A Publication of Housing Nantucket

January 2009

GREEN & Affordable

Guidelines for the Construction and Renovation of Housing Units

GREEN & AFFORDABLE:

Guidelines for the Construction and Renovation of Housing Units
for Housing Nantucket

This publication was prepared by Aaron A. Marcavitch with input from the Vermont Housing Finance Authority, the Maine Housing Finance Authority, the U.S. Green Building Council, the Sustainable Sites Initiative, and the University of Minnesota's "Minnesota Green Affordable Housing Guide."

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Intoduction:

Building green, doesn't mean you can't build affordably...

Green building is a broad term that generally means reducing impact on the enviornment through design, construction and operation of buildings. Global Green USA defines it as *"the process of creating buildings and supportive infrastructure that reduce the use of resources, create healthier living environments for people, and minimize negative impacts on local, regional, and global ecosystems."* (Blueprint for Greening Affordable Housing, Island Press, 2007) A symposium at the National Building Museum in 2007 stated *"green essentially means healthy, energy and resource efficient and enviornmentally low-impact."* One of the key linkages between affordable housing and green building is that by making homes more energy efficient, they are inherently more affordable. This symposium also noted *"In addition to low monthly rent or purchase price, the definition of affordability should also encompass low operating costs, low maintenance costs, and...connected to the broader community and the natural environment."* Residents save on fuel bills, find their homes easier to live in, and - studies have shown - may actually have healthier lives.

The NBM Symposium listed several benefits for greening affordable housing:

- Resident Benefits - Lower energy and water bills; healhty living environment, healthier residents
- Developer/Owner Benefits: Operating cost savings; reduced liability risk from building-related health problems that result from chemical and bilogical contaminants
- Community Benefits: Reduced burden on infrastructure (such as landfills); reduced air and water pollution; healthier working environments for construction, maintenance, and manufacturing workers
- Environmental Benefits: Water conservation

Housing Nantucket was formed in 1994 as NHA Properties Inc. to provide safe, sanitary housing for all Nantucket residents. At that time, the organization lead the way in recycling unwanted buildings for new affordable housing. This early method of using materials wisely was ahead of its time for building "green." Since then, the green movement made major leaps, but Housing Nantucket lagged behind. Houses were accepted that were not energy efficient, had indoor air quality problems, or were not built to be durable. In 2002, the organization changed its name to the Nantucket Housing Office. At that same time, the first site built duplex was built in Tom Nevers. These two units were a test run at some of the goals for building with new construction, but did not utilize "green" construction methods. This unit has also experienced indoor air quality issues and durability issues.

In 2007, the organization changed its name again - this time to Housing Nantucket. The organization adopted a "green and affordable" policy in April of 2007 and

finalized grant requests for the construction of two new units - both of which were intended to seek the LEED for Homes certification. Each of these steps has brought the organization closer to understanding the key elements of building “green..” These standards are intended to be an extension of that effort.

In particular, these standards will bridge the gap between new construction, house recycling/renovation, and sustainable building practices. Each section will detail some of the major steps in building new or renovating a house move and tie in the important elements of greening a building - from better energy efficiency to material use.

These standards are a work in progress and reflect both the fifteen years of progress for the organization and the plans for the future. Ideally these standards are woven into each new project that the organization takes on - from a simple house move, to a new duplex, to an entire development.

Much of the information that is contained in this set of standards is taken from a few major sources. MaineHousing’s “Green Buildng Standards,” first published in 2005; Vermont Housing Finance Agency’s Green Building and Design Standards, published in 2008; and the Sustainable Sites Initiatve, drafted in 2008 were all referenced and utilized in the creation of these standards. The two sets of standards for housing - LEED for Homes and the Green Communities Criteria were both used as reference points throughout these standards and are assumed to be utilized to meet all of the necessary elements contained herein. Global Green USA’s *Blueprint for Greening Affordable Housing* was referenced throughout this process.

See also:

Universal Specifications - Green Construction (NHA Properties Inc. March 2009)

Design & Planning

Design & Planning R1: Integrated Design

Standard
For each project create a “integrated design team plan.”

Requirements
Plan shall include:

- The name and function of each member of the design and construction team (if following LEED for Homes, ensure inclusion of all relevant members for ID 1.2)

- A statement on the “green” goal for the project and the intended outcome (i.e. LEED for Homes Silver, etc.)

- A brief description of the strategies, methods, and materials to be incorporated into the project and the process for selecting these items

- Any checklists related to LEED or other criteria (i.e. Green Communities)

- A corresponding checklist identifying team members who are responsible for carrying out the criteria checklist and any items from this standard system (if following LEED for Homes, ensure inclusion of all relevant members for ID 1.2)

- A plan detailing whom from the team shall be responsible for ensuring completion of all relevant “green” features, ensuring their correct installation, and who will provide documentation and information about the function/operation of the system

- Minutes of any meetings or documentation of email or phone conversations which demonstrate the integrated design methodology

- Integrate a durability plan (see LEED for Homes ID 2)

Resources
- Whole Building Design Guide: www.wbdg.org/wbdg_approach.php
- Congress for New Urbanism: www.cnu.org
- Smart Growth Network: www.smartgrowth.org
- Urban Land Institute: www.washington.uli.org

Special Notes
Requirements apply for renovation, but checklists may be omitted on a case by case basis.

Design & Planning R2: Solar Orientation

Standard
Orient building to make the greatest use of passive solar heating and cooling.

Requirements

- Develop a site plan which indicates location of building on an east-west axis. The east- west axis of the building should be within 15 degrees of due east-west.

- The glazing area on the north- and south-facing walls of the building should be at least 50 percent greater than the sum of the glazing area on the east- and west-facing walls as allowed by the Historic District Commission.

- The roof should have a minimum of 450 square feet of south-facing area that is oriented appropriately for solar applications as allowed by the Historic District Commission.

- All design elements should be incorporated in and noted on the final design documents.

Resources
- U.S. Department of Energy: www.eere.energy.gov/buildings/info/design/integrated-building/passive.html

- Passive Solar Design for the Home: www.nrel.gov/docs/fy01osti/27954.pdf
-

Special Notes
This requirement may be waived for projects where site planning and HDC may not allow such orientation.

Design & Planning R3: Evaluation of Site Conditions

Standard
Thorough evaluation of site conditions ensures limited costs associated with unexpected environmental hazard mitigation, limited costs associated with unexpected site improvements.

Requirement

Do not build on:
- land within 100 feet of wetlands, including isolated wetlands or streams (Bike and foot paths may be allowed if at least 25 feet from the wetlands boundary)
- Land that is specifically identified as habitat for any species on federal or state threatened or endangered lists
- Land with elevation at or below the 100-year floodplain
- Land within 100 feet of critical slope area
- Prime farmland
- Public parkland

Develop a plan indicating the following:
- Floodplain determination (if site is located in a floodplain)
- Wetlands delineation (if site is located near a wetland)
- Opinion from a Professional Engineer (PE) on the adequacy of water/wastewater connections
- Professional Engineer's opinion on the site's capacity for wastewater and storm water discharge
- Site evaluations must be completed by an engineer and other professionals to document any site challenges. Timing of the evaluation is determined by the development and project manager; however, if the evaluation of the site is not completed prior to the development budget, the Director may delay the project.
- Final plan should indicate engineers stamp, signature and include any permit documentation (i.e. well or septic permits)

Special Notes
This requirement may be fufilled by meeting the Sustainable Sites Initative criteria system under 1: Site Selection.

Design & Planning R4: Community Input/Process

Standard
All designs should meet Planning Board and Historic District Commission standards and should generally have a buy-in from the surrounding neighborhood.

Requirements

- Document permit process and all meetings during which changes to intial concept design were made.

- Document any meetings held with neighbors and abutters. Ensure that at a minimum direct abutters are notified of new construction projects. Any letters or emails should be part of final project.

- Document any changes requiring reduction or elimination of green elements.

Sites & Landscape

Site R1: Landscaping

Standard
For all landscaped areas, use at least at least 75% non-invasive species that do not require irrigation. Native plantings are preferred. This is measured by the disturbed area to be replanted (i.e. Not under roof).

Requirement

Plant with trees, shrubs, perennials, annuals and groundcovers that are:

- hardy and native to the island
- are not invasive
- are drought tolerant
- and/or
- do not promote the use of excessive turf

- Permanent irrigation system shall not be used, except on a case by case basis and with significant investigation into other irrigation methods – such as rainwater collection.

- Develop a a site plan demonstrating areas of paving, landscaping (with species) and building footprint

- Provide a list of all species to be planted

Resources

Sustainable Sites Initative: www.sustainablesites.org

Site R2: Site Preservation

Standard

For all projects, preserve existing trees and vegetation to practicable levels. Buffers between new projects and neighboring parcels should be followed at all times. Clearing around the work area should not exceed 25' (Work area includes: buildings, driveways, solar access, areas cleared for food production and as required for grading for drainage requirements.) Within the 25' attempt to preserve existing trees and vegetation to the extent possible and practical.

Requirement

- Preserve existing trees and vegetation to the extent possible using best practices
- Create an inventory of existing healthy trees and vegetation on the site
- Create an identification schedule of trees and vegetation to be saved
- Detail strategies to be used:
  - Protective barriers (Must extend to the drip line of tree)
  - Relocation
- Provide site plans (pre-development and post-development) highlighting areas, trees, and/or vegetation to be preserved or relocated on site

Resources

Nantucket Land Council: www.nantucketlandcouncil.org

Site R3: Dark Skies/Light Pollution

Standard

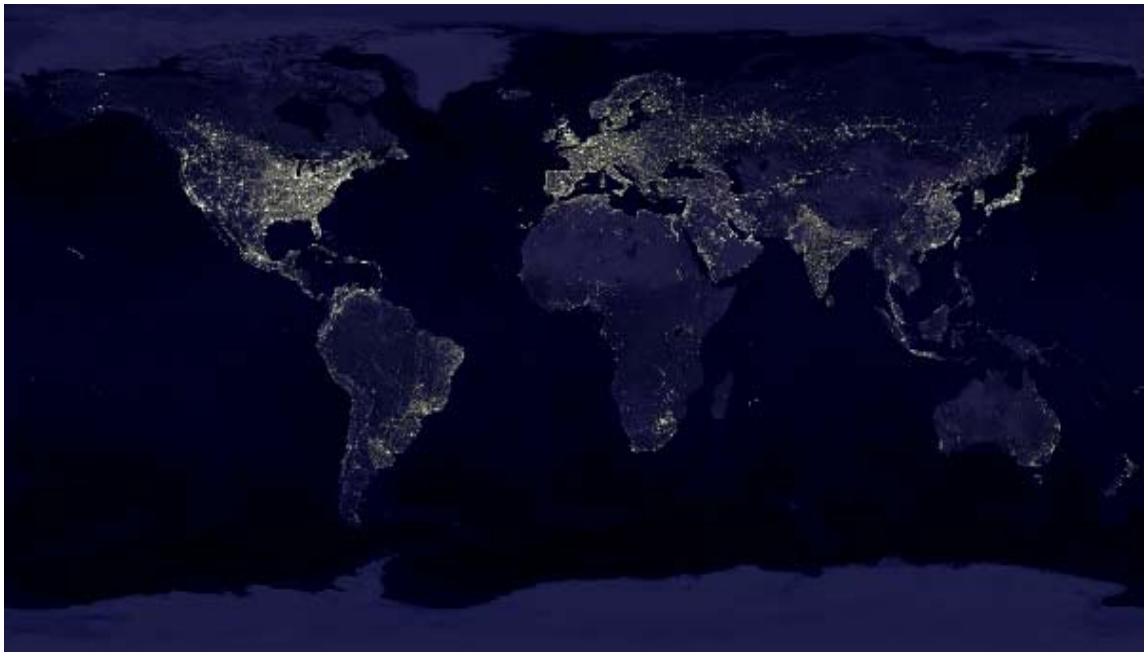
Utilizing goals of local bylaw, minimize light pollution to the night sky.

Requirement

- Design outdoor lighting to provide security without creating light pollution.
- Do not exceed requirements of local lighting bylaw.
- Design interior and exterior lighting so that zero direct beam illumination leaves the project site.
- Do not use unshielded fixtures (floodlights)
- Site lighting plan to be provided as part of overall site plan

Resources

International Dark Sky Association: www.darksky.org



Construction & Methods

Construction Methods R1: Indoor air quality & mold

Standard
Project manager must implement a water management plan for the building to prevent indoor air quality (IAQ) problems from mold.

Requirements

Exterior
Footings & Slab
1. Create a capillary break at the footing with damp proofing or low perm/elastomeric paint

2. Install a foundation drain at outside perimeter edge of footing where a basement is part of project.

3. If necessary, install a sub-grade (footing) drainage system

4. Install a gravel bed beneath slab minimum 4" depth, ½" gravel, no fines

5. Ensure installation of a six mil polyethylene vapor diffusion retarder between slab and gravel with joints lapped at least one foot

6. In cases of a living space on top of slab, install a 1” foam barrier or radiant underfloor heating.

Surface Drainage
1. Ensure slope of final grade is 5/8” per foot for 10 feet (or 1/4” per foot for patios and driveways) away from foundation
I

2. At all times, ensure downspouts, when connected to a gutter system, deposit roof water at least 5' from the foundation

3. Install a graded perimeter of impermeable backfill around the foundation, or install an equally efficient method of controlling surface water

Basement
1. Install damp proofing applied to grade

2. Only use a porous backfill material against foundation walls

3. Create a capillary break finish system that drains water to footing drain and/or install an exterior insulation system

4. Ensure capillary breaks between foundation and framing

Crawlspaces
1. All crawlspaces must be sealed and conditioned.

Windows & Doors
1. Ensure sill jambs and headers are wrapped with membrane for moisture protection

2. Casement windows should not be used – unless required by HDC or installed to minimize water intrusion.

Interior
1. Install drainage pans or floor drains under water heaters and clothes washers when installed on or over finished floors (not required when located in unfinished basements)

Envelope

1. No wet blown insulation (damp spray cellulose)

2. Use non-paper backer board in wet areas. Use fiberglass or similar enclosure or, if using any form of grouted material, use backing materials such as cement board, fiber cement board or equivalent (i.e., not paper-faced).

Resources

Building America: http://www.eere.energy.gov/buildings/building_america/

Building Science Corporation: http://www.buildingscience.com/

Housing and Urban Development (HUD) 'Durability by Design' available at http://www.huduser.org/intercept.asp?loc=/Publications/PDF/durability_by_design_part1.pdf

Construction Methods R2: Air Leakage

Standard
Construction methods shall be used to prevent all air leaks.

Requirements

Building can be air sealed using the polyethylene vapor barrier or the airtight drywall approach (ADA).

In addition to sealing poly or drywall:
1. Gaskets or sill seals under mud sills along foundation walls.

2. Seal first floor band joists to the adjoining mud sills and plywood decking using adhesive or caulk. Use construction adhesive or caulking between multiple sill plates.

3. Seal any band joists between upper floors to the adjoining top plates and plywood decking. Use construction adhesive or caulking between multiple top plates.

4. Seal bottom plates of exterior frame walls to the sub-floor with construction adhesive or
caulking.

5.Avoid locating bathtubs and shower enclosures on exterior walls. If installed on exterior walls insulate with a rigid air barrier and air seal this area BEFORE shower/tub is installed.

6. Avoid recessed can lighting in the thermal envelope. Any recessed lighting fixtures located in the thermal envelope must be “IC-rated” and meet ASTM-E287 (“Washington State approved” for air tightness) and installed with the gasket kits and related accessories needed to meet these standards. All metal bath fan housing must be sealed to sheetrock with caulk or minimally expanding foam.

7. Window frames and door jambs must be sealed to their rough openings using low expansion foam, backer rod or caulk but NOT fiberglass.

8. All penetrations through the building envelope must be carefully sealed with effective, durable materials. Typical penetrations include chimney, duct & plumbing chases and penetrations of pipes and wires through the top plates of top story walls. It is particularly important to seal all possible air paths to the attic.

9. Building areas such as kneewall-floor transitions, dropped soffits, split-level transitions, tuck-under garages and cantilevers must be identified and sealed with a continuous air barrier. Where joist spans or stud bays run between a heated and unheated area all bays must be blocked and sealed at the transition.

10. Attic and crawl space access doors and hatches must be weather-stripped and insulated. Plumbing, electrical, mechanical and other chases open to attics must be sealed.

11. All plumbing, electrical, electric box, dryer duct or bath fan duct penetrations on exterior walls and ceilings should be airsealed. Electrical boxes may be placed in airtight enclosures (Lessco box or equivalent).

12. Seal bottom edge of sheetrock to subfloor or slab on exterior walls with minimally expanding foam.

Special Requirements for Stress Skin Panels, Structural Insulated Panels, or Insulated Concrete Forms

1. Air seal ceiling systems, wall-ceiling and wall-floor junctions.

Resources
For airsealing approaches and details:

Building Science Corporation:
www.buildingscience.com

Building America:
www.eere.energy.gov/buildings/building_america

Construction Methods R3: Energy Efficiency

Standard
Energy efficient windows optimized for solar gain
OR
advanced framing techniques such as OVE, SIPS, ICF, stress skin panel and others.

Requirements
1. Windows must be National Fenestration Rating Council (NFRC) rated AND have:
   a. U value of less than .35
   b. Solar Heat Gain Coefficient (SHGC) of .35 or higher
   c. Air Leakage Rate (AL) of .30 or less

2. For advanced framing:
   a. OVE (Optimum Value Engineering) - see below
   b. ICF (Insulated Concrete Form)system
   c. SIPS (Structural Insulated Panel) system

Any one of the “advanced framing techniques” (OVE or ICF or SIPS) can be utilized to meet the standard. Further, if for example Optimum Value Framing (OVE) is proposed, it shall be utilized throughout the entire building or project and the more energy efficient windows would then not be required. If, however, Structural Insulated Panel Systems (SIPS) were proposed for a roof system only, with the wall systems designed as conventionally framed, we would expect that energy efficient windows would also be provided in order to meet the intent of the R3 requirement. Therefore, it is important that both the alternative selected be effective and that the extent of the impact be fully understood in determining compliance with the R3 requirements.

Providing energy efficient windows and advance framing techniques provide the best energy efficiency.

Provide documentation for NFRC window labels
OR
Construction drawings highlighting framing details

Resources
www.efficientwindows.org
www.energystar.gov
www.nfrc.org
www.sips.org
www.icfhomes.com/
www.buildingscience.com/buildingamerica/targets.htm, then “Advanced Framing”
National Association of Homebuilders 'Simplified Residential Framing Guide'
www.nahbrc.org

Notes
Optimum Value Engineering (OVE) includes but is not limited to:
1. 2x6 @ 24"" o.c.
2. Align windows and other openings with framing layout
3. Use of box headers designed for loading conditions
4. Eliminate unnecessary studs such as at corners and T-walls
5. Use drywall clips or an acceptable alternative to eliminate drywall backer studs and ceiling blocking
6. Corner bracing for racking support

Construction Methods R4: Insulation

Standard
Insulate building to meet air tight standards

Requirements
If building cavities are insulated with cellulose or fiberglass insulation, they must have effective air sealing and wind protection provisions so that air movement through insulation material is eliminated.

Flat ceilings shall be insulated to R-38 or better (minimum 12" of blown cellulose). We recommend, but do not require, installing at least 15" of blown cellulose after the attic has been effectively air sealed.

For new construction, sloped ceilings shall be effectively insulated to R-30 or better.

Walls shall be insulated to R- 19 or better.

Any floors over unheated spaces shall be insulated to R-30 or better.

Foundation or frost wall for slab edge on grade shall be insulated to minimum R-10 from the top of the foundation to the footing. Slab edge insulation detail must provide complete thermal break. Installing at least 1" of rigid extruded polystyrene foam (R-5) under non-radiant slab-on-grade foundations for condensation control and occupant comfort.

If radiant heat slab is installed, insulation under slab shall be no less than 2" of rigid extruded polystyrene foam (R-10).

Block space between trusses or rafters at soffit with durable material sealed in place to prevent the flow of air through or under ceiling insulation. (This requirement applies to vented roofs that are insulated with fiberglass, cellulose or other products that do not stop air flow and not to systems that utilize stress skin panels, rigid insulation, SIPS etc.)

Insulated Core Doors must meet the following:
a. U Value equal to .15 or less
b. Air Leakage Rate (AL) of .30 cfm/SF or less
c. Hollow metal doors AND frames shall be thermally broken type

2. Full Glass Doors
a. U Value of less than .35
b. Solar Heat Gain Coefficient (SHGC) of .35 or higher
c. Metal for doors AND frames shall be thermally broken type
d. Full glass doors should only be used as part of a vestibule entry system

Construction Methods R6: Appliances/Systems

Standard
Energy Star labeled systems and appliances

Requirements
1. Energy Star rated furnaces, boilers utilizing sealed combustion up to 300,000 BTU sizes, then use AFUE greater than or equal to 85%
2. Energy Star rated refrigerators for all units
3. Energy Star rated clothes washers for on-site laundry facilities
4. Where installed - Energy Star rated dishwashers, freezers
5. Where installed - Energy Star rated heat pumps
6. Where installed - Energy Star rated ceiling Fans
7. Energy Star rated exhaust fans ducted outdoors
8. Energy Star rated range hoods ducted outdoors
9. Clothes Dryer shall be ENERGY STAR labeled AND have a Modified Energy Factor (MEF) of 2.0 or higher (CEE Tier 2). Qualifying models can be found here: wwwf.cee1.org/resid/seha/rwsh/rwsh-prod.pdf Dryers shall be ducted outdoors with smooth-walled rigid ducting and backflow dampers at wall.

Resources
Consortium for Energy Efficiency:
www.cee1.org/

Energy Star:
www.energystar.gov/

Construction Methods R7: Water Efficiency

Standard
Water Efficiency: Low flow faucets and showerheads

Requirements
1. Faucets: Flow rate of no more than 1.5 gallon per minute (GPM)
2. Showerheads: Flow rate of no more than 1.75 gallons per minute (GPM)
3. Toilets: Rated at 1.3 gallons per flush (GPF) or less OR dual flush

Resources
H2ouse.org:
www.h2ouse.org/
Composting Toilet Reviews: www.buildinggreen. com/features/mr/waste.html.
Water Use It Wisely: www.wateruseitwisely.com/ toolsLinks/index.shtml.

Special Notes
See LEED for Homes WE 3.1/3.2. Ensure that toilets selected will take into consideration the needs of a rental household. WaterSense certified fixtures will ensure both efficiency and operational effectiveness. Information is available at www.epa.gov/owm/water-efficiency.

Construction Methods R8: Ductwork and Pipe Insulation

Standard
Seal ductwork with duct mastic to prevent air leakage. Ensure all pipes are insulated correctly

Requirements
Seal duct connections with water based duct mastic.

Areas that must be sealed include:
1. Swivel elbows
2. Branch take-offs from trunk ducts
3. Finger jointed connections
4. Folded corners of boots & fittings
5. Filter racks & plenum connections

All loop piping is insulated to the following ASHRAE standards:
- Nominal pipe diameter <= 1.5” has minimum 1” insulation
- Nominal pipe diameter >1.5” has minimum 2” insulation

Pipe insulating values based on material with insulating value of R-3.7 per inch (conductivity not exceeding 0.27 Btu per inch/h/ftÇ/°F)

All hot water hydronic distribution piping shall be insulated to the following ASHRAE standards:
- Nominal pipe diameter <= 1.5" has minimum 1" insulation
- Nominal pipe diameter > 1.5" has minimum 2" insulation

Pipe insulating values shall be based on material with insulating value of R-3.7 per inch (conductivity not exceeding 0.27 Btu per inch/h/ftÇ /°F)

Construction Methods R9: Solar Assist (Preheat) Domestic Hot Water Systems

Standard
Where physically possible and economically feasible, capture the sun's energy to heat domestic hot water.

Requirements
1. Analyze each site for potential exposure to the sun.

2. To the maximum extent possible, orient and construct buildings to take full advantage of available sun

3. Calculate a cost/benefit analysis of providing solar assisted domestic hot water system(s).

a. System costs shall include all equipment, labor, and any necessary project upgrades (structure, electrical, etc.) to provide a complete system.
b. System shall be sized to provide a minimum output equal to 80% of estimated summertime need.
c. Baseline for comparison shall be the conventional fuel used for the heating of domestic hot water at current market rate plus 5% as a starting point.
d. Rate of escalation for fuel costs shall be 5% per year.
e. Term for comparison shall be 30 years.
f. Cost of money shall be equal to that of the other portions of the project.
g. Expected available energy shall be based on standards in the industry for the project location.
h. Daily hot water demand shall be highest in the morning.
i. SRCC Certification and Rating Category C Mildly Cloudy Day, shall be basis of BTU/day output of collectors.

4. System to include energy output monitoring.

Resources
American Solar Energy Society: www.ases.org.

Database of State Incentives for Renewable Energy: www.dsireusa.org.

Construction Methods R10: Interior/Exterior Lighting

Standard
Lamps and fixtures shall be Energy Star rated

Requirements
All compact fluorescent fixtures meet ENERGY STAR criteria. If magnetically ballasted fixtures are installed, they must use “instant on” lamps to avoid flicker on starting. Fixtures that carry the ENERGY STAR label have the following characteristics:

- All lamps in residential spaces shall have a minimum color-rendering index (CRI) of 80.
- All lamps in residential spaces shall have a color temperature in the range of 2700-3500K.
- All lamps within a room have a similar color temperature for aesthetics.

Recessed light fixtures installed in the thermal boundary shall be:

- Certified for insulation contact (“IC-rated”).
- Airtight design compliant with the Washington State Energy Code (meets ASTM E283).
- Lamped with pin-style base compact fluorescent lamps (no screw-ins). If recessed fixtures are installed to protrude into attic, attic insulation details need special attention to ensure proper insulation values.

Minimize the number of different replacement lamp types required at a property (e.g., use all circline and Super T-8, or all PL style and Super T¬8.)

Halogen torchiere floor lamps are prohibited for installation by tenants

Resident-controlled exterior lighting shall be compact fluorescent and properly rated for exterior conditions and starting characteristics in cold temperatures. Recommended fixtures have an integrated photocell for both savings and security, by preventing daytime operation.

Provide automatic on/off lighting controls activated by occupant load and/or natural light sensors or other “smart” control systems for lights

Resources
Energy Star: www.energystar.gov

Construction Methods R11: Heating and Ventilation

Standard
Develop low impact mechanical and natural ventilation. Create energy efficient heating systems.

Requirement
Operable windows to the east and west to take advantage of summer ventilation

Each unit shall have, at minimum, an exhaust-only ventilation system (ENERGY STAR qualified low wattage bath fan with 24-hour control).

Fan CFM rating and sone level to be sized according to ASHRAE 62.2 2003 Guidelines regarding the number of bedrooms in the unit and whether or not fans run continuously or intermittently.

All bedroom and bathroom doors shall be undercut by a minimum of 1/4” clear space after carpet installation to allow free airflow. Transfer grilles or transoms to allow free airflow are also acceptable.

All ventilation ducting shall be sealed smooth-wall rigid metal or PVC with a minimum of elbows.

All ductwork in unconditioned spaces shall be effectively insulated to minimize condensation of water vapor and pitched to the outside.

All venting joints shall be sealed with mastic or PVC glue. No duct tape shall be used.

Ducting shall terminate at exterior wall of building at a dampered terminus (dryer vent style cap). Fan housing perimeter shall be sealed to bathroom sheetrock for air leakage control and more efficient fan performance.

There shall be no electric resistance heat in any location or application.

Basement heat distribution is generally not recommended unless it is a living space. If basement heat is required, thermostats with low range set points of 45 degrees are recommended in this application so they are used only for freeze protection.

Propane- and natural gas-fired boilers shall have a minimum AFUE of 85.0%. Modulating output boilers are recommended, but not required.

Low-mass (< 5 gallons of boiler water contents) cold-start boilers are recommended, but not required in small single boiler installations where circulating loops are not necessary.

Heating system sizing is based on Manual J calculations or equivalent.

All thermostats are required to be non-mercury type to avoid charges at disposal time.

Each residential unit shall be individually zoned, and apartments with two or more levels have individual zones per level.

Resources
Home Ventilating Institute:
www.hvi.org/

Notes
Timer controls (such as Airtrak or equivalent) can be installed to cycle the air on a set schedule in order to provide supplemental ventilation and improve air quality. Airtrak Controller, Tamarack Technologies: www.tamtech.com

Materials & Resources

Materials and Resources R1:
Pigments, paints, sealants and adhesives

Standard
Use low VOC pigments, paints sealants and adhesives

Requirement
Volatile Organic Compound (VOC) emissions from paints and coatings must not exceed the VOC limits of Green Seal's standard GS-11 requirements:

1. Non-flat: 150 g/L

2. Flat: 50 g/L

Volatile Organic Compound (VOC) emissions from adhesives and sealants must not exceed VOC limits of South Coast Air Quality Management District Rule #1168 AND sealants used as fillers must meet the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51

Resources
Sustainable ABC:
http://www.sustainableabc.com/m_p_f_a.html

Zero VOC Paint Guide:
http://www.aqmd.gov/prdas/brochures/paintguide.html

Green Seal: www.greenseal.org (Charge for publication)

Sourcebook for Green & Sustainable Building:
http://www.greenbuilder.com/sourcebook/FinishesAdhesives.html

South Coast Air Quality Management District:
www.aqmd.gov/rules/html/r1168.html

Bay Area Air Quality Management District:
www.baaqmd.gov

South Coast Rule #1168 by the South Coast Air Quality Management District:
www.aqmd.gov/rules/html/r1168.html

Materials and Resources R2:
Flooring and Carpets

Standard
All installed carpet must meet CRI low emission label standard. Also, there shall be no carpet in kitchens, bathrooms or within 3' of primary entry doors to the outside.

Requirement
Carpet systems must meet or exceed Carpet & Rug Institute (CRI) Green Label Indoor Air Quality Test Program.

Do not place any carpet in kitchens, bathrooms or within 3' of primary-entry doors

Resources
Carpet & Rug Institute: www.carpet-rug.com

Building Green Guide:
www3.uwm.edu/Dept/shwec/publications/cabinet/reductionreuse/615.SG.0502%20Update%2011.pdf

Materials and Resources R3:
Reduce impact of material use

Standard
Use framing and finish lumber harvested from sustainable managed forests AND/OR regional materials AND/OR durable materials

Requirement
Choose any of the following:
1. Use framing and finish lumber milled from logs harvested from sustainable managed forests - credit requires that 25% of wood products (as measured by dollar value) used in the project come from "certified forests".

2. Local / regional materials that are manufactured / harvested / extracted within a 300 mile radius of the project

3. For durable materials — use at least two of the following products:
- Long lasting, low maintenance siding made out of a renewable, sustainable or recyclable resource
- Composite decking with high recycled content
- Natural linoleum flooring
- Ceramic tile bathroom or kitchen flooring
- Roofing with a reasonable expected life of at least 40 years
- Insulated glass with a reasonable expected life of at least 20 years
- Siding with a reasonable expected life of at least 40 years
- Wood, cork or bamboo flooring

For certified wood, certification of the forestland may be by the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), American Tree Farm System (ATFS), Certified Master Logger Program (MLP), or some other established standard, as such standards evolve over time.

For local/regional materials: Declaration from product vendor or manufacturer stating where product is manufactured

For durable materials: Manufacturer’s product information and warranties

Materials and Resources R4:
Recycling and Site Waste management

Standard
Provide for the recycling of materials – during and after the project.

Requirement
Provide recycling area for each unit and building.

Ensure that recycling containers are labeled properly to enable accurate disposal.

Provide an opportunity for a deconstruction company to bid on demolition work or provide materials for recycling.

All construction waste must be recycled when feasible.

Provide a construction waste management plan

Operations & Inspections

Operations & Inspection R1:
Blower door test

Standard
For new construction projects each building will be “Blower Door” tested.

Requirement
Blower Door test conducted with calibrated equipment operated by a trained and qualified technician to be performed before the drywall is installed if polyethylene is the air barrier & after installation if airtight drywall approach (ADA).

1. Blower Door test report(s) completed by a trained and qualified technician or other certification or summary report from testing agency that document that blower door tests were done

2. Verify that any unwanted leakage areas identified by the test are sealed after the test

3. Verify that test results demonstrate that the building meets the envelope leakage requirements of the International Energy Conservation (IECC) 2004 Supplement

Resources
The Energy conservatory: http://www.energyconservatory.com
Infiltec: http://www.infiltec.com/inf-bd.htm

Operations and Inspections R2:
Post Occupancy Requirements

Standard
Provide tenants and facility managers with educational materials about green design, building operations, recycling and building maintenance

Requirement
1. Introductory presentation to facility managers describing design, operations, recycling, site and building maintenance goals

2. Owners/managers provide educational materials as applicable to tenants either in brochure form or tenant handbook regarding green practices or systems within project