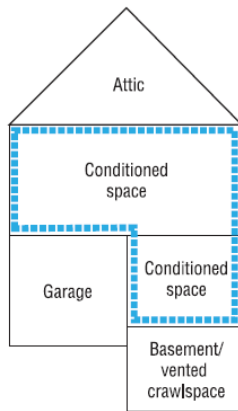


**Building Thermal Envelope** — The basement walls, exterior walls, floor, roof, and any other building element that enclose conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space. —2009 IECC

The *building thermal envelope* is the barrier that separates the conditioned space from the outside or unconditioned spaces. The building envelope consists of two parts - an air barrier and a thermal barrier that must be both continuous and contiguous (touching each other). In a typical residence, the building envelope consists of the roof, walls, windows, doors, and foundation. Examples of unconditioned spaces include attics, vented crawlspaces, garages, and basements with ceiling insulation and no HVAC supply registers.

Example 1

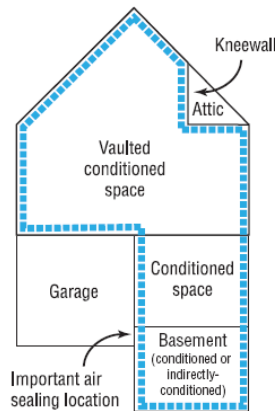


This is a conventional approach that likely locates all ductwork in unconditioned spaces.

*Example R-values<sup>1</sup>*

- Flat ceiling: R-30
- Exterior walls: R-13 + R-3 sheathing
- Floor over garage and basement/crawl: R-19
- Ductwork sealed with mastic and insulated to R-8 in attic, R-6 in basement/crawlspace
- Garage<sup>5</sup>, attic and basement/crawl are unconditioned spaces

Example 2

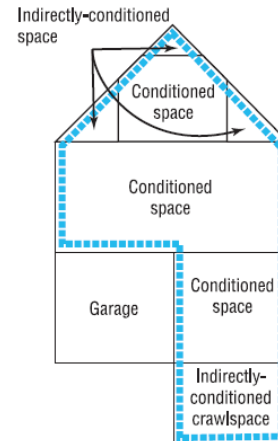


If supply registers deliver conditioned air to basement, it is considered conditioned. With no supply air, it is considered an indirectly-conditioned space.

*Example R-values<sup>1</sup>*

- Flat ceiling: R-38
- Kneewalls<sup>2</sup>: R-18 (required) (R-13+ R-5, R-15 + R-3, R-19 in 2x6)
- Vaulted ceiling<sup>3</sup>: R-19 air-permeable insulation plus R-5 rigid foam board
- Exterior walls: R-13
- Basement masonry walls: R-5
- Basement slab<sup>4</sup>: R-0
- Ductwork sealed with mastic and insulated to R-8 in attic, R-6 in basement
- Garage<sup>5</sup> and attic are unconditioned spaces

Example 3



The top conditioned floor functions as a vaulted ceiling with interior walls although it appears to have kneewalls and a flat ceiling. An advantage of this approach is that all upstairs ductwork is located inside the building envelope.

The crawlspace walls are insulated and do not contain vents. The crawlspace ground is covered with concrete or 100% plastic and functions as a "mini-basement."

*Example R-values<sup>1</sup>*

- Vaulted ceiling<sup>3</sup>: R-19 air-impermeable foam insulation
- Exterior walls: R-13 + R-3 sheathing
- Crawlspace walls: R-5
- Ductwork sealed with mastic and insulated to R-6
- Garage<sup>5</sup> is unconditioned space

1 R-values shown are examples and not code requirements. Refer to table 402.1.1 for specific prescriptive insulation requirements.

2 An *attic kneewall* is any vertical wall that separates conditioned space from an unconditioned attic. In Georgia, kneewalls must be insulated to R-18. A sealed attic-side air barrier (OSB, foil-faced sheathing, etc.) is required when using air permeable insulation.

3 Requires trade-off (such as REScheck) since prescriptive ceiling requirement is R-30 / R-38, see roofline installed insulation options and section 806.4 of the 2006 IRC.

4 Slab Insulation is not required in Georgia due to termite risk.

5 Although there is nothing to prevent the garage walls from being insulated, due to indoor air quality concerns, the garage should never be considered inside the building envelope.