



BUILDING AMERICA TOP INNOVATIONS HALL OF FAME PROFILE

INNOVATIONS CATEGORY:

4. Infrastructure Development
- 4.3 Informing Codes and Standards Process

Unvented Crawlspace Code Adoption

Crawlspaces that are unvented and insulated along the interior or exterior sides of the walls remain drier in humid climate zones.

Building America contributions to getting unvented crawlspaces adopted in the model energy code has helped influence the thousands of new homes to be constructed with crawlspaces. As a result, builders are sealing and insulating crawlspaces with up to 20% in heating and cooling energy savings while substantially reducing the risk of moisture problems.



BUILDING AMERICA TOP INNOVATIONS

Recognizing Top Innovations in Building Science – The U.S. Department of Energy's Building America program was started in 1995 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing industries on the road to high-performance homes.

Building America research played a major role in helping to clarify and contribute to code requirements that allow unvented crawlspaces in new home construction. This is critical because unvented crawlspaces save energy while improving comfort, health, and durability in most climate zones.

In most climate zones, conditioned crawlspaces perform better than vented crawlspaces in terms of safety, health, comfort, durability and energy consumption. Building America research has demonstrated how these conditioned crawlspaces also do not cost more to construct than vented crawlspaces.

Crawlspace venting is a widely accepted business practice across the country. However, in humid climates, the warm humid air entering the crawlspace is more likely to condense on crawlspace framing than to help dry out the crawlspace. This is because the outside air can often have a dew point that is higher than the interior crawlspace framing surface temperature. As evidence, existing vented crawlspaces have experienced serious moisture and mold problems costing builders and homeowners significant resources to repair.

The housing industry has been reluctant to use unvented crawlspaces despite their compelling benefits and the history of problems with existing vented crawlspaces. One of the reasons commonly cited by builders and designers is “the code does not allow me to build unvented crawlspaces.” This is both generally correct and misleading (Lstiburek 2004). The model codes do not allow the construction of “unvented” crawlspaces—except in very limited circumstances, but they do allow the construction of “conditioned” crawlspaces. The distinction is important and necessary, according to Joe Lstiburek of Building Science Corporation, a Building America research partner (Lstiburek 2004).

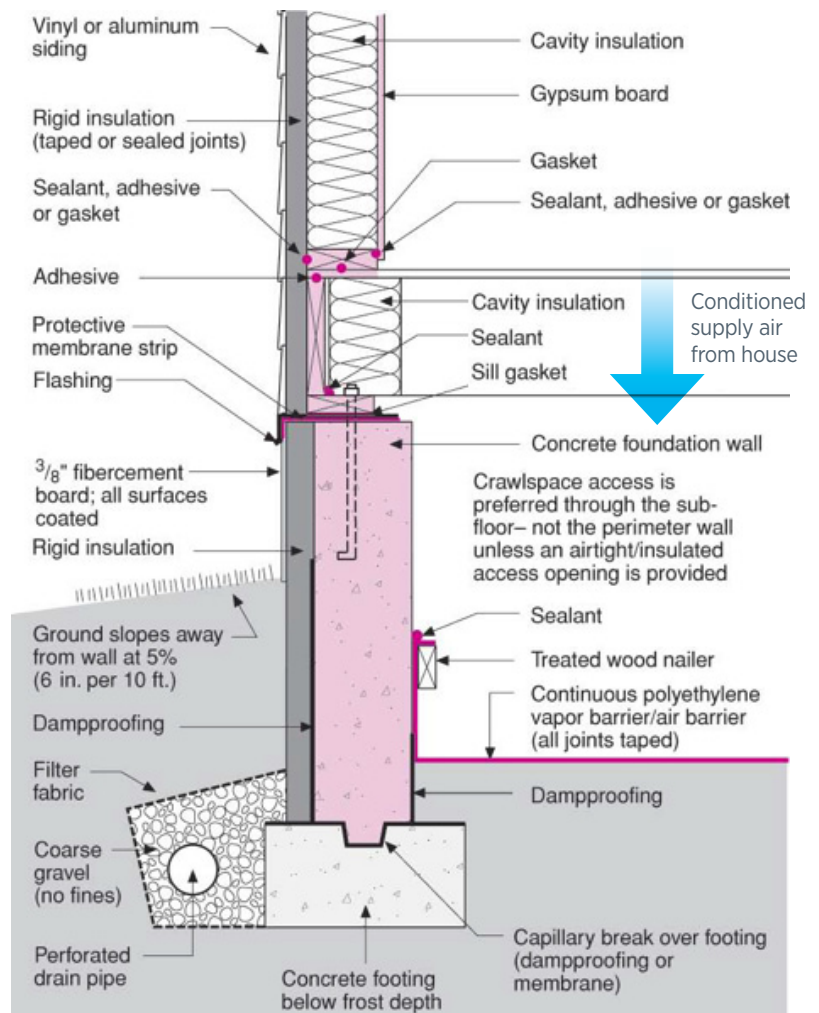
Building Science Corporation conducted a review of the codes in 2004 to determine what code language actually stated regarding crawlspace requirements. BSC reviewed the following codes: the 2003 International Mechanical Code (IMC), the 2003 International Building Code (IBC), the 2004 Supplement to the International Energy Conservation Code (IECC), and the 2004 Supplement to the International Residential Code (IRC). Building Science Corporation determined that codes allow unventilated crawlspaces under these conditions: when there is a continuous ground cover, perimeter walls are insulated, and the crawlspace is conditioned.

Building Science Corporation performed a field study where four conditioned crawlspaces were constructed and monitored over a 12-month period: three in Ohio and one in New Mexico. The results were published in a report titled, *Conditioned Crawl Space Construction, Performance and Codes* (Lstiburek 2004). The data in that report supported the 2004 IECC code requirements allowing the construction of conditioned crawlspaces.

The study results were consistent with those found in other studies showing that **unvented, conditioned crawlspaces with insulation on the perimeter perform better in terms of safety and health (pest control), comfort (warm floors, uniform temperatures), durability (moisture), and energy consumption than passively vented crawlspaces with sub-floor insulation.** This is because they are cooler and dryer in the summer, which minimizes condensation on framing surfaces. In addition, there is less heat loss from the home during winter, which results in more comfortable floors and less risk of freezing pipes. To these points, Lstiburek found in the Ohio-New Mexico study that crawlspace temperatures, dew points, and relative humidities mirror those of the house interior.

Crawlspaces should be designed and constructed as mini-basements, as part of the house within the conditioned space. To meet code requirements, the crawlspace floor should be covered with a ground cover consisting of 6-millimeter plastic that is overlapped and sealed at the edges and secured to the side walls; perimeter walls should be insulated to code-specified levels (e.g., rigid foam on the exterior or rigid fiberglass, **spray foam, or rigid foam on the interior**); and perimeter drainage should be provided just like a basement when the crawlspace ground level is below the ground level of the surrounding grade. The crawlspace can be conditioned in one of three ways: 1) **supply air from the home to the crawlspace**, 2) **return air to home via transfer grille or to outside via exhaust fan**, or 3) connect the crawlspace to a conditioned basement. A soil gas venting system should be installed as part of a complete radon-resistant construction system.

It should be noted that Building America research encourages the use of slab-on-grade foundations rather than crawlspaces for locations that are not subject to frequent flooding.



Insulating along the exterior wall is one option for an unvented crawlspace.

Humidex accomplishes both #1 and #2 with respect to conditioning the crawl space.

REFERENCES

Lstiburek, J. 2004. *Conditioned Crawl Space Construction, Performance and Codes*, RR-0401, www.buildingscience.com/documents/reports/rr-0401-conditioned-crawlspace-construction-performance-and-codes.