

INDOOR AIR QUALITY

DESIGN GOALS

Integrate technologically and economically innovative, low-energy strategies
Minimize occupant distraction
User-friendly controls
Minimize pollutant sources

BIO-SIP INDOOR AIR QUALITY FEATURES

Mechanical Systems
Energy Recovery Ventilator
Exhaust Fans
Heating And Cooling Systems
Passive Ventilation
Low VOC materials

Each of these features is described in more detail below.

Mechanical Systems

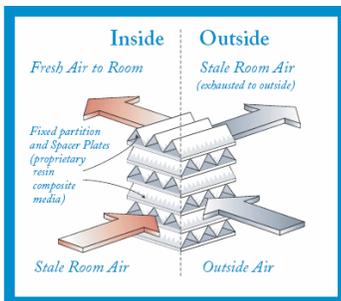
Energy Recovery Ventilator

Knowing that our home has a tight envelope, due to our Bio-SIP construction, we needed to use mechanical ventilation to ensure suitable indoor air quality. For this purpose, the RenewAire BR70 Energy Recovery Ventilator (ERV) was installed.

The benefits of this installation are listed below:
Provides the ASHRAE recommended minimum of 8.4 air changes per day.

Air to air energy exchanger preconditions the fresh air recovering up to 85% of the energy being exhausted.

Reduces the loads on the heating and cooling system
Saves energy and operating costs



The exiting conditioned indoor air is being used to pre-treat unconditioned entering outside air.

Image Courtesy of Renewaire.

Mini-Split System AC

Decreases occupant distractions
Low cfm entering space
Passive mixing design (large distance between entering and exhaust vents).
Ease of Use – Occupant only has to set the equipment once, and it automatically provides ASHRAE-required ventilation.

Exhaust Fans

Exhaust Fans will be employed in several places throughout the house to help with typical “problem” areas when natural ventilation may not be feasible, during extremely hot or cold days, for instance. These areas include the bathroom and the kitchen stove. The exhaust fans are easily operated on demand with accessible on/off switches

Heating and Cooling Systems

Radiant Flooring

Hydronic systems have numerous health benefits over conventional forced air systems.

Studies in Germany have shown that there is a reduction of 50-80% in dust mite populations in homes that use radiant floors.



Image Courtesy of Ohio State University

Unlike carpet, traditional radiant flooring surfaces, such as tile and hardwood floors, minimize dust generation in a house. Plus, these surfaces are readily cleaned at the first signs of dust accumulation, unlike carpet. Additionally, hydronic systems use a water circulating pump to deliver the heat through the floors. This system eliminates the large fan system and the need for routine air filter changes. By eliminating the filter and fans, dust, pollen, pet dander, and mites are no longer airborne when the system is heating the space. With no air movement and no dirty filters, allergens and irritants are subdued.

Both indoor units contain washable long life filters. This design allows owners to wash the filters as frequently as the like without having to worry about

the cost of replacement or the impact disposable filters have on the environment.

passive ventilation

Natural ventilation requirements were considered within the context of daylighting, non-swing season heating and cooling loads, and aesthetics. In both D.C. and Boulder, the prevailing winds are from the Southwest.

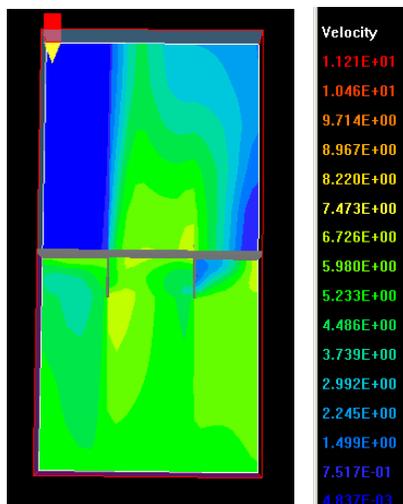
Rules of Thumb

The following general rules of thumb from the *2001 ASHRAE Fundamentals Handbook* were considered during the design of the natural ventilation system:

1. Kitchen and bathroom smells should be isolated and exhausted.
2. Natural ventilation is most effective when occupants are given control.
3. Due to the small height and temperature differentials that are expected in the house, the design will rely more on wind currents than on the buoyancy effect.
4. Outlets smaller than inlets create lower but more uniform airspeed through the room
5. Inlet and outlet placements should be staggered to promote mixing.

Computer Simulations

In addition to general rules of thumb, simple models were created in Phoenix to inform design. A sample output of airflow through a double casement window is displayed below.



Design results

The following items are key features of our natural ventilation design:

1. All windows, excluding the large picture windows on the North side, are operable.
2. All openings on the South side are larger than the openings on the North side, as to promote slower airflows and better mixing within the space.
3. Window placements are staggered on the North and South walls to prevent short-circuiting of airflows in the space.
4. Greater than 1.5 square foot opening in the bathroom to provide adequate ventilation.

LOW-VOC MATERIALS

Another factor contributing to the generally poor indoor air quality of modern American homes is the prevalence of off-gassing VOC-containing materials. In accordance with its mission statement, CU used as many low-VOC, bio-based materials as possible, both for construction materials and indoor finishes and furnishings.



Bio-based building products made from natural materials.

