The Green Building:
A Case Study in Louisville, Kentucky

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Gill Holland, green developer / film producer

On March 13, 2006, my wife Augusta and I bought a 110 year-old warehouse building (photo of front of building here) in the slightly run-down, but (we felt) up-and-coming East Market District in downtown Louisville, Kentucky. A month later on April 27, we emailed our architect Doug Pierson at "Form Environment Design (FER)" saying we wanted to go for official LEED certification. We knew we had lots of green ideas, but were just learning about this certification. We figured it was like dieting: if one is going to diet, one should not be scared to get on the scale. We decided to try to follow the US Green Building Council's (USGBC) guidelines for both green building and sustainable design: LEED: Leadership in Energy and Environmental Design. On a trip early in our courtship, we had visited the public library in Seattle, which was an early LEED Silver awardee. We also wanted to apply what we consider to be the pre-eminent 21st Century building technique to our 19th century building and try to bring awareness of green building to Louisville and its developers. After making two environmental films and being acutely aware of our being part of the problem in the increase of carbon in our atmosphere, we also wanted to be "part of the proverbial solution" as opposed to just part of the problem. This seemed like a great place to start.

One of our first questions was simple and probably similar to many developers' notes to their architects and contractors: We would like to try and get LEED certification for the project, so does the cost estimate take this into consideration? If not, roughly what would be the percentage increase to do a LEED-certified renovation? In retrospect we were pretty "green" and inexperienced before we ever became the kind of "green" we wanted to be!

The first answer concerning getting certified at the lowest LEED level was that, based on many factors, there would be a 5-10% increase in cost. Our estimates show that each higher level (the levels are standard LEED, silver, gold and platinum) was another 5% in increase, so we ended up about 25% higher. We also estimate that it took about eight months longer to finish the building, partially due to the sourcing of the FSC (Forest Stewardship Council-certified) wood. Our architect Doug Pierson had an in-house LEED consultant/certified architect so we would not have to hire out of house for that, but as he said, "There is additional coordination and administration work involved to do the paperwork and tracking through certification. We also have to keep the consultants in line with the LEED requirements (for example, some LEED points are tied to exterior 'light pollution' and restricted watts per square foot. We would therefore have to make sure that we and the electrical consultant specify the right type of fixtures. This is often a trial and error process and may take more iterations than without going LEED). The increase in fee would depend on the level

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of certification."

It was only later in the project that the architect commented that with all our ideas (solar panels, geothermal, green roof, radiant heat, thermal energy storage, etc.), we really could and should end up with the highest "Platinum" LEED certification. There were a couple more tweaks we could do to try to ensure that happening. This would up our cost, but we decided that we were so close we should go for it.

Then came this interesting note from Doug:

"The real trick is finding a contractor who will follow through during the construction phase. A lot of the points are gained through the use of local materials purchases (bulk inexpensive materials from China will cost points), waste management, recycling, and a coordinated tracking of bill of materials. All of these are under the scope of the contractor. We can work with the contractor to make sure they know what they need to do, but we cannot police them,. Finding the right contractor for a certified building is imperative." We also were to learn that renovating an existing structure is especially difficult because you can't control the situation as you could if you were building from scratch."

We knew that our friend Tim Peters was going to be our contractor so we felt comfortable moving forward with his experience, and he brought along the foreman Richard Pickard who proved invaluable.

When nationally-renowned (and rightly-named) green roof expert Ed Snodgrass came for a conference, we learned that the greenest building is a building that already exists, no matter where you are. So by using an existing structure instead of tearing it down to build something green from scratch, we were already getting green "points," at least on the karmic level if not for LEED certification.

The USGBC also was and may still be tweaking its rules for its LEED program for green renovations so that was something we had to take into account. Some of the initial points regarding site sustainability in the LEED scheme were easily proven: we were renovating, which seemed to us like we should get the point for re-building on a same site; we were located on the bus routes/public transportation; we would build a bike rack and we'd dedicate a place to park hybrid vehicles and include a shower to promote employees biking to work; and we were on the bike path; and we were happy to landscape and design the exterior to reduce the heat island effect.

The EPA at http://www.epa.gov/heatisland/index.htm defines the term "heat island" as a "built up area that is hotter than nearby rural areas. The annual mean air temperature of a city with one million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. In the evening the difference can be as high as 22°F (12°C). Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality."

We also wanted automatic lighting controls to reduce light pollution and the cost of absent-minded workers who might forget one of the greenest daily acts: simply turning off the lights when leaving a room.

Sept 29th, 2007 Demolition Starts

On one level we were like the crystal meth addicts who, upon seeing an empty house or a house for sale, break in and strip out the copper wiring to re-sell. Until the economic meltdown, copper was trading at high rates. On the way to work I even started noticing manhole covers missing.

We made a list of everything we could recycle: doors, door knobs, light bulbs, copper

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plumbing. We tried to sell as much as we could; we gave away the other stuff. LEED requires a certain percentage of demolition and construction waste to be recycled in addition to significant use of recycled material in the construction and locally-sourced material.

It's not just the classic "reduce, reuse, recycle" at play here; it's also how much can you divert from going to the landfill. The easy part is dedicating an area in the finished building as a recycling center; the hard part is demolishing responsibly.

Normally when you demo a building, you take some sledgehammers and just trash it, fill up the dumpster, take it to the landfill. It takes a lot of time to demolish a building in an environmentally friendly manner and time is money. Land is finite, and more and more humans live on it. For LEED, you have to weigh all the debris, and a percentage of its total weight and physical space must not go in the landfill. We hired a local group called Green City Recycling who helped oversee the paperwork of the removal process and itemization of what was salvaged. For a complete list of what was not sent to landfill, see the end of this article. From their website, www.greencityrecycling.com " recycling today for tomorrow," Green City Recycling is committed to the mission of preserving our earth's resources by providing construction landfill diversion and commercial recycling services. Green City removes the valuable resources and transfers them to worldwide markets, where they are recycled, remanufactured and reused.

We recycled. There were beautiful old timbers and joists that other people wouldn't have spent the time to save. We inventoried every piece of wood, re-milled them, finished them, and we're reusing them. There are 16 x 4s, which they don't even make anymore. You figure the tree had to be over 100 years old when it is was chopped down 110 years ago for the building so that's like first growth timber — beautiful stuff -"Revolutionary Timber" we call it. We set up a workshop in the back of the building to plane the planks down and remove the smoke and soot. It was blackened with age and from the days of coal being burned in the building for heat. It looks beautiful. On our web-site http://www.thegreenbuilding.com is a nice short film on this wood reclamation process, which was directed by Robin Burke. Our conference room tables were built from these timbers by our foreman Richard Pickard. (photo of wood milling station)

All the plaster, instead of using sand to blast it, we actually used a corn husk-based sand to blast it off. It's biodegradable, a natural, local product. Obviously the plaster had to go to the landfill because there's no place to use that. So that becomes part of the demo process.

Buildings in the United States count for probably over sixty percent of total electrical use. Buildings are a huge carbon footprint in terms of humans on the Earth. So first we went through to see what we could recycle. Here is the list:

Green City Recycling received 1,029.5 cubic yards of material in dumpsters from our project. 436.5 cubic yards of that material did go to landfills, but 551 cubic yards ("cy") of material was diverted and recycled. Summary of recycled materials:

Wood 301.5 cy
Cardboard 38 cy
Concrete 126 cy
Metal 54 cy
Plastic 19.5 cy
Other 12 cy

In terms of what is called "Eco-Tech Environmental," we had approximately eight 20- cubic yard dumpsters not diverted from landfill, and three 20 cubic yard dumpsters of recycled materials

We also worked with ISA Recycling, a local Salvage Yard and salvaged 13,386 pounds of

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metal. This included steel, steel copper, cables, lead, and siding.

Dillon Construction services carted off the following materials to be reused at other sites:
150,000 BTU furnace and compressor
1200 square foot carpet
Four windows
Ten light fixtures
Two 125,000 btu furnace and AC units
1 door
125,000 BTU furnace and AC unit

We donated to the Tallgrass Farms Foundation the following materials to be reused in an old farm house:
70 gallon water heater
125,000 BTU furnace
12 wood newel posts

Forty-two 50-gallon bags of sawdust are to be used as animal bedding at the farm.

Then we made the following donations to Habitat Restore for Habitat to sell:
Furnace and compressor
A coil unit and compressor
72 light fixtures
122 florescent tubes
22 locksets
17 hinges
1 vanity and sink
1 toilet
1 medicine cabinet

Our glass contracts Kentucky Mirror + Plate Glass took for reuse in other project:
2 areas of glass 50' long x 12' high, and Larry's Heating & A.C. recovered Freon from six condenser units.

Construction Starts

As you start building, you try to use only local products. You don't want products that come from Brazil, because of the carbon footprint of the travel of that product. You get points for local products that are harvested and sourced from within 500 miles. The support of the local economy is an ancillary benefit to the community of green building. You get points for not using certain harmful finishes and paints. The EPA says that indoor air is three times worse than outdoor air, which is gross when you think of all the off-gassing going on. Obviously lead-based paints are no longer in use, but most paints have lots of toxins/volatile organic compounds (VOC's). When you breathe them all day long, they go into your blood system; when your kids are born they're born with these toxins in their blood system, then they get more toxins over their lifetime. That's a generational increase of toxins in our children's bodies.

We did not use anything with high VOC's, only low to zero VOC's (which exceeds LEED requirements). All the new wood we needed was sourced locally, and it's Forestry Stewardship Council-certified, FSC wood. That means it comes from sustainable forests. Instead of clear-cutting, they responsibly harvest one out of every three rows.We knew this was going to cost a little more money, because right now there's not yet a lot of demand for FSC wood. We also took pleasure in knowing we had hired people and were paying them to learn a new skill. The workers on the project got educated as to where to buy these products, what to look out for in these products, and why these things are important. They

will pass this information along and take it to their next jobs.

There was a high percentage of recycled content in the building construction materials including:
30% of concrete
70% of heavy and light gauge steel
40% of gypsum board
10% of cement board
40% of concrete blocks
30% of all glass
70% of all aluminum window products
70% of all roof flashing products
100% of wood floors
15% of translucent acoustic gallery ceiling
60% of bathroom partitions
30% of ceramic tile
80% of batt insulation (recycled denim from blue jeans)
35% of rigid exterior building insulation
30% of architectural exterior louvers
20% of countertops
3% of exterior sheathing
35% of vinyl composite tile flooring
60% of linoleum flooring
40% of all furniture and finishes

The Green Roof

Green roofs are important for four main reasons: they save energy, they reduce the heat island effect, they increase water efficiency, and they increase green space and oxygen. Green roofs just make sense to me in a back-to-nature kind of way: my mother is a native Norwegian and the Vikings may have had the first green roofs. There are a lot of green roofs over there. I don't know if some of the people out in the countryside know how environmentally friendly they are. Of course, sometimes they have goats up there. I don't think in Louisville we're going to have goats on our roof!

Energy savings:
The temperature on a black tar roof in the summertime can go up to 170 degrees Fahrenheit. Air conditioning buildings down to a comfortable 76 degrees takes a lot of energy. With a green roof, the dirt and grass collect and repel most of that heat and insulate in the winter. Our non-green roof surfaces are painted reflecting white so they don't absorb heat, and their solar reflective index (SRI) exceeds LEED requirements.

Water efficiency:
The earth and grass act as a natural filter. It takes three days for rain to run through a grass roof. Generally storm water runoff is a problem. Heavy rainfall runs off of roofs and streets paved with impervious pavement and then floods already stressed-out municipal drainage systems (especially here in Louisville). This volume increases the amount of everything from animal feces to oil from the streets in the water system. On top of that, instead of being filtered down back into the local aquifer where it is needed, the water here in Louisville goes right out into the Ohio River and ends up in the atoxic zone in the Gulf of Mexico.

There are two kinds of green roofs: the "extensive" has a shallower four-inch base that is a unique soil mix of expanded shale and humus and is better for low-lying sedums and grasses; and the deeper has six inches of earth that bushes can grown on. Our engineers said we would have to spend some money to shore up the roof in order to accommodate the heavier six-inch roof, so we went with the gravel and sedums (see picture). For LEED, a

percentage of these plans must be drought-resistant and local: this requirement makes sense because you don't want to have to be watering the roof! Our local horticulturalist Tracey Williams from Green Sleeves Design chose Sedum spurium 'John Creech', Sedum spurium 'Dragon's Blood', Sedum sexangulare, Phedimus 'Golden Carpet' and Sedum album. The modern and bold design of the plant layout for the roof depicts a Norwegian symbol for the sun and the creativity and the dynamism of solar energy. (photograph of sedum)

Alongside the side of the green roof we have three massive rain barrels (photograph) for any overflow. These pour into an underground culvert which then takes any excess run-off into our rain garden, a depressed area towards the rear of the building which is basically a water retention pond designed to slow run-off, allowing the water to seep into the earth slowly.. The rain garden is anchored by two strong, native trees which typically grow in moist and low-lying area. Nyssa sylvatica (Blackgum or Tupelo) and Taxodium distichum (Bald Cypress). The area, also known as a bio-swale, is under-planted with Chasmanthium latifolium (River Oats). The rain-garden is in progress and new plants will be slowly added and Tracey's plan is to keep sowing native seeds to naturalize the area.

For Tracey, "River oats is the theme for the entire building's design - a strong visual band that unifies the whole area. It is highly-adaptable and tolerant of difficult situations, wet soil, drought, sun or shade. The Betula nigra (River Birches) close to East Market Street offer both height and scale for the expanse of brick, road and parking lot and visual interest at eye-level with their beautiful exfoliating trunks. The courtyard is planted with the white-blooming forms of the native Cercis canadensis (Whitebud) and the moveable planters hold native Switchgrass (Panicum virgatum 'Heavy Metal')."

Besides the low-hanging fruit of low-flush toilets, another element of water efficiency is waterless urinals but the KY law health department forbids them at this time.

Solar Panels/Photovoltaics

Compared to green roofs, solar panels have become much more universally accepted and utilized. While green roofs need a bit of cultivation, solar panels are relatively easy. You can order them, have them shipped to you if you cannot buy them in your area, and then it's just a matter of installation and inverting the energy from DC to AC. We were lucky in Louisville to have a company called Solar Designs, Inc available and its leader Dave Gabhart oversaw most of our alternative energy plans. He calls The Green Building the culmination of his life's work in this arena (www.solar-designs-inc.com).

Solar panels are made out of photovoltaic cells. We spent about $112,000 on the 81 panels we use which provide almost fifteen Kilowatt/hours on sunny days. That is enough to power the building so on good days, we are "off the grid" metaphorically (at present we still have to go through the grid). We do not generate enough energy to store and even if we did, batteries are not inherently "green" (though can be effective in remote areas). We do not yet have net metering on our building in Louisville so cannot yet sell any excess back to the electrical company. Kentucky, however, does allow this option and the paperwork is underway to accomplish it. Doing the math based on the average number of sunny days in Kentucky and the present cost of electricity, we should recoup in about sixteen years and then have a fixed asset that gives us a 2% return (which based on the stock market's performance in 2008 is very attractive!) If one assumes the costs of energy will double every five years as it seems to have historically, the time to recoup drops significantly and the return increases. I also believe that emissions trading and carbon "cap and trade" will be instituted sooner than the general populace believes and we will be ahead of the curve. We never consider the additional expense of the solar, geothermal and green roof as cost "increases" to the project. For us, they are low-yielding, but highly conservative "green" investments. (photograph of panels)

The three DC-AC converters placed on the wall below the solar paneled roof are crowd pleasers. They count the amount of CO2 saved from entering the atmosphere due to the panels. So far, taking the less-sunny fall months as an average, we are saving 30,000 pounds of CO2 a month. If taxing carbon emissions becomes a reality, we will quickly make back our solar investments in savings! According to the carbon footprint calculator found at http://www.carbonfootprint.com/calculator.aspx, my driving a 2006 Toyota Prius 500 miles a month puts 202 pounds of CO2 into the atmosphere so the solar panels alone will more than offset the emissions of up to forty-four employee's cars in the building! When full, the building will have fewer than that.

Then we also have skylights. Studies show that buildings with natural lighting have higher employee productivity and higher employee retention. People just like working in a building that has sunlight as opposed to artificial light. It makes sense. Humans are animals. That also counts as a LEED point. In our building, the previous tenants had actually cinder blocked up all the windows except for those facing the street. So we restored the nine windows and now have tons of natural light. Natural light has jumped from 20% of the spaces to 95%. This intangible benefit does not have a directly quantifiable financial return on investment but is important. (photo of rear with wall of windows)

Geothermal Heat Pumps

Ten feet below the surface of the Earth, the temperature is always between 50 and 60 degrees. One can either dig 300-foot wells, or put coils 6 feet down below the ground surface, run them horizontally under the ground for 300 feet which is enough time for the water to cool to that temperature. The water then comes back up into the building and goes through a "heat exchanger" which releases the captured heat in the winter and then removes any cool air and in the summer, the water bring in coolness and takes the heat from the building back out into the earth. We chose the option of digging twelve 300-foot wells which in most urban situations is more practical since you may not own the neighboring lot. Our wells are "closed loop" so we are not taking water and then dumping the dirty, used, and heated water back into the aquifer.

So in the winter, the wells and coils heat your building, and in the summer, they cool your building. This is free energy from the Earth. The only cost is for the compressors to move the energy in or out of the building and delivering it to the spaces. (chart of energy efficiency)

We also put in a state of the art 1,100-gallon ice storage tank (I refer to it as our "ice bucket"). This storage tank takes energy from the grid at night when it is least in demand and also cheapest and uses the geo units to freeze the thousands of 4" diameter ice balls in the giant container. Then it releases this energy when cooling is needed over the course of the day in conjunction with the geothermal wells. If everyone were to install such ice buckets, there would never be the black-outs that happen at 2pm on summer days in California when everyone reaches for the AC switch and the lights go out! The energy consumed to freeze the balls is ¼ the amount of energy and also its off-peak hour costs that would be required by traditional air conditioning methods to cool the same capacity that the balls cool. (photograph)

Indoor Air Quality

While a lot of this gets too scientific for me, the basics are that smoking is banned and there is an automatic carbon dioxide control system. So whenever the CO2 level in a room hits more than 550 adjustable parts per million, vents open to release that "old" air and bring in fresh air. There is also a monitoring and control system for general comfort temperature wise. A side benefit is that this CO2 control also measures the amount of fresh air in a building so you can get a measurement of how much ventilated air is displacing inefficient, re-cycled and less healthy "conditioned" air. Maybe this is also why everyone who enters

the building remarks that it smells fresh. Automatically controlling fresh air minimizes the expensive costs of heating and cooling outdoor air. The main electric fans and pumps vary their speed as needed to save energy.

Indoor environmental quality: The Green Building meets or exceeds the standard American Society for Heating, Refrigerating and Air-Conditioning Engineers, Ventilation for Acceptable Indoor Air Quality and through architectural design maximizes daylight and views in 95 percent of all regularly occupied spaces.

Other Fun Facts related to The Green Building:

In doing the research, we found that cement plants are five percent of the world's total CO2 output, which is astounding, and you need cement for concrete, so our concrete blocks are "mineshaft blocks" made partially out of slag and fly ash. Slag is a byproduct of making iron. Fly ash is a byproduct of coal. So instead of some of these coal by-products ending up in a toxic pond like the one that just broke in Tennessee, we're re-using them in a constructive way.

Normally gypsum board has 0-10% recycled content. Kim Glass and Doug looked all over the country and found that our supplier (local, of course) provided 40% recycled content, eight times as much as the national average!

In the back, there is going to be a green wall. I don't even know if there are any in America, but we saw one in Paris: literally a wall of plants. It's beautiful and it's environmental. We plan on growing herbs and spices on the lower reaches of the wall for use by 732 Social, the restaurant on the ground floor.

Not-so-green Paving

We learned a lot about pervious pavement, but this is one of the only green things we do not do. The parking lot is a separate property so we do not need it for the LEED points for The Green Building (and it becomes slightly annoyed trying to play the points game). Laying down pervious pavement would have cost $40,000 more than the traditional tarmac (70% more). Since we may not keep the parking lot paved for more than a couple of years in order to use it for a better purpose (ie the year round public market we are starting) we compromise and leave half the parking lot unpaved. We refer to our unpaved areas as our "bioswales" and are happy that the water will still drip down to our aquifers. Bioswales have become popular landscaping methods to filter out pollution from surface water runoff.

Conclusion: Energy and Atmosphere:

The building is designed to outperform Kentucky energy codes by 65%. If there were any computer energy models available to input and measure the value of our ice bucket, radiant floor heat, and passive heat re-integration simultaneously with other features, this number would be even higher. The century-old drafty masonry shell has been completely sealed with inert recycled insulating materials and the original window openings, previous filled in with cinderblocks, have been restored with low-e insulated glass. Exterior louvers are used on the south side to prevent heat build-up from sunlight. Renewable energy sources from photovoltaics and geothermal heating and cooling help increase the overall energy efficiency of the building. No chlorofluorocarbon-based refrigerants are used in the air conditioning and no halon gases in the fire suppression system; control systems meter HVAC systems, water usage and energy performance of the building.

Please come visit in person or online at http://www.thegreenbuilding.com! I would like to thank my wife Augusta, Doug Pierson, Tim Peters, Richard Pickard, Dave Gabhart, Kim Glass and Tracey Williams for their help with many of the details of this article.

Gill is an award-winning film producer (environmental docs include Al Gore's 2008 Reel Current Award winner MOUNTAIN TOP REMOVAL and the Sundance Film Festival hit FLOW: FOR LOVE OF WATER) and green developer in Louisville, KY. He was also the Executive Producer of SWEETLAND, the first carbon-neutral independent film.

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