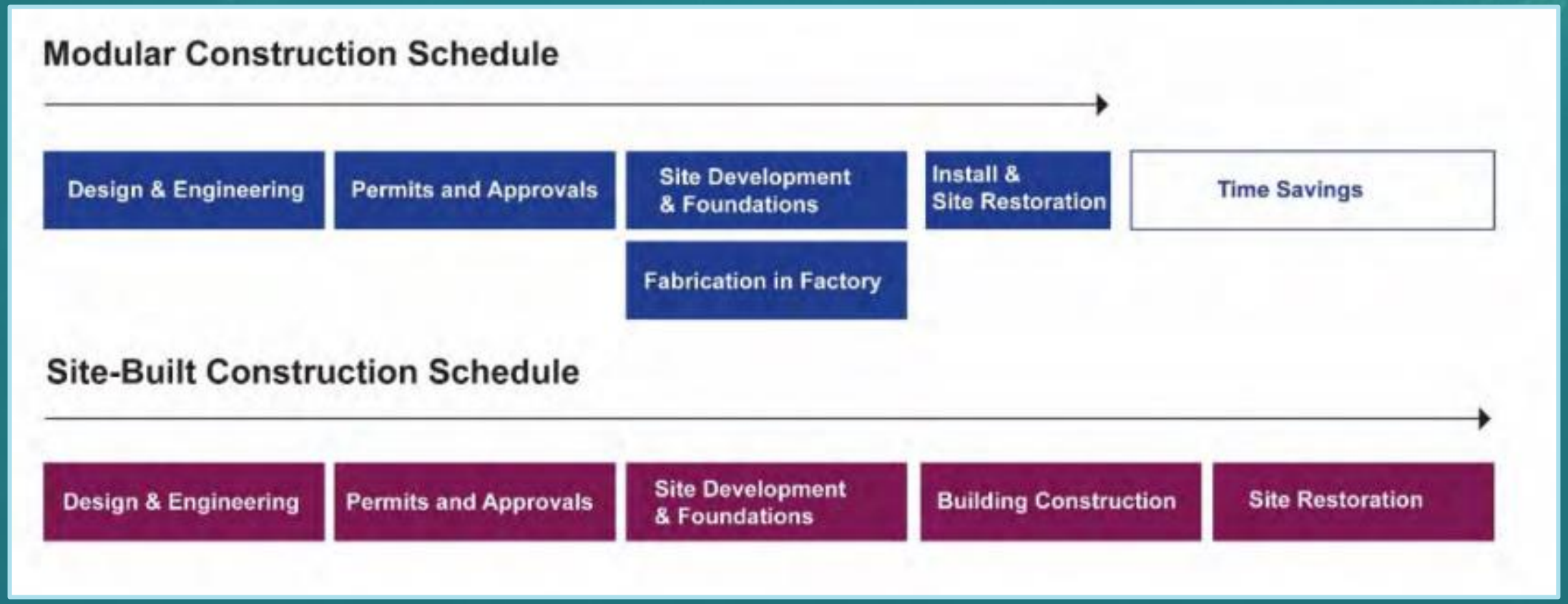
Research



Data from the U.S. Census Bureau, 2020

Off-Site Construction

Schedules



Off-Site Construction

Standards by the International Code Council (ICC)
and the Modular Building Institute (MBI)

ICC/MBI 1200-2021 Standard for Off-site Construction

- Planning, design, fabrication, and assembly

ICC/MBI 1205-2021 Standard for Off-site Construction

- Plan review and inspection
- Offers guidance to jurisdictions without statewide off-site construction programs by enabling the use of third-party inspectors and RVI

ICC 1210-202X

- Standard for mechanical, electrical, plumbing systems, energy efficiency and water conservation in off-site construction

RVI and Off-Site Construction

Project resources:

https://neep.org/building-energy-codes-and-appliance-standards/prefabricated-construction-and-remote-virtual

For more information, contact Cornelia Wu at cwu@neep.org

Mike Turns

Performance Systems Development

Director, Energy Code Services

Moving Energy Efficiency Forward

We combine building science with technology to help utility companies, program implementers, and building performance professionals achieve energy savings.

Why Remote Inspections

- Reduce human contact
- Reduce travel time, expenses, and GHGs
- Scheduling flexibility and overcoming tight inspection windows (e.g., insulation)

Challenges

- Video conferencing learning curve
- Internet connectivity
- Job site noise
- Communicating inspection requirements and process

The National Conversation

- DOE National Energy Codes Conference
- ICC/NEEP/MEEA survey and interviews
- ICC resources

https://www.iccsafe.org/advocacy/safety-toolkits/remote-virtual-inspections/

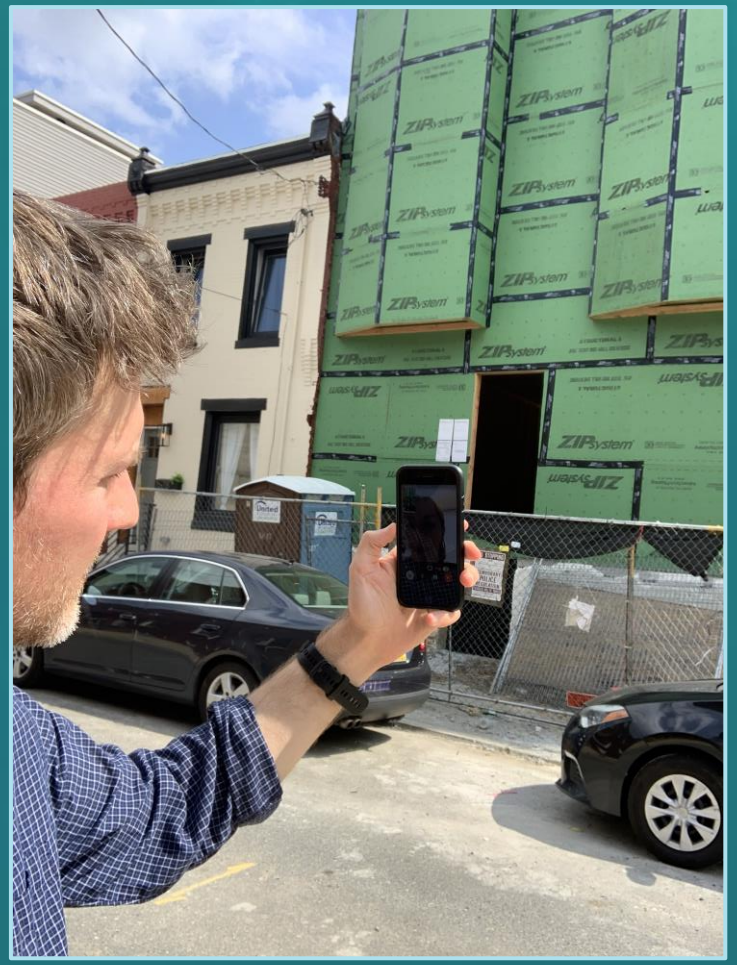
Video Conferencing Platforms

- FaceTime
- Zoom
- Google Duo
- MS Teams
- Etc.

Remote Inspections

- The builder's representative is the eyes of the code official
- The code official guides the builder's rep around the site

Remote Inspections



Job super onsite

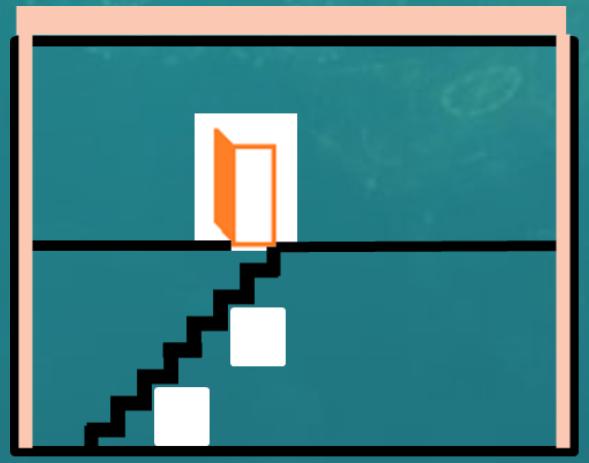
Inspector in office

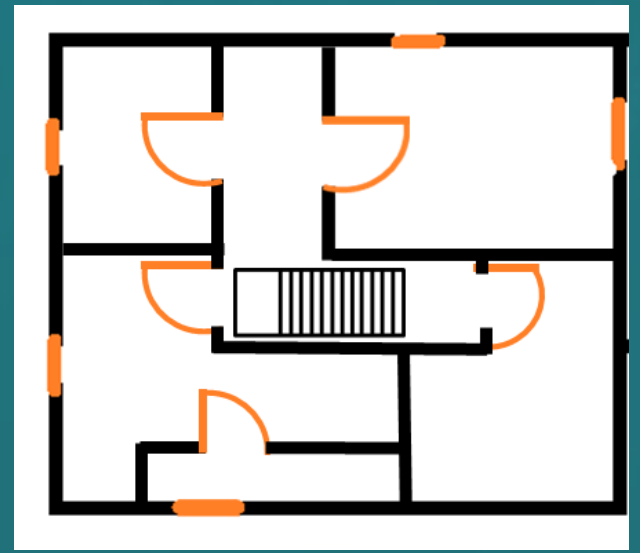
Preparing the Customer (e.g., Job Super)

- **Things to consider**:
  - Battery Life
  - Internet Availability
  - Time Allowance
  - Technology
  - Photo Capturing
  - Minimize Job Site Noise

Sample Inspection Process

- Start at the street
  - Confirm site address (or another identifier)
  - View elevations
- Move inside
  - Have a standard route (e.g., top to bottom, clockwise around each floor)
- Use a checklist to guide onsite rep

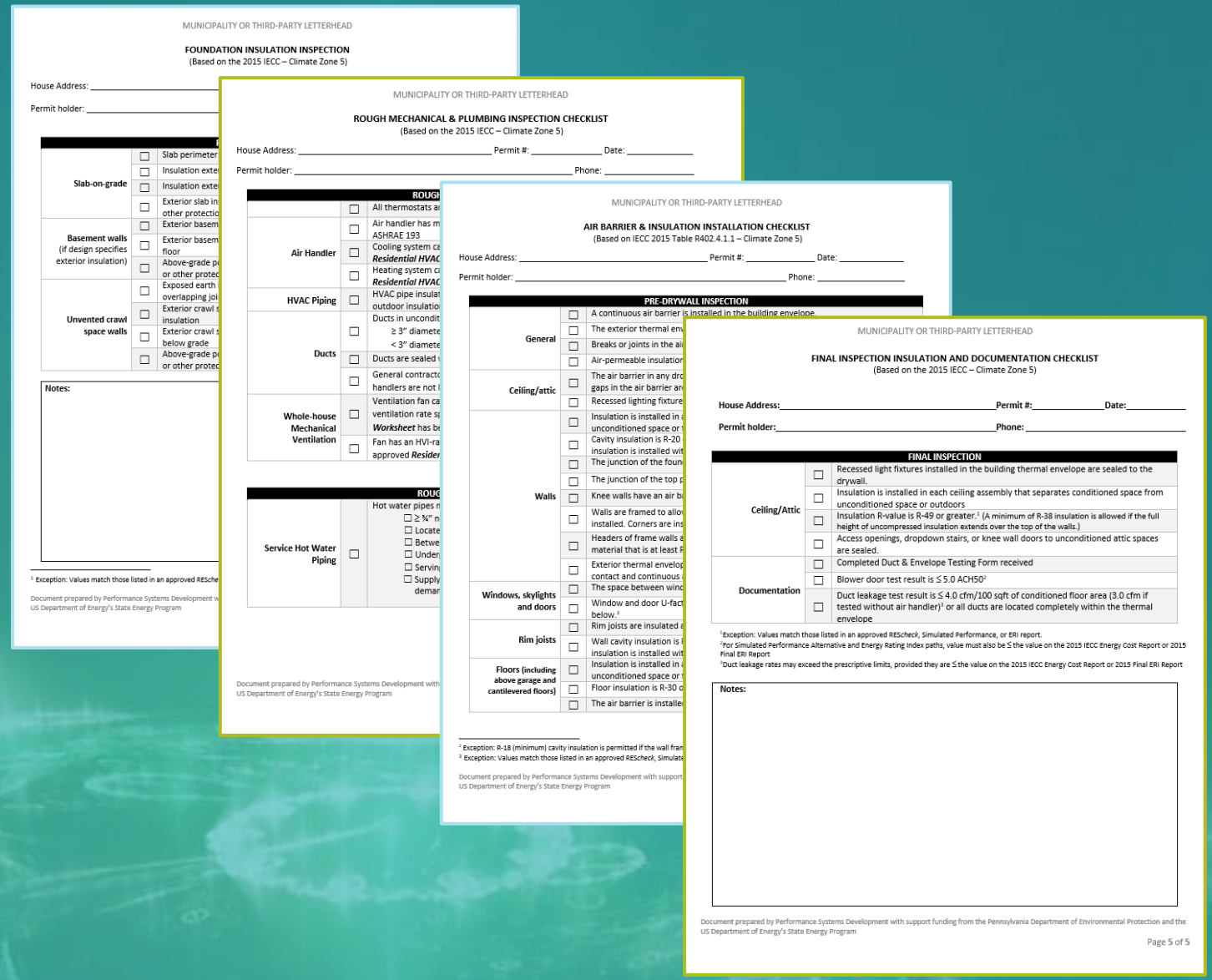




Checklists

PENNSYLVANIA RESIDENTIAL ENERGY CODE INSPECTION CHECKLIST

Based on the 2015 International Energy Conservation Code
Climate Zone 5



MUNICIPALITY OR THIRD-PARTY LETTERHEAD

FOUNDATION INSULATION INSPECTION
(Based on the 2015 IECC – Climate Zone 5)

House Address: _____

Permit holder: _____

Slab-on-grade	☐	Slab perimeter
	☐	Insulation exte
	☐	Insulation exte
	☐	Exterior slab in other protectio
Basement walls (if design specifies exterior insulation)	☐	Exterior basem
	☐	Exterior basem floor
	☐	Above-grade p or other protec
Unvented crawl space walls	☐	Exposed earth overlapping joi
	☐	Exterior crawl s insulation
	☐	Exterior crawl s below grade
	☐	Above-grade p or other protec

Notes:

[1] Exception: Values match those listed in an approved REScheck

Document prepared by Performance Systems Development w
US Department of Energy's State Energy Program

MUNICIPALITY OR THIRD-PARTY LETTERHEAD

ROUGH MECHANICAL & PLUMBING INSPECTION CHECKLIST
(Based on the 2015 IECC – Climate Zone 5)

House Address: _____ Permit #: _____ Date: _____

Permit holder: _____ Phone: _____

	☐	All thermostats a
Air Handler	☐	Air handler has m ASHRAE 193
	☐	Cooling system ca ***Residential HVAC***
	☐	Heating system ca ***Residential HVAC***
HVAC Piping	☐	HVAC pipe insulat outdoor insulatio
Ducts	☐	Ducts in uncondit ≥ 3" diamete < 3" diamete
	☐	Ducts are sealed
	☐	General contracto handlers are not
Whole-house Mechanical Ventilation	☐	Ventilation fan ca ventilation rate sp ***Worksheet*** has be
	☐	Fan has an HVI-ra approved ***Resider***
Service Hot Water Piping	☐	Hot water pipes n ☐ ≥ ¾" n ☐ Locate ☐ Betwe ☐ Under ☐ Servin ☐ Supply demar

Document prepared by Performance Systems Development with
US Department of Energy's State Energy Program

MUNICIPALITY OR THIRD-PARTY LETTERHEAD

AIR BARRIER & INSULATION INSTALLATION CHECKLIST
(Based on IECC 2015 Table R402.4.1.1 – Climate Zone 5)

House Address: _____ Permit #: _____ Date: _____

Permit holder: _____ Phone: _____

PRE-DRYWALL INSPECTION		
General	☐	A continuous air barrier is installed in the building envelope
	☐	The exterior thermal env
	☐	Breaks or joints in the ai
	☐	Air-permeable insulatior
Ceiling/attic	☐	The air barrier in any dro gaps in the air barrier ar
	☐	Recessed lighting fixture
Walls	☐	Insulation is installed in unconditioned space or
	☐	Cavity insulation is R-20 insulation is installed wit
	☐	The junction of the foun
	☐	The junction of the top p
	☐	Knee walls have an air ba
	☐	Walls are framed to allo installed. Corners are ins
	☐	Headers of frame walls a material that is at least F
	☐	Exterior thermal envelop contact and continuous
Windows, skylights and doors	☐	The space between winc
	☐	Window and door U-fact below.[3]
Rim joists	☐	Rim joists are insulated a
	☐	Wall cavity insulation is insulation is installed wit
Floors (including above garage and cantilevered floors)	☐	Insulation is installed in unconditioned space or
	☐	Floor insulation is R-30 o
	☐	The air barrier is installe

[2] Exception: R-18 (minimum) cavity insulation is permitted if the wall fran
[3] Exception: Values match those listed in an approved REScheck, Simulate

Document prepared by Performance Systems Development with support
US Department of Energy's State Energy Program

MUNICIPALITY OR THIRD-PARTY LETTERHEAD

FINAL INSPECTION INSULATION AND DOCUMENTATION CHECKLIST
(Based on the 2015 IECC – Climate Zone 5)

House Address:_____ **Permit #:**_____ **Date:**_____

Permit holder:_____ **Phone:** _____

FINAL INSPECTION		
Ceiling/Attic	☐	Recessed light fixtures installed in the building thermal envelope are sealed to the drywall.
	☐	Insulation is installed in each ceiling assembly that separates conditioned space from unconditioned space or outdoors
	☐	Insulation R-value is R-49 or greater.[1] (A minimum of R-38 insulation is allowed if the full height of uncompressed insulation extends over the top of the walls.)
	☐	Access openings, dropdown stairs, or knee wall doors to unconditioned attic spaces are sealed.
Documentation	☐	Completed Duct & Envelope Testing Form received
	☐	Blower door test result is ≤ 5.0 ACH50[2]
	☐	Duct leakage test result is ≤ 4.0 cfm/100 sqft of conditioned floor area (3.0 cfm if tested without air handler)[3] or all ducts are located completely within the thermal envelope

[1] Exception: Values match those listed in an approved REScheck, Simulated Performance, or ERI report.
[2] For Simulated Performance Alternative and Energy Rating Index paths, value must also be ≤ the value on the 2015 IECC Energy Cost Report or 2015 Final ERI Report
[3] Duct leakage rates may exceed the prescriptive limits, provided they are ≤ the value on the 2015 IECC Energy Cost Report or 2015 Final ERI Report

Notes:

Document prepared by Performance Systems Development with support funding from the Pennsylvania Department of Environmental Protection and the US Department of Energy's State Energy Program

Page 5 of 5


You got it.
OK, let’s verify the site.
Thanks. Now take me up to the foundation wall, please.

FOUNDATION INSULATION INSPECTION – SLABS

Splitting Batts Around Wiring in Garage Wall

Summary

- **The easy stuff**
  - Window U-factors and SHGCs (window stickers)
  - Insulation R-values (fiberglass)
- **Moderate**
  - Insulation installation quality
  - Specific air barrier locations
- **Difficult**
  - Certain types of lighting
  - Witnessing blower door and duct leakage testing setup and results

For more information, contact Mike Turns at

mturns@psdconsulting.com

Mike Browne

Energy Raters of Massachusetts, Inc.

President

Practices for HERS Rating and Modular Plants

HERS Rating in Modular Plants

- Raters perform inspections in the plant (find a local Rater?)

HERS Rating in Modular Plants

- Raters do not perform in-plant inspection (Grade 3 insulation)

LEED for Homes Photo-Documentation Guidelines

- The photos shall be date-stamped.
- The photos shall not be blurry or distorted.
- Several photos shall be taken for each LEED measure - at varying levels of proximity to the LEED measure. In this manner, both the general location and the specifics of the LEED measure can be observed.
- Photos of the whole house (or whole project site) shall be included as part of each set of photos taken. Location of photo within project site must be verifiable.
- Photos in each set shall be arranged in a logical sequence.

History of HERS Rating in Modular Plants

- ENERGY STAR Modular Home plant certification (no longer available except for manufactured homes)

1. A manufactured home is defined as a home built in a factory that is subject to the federal Manufactured Home Construction and Safety Standards (commonly referred to as the HUD Code) contained in 24 CFR 3280.

HERS Rating in Modular Plants

- **Sampling Protocols**
  - RESNET
  - ENERGY STAR
  - LEED
  - PHIUS+
  - NGBS

Remote Covid Protocols for HERS Rating and ENERGY STAR

- Ending June 11, 2023
  - https://www.resnet.us/wp-content/uploads/RESNET-Remote-QA-Protocols-03162020-1.pdf

Remote Covid Protocols for Remote Field Inspection

- Minimum Requirements
  - Lighting to illuminate even the darkest corners
  - Computer hardware device (e.g., cell phone, tablet, laptop, etc.) must be capable of live video streaming or recording
  - Any necessary apps must be loaded on the hardware device (see Appendix A for recommended applications). App should allow for screenshots and/or protocols for Remote Inspections and Diagnostic Testing recording of Remote Field Inspection
  - Minimum of 3G cellular or wireless internet connection
  - Ladder
  - Tape measure

Remote Field Inspection

Remote Field Inspection Process

1. The Builder representative shall begin Remote Field Inspection from the outside with an elevation view (typically front) of the building. The address must be visible in the initial view. If street number is too small to see from a full elevation view, then the Builder representative shall walk/zoom up to the street number sign until clearly visible to the Rater/RFI. If there is no street number signage installed on the house, then a building permit, lot/block signage, or other identification posted on-site shall be captured with the video camera to establish that the Builder representative is at the correct location. For multifamily dwellings, the video shall capture the approach from the respective elevation view up to the dwelling unit that is being inspected.

For more information, contact Mike Browne at
mbrowne@advancedbuildinganalysis.com

Lucas Toffoli

RMI/Advanced Building Construction Collaborative

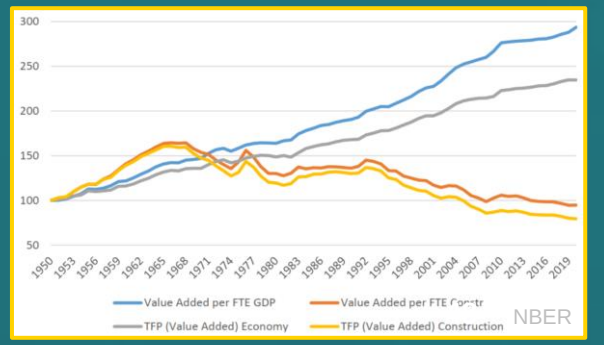
Principal

We Need to Address Multiple Buildings-Related Challenges Simultaneously and Rapidly

Catastrophic climate change is on the horizon—and buildings are a significant driver.

Inefficient homes and a deficit of millions of units of attainable housing burden families, workers, communities, and the economy.

Labor productivity in construction has declined since the 1960s, hindering the market's ability to adapt.



We Need to Improve What We Build *and* How We Build It

Advanced building construction (ABC) sits at the intersection of:

Energy-efficient building decarbonization

Including:
- Off-site construction
- Streamlined processes
- Digitized workflows

Scalable industrialized construction (IC) methods

- Utility and maintenance savings
- Increased thermal and acoustic comfort
- Improved indoor air quality and health
- Resilience, including passive survivability
- Reduced emissions (for climate, compliance)
- Electricity system benefits
- Higher productivity and faster delivery to fulfill business and climate objectives
- Reduced disruption
- Increased schedule and budget certainty
- Enhanced precision and QC, reduced waste
- Improved safety

Different Prefab Approaches Vary in the Level of Work Completed Off Site, With Implications for Inspections

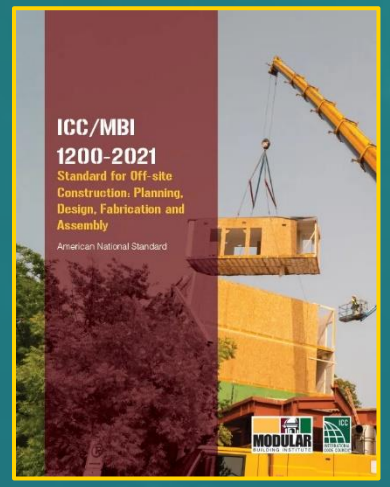
Open Systems

- Simpler prefab, with greater use of local/on-site labor to complete
- Can be inspected on site, similar to conventional construction
  - Can still employ RVI at the job site—if AHJs allow

Closed Systems

- More work completed in a controlled factory setting
- Require in-factory inspection or evaluation
  - Can be done in person or remotely, and directly or by a third-party inspector—if AHJs allow

ICC/MBI Standards Guide Practitioners and AHJs to Help Streamline Use of Off-Site Construction



ICC/MBI 1200

- Focused on design, fabrication, and assembly
- Outlines roles of architects, manufacturers, CMs, and GCs

ICC/MBI 1205

- Provides framework for permitting, in-factory and on-site inspections, and third-party plan review and inspections
- Outlines roles of builders, state programs, and AHJs

Case Example: Salt Lake City, UT

A Common Challenge

- Like many urban areas, Salt Lake City faces a shortage of attainable housing
- Historically, city officials had to inspect projects but could not leave the jurisdiction—a barrier to off-site approaches
- Utah does not have a statewide regulatory program for off-site

A Solution in Action

- Action by the city council made SLC the first jurisdiction to adopt ICC/MBI 1200 & 1205
- Within the first year after adoption, SLC saw a substantial increase in housing deployment, starting with ADUs
- SLC is now considering zoning changes to increase deployment

For more information, contact Lucas Toffoli at ltoffoli@rmi.org.

Thank you for attending today's RSS!

We look forward to seeing you again.