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GREEN BUILDING TIPS – helpful design guidelines

Some useful tips on how to easily integrate "green building" into your next building project:

Keep in mind that every region should employ different "Green Building" strategies. Strategies should reflect the region's climate, material availability, and building practices. An igloo would make sense on the north slope of Alaska but would NOT be a green building in North Caroline….

Regarding comfort and energy efficiency for residential structures in most parts of the country where air-conditioning is used a lot the primary culprits are INFILTRATION of outside air, improper ORIENTATION, excess SOLAR HEAT GAIN, and internal loads that produce HUMIDITY and HEAT.

Also keep in mind that a house is a SYSTEM - often one component (such as a power attic fan) can affect another seemingly unrelated feature (such as mold growth under a bathroom vanity). Furthermore, buildings are built differently than they were just a quarter a century ago. Three important aspects that have radically changed the operation of a typical building are:

- The extensive use of thermal insulation.
- The development of tighter building envelopes.
- The popular use (and over sizing) of forced-air heating and cooling systems.

These items have significantly added to the comfort of our homes and buildings – yet have also made them much more susceptible to problems if not done correctly! A high performance house is like a high performance car – will need more attention and operator skill!

USEFUL AND OBJECTIVE RESOURCES AND TOOLS

- **Climate data**: NOAA website for local climate date is www.noaa.gov phone (828)271-4800
  http://lwf.ncdc.noaa.gov/oa/documentlibrary/clim81supp3/clim81.html

- **Green building newsletter**: Environmental Building News **www.BuildingGreen.com**

- **Home rating:** NAHB Model Green Home Building Guidelines **www.nahbrc.org**

- **Roof overhang and window sizing**: Sun Angle Calculator is available through Ball State University (Center for Energy Research, Education and Service) **www.sbse.org/resources/sac/index.htm**

- **Climate change and assorted Green Building information: www.architecture2030.org** or **www.soloso.aia.org**

CLIMATIC DATA FOR SELECTED CITIES:

Orlando, Florida	**Lat 28.5 Elev. 118**	**Heating DD 733**	**Cooling DD 3226**	**Avg. Rain 55.5”**
Austin, TX	**Lat 30 degrees**	**Heating DD 1760**	**Cooling DD 2920**	**Avg. Rain 33.6”**
Asheville, NC	**Lat 35.3 degrees**	**Heating DD 4250**	**Cooling DD 850**	**Avg. Rain 47”**
Charlotte, NC:	**Lat 35 degrees**	**Heating DD 3200**	**Cooling DD 1650**	**Avg. Rain 43.5”**
Wilmington, NC	**Lat 34 degrees**	**Heating DD 2430**	**Cooling DD 2015**	**Avg. Rain 57”**
Raleigh/ Durham, NC	**Lat 35.9 degrees**	**Heating DD 3515**	**Cooling DD 1385**	**Avg. Rain 52”**
Albuquerque, NM	**Lat 35.1 Elev. 4094**	**Heating DD 4281**	**Cooling DD 1290**	**Avg. Rain 9.5”**

ORIENTATION - very basic but extremely important & often over looked

- **Orient streets in a new subdivision to run east-west** as much as possible so that the majority of the building lots can have either a north or south facing front and rear. (See below.)

- **Orient building to minimize summer hot afternoon solar gain** and allow for some winter solar heat gain. Long sides to face south & north. Sunny solar heat collecting “sunrooms” or “green houses” are not appropriate in the south.

- **Orient to take advantage of the prevailing breezes** during the Spring, Summer, & Fall. Look up the climatological data for your area, or call your local airport, to find out where the prevailing breezes generally come from in your area. Refer to the NOAA website for climate data.

INFILTRATION

- **Install a moisture and vapor retarder on the warm (or more humid) side of the wall**. In the North this is the inside surface (unless you are in an area where air-conditioning is used a lot of the year), in the southern United States this is the outside surface of exterior walls. Remember, you want to keep humidity from infiltrating the wall cavity. Typically, when you are air-conditioning a house walls dry “out” to the interior because the a/c system draws moisture out of the air. Spray foam insulation is particularly good in areas where significant air-conditioning and heating loads exist because it is a safe vapor retarder that works appropriately in the summer and the winter.

- **Excess humidity exasperates many Indoor Air Quality effecting pollutants.** Critical to keep interior of structure below 50% Relative Humidity, but don’t go below 35% RH.

- 30# ASTM building felt in conjunction with a **commercial grade building wrap** that is well taped makes for a good weather barrier system. Remember, you want to create a raincoat underneath the wall cladding because houses aren’t perfect and cracks will occur that will let things in that you still want to keep out of the house.

- **Make sure all flashing is installed “shingle style”.** (Upper piece OVERLAPS lower piece - very common mistake we see on most jobsites!)

- **Do not use vapor barriers on the inside surface of exterior walls** - including vinyl wall coverings, in buildings where air-conditioning is used for a significant part of the year! Improperly placed vapor barriers can trap moisture in the walls – leading to serious mold problems.

- **Go easy on the amount of recessed cans** (even the so called "airtight" ones) that puncture the thermal envelope of the building. They are counter productive to reducing infiltration of outside air. Try to restrict unnecessary light switches and electrical boxes on exterior walls - they too, puncture the thermal envelope.

- **Never use anything but well sealed ducts to move conditioned air.** *Unlined* return air wall chases are especially bad; so are open return air plenums above dropped ceilings, and using floor joist cavities. We see this mistake a lot!

- **Spray polyurethane foam insulation is especially effective in reducing infiltration and vapor (humidity) flow**.

- **Wet blown borate based wall cavity insulation is also very good** (when used in conjunction with good air sealing practices) in reducing infiltration. And cellulose from recycled cardboard and paper is very "green". (Makes good use of post-consumer recycled products, and the borates are a natural insect repellent.)

- **A vented crawl space can create more moisture and humidity problems than it solves**. We don't recommend venting them unless there is a know source of ground water under the building that cannot be controlled otherwise.

- **Ventilating an attic can cause moisture and humidity problems in areas of high humidity** - and lead to higher energy bills. Sealing the attic and ventilating a continuous air space immediately below the roof decking, not the attic, is better.

UNWANTED SOLAR GAIN – Passive Strategies

- **Proper orientation** that minimizes exposure to the afternoon sun is key.

- **Dark roofs absorb heat** (not good in the Summer) and will require use of a radiant barrier.

- **Ample roof overhangs** are good - and will make for less building maintenance, longer lasting buildings, and happier clients – enhancing the designer and builder's reputation for responsible building.

- **Shade all the East, South, and especially West facing windows** from the Spring, Summer, and Fall sun. "Low E" windows are **NOT** a substitute for proper shading and solar control. A properly sized overhang does a much more effective job.

- **A radiant barrier on the underside of the roof, will substantially reduce heat gain through the** roof - reducing A/C bills, enhancing occupant comfort, and extending the weeks in a year a home can be comfortable without using mechanical air-conditioning. Radiant barriers do NOT lead to the deterioration roof shingles - contrary to some myths from 15 years ago. Radiant barriers DO need to be installed in conjunction with an air space and will **NOT** provide benefit where in direct contact with another building material.

- **Sealed attics and radiant barriers** also make it less of a problem to run A/C ducts in the attic. However, it is always best to run ducts in a conditioned or semi-conditioned space, such as ceiling fur downs or in an unvented attic.

LIGHTING

- **Become familiar with the new types of fluorescent lamps** - especially the thin "T2" and "T5" type and the new "wide spiral" compact fluorescents. The light quality is superior and you can get a wide range of color correctness. Fluorescents put out very little heat and last longer than incandescent and halogen lamps. (Approx 70% of the energy comes out in the form of light.) 2700K to 3000K lamps approximate the light color of traditional incandescent bulbs.

- **Halogen and Xenon lamps** DO put out more lumens per watt compared to a standard incandescent - but still produce a lot of glare and heat that the air conditioner will have to fight. (90% of the energy used is heat, 10% is light.) So go easy on using them in a home for anything other than occasional use accent lighting.

- **Go easy on the use of recessed cans**. Fluorescent ones are better but the cans still make for punctures in the building's "thermal envelope" – even the so-called "air tight" ones.

- **Proper natural day lighting**, especially indirect daylight from high windows, can make for substantial energy savings and an enhanced indoor environment. (Clerestory windows do this well; and if operable, can be used to naturally siphon heat out of the space below in the Spring & Fall.)

HVAC (Heating, Ventilating, & Air Conditioning)

- **Proper sizing of the air-conditioning system is critical**. Over capacity can cause mold growth within the ducts and other places within the building or house - leading to poor indoor air quality and occupant health problems. With proper windows & shading, most houses should require no more than 1 ton of cooling capacity for every 650 square feet of living area; 800 sq. ft./ton is now very attainable and should be the goal of a well designed & built residence

- **Leaky ducts rob energy efficiency and are unhealthy**. They are a bigger problem than low efficiency air conditioners. Supply duct leakage can cause depressurization of a home, inviting outside air & humidity into the home from unknown and unwanted sources, leading to serious indoor air quality problems and possibly mold.

- **Ducts with a slick interior surface - such as metal - are best for delivering clean air and staying clean**. Ducts lined with interior insulation, such as fiberglass duct board or lined metal ducts, attract dirt and can't be effectively cleaned – setting upon conditions conducive to mold.

PLUMBING

- **Water heater placement is important**. Isolate gas units from the indoor air of the home and provide them with their own source of combustion air directly from the outside; "sealed combustion" units are ideal. Thoughtful placement (close to bathrooms & kitchen) can also negate the need for energy wasting circulating pumps, and still ensure quick hot water to the points of first need in a home – usually the Master Bath.

- **Avoid oversized (75 gallon and larger) water heaters**. They generally don't produce heat as efficiently as smaller ones because they are exempt from the Federal energy conservation guidelines. A good high output 50 gallon gas unit will produce the same amount of hot water, enough for most large homes with oversized Master Bath tubs, more efficiently. A simple **backflow prevention** valve on the water line feeding the water heater can save significant energy, and keep the cold tap water from becoming undesirably warm.

- **Insulate ALL water lines** (even cold water lines) and those running in our below the foundation. Uninsulated cold water lines (including A/C system condensate lines) are susceptible to condensation forming on them – setting up conditions for mold growth AND inviting insects into wall and ceiling cavities.

- **Running supply water lines overhead and utilizing the manifold and sub-manifold system** of distribution will ensure quicker delivery of hot water – wasting less water and energy. This is particularly appropriate in "sealed" attics where the insulation is placed directly below the roof decking because of the low risk of freezing temperatures.

HEALTH, INDOOR AIR QUALITY & HOMEOWNER EDUCATION

- **Avoid chemical treatments for insects, termites, etc.** They don't last, lead to occupant health problems, and pollute the underlying ground water. Consider sand barriers or stainless steel screen barriers in and around the foundation for termite control. About 1 1/2 times the cost of standard chemical treatments but is a PERMANENT solution. (Chemicals only last about five years.) Consider spraying the frame of the structure with a natural brine solution that makes the entire frame insect resistant.

- **Use low VOC** (Volatile Organic Compounds) **latex paints on the interior**. Most major paint manufactures have them now. They are no longer considered exotic. Avoid high sheen or glossy wall paint on the interior surface of exterior walls where it could create a vapor barrier on the wrong side of the wall.

- **Air out carpeting for two days before installation**. (Unroll it outdoors and let it "off gas".) In this way VOC's will not be absorbed so much by other elements within the home or building interior.

- **Install high quality outside venting exhaust fans** in all bathrooms, kitchens, and other rooms where there may be a lot of internal moisture generation. BUT be careful not to draw so much air out that you create a negative pressure in the home or building because that will exacerbate the infiltration of unwanted outside air. Install automatic shutoff timer switches on all exhaust fans - bathroom, kitchen, etc. We prefer the electronic ones because they are quiet, reasonably priced, and last longer than the wind-up ones.

- **Keeping humidity levels low is an important part of controlling indoor air quality.** Front loading clothes washers impart less humidity into a home because they are sealed during operation.

- **Educate yourself, the homeowner (or building operator) about the importance of controlling indoor air quality and humidity levels**. Turn on the exhaust fan when cooking, using the dishwasher, doing laundry with a conventional top loading washing machine, taking a bath or shower, etc. A common sense approach to living within the home can have a big impact! Don't use toxic cleaners, such as many oven cleaners, on a day when the house is all "buttoned up" and can't be aired out. Same goes for interior painting and decorating projects.

LANDSCAPING & WATER CONSERVATION

- **Excess water consumption and droughts are a serious problem** -- even in parts of the country where drinking water had traditionally been in abundance. A few summers ago the Northeast had a more serious drinking water supply problem than the southwest.

- **Water is heavy** (weighs approx. 62 pounds per cubic foot) **and is expensive to move throughout a municipal water system.** The energy used treating and distributing water is usually the single greatest consumer of electricity in a typical American city. Basic water conservation measures inside the house and on the exterior landscaping can reduce municipal water treatment energy use by thirty percent or more in most southern US cities.

- **A thicker layer of topsoil will mean a lawn will require less watering** during the hot summer months -- conserving water during drought periods.

- **Protect and preserve the native trees on your building site.** They provide shade, good wind buffers, and enhance the marketability of any home or building.

- **Harvest the native topsoil** on a site when grading and excavating for the foundation. It will usually be far better for landscaping purposes than topsoil brought in from off-site - and will save money.

FINAL THOUGHTS

- **DON'T TAKE ALL OF THESE SUGGESTIONS VERBATIM!**

- **Many of these suggestions are particularly appropriate to the southern United States**. Use your creativity to EXPAND upon these thoughts and come up with solutions that use LOCALLY appropriate strategies, materials, and methods. That's perhaps the most important point about how to mainstream green building practices!

WOOD CONSUMPTION EVALUATOR - Board feet consumed per square foot

SIZE	SPACING			Note: Board feet calculation based on actual dimensions
	12" o.c.	**16" o.c.**	**19.2" o.c.**	**24" o.c.**
2x4	0.4375	0.3281	0.2734	0.2188
2x6	0.6875	0.5156	0.4297	0.3438
2x8	0.9063	0.6797	0.5864	0.4531
2x10	1.1583	0.8672	0.7227	0.5781
2x12	1.4063	1.0547	0.8789	0.7031