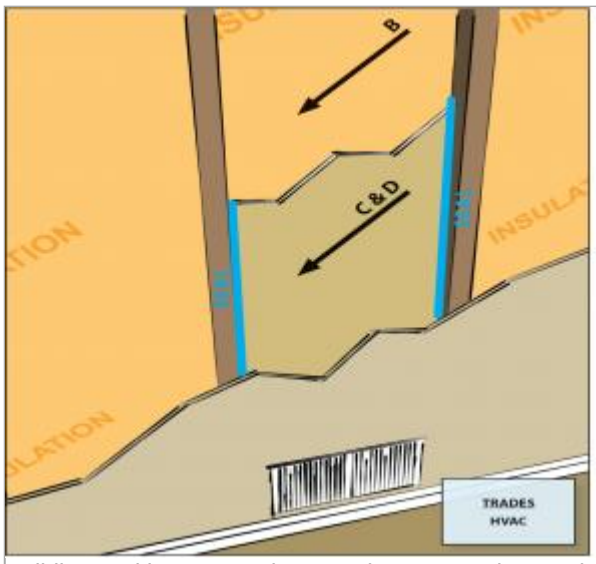
Building Cavities Not Used as Supply or Return Ducts

Last Updated: 06/04/2014

Scope



Building cavities not used as supply or return ducts unless they meet Items 3.2, 3.3, 4.1, and 4.2 of this Checklist

Do not use building cavities as part of a forced air supply or return system.

DOE Zero Energy Ready Home Notes

The U.S. Department of Energy's **Zero Energy Ready Home Program requires** that builders comply with the U.S. Environmental Protection Agency's Indoor airPLUS Program requirements. The **Indoor airPLUS checklist** (Item 4.2) requires that builders do not use building cavities as part of the forced air supply or return systems.

ENERGY STAR Certified Homes Notes:

[Note: Guidance for ENERGY STAR Certified Homes Version 3.0, Revision 08 is coming soon.]

The **ENERGY STAR Certified Homes (Version 3.0, Revision 07) HVAC System Quality Installation Rater Checklist** dictates the following (Item 2.5): Building cavities cannot be used as supply or return ducts unless they meet Items 3.2, 3.3, 4.1, and 4.2 of the ENERGY STAR HVAC System Quality Installation Rater Checklist.

3.2 *Prescriptive Path*: Supply ducts in unconditioned attic have insulation >= R-8.
Performance Path: Supply ducts in unconditioned attic have insulation >= R-6.

3.3 All other supply ducts and all return ducts in unconditioned space have insulation >= R-6.

4.1 Total Rater-measured duct leakage meets one of the following two options:

4.1.1 Rough-in: <= 4 CFM25 per 100 sq. ft. of conditioned floor area (CFA) with the air handler and all ductwork, any building cavities used as ductwork, and duct boots installed. In addition, all duct boots are sealed to the finished surface; rater-verified at final.

4.1.2 Final: <= 8 CFM25 per 100 sq. ft. of CFA with the air handler and all ductwork, any building cavities used as ductwork, duct boots, and register grilles atop the finished surface (e.g., drywall, flooring) installed.

4.2 Rater-measured duct leakage to the outdoors is <= 4 CFM25 per 100 sq. ft. of CFA.

See the Compliance tab for additional details.

Description

Nearly all codes restrict the use of cavity spaces as supply ducts. However, it has been common practice to use cavity spaces as return air pathways. Building cavities used as return air plenums are probably the biggest duct leakage culprits we have in the HVAC industry today.

Still commonly used is the panned floor joist. Using floor joists as return ducts by panning can cause leakage because negative pressure in the cavity will draw air from the outside into the cavity through the construction joints of the rim area at the end of the joist cavity.

Figure 1 shows a floor joist cavity used as a return air duct by nailing a sheet good, such as gypsum board, sheet metal, foil insulation, or OSB to the bottom of the floor joists. There are manufacturers advertising “insulating” sheet good products to aid in this practice; however, using panned floor joists as an HVAC air pathway is highly discouraged because air leakage will be very difficult, if not impossible, to prevent.

Figure 1. Some builders create pan joists by attaching a solid sheet good to the bottom of a floor joist to create a return air pathway. Pan joists should not be used as return air pathways because they cannot be air sealed properly. (Image courtesy of CalcsPlus)

Cavities (or interstitial spaces) within walls are also sometimes used as supply or return air pathways. These cavities often connect inside air with outside air from an attic or crawlspace. It is very difficult to make such cavity spaces airtight. When cavity spaces are used as return air pathways or supply air ducts, a few issues will arise. Because cavity spaces are leaky, building pressure imbalances across the building envelope will occur, driving building infiltration. A cavity space used as a return air pathway will pull pollutants into the building from unknown sources. Another issue (less talked about) with using cavity spaces as return air pathways is fire safety. Building materials such as wood products do not meet the flame and smoke spread criteria as do approved duct materials. Using cavities as return or supply ducts is not a fire hazard in itself but will encourage a fire to spread throughout the building. In humid climates, a cavity space used as a return air pathway will pull humid air into the cavity space, possibly encouraging mold or rotting of building materials.

Other common framing cavities used as return air pathways or plenums are air handler platforms, open floor truss cavities, and dropped ceilings.

Figure 2. Open floor trusses used as return air plenums can draw air from any place connected to that floor. (Image courtesy of CalcsPlus)

Figure 3. Air handler platforms used as return air plenums can draw air from vented attics and crawlspaces through other connected framing cavities. (Image courtesy of CalcsPlus)

While none of these spaces make acceptable air pathways on their own, some building cavities such as floor joists can make acceptable duct chases to contain an insulated, air-sealed, metal or flex supply or return duct.

How to Use Building Cavities as Duct Chases for Supply and Return Pathways:

1. Plan duct layout at the design stage. Indicate floor joist cavities, dropped ceiling soffits, or other building cavities that will be used as duct chases. Calculate required duct sizes using ACCA Manual D (**ACCA 2009**). Ensure that the cavity spaces are free of obstructions and large enough to hold the duct plus insulation.
2. Use only approved duct materials such as galvanized steel, aluminum, fiberglass duct board, and flexible duct that meet local code smoke and flame spread criteria.
3. Make sure that all supply and return duct connections are sealed with mastic or approved tape.
4. Because ductwork in cavity spaces is likely to be inaccessible, test the duct system for airtightness with a duct blaster test before installing the drywall.
5. At a minimum, line the air handler platform with duct board and mastic seal the corners.

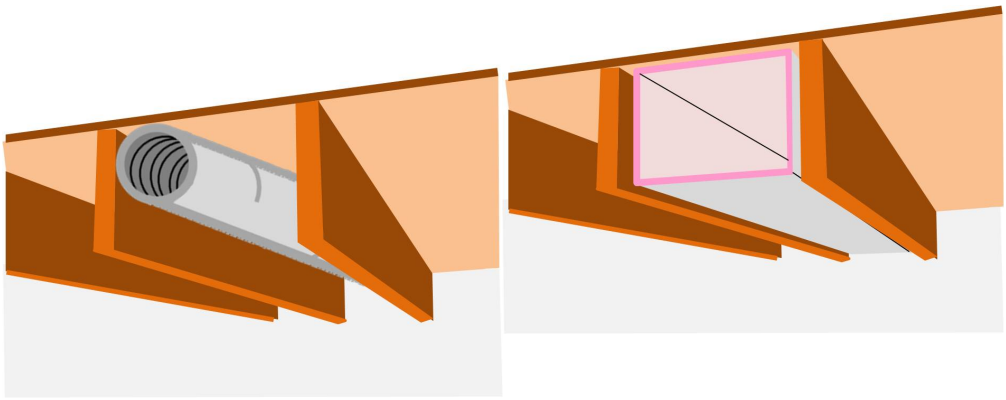


Figure 4 . Floor joist cavities can make acceptable duct chases for insulated, air-sealed metal, flex, or fiberboard duct. (Image courtesy of CalcsPlus)

Ensuring Success

Use recognized and acceptable duct materials for all HVAC airways. For residential construction, acceptable duct materials include galvanized steel, aluminum, fiberglass duct board, and flexible duct. Consider duct layout in the initial framing design stage. Do not use a building cavity space alone as a supply or return air pathway. For the cavity to serve as a supply or return air pathway, it must contain a sealed, insulated duct made of approved duct materials. Use a duct blaster test to detect duct leakage and to confirm proper air flow at each duct supply outlet.

Climate

No climate specific information applies.

Training

Right and Wrong Images

None Available

CAD

None Available

Compliance

The Compliance tab contains both program and code information. Exact code language is copyrighted and may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

DOE Zero Energy Ready Home

The U.S. Department of Energy's Zero Energy Ready Home mandatory program requirements specify that builders must comply with the U.S. Environmental Protection Agency's Indoor airPLUS Program. The Indoor airPLUS checklist (Item 4.2) requires that builders do not use building cavities as part of the forced air supply or return systems.

ENERGY STAR Certified Homes

[Note: Guidance for ENERGY STAR Certified Homes Version 3.0, Revision 08 is coming soon.]
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Performance Path: Supply ducts in unconditioned attic have insulation >= R-6.

3.3 All other supply ducts and all return ducts in unconditioned space have insulation >= R-6.

4.1 Total Rater-measured duct leakage meets one of the following two options: (16)

4.1.1 Rough-in: <= 4 CFM25 per 100 sq. ft. of conditioned floor area (CFA) with the air handler and all ductwork, any building cavities used as ductwork, and duct boots installed. In addition, all duct boots are sealed to the finished surface; rater-verified at final. (17)

4.1.2 Final: <= 8 CFM25 per 100 sq. ft. of CFA with the air handler and all ductwork, any building cavities used as ductwork, duct boots, and register grilles atop the finished surface (e.g., drywall, flooring) installed. (18)

4.2 Rater-measured duct leakage to the outdoors is <= 4 CFM25 per 100 sq. ft. of CFA. (16,19)

ENERGY STAR Footnotes:

(16) Duct leakage shall be determined and documented by a Rater using a RESNET-approved testing protocol. Leakage limits shall be assessed on a per-system, rather than per-home, basis. For balanced ventilation ducts that are not connected to space heating or cooling systems, a Rater is permitted to visually verify, in lieu of duct leakage testing, that all seams and connections are sealed with mastic or metal tape and all duct boots are sealed to floor, wall, or ceiling using caulk, foam, or mastic tape.

(17) Cabinets (e.g., kitchen, bath, multimedia) or ductwork that connect duct boots to toe-kick registers are not required to be in place during the 'rough-in' test. For homes permitted through 12/31/2013: Homes are permitted to be certified if rough-in leakage is <= 6 CFM25 per 100 sq. ft. of CFA with air handler and all ductwork, building cavities used as ductwork, & duct boots installed.

(18) Registers atop carpets are permitted to be removed and the face of the duct boot temporarily sealed during testing. In such cases, the Rater shall visually verify that the boot has been durably sealed to the subfloor (e.g., using duct mastic or caulk) to prevent leakage during normal operation.

(19) For homes that have <= 1,200 sq. ft. of conditioned floor area, measured duct leakage to outdoors shall be <= 5 CFM25 per 100 sq. ft. of conditioned floor area. Testing of duct leakage to the outside can be waived if all ducts & air handling equipment are located within the home's air and thermal barriers AND envelope leakage has been tested to be less than or equal to half of the Prescriptive Path infiltration limit for the Climate Zone where the home is to be built. Alternatively, testing of duct leakage to the outside can be waived if total duct leakage is <= 4 CFM25 per 100 sq. ft. of conditioned floor area, or <= 5 CFM25 per 100 sq. ft. of conditioned floor area for homes that have <= 1,200 sq. ft. of conditioned floor area.

2009 IECC

Section 403.2.3 Building cavities (Mandatory). Building framing cavities cannot be used as supply ducts. Section 403.2.1 Insulation (Prescriptive). Supply ducts in attics are insulated to a minimum of R-8. All other ducts in unconditioned spaces or outside the building envelope are insulated to at least R-6.*

2009 IRC

Section M1601.1.1 Above-ground duct systems. Stud wall cavities and spaces between solid floor joists cannot be used as supply air plenums.*

2012 IECC

Section R403.2.3 Building cavities (Mandatory). Building framing cavities cannot be used as supply ducts or plenums. Section R403.2.1 Insulation (Prescriptive). Supply ducts in attics are insulated to a minimum of R-8. All other ducts in unconditioned spaces or outside the building envelope are insulated to at least R-6.*

2012 IRC

Section M1601.1.1 Above-ground duct systems. Stud wall cavities and spaces between solid floor joists cannot be used as supply air plenums. Stud wall cavities in building envelope exterior walls cannot be used as air plenums.*

*Due to copyright restrictions, exact code text is not provided. For specific code text, refer to the applicable code.

More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Case Studies

None Available

References and Resources*

1. **ACCA Manual D - Residential Duct Systems**
   Author(s): Air Conditioning Contractors of America
   Organization(s): Air Conditioning Contractors of America
   Publication Date: December, 2013
   Standard outlining industry procedure for sizing residential duct systems.

2. **DOE Zero Energy Ready Home National Program Requirements**
   Author(s): DOE
   Organization(s): DOE
   Publication Date: August, 2015
   Standard requirements for DOE's Zero Energy Ready Home national program certification.

3. **ENERGY STAR Certified Homes, Version 3 (Rev. 07) Inspection Checklists for National Program Requirements**
   Author(s): EPA
   Organization(s): EPA
   Publication Date: June, 2013
   Standard document containing the rater checklists and national program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 7).

4. **Flexible Duct Performance and Installation Standards**
   Author(s): Air Diffusion Council
   Organization(s): Air Diffusion Council
   Publication Date: January, 2010
   Standard providing a comprehensive approach to evaluating, selecting, specifying and installing flexible duct in HVAC systems.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide

The following Building America Teams contributed to the content in this Guide.

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