THINK GREEN BUILDING
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To: Potential Design Clients **Date**: 11.14.08

Concerning: Introduction to Our High Performance Natural Building System

Hello Potential Client Partners!

These are exciting times at Think Green Building. We have spent the last two years developing a housing system that we believe achieves the following:

(1) Increases comfort, long-term affordability, sensory enjoyment, and fosters a healthier lifestyle through increased connection to nature

(2) Reaches scientifically established benchmarks for residential construction defining a drastic reduction in emissions that contribute to our present global warming crisis.

(3) Contributes to a sustainable solution to our present economic crisis by focusing on local materials and workers while creating opportunities for the creation of a variety of local green construction businesses.

I have written this document as an introduction for potential client partners to this housing system and design approach. We believe passionately that this approach is accessible to anyone with the resources to consider building a new house in the first place. However, there are still some things we don't know. For example, exact pricing is at present difficult because we are using new materials and systems like site-produced compressed earth blocks, interior earthen plasters, and adjusted wall systems. We need to work through several projects to more clearly quantify expenses and to find the kinks that might slow the process down. Therefore, I call you "client partners", to point out that what we are doing is new and its success will require common goals and teamwork for all involved. We will be asking for more cooperation and innovative spirit from contractors and more patience and flexibility from clients. In return, we offer the fruit of our creative labors for the past many months, a period of late nights, financial sacrifice, and, to be honest, plain ol' courage. In all humility, I also believe we are offering a serious step toward solving the environmental, economic, and, yes, even social problems of our time.

Context

Based on widely accepted global climate change predictions, we need to drastically cut our carbon emissions very quickly. Highly credentialed scientists like James Hansen of NASA and many others estimate that we have only 10 years to greatly reduce present emissions if we are to prevent a warming effect that would spiral out of control with dire consequences for humans. In our daily lives, our carbon emissions derive substantially from our energy use. Since our houses represent about ½ of our energy consumption, then making our houses more energy efficient and consequently reducing their emissions is the single most effective step we can take.

A group called Architecture 2030 has evaluated the climate research and come up with benchmarks for the construction industry that, if followed, will theoretically get us to the required reductions. They present their plan as a challenge, the 2030 Challenge. We are signatories to that challenge. The specifics can be reviewed here: www.architecture2030.org.

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The summary is that we have agreed to design buildings right now that will be at least 50% more energy and green house gas (GHG) efficient than the code mandated norm for our region. This percentage goes up yearly so that in 2025 we agree to design buildings that represent a 90% reduction. We have gone a step further and decided not to take an incremental approach. Our goal is to meet the 90% reduction as soon as possible.

Summary of Our Approach

Luckily for us, this isn't a new idea. People have been creating buildings meeting this performance benchmark for a number of years. There is a performance standard in Germany called "Passivhaus" (passive house) that defines a clear prescriptive approach to creating designs at this level. The trick for us is to (1) apply these principles to the specifics of our climate and (2) make a 90% increase in energy efficiency affordable to people used to paying for inefficient buildings.

Too often, however, such science-driven initiatives result in theoretically impressive though impractical designs. If realized at all, the finished product can be more science project than home. Our approach is to combine solid, state of the art building science with a flexible building system that allows climate and site specifics along with local/natural materials to be integrated with the needs of the client. The result is not only more beautiful buildings supplying the full spectrum of needs associated with the archetypal concept of "home", but buildings that surpass the energy, resource, and environmental performance of their solely hi-tech performance focused cousins. Our guiding principle is sustainability which we define as a matrix supplying the following six variables: low construction impact, resource efficiency through the life of the building, longevity, healthy indoor environment, beauty, and affordability. These elements are the basis of the building approach described below.

In summary, our design goals are to merge state of the art building science and technology with natural and local building materials in a package that is a contribution toward a sustainable built environment for all of us. Here are the basic housing components we have determined are necessary to achieving these goals.

(1) **Super-insulation.** The majority of energy used in a house goes to space heating and cooling. The better we can maintain interior temperatures, the less we have to heat and cool. Therefore, we specify insulation levels far in excess of code mandates. R-20 to 40 under slab (code doesn't require sub-slab insulation), R-35 to 40 in the walls (code = R-13), R-60 in the ceiling (code = R-38)

(2) **Air tight construction.** Air-tightness goes hand in hand with super-insulation because it doesn't matter how much insulation you have if air is leaking in or out around it. By creating an extremely air-tight building, we can greatly reduce heat loss or unwanted heat gain.

(3) **Thermal mass.** In our climate, nights are always cool during the hotter months. By installing more interior thermal mass, we can capture that nighttime cool and use it to stabilize interior temperatures during the day when it is hotter outside.

(4) **Efficient windows and doors.** Conventional windows and doors have dismal R-values (R-1 to R-3) and are leaky. Sticking an R-2 window in an R-40 wall won't get us to where we want to go. We specify high efficiency windows and doors with R-values in the R-7 range with excellent air leakage ratings.

(5) **Heat exchange ventilation.** All buildings need to provide a constant supply of fresh air. Natural ventilation (opening windows placed to maximize ventilation) is our first strategy. However, for those times that indoor air is being heated or cooled (in our case dehumidified, see discussion below), this strategy won't work. In order to be energy efficient, we need to create air exchange while keeping a temperature differential between indoor and outdoor air. This is accomplished by closing our airtight, efficient windows and using an efficient ventilating fan that has a heat exchanger to create air exchange with minimal heat loss. This unit is called an ERV (energy recovery ventilator).

(6) **Innovative heating and cooling.** By creating an airtight, super-insulated, massive building shell, we have radically reduced our heating and cooling requirements, known as heating and cooling "loads". By incorporating passive solar heating and cooling into our designs, we can satisfy some of these loads without any added energy input. As a combined result of these measures, our active heating and cooling systems can be small and hyper-efficient:

a. **Heating.** Based on variables such site conditions, building layout, and client goals, we choose between two heating system options. Both use solar energy to provide most of the heat:

   i. **Solar thermal.** Solar collectors heat a liquid that is moved to a storage tank. This energy is used both to heat water for domestic use and to heat air to warm the building. This space heating is accomplished by running the hot liquid through a heating coil in the ERV duct. The ERV fan then moves the warm air where it is needed. Back-up heat is supplied by a tiny electric resistance, gas, or wood heater.

   ii. **Solar electric.** A very small ductless heat pump (mini-split) and a heat pump water heater are installed to heat air and water. Since loads are small, electricity for these systems can be provided with solar electric panels (PV).

b. **Cooling.** Comfort is a function of several variables including air temperature and humidity. Our nights are cool during the cooling season. Because our super-insulation creates such a low cooling load, we can use our ERV as a whole house attic fan to access cooler nighttime air to lower the temperature of our interior mass, thereby creating a comfortable temperature without mechanical cooling. Still, the air will sometimes be humid, so we'll need to dehumidify. A whole house dehumidifier should use about 20% of the energy of a conventional air conditioner, so we'll achieve the same comfort with an 80% reduction in energy use. If, however, a client wants the option of having AC, then we would choose the second heating system option above and install a mini-split heat pump that both heats and cools.

(7) **Zero Net Energy (ZNE) and Carbon Neutral (CN).** A ZNE building is one that produces at least as much energy as it uses. A CN building takes that a step further by creating enough supplemental energy through its service life to offset the carbon emitted as a result of its construction. These thresholds are reached by including on-site renewable energy production, such as solar electric, wind, or hydro, as part of the house's integrated systems. By adding daylighting (part of passive solar design), low energy bulbs (compact fluorescents right now, but super efficient LED's are on the threshold of affordability), and very efficient appliances, our household electrical load will be small enough to make these

technologies much more affordable. Therefore, all of our buildings will be designed to be ZNE and CN ready. In other words, the renewable energy systems will be part of the design to be either included in initial construction or installed easily at a later date when funds are available.

(8) **Reduced building size.** Our designs are much smaller than the national average. There are three reasons for this:

a. Whatever performance standard you achieve, the larger the building the more energy it will use.

b. Obviously, a performance increase of 70 – 90% is going to cost more money per square foot. To reduce costs, we need to build smaller.

c. With the partnership of functional outdoor rooms (see below), we strongly believe that well designed smaller buildings are more enjoyable to live in and maintain.

(9) **Local materials.** Reducing the energy consumption and GHG emissions of a building during it's use is only part of the equation. We also need to be conscious of the impact of the construction of the building. By using local and site-harvested materials as much as possible, we can reduce the environmental construction footprint of the building. We specify local materials and direct the production of site-harvested materials whenever possible.

(10) **Conservation of water resource.** Energy isn't the only resource we need to conserve. Clean water is becoming the next global issue. Our present societal systems approach is to dump everything imaginable into water and then go to great lengths to clean it up only to dump the same things right back in. This process creates an endless polluting cycle with dire consequences. Our approach is to first reduce demand through careful plumbing planning, installation of efficient fixtures, and inclusion of a raincatchment system in all designs. Next, we simply don't pollute the water by educating clients about appropriate soaps and cleansers and specifying composting toilets where applicable. Finally, we reuse water by including greywater systems where legal.

(11) **Longevity.** Another component of environmental construction impact is the lifespan of a building. The longer a building lasts, the longer we can postpone the energy and carbon investment in constructing a new one. In Europe it is not uncommon for buildings to be in active use for hundreds of years whereas in the US it is common for a building to last only 35 years. Long lasting buildings have two characteristics: durability and flexibility to adjust to changing use requirements. Our goal is to create buildings that meet both of these criteria and consequently are in active use for a long time. One of our mantras is "the 500 year house".

(12) **Healthy indoor environment.** All of this performance enhancement is useless, if the building isn't a healthy nurturing place to be. As a result, we go to great measures to make sure the building has excellent indoor air quality. We have a very good start because the efficient building envelope / ventilation / dehumidification strategy already outlined creates clean, comfortable air without drafts. In addition, we specify either site-made or commercial natural finishes.

(13) **Healthy outdoor environment.** We see a house as made up of indoor and outdoor rooms with transitions between them. In our climate, outdoor living space is luxurious, useful much of the year, relatively inexpensive to build, and has the best air quality. By

integrating outdoor space with indoor space, we can create a smaller house that feels larger. We also gain a vibrant landscape that produces food, provides habitat, attenuates air movement and sunlight to increase building efficiency, and manifests a canvas of sounds, sights, smells, tastes, and feelings that change with the seasons.

(14) **Beauty.** Beauty for us isn't an abstraction. It's a tangible design category as important to the function of the building as anything else. Our goal is to create buildings that nurture people and help foster community. Of course, beauty is subjective, so a particular building can't realistically be beautiful to and therefore appropriate for everyone. Our particular aesthetic pallet includes thick exterior walls with undulating plaster surfaces, large roof overhangs, ample natural light in all rooms, smooth transitions between indoor and outdoor rooms, and a variety of edges between outdoor living spaces and the planted and natural environment of the site. However, our performance standard does not demand a particular aesthetic and we are working on finish packages that will span the gamut of personal needs and tastes.

(15) **Affordability.** It's safe to say that most people would love to have what we're describing: a beautiful house that costs almost nothing to run and is connected seamlessly to a wondrous, productive outdoor landscape. However, you can't get drastic performance increases without paying more per square foot. It's our mission to make these buildings affordable for as large a cross-section of our population as possible. Here's our strategy:

a. **Value engineering.** Our system is flexible and can accommodate different wall system construction approaches. We currently have three options on which we are doing a cost comparison analysis. Some of our long term goals, like the 500 year house, will have to be subordinate to immediate affordability. Also, we are creating customizeable repeatable designs to lower design costs and allow a level of construction drawings not common in residential construction. This means that more of the thousands of decisions required to complete a house will be defined at the outset, therefore increasing efficiency, reducing confusion, and allowing more accurate cost estimating from the contractor.

b. **Functional square footage.** Our approach of combining indoor and outdoor rooms allows a smaller indoor footprint to deliver equivalent useful living space to that of a larger building. We call this "functional square footage". Since outdoor rooms are less expensive to build, our functional square footage price will be substantially lowered in comparison to the price for our interior square footage alone. This will bring the overall price of our buildings more in line with their conventional counterparts which consist solely of indoor space.

c. **Paradigm shift.** Of course, construction costs are only one component of the complete cost of a building. Better efficiency and durability mean lower utility and maintenance costs. You start saving money immediately when you move into one of our houses. In the end, we intend to be part of an educational movement that adjusts the present short-sighted definition of "cost" to include the financial, environmental, and social costs of the entire life-cycle of the building. We feel strongly that this paradigm shift is a prerequisite for moving toward a sustainable built environment locally and beyond.

(16) **Construction management.** Performance values, cost estimates, and aesthetic renderings are only theoretical. Their manifestation in the real world requires careful follow

through of design in the construction process. There are presently no local codes or regional certification programs that might guide builders to realize the performance standards inherent in our designs through the construction process. Therefore, it is important that we work closely with builders to realize our designs. As we grow, we'll establish training sessions for builders and a tie-in to the local Healthy Built Home certification standard. Right now, we are careful to help clients choose builders who are on board with our approach and who we feel have the skills required to carry the design through. In addition, we have created our own internal certification procedure that requires that we be on-site to review critical junctures in the construction process.

Working With Us Through This Transition

A central point to make here is that we have completely committed ourselves to the propagation of high performance natural buildings using the system outlined here. If we do the design, it will use this approach. After a number of these houses have been constructed and monitored, we'll be able to function like any other design firm. To lower design costs and insure the most efficient integration of all passive and active systems, we plan to offer a series of customizeable package designs, but we'll also be available for full fledged custom design.

The pivotal unknown right now is price. At present we are working with EcoConcepts (creators of the Hudson Street and GAIA green building communities) on a single family home in west Asheville using the materials, systems, and construction approaches outlined in this document. The design phase is well under way and the contractor is chomping at the bit to build it, so progress should be quick. This building will serve as an analysis model for our future projects. More immediately, we will use this design to create a study set of plans for review by several local contractors with whom we work closely. We will ask them to price all three wall systems and other variations. Since we will be specifying systems, finishes, and outdoor space, these estimates will be fairly inclusive and should give us a useful square footage price for the building system as a whole and a comparison price for different wall systems.

We hope to have pricing on the study set completed by the first week of December. That is most likely the earliest date at which I'll have meaningful pricing numbers to offer. At present, we have five clients who have been on hold as we finish the groundwork to be able to make a complete transition to this building system. If you are at all skeptical or have the time flexibility, you may want to wait until a house has been completed or at least detailed pricing analysis has been completed before partnering with us on a design. At the same time, I need to keep cash flow happening to pay salaries, so we are ready to schedule the next design as soon as any of you want to commit. Any floor plan that we develop could be used with a different insulation envelope and mechanical systems, so I propose that we move forward on floor plans. If you get cold feet about our full approach or don't feel you can afford it, then you can take the floor plan to a conventional green builder and build it to their specifications.

I realize this is a huge amount of information to take in and that you'll have questions. After reviewing this document, feel free to call me at 828-230-9857 either to set up an appointment or to discuss things on the phone.

Onward!