INSULATION AND INSTALLATION OF DUCTS

OREGON RESIDENTIAL SPECIALTY CODE (ORSC)

On April 1, 2021, the 2021 Oregon Residential Specialty Code (ORSC) became effective, introducing new requirements for the insulation and installation of ducts and revisions of existing provisions. Compliance with these new or revised sections became the mandatory prescriptive path for ORSC governed designs on Oct. 1, 2021. This technical bulletin highlights the intent of the new 2021 ORSC ductwork provisions for installing heating, ventilating and air-conditioning (HVAC) systems and provides compliance examples.

INSULATION OF DUCTS

Section N1105.2

All new duct systems, or new portions of duct systems exposed to unconditioned spaces, and buried ductwork within insulation that meets the exception to Section N1105.3, shall be insulated to a minimum level of R-8. Duct systems, or new portions of duct systems, located entirely within the building thermal envelope may be insulated to a level less than R-8.

INSTALLATION OF DUCTS

Section N1105.3

All new duct systems, air handling equipment and appliances shall be located fully within the building thermal envelope. Section M1601.4.11, *Ductwork installation location*, repeats this requirement.

Because it may not always be technologically or economically feasible, or practical to construct all duct systems fully within the building thermal envelope, there are exceptions to the requirements:

1. Ventilation intake and exhaust ductwork.
2. Up to 5% of the length of an HVAC system ductwork shall be permitted to be located *outside of the thermal envelope*.
3. Ducts *deeply buried* in insulation in accordance with all the following:
    a. Insulation shall be installed to fill gaps and voids between the duct and the ceiling, and a minimum of R-19 insulation shall be installed above the duct between the duct and unconditioned attic.
    b. Insulation depth marker flags shall be installed on the ducts every 10 feet or as approved by the building official.

The following figures delineate construction methods that may be used to locate new duct systems, air handling equipment and appliances fully within the building thermal envelope. These are not comprehensive examples of construction methods, as other options may be approved by the local building official.

LOCATING AIR HANDLING EQUIPMENT WITHIN THE THERMAL ENVELOPE

The air handler must be installed inside conditioned space, with exceptions. This practice typically requires constructing a mechanical closet below the ceiling or floor plane (Figure 1). An access door to shall be provided for maintenance purposes. If located in crawl space or garage, the closet and door must conform with Section N1104 (Figure 2). Ducts shall comply with Section N1105.2.

Figure 1: Air handler in conditioned space

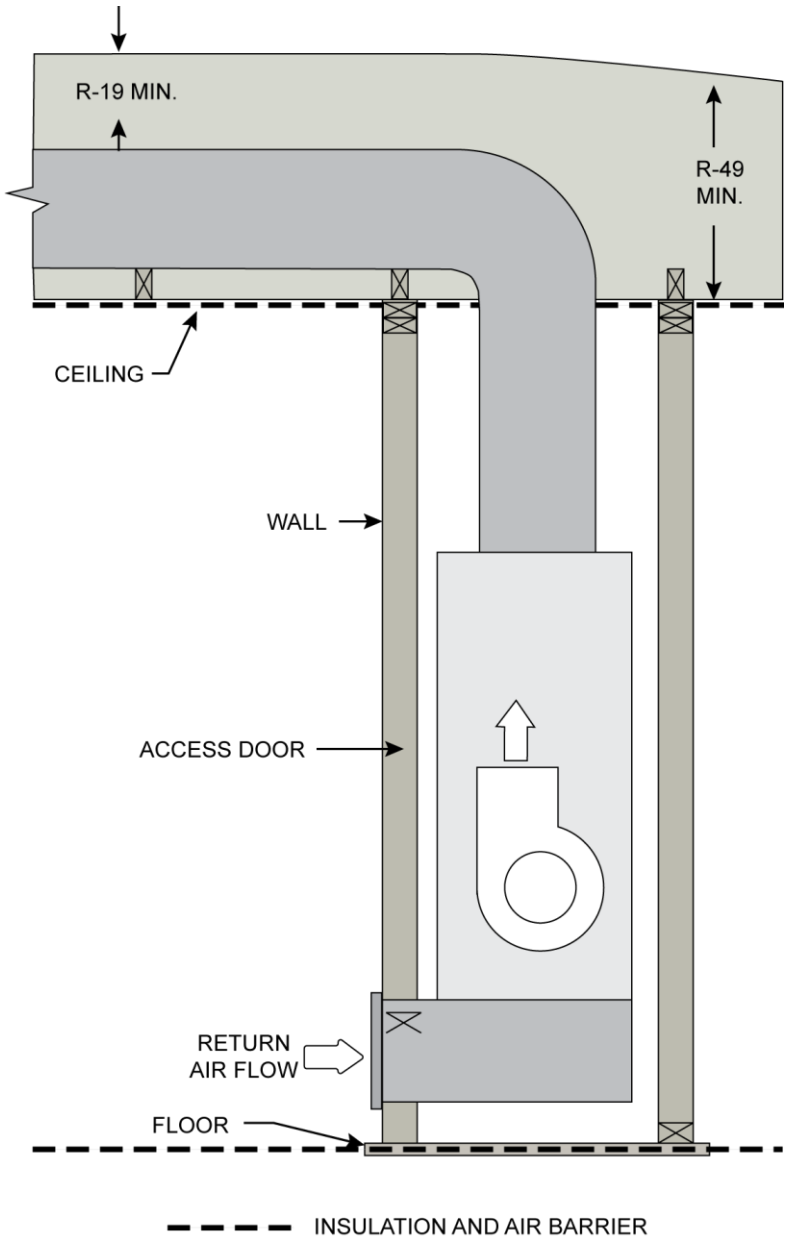
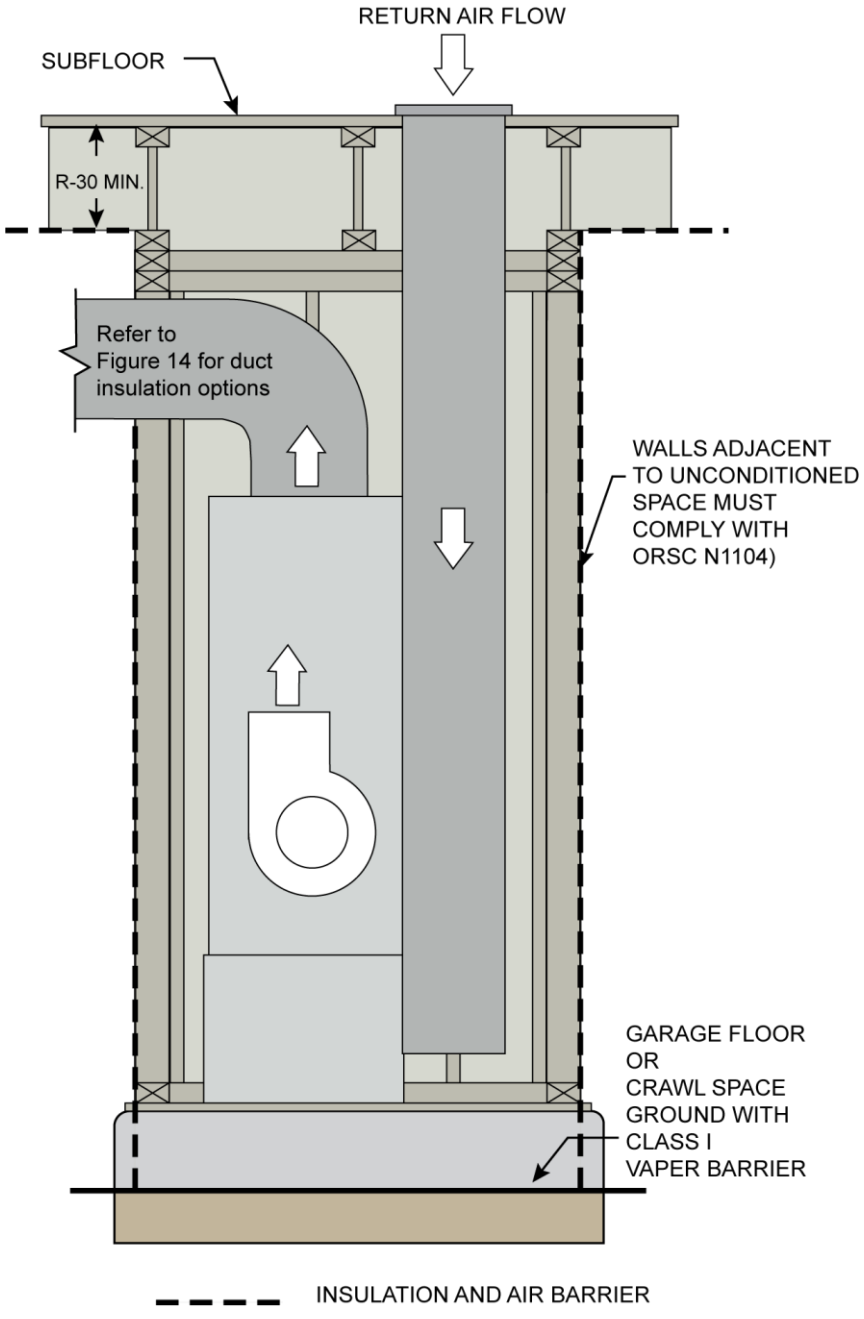


Figure 2: Air handler in crawl space or garage



AIR HANDLING EQUIPMENT EXCEPTIONS

Up to 5% of the length of an *HVAC system* shall be permitted to be located outside of the *thermal envelope*. The *HVAC system* includes the equipment, distribution network and terminals that provide either collectively or individually the processes of heating, ventilating and/or air-conditioning processes to a building. Ducts shall comply with Section N1105.2.

Figure 3: Air handler in attic, with 5% allowance. The unit shall not be buried in insulation to ensure access for maintenance and proper function of the equipment.

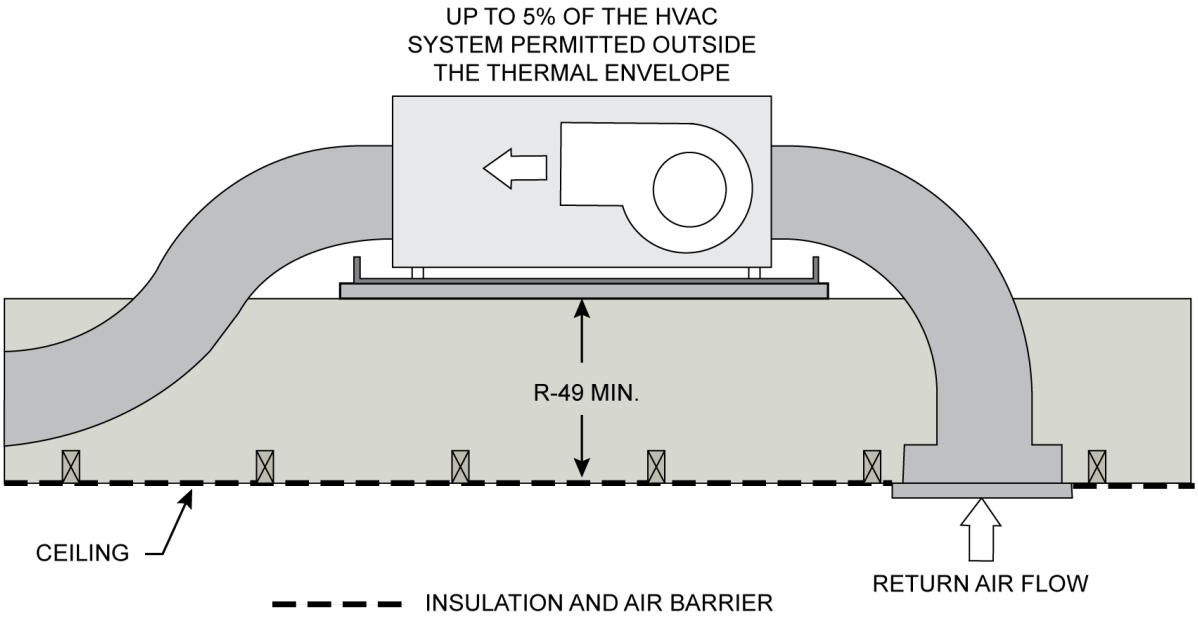
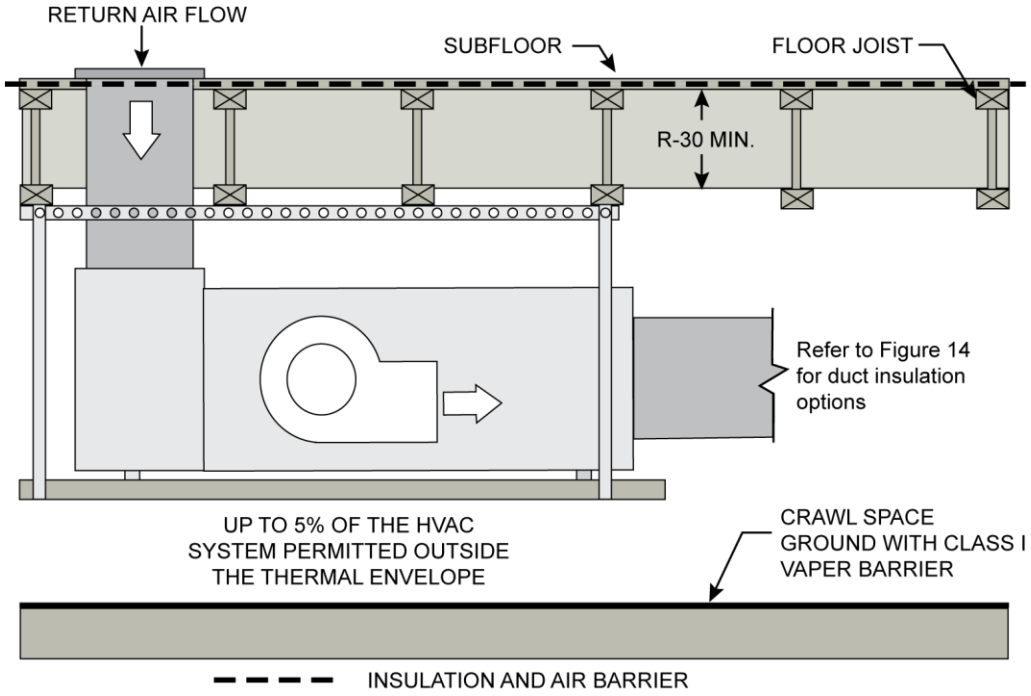
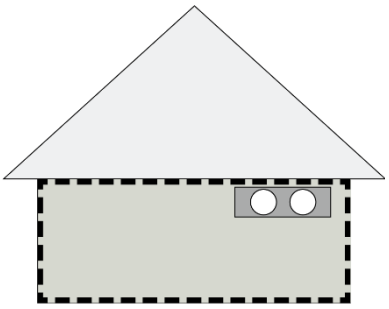


Figure 4: Air handler in handler in crawl space, with 5% allowance. Access for maintenance and proper function of the equipment shall be available.



LOCATING DUCTS WITHIN THE THERMAL ENVELOPE

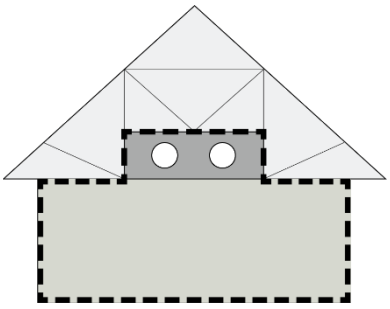


DUCTS IN DROPPED CEILING

Figure 5: Ducts in a dropped ceiling

Application: This approach is appropriate for single-story homes with 9- or 10-foot plate heights. It is also useful in two-story designs and for branch ducts in a house that may use a different approach.

Description: The key element of this approach is to run ductwork in soffits or bulkheads built within the thermal envelope. These building cavities, and the ducts, are now surrounded by the building air barrier and full insulation. One good location for a dropped ceiling is a central hall adjacent to several bedrooms. The space above the ceiling allows easy access to each of the bedrooms.

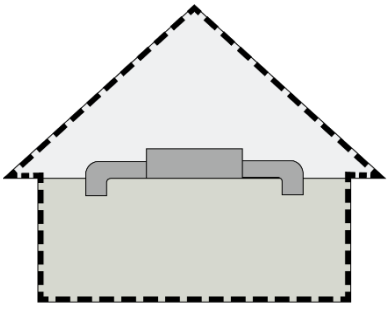


INVERTED SOFFIT OR MODIFIED TRUSS

Figure 6: Inverted soffit or modified truss

Application: This approach is appropriate for single-story homes with plate heights as low as $7^1/_2$ feet. It is also useful for branch ducts in a house.

Description: Duct chases are created by extending the thermal envelope into the attic. These extensions are surrounded by the building air barrier and insulation. An inverted soffit would typically be located near the center line of the long axis of the floor plan because it would serve as the main supply trunk. An inverted soffit is invisible from the living space and adequate design flexibility, especially when parallel to the trusses.

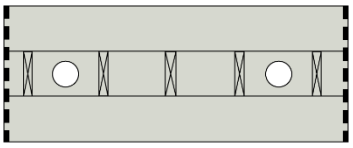


DUCTS IN UNVENTED ATTIC

Figure 7: Ducts in an unvented attic (ORSC R8056.5)

Application: This approach is most useful in single-story homes because it allows easy access to every room. It could also be used for the upper story in multi-story homes.

Description: By locating the thermal boundary at the roof plane instead of the ceiling, a large area of useful space is created in the attic. Insulation, air barrier and vapor retarder are all attached to roof framing. One way to create a conditioned attic is with spray foam applied to the underside of the roof sheathing. It's possible to accomplish the same thing with blown-in insulation although additional framing would be required to hold full insulation depth.

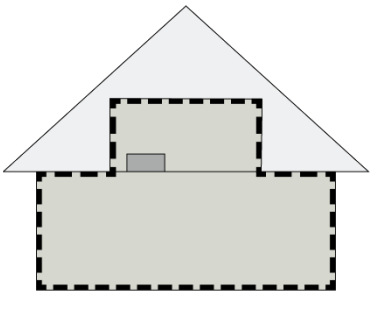


DUCTS BETWEEN FLOORS

Figure 8: Ducts between floors

Application: This approach works only with two-story homes

Description: To some extent the space between floors may already used to run ducts, pipes, and wires. While ducts easily run between floor joists, it can be very difficult to run ducts across joists. Use of open web floor trusses can allow unrestricted access to rooms on the upper and lower floors.



INSULATED ATTIC SPACE

Figure 9: Insulated attic space

Application: This approach is useful for single-story homes and the upper level of two-story homes. It may also be used for locating the HVAC equipment within the thermal envelope while the ducts are buried in a vented attic.

Description: Similar to an inverted truss, an insulated attic space approach extends the conditioned space into the attic creating a small 'room.' The purpose is to house the HVAC system and all (or most) of the ducts. In this case, the space may be large enough to locate the furnace and other equipment. In designs with a steeply pitched roof, a space below the roof may be carved out for storage and other purposes. Because this space is conditioned it shall have a complete and continuous thermal barrier in the walls and ceiling.

INSULATION AND AIR BARRIER

Application and descriptions above taken from the Ducts Inside Training Manual at ductsinside.org.

DUCTS WITHIN ATTIC SPACES – DEEPLY BURIED EXCEPTION

When installing ducts in a vented attic space, requirements must be met to qualify for the exception. Ducts shall comply with Section N1105.2.

Figure 10:

Insulation shall be installed to fill gaps and voids between the duct and the ceiling, and a minimum of R-19 insulation shall be installed above the R-8 duct adding additional separation between the ductwork and the unconditioned attic.

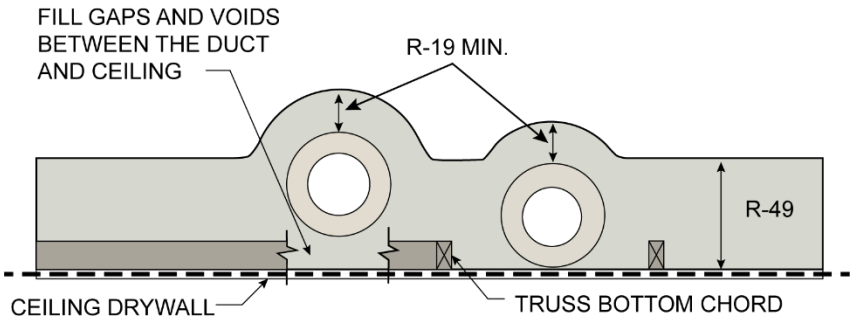


Figure 11:

Insulation depth marker flags shall be installed on the ducts every 10 feet or as approved by the building official.

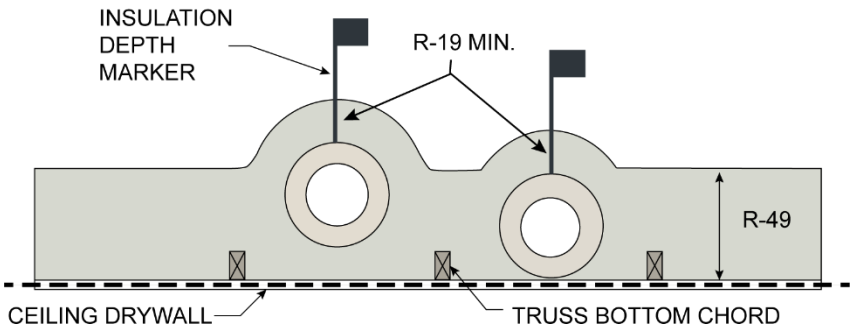
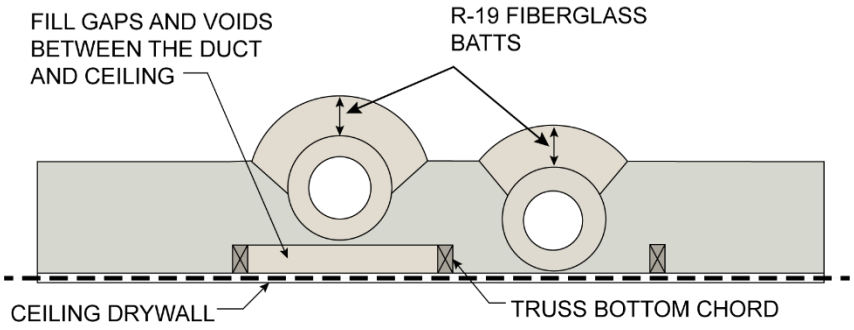


Figure 12:

Fiberglass batt material may be used to achieve the R-19 insulation level above the duct.



DUCTS WITHIN UNDER-FLOOR SPACES

When installing ducts in an under-floor space, there are a few options to prescriptively meet the ductwork requirements including the deeply buried exception. The following are examples of compliance for ducts related to under-floor spaces and options for compliance with the exceptions. Ducts shall comply with Section N1105.2.

Figure 13: The most straightforward of these options is to make the under-floor space part of the thermal envelope by adding either R-15 continuous insulation (c.i.) or R-21 blown/batt (in framed cavities) to the below grade walls. Continuous insulation may be located on the exterior or interior of the below grade wall in accordance with Section N1104.2.6. The space shall also comply with R408.3, *Unvented crawl spaces*.

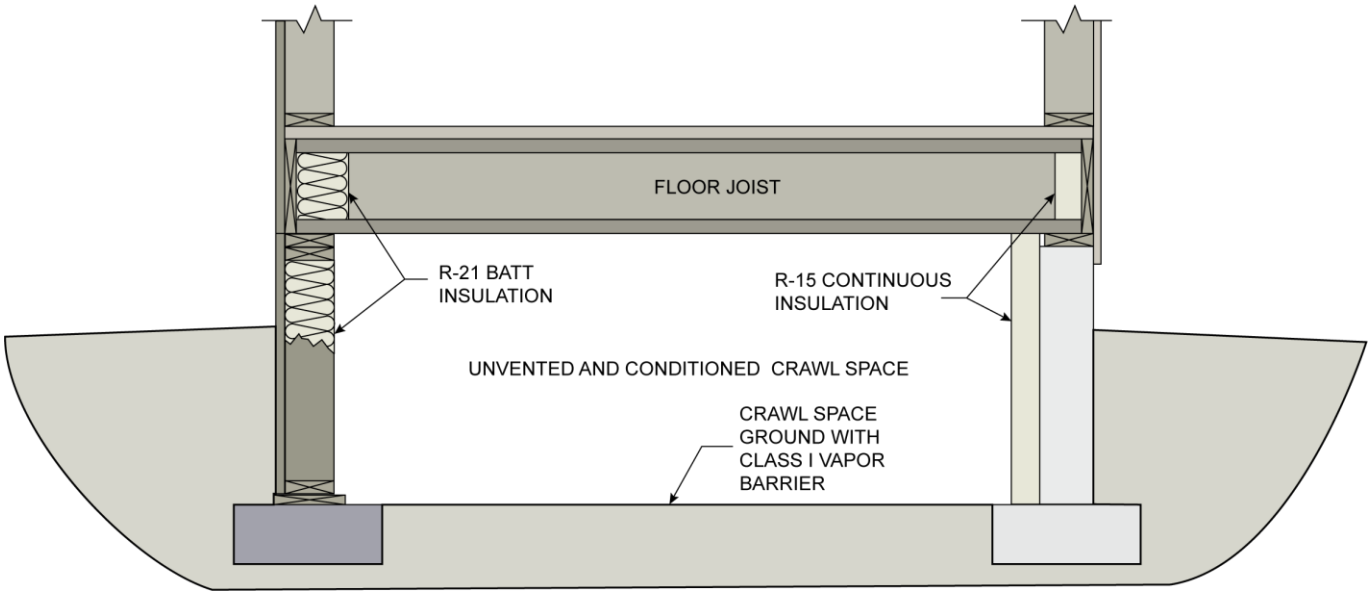
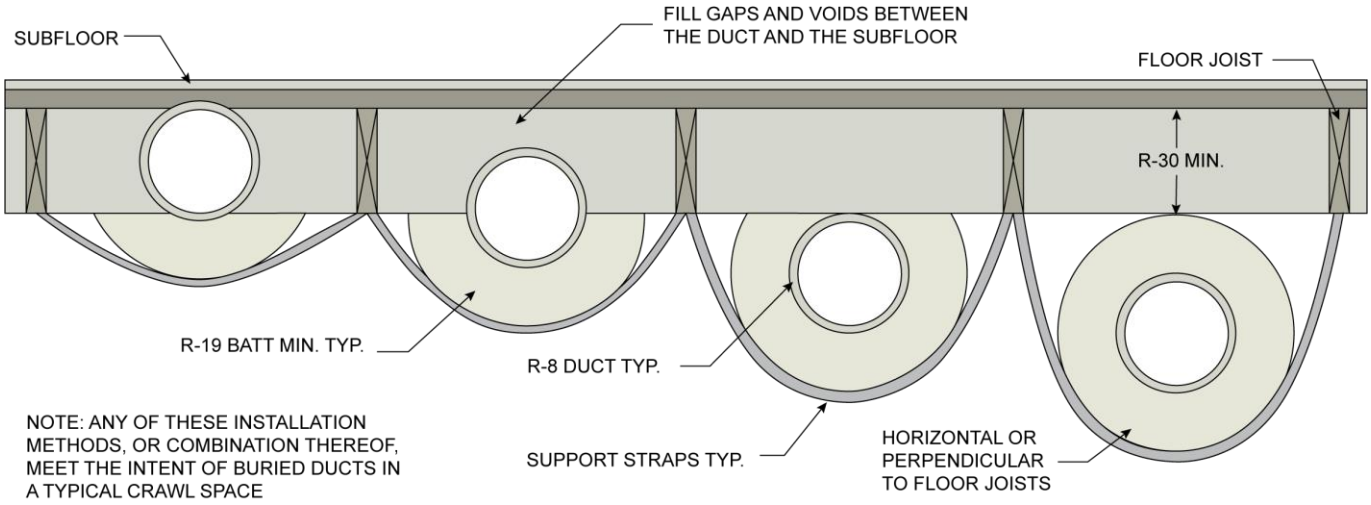


Figure 14: When in a vented under-floor space, batt insulation may be used to achieve the R-19 insulation level around the entire surface area of the duct *not in contact* with the required R-30 floor insulation. Floor insulation shall be installed to fill any gaps and voids between the duct and the floor. Depth marker flags are not required as long as the additional batt insulation is clearly marked as R-19 and there is minimal compression of the batt by support straps or other material.



USE OF BUILDING CAVITIES FOR AIR DUCTS OR PLENUMS

In new construction—Section M1601.1.1.1

Except as allowed by Section M1601.1.1, the use of building cavities for air ducts or plenums is *not* allowed in new construction or in an addition to an existing structure. For stud wall cavities and spaces between solid floor joists to be used as transfer air plenums, they must comply with five specified conditions.

In existing buildings—Section M1601.1.1.2

The use of building cavities for air ducts or plenums is allowed in the alteration or remodel of an existing structure. For stud wall cavities and spaces between solid floor joists to be used as air ducts or plenums, they must comply with five specified conditions.

JOINTS, SEAMS AND CONNECTIONS OF DUCTWORK

Section M1601.4.1

Tape shall *not* be used to seal metal ductwork, or be used as the sealing method between metal duct and flexible or fibrous duct. Tape is *only* allowed to be used with metal duct at connections to equipment requiring future replacement. Joints, longitudinal and transverse seams, and connections of ductwork shall be securely fastened and may only be sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric systems, liquid sealants, or approved equivalents.

CONCLUSION

To achieve the U.S. Department of Energy (DOE) Zero Energy Ready Homes (ZERH) performance equivalency for regulated site energy use by 2023, the division took this step to improve heating and cooling performance by incorporating portions of the ZERH insulation and installation requirements into the 2021 ORSC.

There are many ways to locate the duct systems and air handling equipment fully within the building thermal envelope. If this is not feasible, then duct systems which are deeply buried in insulation are an acceptable alternative. Up to 5% of the total length of an *HVAC system* shall be permitted to be unburied and/or located outside of the *thermal envelope*. The use of building cavities and tape is no longer allowed, except as outlined above.

As with all site-specific matters, it is recommended to begin development discussions early in the initial planning stages. This technical recommendation also reminds the end user that local building officials retain broad local flexibility and discretionary authority on administration and enforcement of the state building code.