Placement of Ducts and HVAC Systems in Conditioned Space: An Overview

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Why move ducts inside?

• Energy savings from reducing forced air exchange due to duct leakage
Why move ducts inside? (continued)

• Reduce pressure imbalance problems
• Energy savings from less hostile duct environment
• Reduced heating & cooling loads—equipment downsizing
Duct Location Options

• Basement + interior walls
• Conditioned crawl space + interior walls
• Dropped HVAC coffer
• Raised HVAC coffer
• Floor truss space (two-story plans)
• Unvented roof system

• Warning: Combustion Appliance Location
Basement Duct System

- Standard system in many regions
- Second floor ducts must be in first floor interior walls or trunks off of floor system—not in attic.
Conditioned Crawl Space

- Wood siding (all surfaces painted)
- Air space
- Rigid insulation (taped or sealed joints)
- Furring
- Sealant, adhesive or gasket
- Adhesive
- Sealant, adhesive or gasket

Crawl space access is preferred through the sub floor—not the perimeter wall unless an airtight/insulated access opening is provided.

- Ground slopes away from wall at 5% (6 in. per 10 ft.)
- Filter fabric
- Coarse gravel (no fines)
- Perforated drain pipe

Concrete "sloppy" footing

- Unfaced batt insulation
- Gypsum board with semi-vapor permeable (latex) paint
- Sealant, adhesive or gasket
- Sealant at a corner of bottom plate and subfloor or gasket under bottom plate
- Unfaced batt insulation
- Sealant
- Sill gasket

Protective membranes also act as capillary break

Concrete foundation wall

Rigid insulation with taped or sealed joints (select materials with smoke developed and fire spread ratings approved for exposed application)

Continuous polyethylene vapor diffusion retarder/air flow retarder (all joints taped) taped to perimeter membrane
Conditioned Crawl Space Duct System

Note: Colored shading depicts the building’s thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.
Conditioned Crawl Space Duct System
Dropped Ceiling Coffered Duct System

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Dropped Ceiling Coffer Duct System
Dropped Ceiling Coffer Duct System
Raised Ceiling Coffer Duct System

BSC+2 HVAC COFFER DETAIL
 NOT TO SCALE

NOTES:
1. THIS DETAIL ONLY SHOWS 10 OF POSSIBLE CONFIGURATIONS FOR SUPPLY DUCTS.
   INSTALL DUCTS AS DETAILED ON FLOOR PLAN.
Raised Ceiling Coffer Duct System

![Diagram of Raised Ceiling Coffer Duct System]

FRESH AIR SUPPLY 6" INSULATED FLEX DUCT TO RETURN SIDE OF AIR HANDLED WALL CUP WITH INSECT SCREEN, AIR RISE PENETRATION

6" DIA DOWNSUPPLY
-97 CFM

TO ABLE TAKE SUPPLY END OF TRUNK

5" DIA DOWNSUPPLY
-100 CFM

4" DIA DOWNSUPPLY
-110 CFM

SUPPLY TRUNK OR EQUAL (-750 CFM)

REAR SUPPLY TRUNK

STAIR TRANSFER GRILLES
3.5" RETURN GRILLES TO
CEILING SPACE

GAMER REGISTERED

EXHIBIT THROUGH Sofa/ REFRIG.

PRESSURE RELIEF
SUPPLIED CEILING SPACE

4" DIA DOWNSUPPLY
-70 CFM

SUPPLY TRUNK OR EQUAL (-750 CFM)

FRESH AIR SUPPLY 6" INSULATED FLEX DUCT TO RETURN SIDE OF AIR HANDLED WALL CUP WITH INSECT SCREEN, AIR RISE PENETRATION

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Raised Ceiling Coffer Duct System
Engineered Floor Truss Duct System

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Engineered Floor Truss Duct System
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Attic-wall air barrier needed
Engineered Floor Truss Duct System
Unvented Roof Duct System

Note: Colored shading depicts the building’s thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.
Unvented Roof Duct System
Unvented Roof Ducts: Energy Comparisons

**House 1 (Base Case)**
- Fully Ventilated Attic, No Ductwork in Attic, Perfect Air Barrier at Ceiling
- AHU and ductwork completely inside the conditioned space

**House 2**
- Fully Ventilated Attic, Perfectly Sealed Ductwork and AHU in Attic, Perfect Air Barrier at Ceiling
- Energy performance -3% to -5% penalty compared with base case due to conductive losses across the ductwork and AHU.

**House 3**
- Fully Ventilated Attic, Leaky Ductwork and AHU in Attic, Imperfect Air Barrier at Ceiling
- Energy performance -15% to -30% penalty compared with base case due to air change induced by leaky ductwork. House 3 is the true "Base Case" for typical residential construction.

**House 4**
- Cost = -$300 compared with House 3
- Non-Ventilated Attic, Insulation Tight to Underside of Roof Deck, Leaky Ductwork and AHU completely inside the Conditioned Attic, Typical Ceiling Construction
- Energy performance -3% to -5% penalty compared with base case (House 1). However, it allows for 15% to 25% savings over the true base case (House 3).
Unvented Roof: Air Sealing Locations

- Porch kneewalls
- Garage kneewalls
Unvented Roof: Construction Detail

- SHEETROCK "AIR BARRIER"
- SEAL ALL HOLES THROUGH SOLE PLATE & TOP PLATE
- "ZERO" TOLERANCE INSULATION
- AIR SPACE
- BRICK
Unvented Roof: Construction Detail

Shingles
Roofing paper
Batt insulation installed with wire stays or twine or “netted” dry blown cellulose or fiberglass
R-5 rigid insulation (vertical and horizontal joints offset from roof sheathing)
3/8” sheathing over rigid insulation
1/2” roof sheathing
Sealant
Rigid insulation notched around roof rafters and sealed
Vinyl or aluminum siding
Rigid insulation (taped, shiplapped or sealed joints)
Unfaced batt insulation
Gypsum board with semi vapor permeable (latex) paint

Note: Colored components designate air flow retarder system