BSC Information Sheet 001

Residential Best Practices Criteria

for All Climates

Rev. 11/2012

This list contains some of the basic characteristics that should be met in all high performance homes. It has been used as our baseline criteria for all of BSC's Building America projects.

However, it is not intended as a comprehensive list of all quality, durability, and performance aspects. In addition, this should not be misconstrued as BSC's recommendations for superlative energy performance. It is simply a basic list of essential criteria for energy performance, durability, thermal comfort, and indoor air quality.

Requirements: Design

- A systematic listing of enclosure R-values is beyond the scope of this document; those decisions would be a function of targeted performance level, climate zone, geometry, and building use. However, at a bare minimum, specifications should not fall below enclosure requirements found in IRC Table N1102.1/IECC Table 402.1.1. For recommended enclosure R values for high performance buildings, see Table 2 in Research Report 1005 "High R-Value Enclosures for High Performance Residential Buildings in All Climate Zones".
- Whole-house dilution ventilation: a mechanical ventilation system must be installed to be capable of meeting a ventilation rate of 7.5 CFM per person (counted as the number of bedrooms plus one) plus 0.01 CFM per square foot of floor area. Additionally, whole-house distribution of outside air is required.
- Local exhaust ventilation: Intermittent spot exhaust of 100 CFM or continuous ventilation of 25 CFM must be provided for each kitchen (no recirculating cooktop hoods). Intermittent spot exhaust of 50 CFM or continuous ventilation of 20 CFM when the building is occupied must be provided for each room having a toilet, bath, shower, or laundry.
- Ventilation intake locations: When a supply-only or balanced ventilation system is used, the intake must go through an outside wall and not the roof (due to proximity to exhaust/vent pollutants, and heated air/VOC's/odors from the roof). Wall intakes should be located at least 10 feet from, and not directly above, any wall exhaust or vent. Further information available in Information Sheet 606: Placement of Intake and Exhaust Vents.
- All combustion appliances (except a gas stove or cooktop) in the conditioned space must be sealed combustion. Specifically, any furnace inside conditioned space must be a sealed-combustion 90%+ unit. Any water heater inside conditioned space must be direct- power-vented. Any boiler inside a conditioned space must be sealed combustion. Further information available in Information Sheet 601: Sealed Combustion.
- Windows with the following climate-specific performance values must be used. Windows outside these ranges can be used in certain designed circumstances, but these are our general guidelines to maximize both energy performance and thermal comfort.

Climate Zone[1]	Maximum U-Value	Maximum SHGC
Zones 1-3	0.40	0.35
Zones 4-8	0.35	0.40

- All ducts and air handling equipment must be in the conditioned space. Further information available in Information Sheet 602: Ducts in Conditioned Space.
- Major appliances (refrigerator, clothes washer, and dishwasher) must achieve Energy Star performance in the top one-third of the DOE Energy Guide rating scale.
- All lighting must be Energy Star qualified with the following exceptions: motion-sensitive outdoor spotlights and solar-powered accent and pathway lighting. LED technology is currently not certified by Energy Star, however, LEDs are acceptable.
- Carbon monoxide detectors (hard-wired units) must be installed (at one per every approximate

1 Different Climate Zones are categorized into Hygro-Thermal Regions.

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1000 square feet) in any house containing combustion appliances, and/or an attached garage.

Requirements: Testing

- Performance testing of the house should be completed as part of the commissioning process. The SNAPSHOT form is a testing template and is available for download to record the testing information. Further information available in Research Report 0413b: SNAPSHOT Form.
- In a production setting, each model type (i.e., floor plan) must be tested until two consecutive houses of this model type meet testing requirements. Additional, testing on this model type can be reduced to a sampling rate of 1 in 7 (i.e., 1 test, with 6 referenced houses). Small additions to a floor plan (e.g., bay window, conversion of den to bedroom) are considered to be the same model type; major changes (e.g., bonus room over the garage, conversion of garage into a hobby room, etc) must be considered a separate model type. Unique or custom house plans must each be individually tested.
- Air leakage (determined by pressurization testing) must be less than 2.5 square inches/100 square feet surface area leakage ratio (CGSB, calculated at a 10 Pa pressure differential); or 1.25 square inches/100 square feet leakage ratio (ASTM, calculated at a 4 Pa pressure differential); or 0.25 CFM/square foot of building enclosure surface area at a 50 Pascal air pressure differential. The calculation of the building enclosure area includes the foundation or below-grade surface areas. If the house is divided into multiple conditioned zones, such as conditioned attics or conditioned crawl space, the blower door requirement must be met with the access to the space open, connecting the zones.
- Total space conditioning system duct leakage must be less than five percent of the total air handling system rated air flow at high speed (nominal 400 CFM per ton) determined by pressurization testing at 25 Pa. Two compliance mechanisms are acceptable: (1) test total duct leakage to the exterior at finish stage, or (2) test total duct leakage at duct rough-in stage. Total duct leakage is recommended to be less than 10% of air handler system rated flow (400 CFM/ton). When more than one air handler exists, each air handling system must individually meet the requirement. If zoning is used, all zone dampers must be open. Motorized outside air ventilation dampers must be closed.
- Local and whole-house mechanical ventilation system airflows must be tested during commissioning of the building.
- Forced air systems that distribute air for heating must be designed to provide balanced airflow to all conditioned spaces and zones (bedrooms, hallways, basements). Inter-zonal air pressure differences, when doors are closed, must be less than 3 Pa using passive transfer grilles or jump ducts, or active return ducts. Further information available in Information Sheet 604: Transfer Ducts and Grilles and Research Report-0005: Transfer Grille Sizing.

Recommendations: Mechanical Equipment

- Air handler external static pressure must be within manufacturer specifications (0.5 WIC/125 Pa maximum typical).

Recommendations: Energy Conservation, Occupant Comfort

- Information relating to the safe, healthy, comfortable operation and maintenance of the building and systems that provide control over space conditioning, hot water or lighting energy use should be provided to occupants.
- The building enclosure and mechanical systems design should be capable of maintaining comfortable conditions throughout the conditioned space as defined by ASHRAE Standard 55-2004 (Thermal Environmental Conditions for Human Occupancy).
- Indoor humidity should be maintained in the range of 25 to 60 percent by controlled mechanical ventilation, mechanical cooling, or supplemental dehumidification. In very cold, cold, and mixed climates (Zones 4 through 8) during the winter, indoor relative humidity should be kept on the lower end of that range. Further information available in Research Report-0203: Relative Humidity.

Recommendations: General Construction

- The building enclosure and site work design and construction should provide effective drainage measures to prevent moisture intrusion, conveying water off of and away from the building.
- Design and construct the building foundation to prevent the entry of moisture and other soil gases.
- Building assemblies should be designed and constructed to permit drying of interstitial spaces.
- Design and construct building assemblies to prevent or control airflow into insulation systems from both the interior and exterior. Further information available in Information Sheet 501: Installation of Cavity Insulation.
- Use radon resistant construction practices as referenced in the ASTM Standard "Radon Resistant Design and Construction of New Low Rise Residential Buildings."
- Provide filtration systems for forced air systems that provide a minimum MERV of 11 or higher.
- A Risk Assessment Protocol should be developed to promote durability. Further information available in Building Science Digest 144: Increasing the Durability of Building Construction.
- A more complete set of guidelines on reducing quality-control related failures in the construction process can be found at the Builders Challenge Quality Criteria Guide.

Recommendations: Green Building

- Material use for the building enclosure should be reduced by 25% using advanced framing or systems engineering of other enclosure systems (concrete, masonry, earth-based or agricultural waste-based systems). Further information available in Building Science Primer-062: The Future of Framing is Here.
- Recycled/salvaged materials and new materials with a high recycled content should be used where cost effective and practical.
- Substantial substitution (30% or more) of waste materials (fly ash or blast furnace slag) for the Portland cement component of concrete and other cementitious building materials should occur. Reference: "Some Basics About Substituting Pozzolans for Portland Cement in Concrete."
- CSA (Canadian Standards Association), FSC (Forest Stewardship Council, PEFC (Program for the Endorsement of Forest Certification) and SFI (Sustainable Forestry Initiative) certified wood products should be used whenever competitively available.
- Construction waste generation should be reduced by 15% or more.
- Domestic water consumption should be reduced by 25% or more.