Chapter 14 - Air Sealing & Insulation

Things to Consider

- **Air sealing and interior insulation work together to:**
  - **Reduce heat transfer through the exterior walls reducing the cost of energy needed to heat and cool the house.**
  - **Restrict fire and smoke from traveling up through the house in case of fire.**
- **Under filling wall cavities or compressing batt insulation will reduce insulation rating.**
- **Fire Rated Gaps and Cracks insulating foam will be used to fill gaps in the building shell and framing between floors.**
- **Improperly installed insulation will reduce its effectiveness and create cold spots in the wall.**
- **Ensure wall cavities are completely filled and tight to the framing.**
- **Do not overfill or stuff insulation into wall cavities or spaces.**

Safety Issues

- **Disposable gloves are required for applying insulating foam.**
- **Respirators, face shields and protective coveralls are required when using the Froth-Pak insulation.**
- **Volunteers and other workers must not enter the house while the Froth-Pak insulation is being installed.**
- **N99 Dust Masks and gloves are required for both the volunteers working the insulation hose and the volunteers filling the blower.**
- **Keep hands out of the blower when it is operating. Always use a push stick.**

What's New

- ✓ Insulation in the joist bays behind bathtub enclosures and double laundry room walls must be inspected before covering with OSB or Tyvek.

Timing & Prerequisites

Phases	Prerequisites
○ *Pre-Mechanicals*	○ *Building is dried in* ○ *5/8 Type-X Drywall has been installed in joist bays of Fire-Rated walls. (See "Build Fire-Rated Wall Assemblies" in Chapter 6 – Walls)* ○ *Fire-Rated Assemblies have been inspected, if needed.* ○ *Joist bays behind bathtub enclosures and double walls in laundry have been insulated and past Pre-Rock inspection.* ○ *Solid vapor barriers have been installed behind bathtub enclosures and double laundry room walls.*
○ *Post Mechanicals*	○ *Mechanicals rough-in Inspections*
○ *Wall Insulation*	○ *Framing Inspection* *Air Bypass Inspection* *Fire-Rated Wall Assembly Inspection*
○ *Post Drywall*	○ *Drywall finishing*
Areas to be Insulated	
▪ *Exterior Walls*	
▪ *Joist Bays*	
▪ *Basement Walls*	
▪ *Plumbing Stud Bays*	
▪ *Attics*	

Air Sealing and Insulating Phases

Pre-Mechanical phase:

- Sealing Plumbing & Chase Wall Stud Bays
- Sealing Windows & Doors
- Insulating Basement Walls
- Holes and Penetrations in the framing

Additional Pre-Mechanicals Activities can be found in:

Chapter 15 - Rough-In Mechanicals - Rough-In Preliminary

- Electric Meter Mounting Panel
- Install Siding J-Blocks
- Mounting Board for Communication Terminations
- Mechanical Platform

Post Mechanical phase:

- Test the electrical Boxes
- Sealing Holes and Penetrations in the framing
- Sump Pump
- Preparing for the Attic Insulation

Wall Insulation phase:

- Insulate Behind Electrical boxes
- Insulate Narrow Stud Bays and Small Areas
- Insulate Exterior Wall Stud Bays
- Insulate Joist bays

Pre-Drywall phase:

- Pre-Drywall Activities

Post Drywall phase:

- Insulate the Drywall Penetrations into the Attic
- Install the Attic Insulation
- Install the Attic Insulation

- The House/Project Lead will work with the Construction Superintendent to co-ordinate these volunteer activities.

Pre-Mechanicals Activities

Critical Issues
➢ The insulation behind bathtub enclosures and laundry wet walls must be visible for inspection. ➢ Sheathing must be cut to expose any hurricane ties or other framing connectors for inspection. ➢ For fire rated walls, joist bays cannot be insulated until the 5/8" Type X drywall in each bay has been inspected. (See "Build Fire-Rated Wall Assemblies" in the Chapter 6 - Walls).

Materials Needed	
Safety Materials	
Disposable Gloves N95 Dust Masks	2 pair per phase 2 boxes
Plumbing & Chase Wall Stud Bays (Non-Fire Rated)	**Plumbing & Chase Wall Stud Bays (Fire Rated)**
Non-faced R-13 / R-19 Insulation Kraft Faced R-13 / R-19 insulation ½" OSB Tyvek (if needed) Silicone Caulk	Foil-faced R-13 / R-19 Insulation Fire-Rated Drywall ½" OSB Silicone Caulk
Windows & Doors	**Basement Walls**
Low-Expansion Gaps and Cracks Insulating Foam (2 cans) Insulation Foam Gun Insulation Foam Gun Cleaner	4'x50' Rolls of Thermal Drape 1 ¾" Cap Nails R-13 Non-faced insulation (Finished Basement only)
Adjoining Attic Walls	
1" Styrofoam Board Tyvek House Wrap 2 ½" Cap Nails	

Sealing Plumbing & Chase Wall Stud Bays

The following stud bays in the exterior walls must be insulated with batt insulation, inspected, and sealed with a solid vapor barrier **prior** to rough-in mechanicals:

- Behind bathtub enclosures
- Double walls in laundry area.
  - Areas behind shutoffs or other connection boxes
- Chases
  - Areas of any exterior wall which will be concealed by a chase.

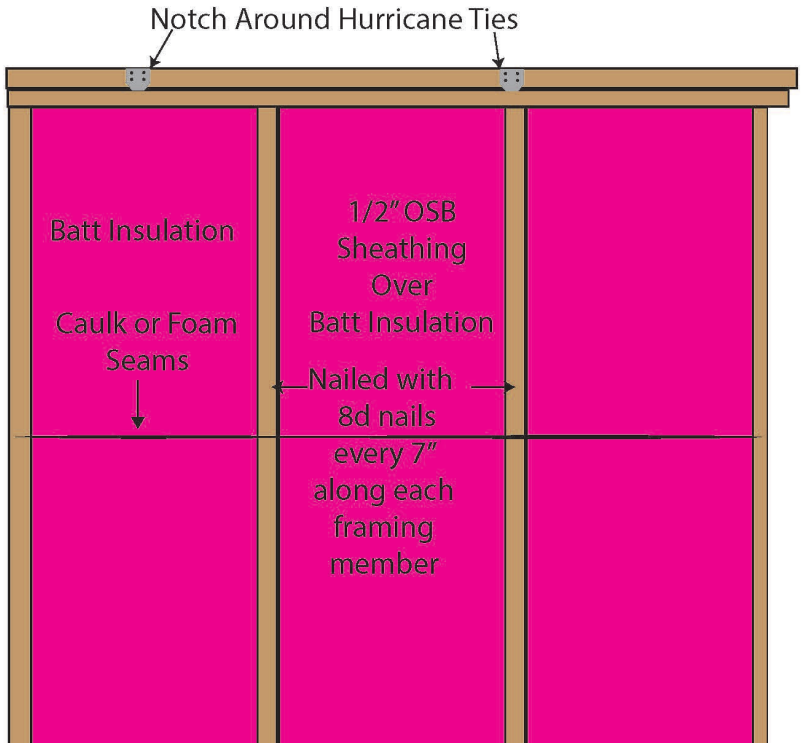
❖ Before insulating the area behind the bathtub, make sure there are studs aligned with the flanges of the tub enclosure. The flanges must be secured to these.

  - If the wall studs do not align with the flanges of the tub, insert another stud at the appropriate place. The flange should be completely supported by a wall stud.

1) Non fire-rated walls

- Install batt insulation to fill the stud bays. (See Insulation Techniques below)
  - For 2x4 walls, install R-13 Kraft faced insulation into the stud bays behind the bathtub.
  - For 2x6 walls, install R-19 Kraft faced insulation.
- Call for a Pre-Rock Inspection
  a. The insulation must pass inspection before installing the vapor barrier.
- Install a vapor barrier over the insulation.
  a. Install ½" OSB sheathing over the stud bays. (See Figure 14.1).
     - It is best to install the OSB horizontally.
     - Install the OSB with 8d common nails; 7" apart along the studs.
     - If the OSB will cover any hurricane ties or other framing connectors, notch the OSB around them.
  b. If installing OSB on a wall of a bathtub enclosure will create an offset in the finished drywall, Tyvek can be used instead on that wall.
- Foam/caulk all seams.
  - Apply a bead of silicone caulk to the seams of the OSB. For large gaps in the OSB, use Gaps and Cracks foam insulation.

Figure 14.1 – Bathtub Enclosure Insulation and vapor barrier



2) Fire-rated walls
- Install foil faced batt insulation to fill the stud bays
  - For 2x4 walls, install R-13 foil-faced insulation into the stud bays behind the bathtub.
  - For 2x6 walls, install R-19 foil-faced insulation.
- Call for Pre-Rock inspection
  a. The insulation must pass inspection before installing the vapor barrier
- Install vapor barrier
  a. Install 5/8 fire-rated drywall vertically with fasteners per spec.
  b. Have the seams mudded and taped.
- Call for Fire-Rated Wall Assembly Inspection
  a. The drywall must be inspected before installing the bathtub.

Seal Mechanical Chases and Soffits Caps

- The tops of any chases and soffits must be covered with ¾" OSB or with two (2) layers of ½" OSB and sealed with foam or caulk. Any sides adjacent to exterior walls must be covered with ½" OSB.

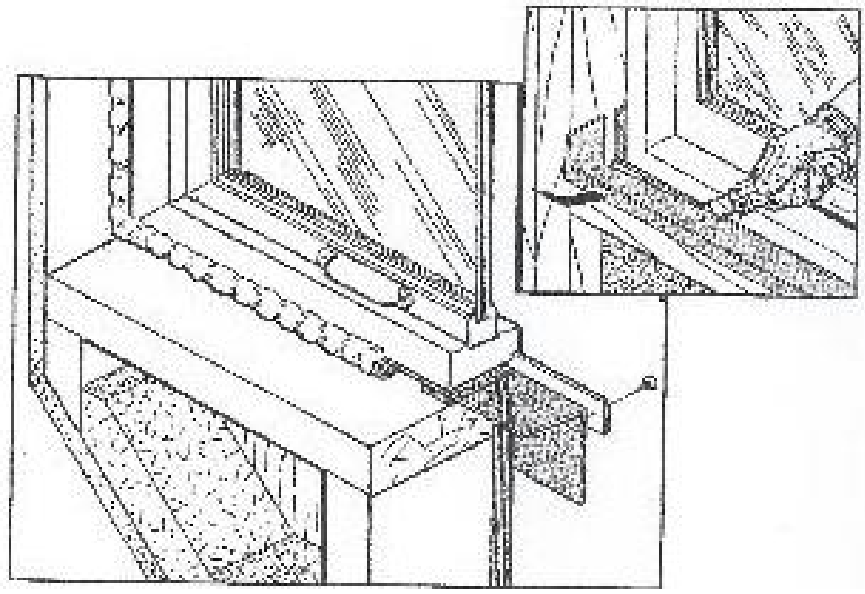
- If the chases and soffits where not capped when they were built, add the OSB cap.

- Apply Gap and Crack insulating foam to the seams along the edges of the OSB.

Air Sealing and Insulating Phases

Sealing Windows & Doors

Figure 14.2 – Windowsill with Back Dam



Insulate Around Windows and Doors

- Cut back shims and sill pans which extend inside of the window. Cut them even with the back of the window.
- Install Low Expansion Insulation foam into the cavities between the windows and the framing lumber. Do not overfill the cavities. **Wear latex gloves.**
  - Covering the windowpanes with plastic wrap before foaming around the window will reduce cleanup.
- Install Low Expansion insulation foam into the cavities between the door casing and the framing lumber. Do not overfill the cavities. **Wear latex gloves**.
- Clean the Low Expansion Insulation foam from the foam gun. This gun will be needed later for sealing holes and penetrations. (see video below)
- Cut back excess foam from door/window openings after foam cures to allow for better drywall installation

Air Sealing and Insulating Phases

Care and Use of Insulation Foam Guns Videos

Insulating Basement Walls

Install Insulation Drape on Basement Cement Walls

The interior of the basement walls from the exterior grade up to the floor joists must have additional insulation to meet the thermal bypass requirements. To meet the requirement, the top 48” of each wall will be covered with a thermal drape. This will add an additional insulation factor of R-10 to the walls.

1. Position the top edge of the drape even with the top edge of the sill plate (just below the floor trusses) and nail in place with 1 ½” cap nails; 1 nail every 16”.
2. Each roll will cover 50’ of wall. Do not cut the drape except at stairway framing and egress windows.
3. Cut out the section of the drape which covers a window.
4. It will be easier to install the drape before any framing for the finished basements is installed.

Air Sealing and Insulating Phases

Before continuing, stop and complete the **“Pre-Mechanical Checklist”** found in Procore/Inspections.

Post Mechanicals Activities

This phase will seal holes and penetrations in the framing to prevent air leakage and prevent the spread of fire, should a fire break out. Additionally, fire-blocking and missing framing must be added where needed.

This phase will also prepare for the attic insulation.

Materials Needed	
Safety Materials	
Disposable Gloves	2 pair per phase
Vertical Penetrations (Fire Blocking)	**Seal Exterior Shell**
Fire-Rated Gaps and Cracks Insulating Foam Insulation Foam Gun Insulation Foam Gun Cleaner	Silicone Caulk Gaps and Cracks Insulating Foam
Attic Insulation Preparation	**HVAC Boots**
Insulation Depth Markers (5-6) T50 Staples Insulation Baffles 1” Cap Nails	Construction Tape
Sump Pump Backup System	
Sump Pump Backup Battery Case	

Safety Issues

- Ensure the electrical boxes are not energized or have been covered.
- The cover for the electrical service panel must be installed when volunteers are working in the area.

Test the electrical Boxes

Once the electrical service has been connected to the house, test each electrical box with an electrical tester. Any box which test as energized must be covered. Notify the Construction Superintendent of boxes which need covers.

Inspect the Framing for Missing Components

Before beginning air sealing and fire-blocking activities, inspect the framing for missing components. During installation of the HVAC, plumbing and electrical systems, studs and plates may have been removed. **Ensure the appropriate load bearing framing is in place, including doubled studs under all load bearing girders and beams are posted to the foundation.**

Replace missing studs with new studs at a new location which does not interfere with the mechanicals. If necessary, notch the studs to allow any electrical wiring to pass through the middle of the stud.

Holes and Penetrations in the framing

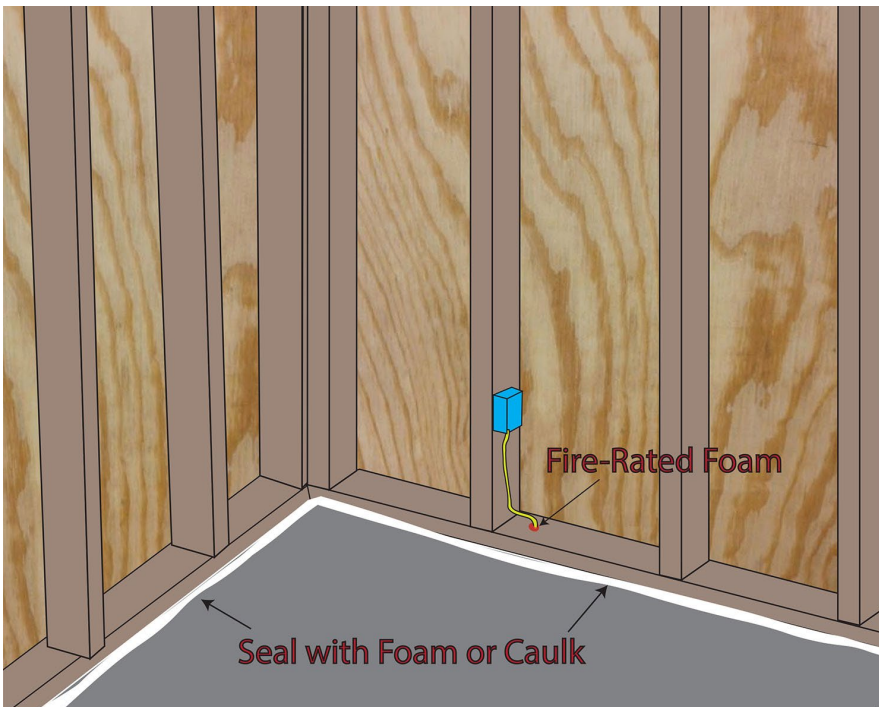
Seal the Bottom Plates

Run a bead of silicone caulk along the seam between bottom plates and the floor of all exterior walls, on both the first and second floor decks.

Seal the Top Plates

Run a bead of silicone caulk along the seam between first and second top plates of all exterior walls, on both the first and second floor decks.

Figure 14.3 – Sealing plates



Seal the Holes in Plates and Subflooring

- Fill all vertical holes in the top and bottom wall plates with fire rated Gaps and Cracks foam insulation.
- Fill all holes in the soffits and chases where the pipes and wiring pass through the OSB with fire rated Gaps and Cracks foam insulation.
- Fill all holes in the exterior wall OSB (e.g. around electrical boxes) with Gaps and Cracks foam insulation.
- For small gaps around wires and pipes running through the subflooring, fill the gap with fire rated Gaps and Cracks foam insulation.

- For large gaps around pipes running through the subflooring, fill the gap with fire-rated Gaps and Cracks foam insulation. For large holes (e.g. around the bathtub drain), stuff the holes with non-faced insulation.

- Very large holes should be covered with OSB before stuffing with insulation.

Seal Gaps in the Vertical Framing Members

- Fill all gaps between framing members (e.g. king and jack studs) with silicone caulk.

Seal Floor HVAC Boots

- Sealing the HVAC boots is best done after the floors have been sanded and just before installing the flooring.

- Seal the gap between the subflooring and the HVAC boots. Apply construction tape over the gap with half of the tape extending over the flooring and half into the boot. Cut separate pieces for each of the four sides of the boot. Clean the flooring and boot of any dust before installing the tape.

Sump Pump

- To reduce the amount of Radon Gas leaking into the basement, the lid of the sump pump needs to be securely fasten to the sump pit and the holes in the lid covered and sealed.

Sump Pump Sealing

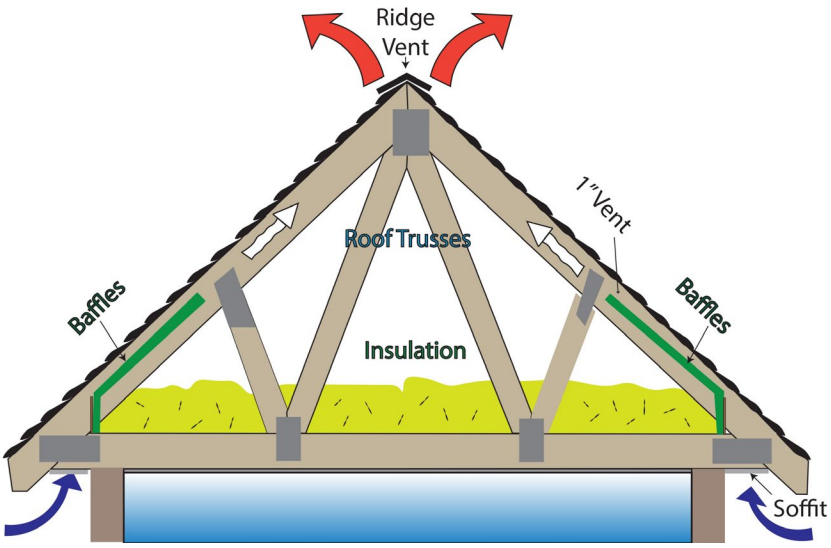
- If the lid has not been screwed down, attach the lid to the sump pit with 1” screws; 1 in each cutout in the lid.
- The seam around the perimeter of the sump pump and any penetration through the lid will also be sealed with a bead of silicone caulk.

Preparing for the Attic Insulation

Install Positive Ventilation Chutes (Attic Insulation Baffles)

Attic ventilation is required to keep the roof cooler and extend the life of the roof shingles. Cool air enters through the soffits and is expelled through the ridge vent. Ventilation baffles hold the attic insulation away from the roof sheathing by 1". This space allows the air to flow up the roof. (see figure 14.5).

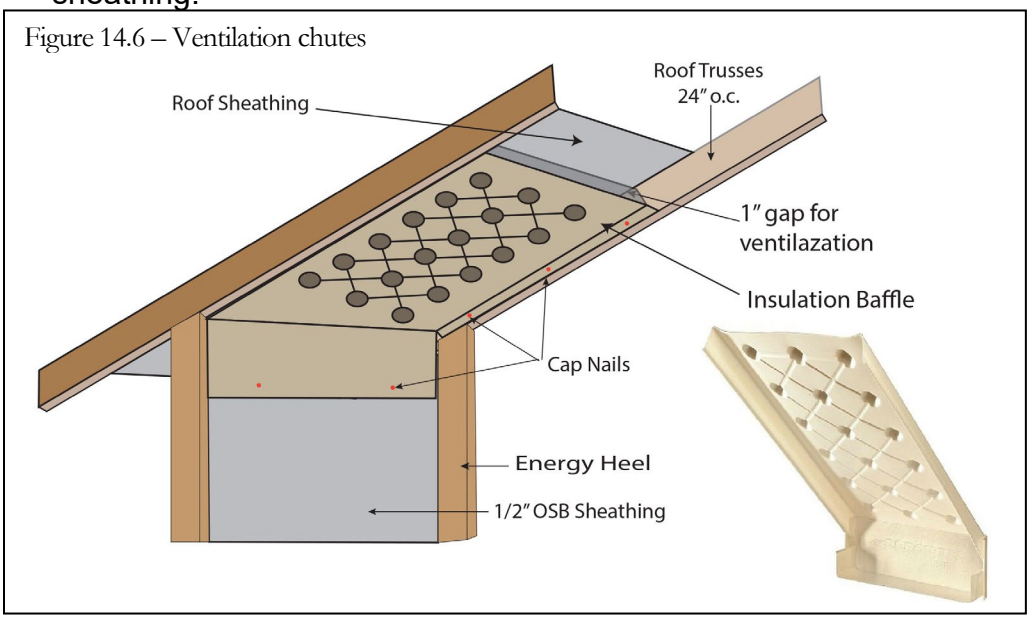
Figure 14.5 – Roof Ventilation



Install ventilation chutes in the bays between each of the trusses/rafters.

1. Press the first baffle for each bay into place as shown in the Figure 14.6.
2. Nail the baffles in place with 1 ½" cap nails; 3 nails into the flange along the roof truss on each side and 2 nails into the bottom flap into the OSB sheathing.

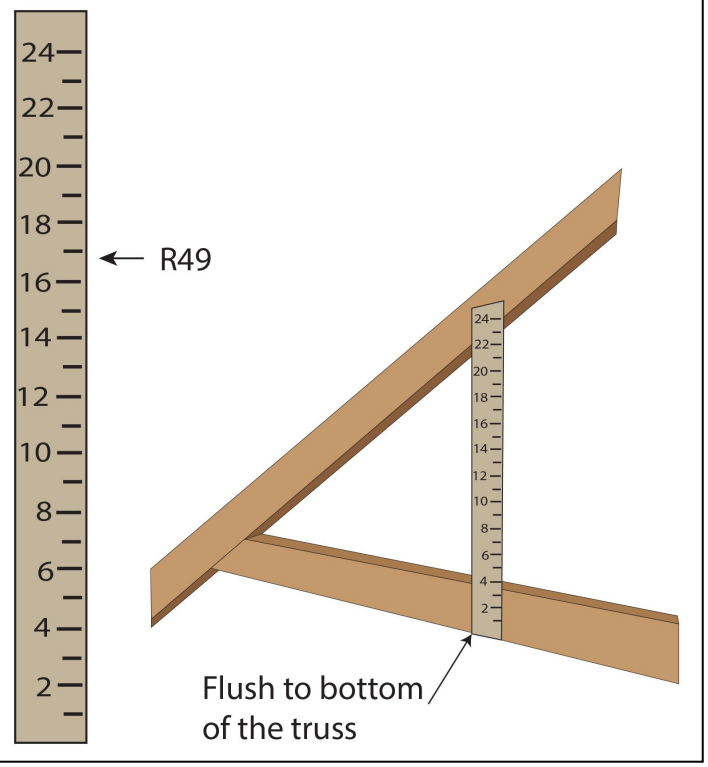
Figure 14.6 – Ventilation chutes



Mark the Roof Trusses with Insulation Height

Install 6 to 8 Attic Insulation Height Markers to the roof trusses in each attic. Spread the markers around the attic to assist in filling each section to the correct depth. Make sure the markers face the attic access.

Figure 14.7 – Attic Insulation Depth Marker



Air Sealing and Insulating Phases

Before continuing, stop and complete the **"Post Mechanical Checklist"** found in Procore/Inspections.

Exterior Walls Insulation

Safety Issues

- **Gloves and N95 dust masks must be worn when handling batt insulation.**
- **Volunteers must take care with utility knives. Blades must be retracted when they are not in use.**
- **Respirators, face shields and protective coveralls are required when using the Froth-Pak insulation.**
- **Volunteers and other workers must not enter the house while the Froth-Pak insulation is being installed.**

Materials Needed	
Safety Materials	
Disposable Gloves N95 Dust Masks	Face Shields Face Masks
Wall Cavities	**Joist Bays**
R-13/R-19 Batt Insulation **R-13 Foil-Face Batt Insulation (Fire-Rated)** **T-50 Staples**	**Froth-Pak Foam Insulation** **R-13 Non-Faced Insulation**

Insulate Behind Electrical Boxes

- Fill the area between the electrical boxes in the exterior walls and the exterior sheathing with expanding foam.

Insulate Narrow Stud Bays and Small Areas

- Small stud bays and small areas of the exterior walls should be filled with expanding foam or stuffed with small amounts of insulation. Do not stuff the insulation in too tight.

Insulate Exterior Wall Stud Bays

The exterior wall stud bays will be insulated using a batt insulation. The videos below show the proper techniques.

1. Cut lengths of Kraft Faced R-13 (2x4 walls) or R-19 (2x6 walls) to fit the area to be covered. Cut the material as described below in “Cutting Batt Insulation”.
2. Stuff Kraft Faced insulation into the areas of wall stud bays which will be covered and non-faced insulation into the joist bays above. Install the Kraft paper side of the faced batts toward the interior of the house.
3. If the wall cavity has a wire or pipe running through it, starting at the bottom of the batt, split the insulation in half. Then shove one half behind the wire/pipe and the other half in front of the wire/pipe.

Insulate Basement Wall Stud Bays

For houses with finished rooms in the basement, the framing along the exterior walls will be insulated with R-13 non-faced batt insulation.

1. Cut batts of R-13 non-faced insulation to fit each stud bay.
2. Stuff the batts into the bays. Friction will keep them in place.

Insulate Joist bays

The 1st floor/2nd floor joist bays and basement/1st floor joist bays will be insulated with spray foam and R-13 non-faced insulation, including the front and back joists.

❖ Ensure any "Fire-Rated" wall assemblies have been inspected before insulating the joist bays.

1. Apply 1" of R-3 spray foam (Froth-Pak) to each joist bay.
   ❖ *Only trained personnel may use the Froth-Pak.*
2. After the Froth-Pak foam has dried, cut, and install pieces of R-13 non-faced insulation over the foam sealant in each bay.
   - Cut pieces of non-faced R-13 insulation to fit each joist bay. The pieces must fit snuggly into each bay.
   - Stuff this material into the openings.
   - Go behind / around vent pipes, wires, etc.
   - Do not staple or cover in any way.

Insulation Techniques

Cutting Batt Insulation

1. Place the insulation on a piece of OSB.
2. Lay a wooden straight edge on top of the insulation along the line to be cut and press it down to compress the insulation.
3. Use a utility knife to cut down through the fibers.
4. It will take several passes to cut completely through the material.

Instructional Videos

DIY Batt Insulation

How to insulate around electrical wires & outlets

Before continuing, stop and complete the **"Wall Insulation Checklist"** found in Procore/Inspections.

Air Sealing and Insulating Phases

Pre-Drywall Activities

The following activities must be performed to ensure the house is ready for the drywall contractors. Failing to prepare the house will likely result in damage to equipment and loss of materials.

Preparation for Drywall Installation
➢ Remove all tools and materials from the rooms to be drywalled. ➢ Send back to the Warehouse any extra bales of insulation. ➢ Remove any temporary lighting and string lights. ➢ Remove the temporary handrails and blocking. ➢ Remove any nails or screws protruding from the wall (such as temporary coat hangers). ➢ Confirm all plumbing test caps and gauges have been removed, especially at kitchen and bathroom drains and supply lines. If testing equipment is found, contact the Habitat Superintendent to have them removed. ➢ Remove the electrical panel, temporary outlet and bath fan covers. Also, remove the laundry box trim ring. Store these items in a safe location on the basement shelves.

Air Sealing and Insulating Phases

Post Drywall Activities

Safety Issues

- Reinstall electrical panel and temporary outlet covers.
- Install handrails as soon as possible (See "Handrails" in Chapter 23 – Interior Doors & Trim).
- Disposable gloves are required for applying insulating foam.

Insulation Blower Safety Issues

- N99 Dust Masks and gloves are required for both the volunteers working the insulation hose and the volunteers filling the blower.
- N99 Dust Masks must be worn whenever you are working around insulation.
- Gloves, long sleeve shirts or protective pull-on coveralls are recommended to minimize skin irritation from fiberglass.
- No Loose clothing is to be worn.
- Be careful when handling chemical and particulates which irritate such as insulation, caulk, and spray foam. (Suggest washing clothing used for insulating separate from other clothing and then run the washer empty to clean out the fiberglass).
- Individuals using the Insulation Blower Machine must be trained in its use, the controls and safety hazards; including the emergency shut off button and the controls for chopper/feeder and blower.
- If anything falls into the hopper (ex. Utility knife, push stick, clothing, etc.) the machine must be stopped immediately, unplugged, and the object found and removed, before restarting the process.
- Keep hands out of the blower when it is operating. Always use a push stick.

Materials Needed

Safety Materials

Disposable Gloves
N99 Dust Masks
Protective Overalls

Attic Insulation	Finished Basement Ceilings
Gaps & Cracks Insulation Foam Cellulose Insulation R-49 Batt Insulation	Rockwool Insulation

Phase Specific Tools Needed

Attic

- Insulation blower, hose, and extension cords
- Retractable ladder.
- Portable Lighting (Head Lamp or LED Work light)

Insulate the Drywall Penetrations into the Attic

Before installing the cellulose insulation in the attic, use Gaps and Cracks insulating foam to seal the holes in the drywall ceilings below the attic where the electrical fixtures and detectors pass through. Apply the foam from the attic, sealing the area around the boxes. Do not spray the foam into the seam as it will drop into the room below.

Seal the Drywall to Top Plates

In the attic, apply Gaps and Cracks foam insulation along the edges of the wall top plates, filling the gap between the drywall ceiling and the 2x4 top plates.

Install the Attic Insulation

The cellulose insulation will be blown-in to a uniform depth of 16 3/4".

Insulation Blower and Hose

1. Setup the insulation blower.
   - Place the blower in a good working area on the first floor and feed the hose up through the attic accesses.
   - The blower can be rolled into the house.
   - Attach the hose to the unit.
   - There needs to be enough hose to reach from the machine to each attic to be filled.
   - Clear the hopper of any cords, push sticks, or other non-insulation materials.
   - Plug in the machine. The cord must be plugged into a GFCI outlet. Do not use multi-plug adaptors or additional extension cords.
   - With the hopper empty, check the functioning of the remote switch on the hose. If it does not work, change the batteries.

2. Stack the insulation bags near the blower. Cut open a few bags to get started.

3. Load the insulation blower.
   - Cut open one end of the bales.
   - Push the insulation bales through the hole in the side of the machine. The knife in the chute will cut open the bag as it enters the machine.
   - Pull the wrapper out of the chute as soon as possible. Do not let it fall into the hopper.
   - The insulation will occasionally "bridge over" and need to be pushed down past the safety bar. Use a push stick to move the insulation down into the lower part of the machine. Keep the push stick above the moving feeder parts.

   ➢ Note – Use a push stick to feed the hopper, not your hands.

   ➢ Do not open more bags of insulation than is needed.

4. Extend the ladder into the attic.

5. Remove the attic access and carefully set it aside.

6. Place a work light in the attic.

7. One volunteer will work in the attic and one volunteer will feed the blower. Both volunteers should wear overalls, N99 masks, eye protection, and gloves.

8. Start at the farthest section of the attic and blow the insulation into place.

9. Fill the outside edges first, then fill the center sections.

10. Keep the spray low.
    - Do not blow insulation into the ventilation chutes.
    - Do not step on the drywall ceiling! Step on the truss horizonal members only.
    - Watch out for roofing nails extending through the roof sheathing into the attic. They are very sharp and can cause bleeding. Wearing a hard hat is best, but not very practical.

Insulate the Attic Access Cover

Before replacing the attic access cover, attach a piece of R49 insulation to the back of the cover.

1. Cut a piece of Kraft Faced R49 insulation to the size of the attic access cover.

2. Apply construction adhesive to the kraft paper side of the insulation.

3. Press the insulation to the back of the access cover, ensuring the construction adhesive fills the gap between the paper and the cover.

4. When the adhesive has setup, reinstall the attic access cover.

Seal joist bays around the basement ceiling drywall

For houses with finished basement ceilings, fill any openings into the space above the drywall ceiling with rock wool insulation.

- Stuff insulation into the joist bays around the outside of the drywall ceiling.
- Stuff insulation around HVAC and Plumbing running around or through the space above the drywall ceiling.
    - Do not stuff the insulation too tight.

Before continuing, stop and complete the **"Attic Insulation Checklist"** found in Procore/Inspections.