COLD CLIMATE HOUSING RESEARCH CENTER
CCHRC

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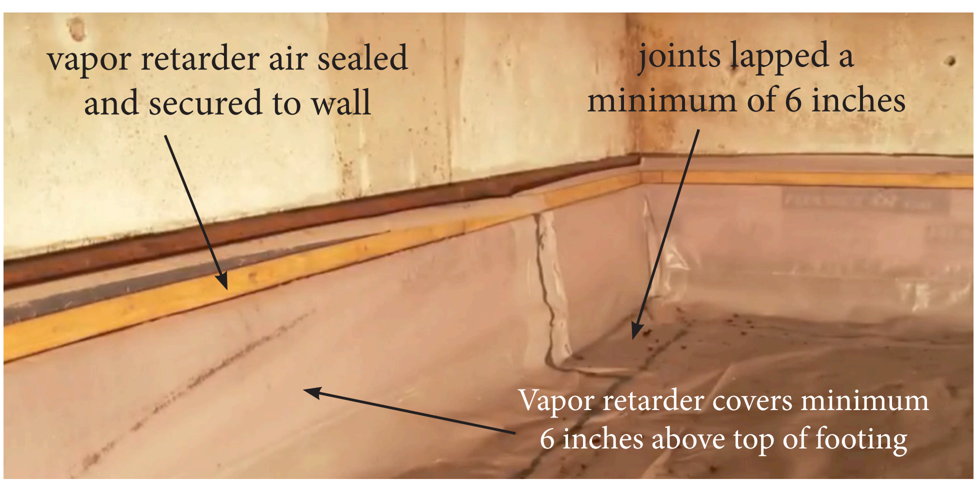
Crawlspace Ventilation

While the crawlspace is not part of your liveable space, it impacts the energy performance and indoor air quality of your whole house. Because it's typically located underground, the crawlspace may be easy to overlook. However, it is also susceptible to moisture issues. No matter how your crawlspace is designed, it's important to consider energy efficiency, moisture control, and indoor air quality.

There are many aspects to maintaining a healthy, durable crawlspace, starting with designing a space that can manage moisture and potential contaminants. This includes excavation and construction methods that resist moisture intrusion and are tailored to the local climate and codes. Other important details include site grading, foundation drains, drainage rock, ground vapor retarders, damp proofing, insulation, and roof drainage. This snapshot, however, focuses not on construction but on how to control moisture once the crawlspace is complete. It is specific to ventilation strategies commonly used in Southcentral Alaska homes.

Passive vs. Mechanical Ventilation

Crawlspaces were traditionally built with vent openings in the foundation wall to allow air to passively move outside. However, passive ventilation doesn't work well in cold climates because it leaves the crawlspace susceptible to condensation and freezing. A more effective strategy is to seal and insulate the space from the outdoors and install a mechanical ventilation system to exchange air.



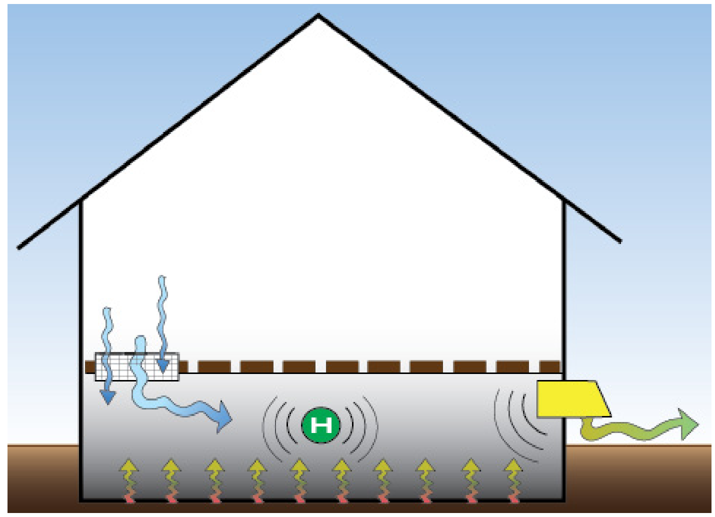
Above: Lack of good sealing and ventilation can lead to mold and rot in the crawlspace.

Left: The crawlspace should have the same detailing as the rest of the home: good air and vapor sealing and mechanical ventilation to keep the indoor air warm and healthy.

Current Ventilation Strategies & Shortcomings

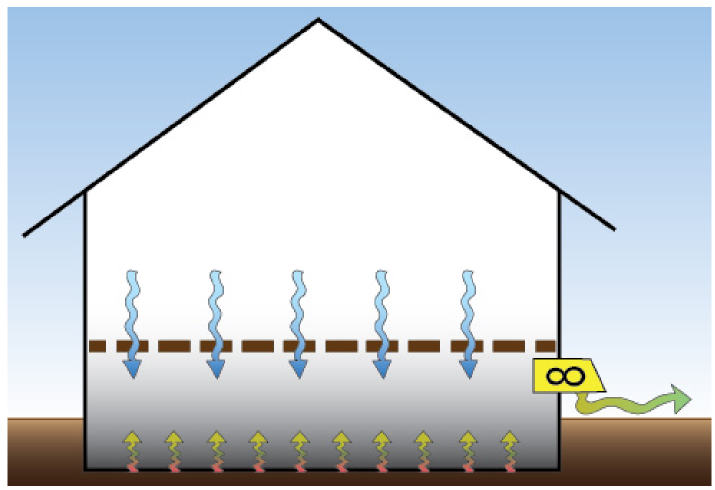
Intermittent Exhaust & Dehumidistat

A common system in Southcentral Alaska is to ventilate intermittently with an exhaust fan when humidity levels in the crawlspace exceed certain limits (controlled by a dehumidistat). This type of intermittent ventilation is popular because it saves energy compared to continuous ventilation. It does not meet International Residential Code, which states that the fan must run continuously, but is permissible by the International Mechanical Code (IMC) when coupled with a dehumidistat set to a 60% humidity. However, the intermittent use of the fan coupled with a dedicated pathway to the living space presents a serious health risk if airborne contaminants are present in the crawlspace.



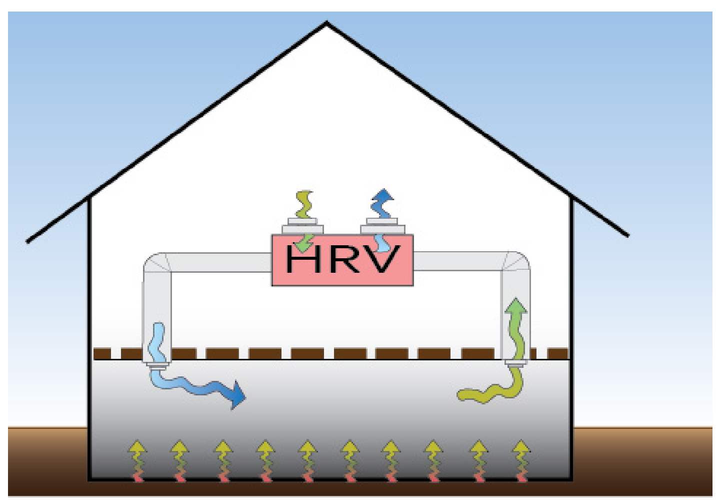
Continuous Exhaust & Passive Supply

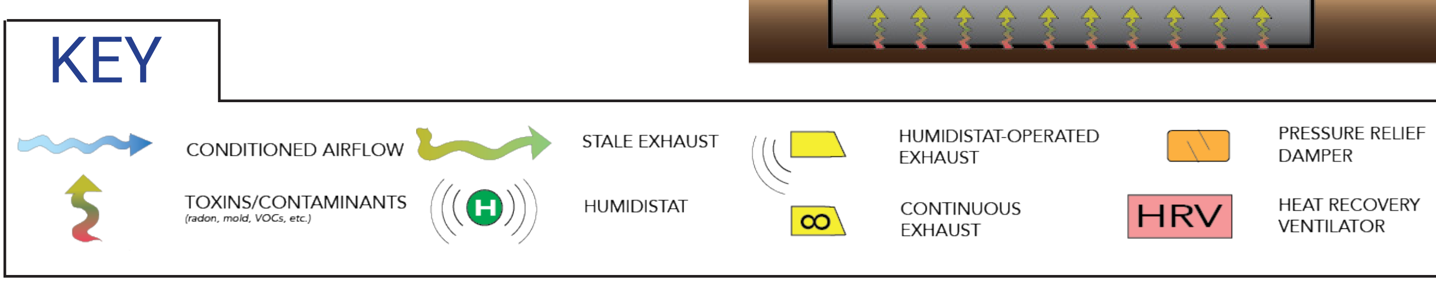
This method relies on air leakage through the subfloor to provide air to the crawlspace while an exhaust fan runs continuously to vent air outside. This does not comply with the IRC as it does not have a dedicated pathway for incoming air. It does not comply with the IMC because it doesn't have a dehumidistat and is not a complete exhaust and supply air system. The appropriate amount of makeup air might not be supplied through a well-sealed floor. The continuous operation of the fan uses extra energy and does not necessarily provide a moisture benefit compared to an intermittent fan with a dehumidistat.



Heat Recovery Ventilator (HRV)

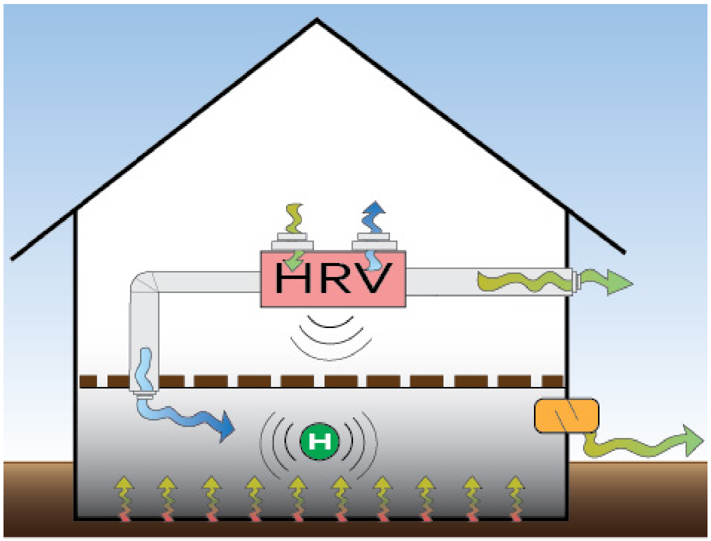
As HRV systems become more widely used in Southcentral homes, they are also being used to ventilate crawlspaces. Installing the extra ducting is fairly convenient and inexpensive. However, it also presents a serious health risk if exhaust air from the crawlspace is able to mix with other indoor air. For example, radon, mold spores, and other contaminants can be disseminated throughout the home when the HRV is in defrost mode if best practices are not followed or changes are made to the crawlspace by future homeowners.





Recommended Ventilation Strategies

Using just an HRV supply line to bring conditioned air to the crawlspace minimizes indoor air quality concerns. The HRV could be controlled by a dehumidistat and a pressure relief damper would exhaust crawlspace air directly outside, preventing pressurization of the crawlspace. This addresses Alaska's Building Energy Efficiency Standards (BEES) concerns since there is a pressure relief outlet. However, since the HRV may not be operating continuously it would not be IRC compliant and IMC compliance would be determined by the code official.



Safety Considerations

There are important safety considerations when thinking about ventilation in the crawlspace.

Radon: Radon is a naturally occurring radioactive gas that can cause lung cancer. Testing is the only way to verify its existence and possible exposure. Limiting communication between the ground and the living space is very important when radon is present. This is why a well-sealed and detailed vapor barrier on the ground is so important.
Refer to epa.gov/radon for more information.

Combustion Safety Testing: A safety inspection of all combustion appliances, including a worst-case depressurization test, is strongly recommended (and required when adhering to Alaska's BEES standard) to ensure the healthy combination of ventilation and combustion systems. A fan that depressurizes any part of the home can backdraft combustion appliances, which can cause carbon monoxide poisoning and death.

Ventilation Codes

There are several codes adopted in Southcentral Alaska that pertain throughout the state. The International Residential Code (IRC) and the International Mechanical Code (IMC) have both been adopted by Municipality of Anchorage. Additional crawlspace ventilation requirements must be implemented to meet the Alaska Housing Finance Corporation's Building Energy Efficiency Standard (BEES). BEES incorporates elements of the 2012 International Energy Conservation Code and ASHRAE 62.2-2010, with specific amendments for Alaska.

Table 1 on the back page presents a summary of allowable ventilation strategies and their implications for indoor air quality in cold climates.

Code	Section	Ventilation Strategies	Cold climate concerns
International Residential Code (IRC)	408.3	Requires continuous mechanical exhaust or conditioned air supply. Either method must be sized at a rate equal to 1 cubic foot per minute (cfm) for each 50 square feet of crawlspace floor area and requires an air pathway to the living space.	Exhaust: Continuous operation of the fan presents an energy burden. Supply: Positively pressurizing a home during the heating season can contribute to driving moist indoor air into the framing cavities, leading to mold and rot. Both: A connection between living space and crawlspace could allow radon or other contaminants to travel into the living space, posing a serious health risk if best practices are not implemented or the fan fails.
International Mechanical Code (IMC)	406.1	Requires mechanical exhaust and supply air system that exhausts at no less than 1 cfm per 50 square feet of crawlspace floor area and shall be automatically controlled to operate when relative humidity exceeds 60%.	Allows the potential for an HRV to use both supply and exhaust ducts in the crawlspace. This type of connection between the living space and the crawlspace via the HRV could allow radon or any other contaminants present to travel into the living space posing a serious health risk.
Alaska Building Energy Efficiency Standard (BEES)	4.2	Supply-only whole-house ventilation systems are not permitted in Alaska during the heating season.	Supply-only is a poor strategy for cold climates and conflicts with suggested supply-only ventilation strategies, like those listed under the IRC.

Alaska's unique crawlspace ventilation needs have led to a variety of experimental ideas and applications. However, as seen in these examples, there is currently no comprehensive strategy that addresses cold climate needs, indoor air quality, and relevant codes. The ventilation strategies outlined do not comprehensively solve water or air quality issues on their own and must be complemented by robust moisture management, best practice detail work, and quality installation. A focused analysis of these concepts along with field data would help create a best practices manual for safe and cost-effective crawlspace construction in Alaska and would help municipalities develop appropriate amendments to national codes.

References

Alaska Housing Finance Corporation. (2012a). Building Energy Efficiency Standards. (Section 4.2, p. 18). Retrieved from https://www.ahfc.us/pros/builders/building-energy-efficiency-standard/

International Code Council. (2012b). International Mechanical Code. (Chapter 2, subsection 202).

International Code Council. (2012c). International Residential Code. (Chapter 4, subsection 406.1).

Municipality of Anchorage. (2017). Anchorage Municipal Charter: Code and Regulations. Title 23: Building Codes. (Chapter 20).