D Acres of New Hampshire

alternative building workshop july 10th 2004!!

Welcome to our July Alternative Building Workshop here at D Acres! We are so excited to share with you the joys and wonders of building with natural materials! There's nothing like the smooth, organic undulations of earthen walls that are sculpted around the places we live, in contrast to the monotonous lines of our conventional building. What fantastic creations we make on the outside are reflected inside us. Similarly, what dreams and aspirations we have we create around us. This form of building isn't just beautiful; some of you may have come because you are a dreamer, like many of us, seeking a future that rides upon the whispers of earth's wisdom, rather than a toxic waste dump. Some of you may have come just because you like the hardy feeling of sticking your hands or your feet in mud! Whoever you are, we welcome you!

Contents:

1. Adjustments to the Cob Cooking Complex

In the fall of 2002, our friend Joy brought us the creation of the **cob oven**. You can find Joy's documentation of the whole project on the web under "Articles and Useful Links" at the D Acres website (www.dacres.org). Since then, not only has the oven brought *us* joy, but birthed many pizzas and loaves, among other goodies. In addition, the elegant **benchwork** was added to the cooking complex last year and this spring saw the addition of the two graceful **burners**. Like all things that look good on paper, they need some tinkering when brought to reality. The burners we have just made this spring need a couple adjustments.

Goal #1: Make a bench next to the burners to sit on while waiting for the pots to cook and to give access to the "vertically challenged."

Sam and Abby have already very graciously laid out the foundations using rocks bonded together with a cob mortar. Next, we must build up the bench using a cob mix (and perhaps apply some creative artwork?).

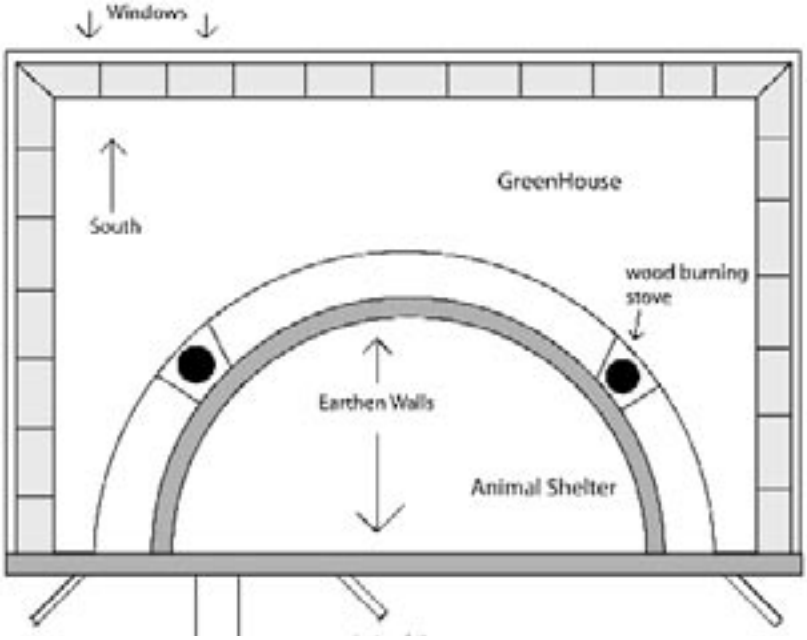
Goal #2: Stabilize the pots and create an airtight seal around the perimeter

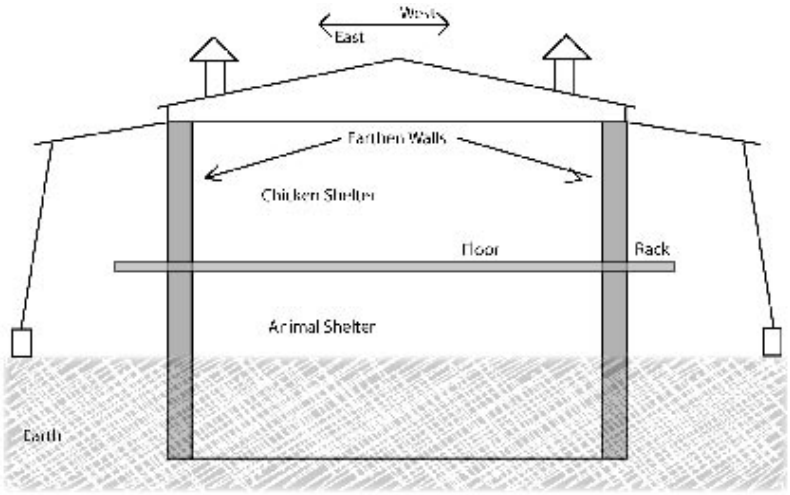
We sealed the pots into the stove and they fit tightly. But there are some honeycombed areas around where the pot are sealed. Apparently we needed to be more assertive when we initially set the pots. For longer life we intend to add some slip to these honeycombed areas. We want to go ahead with this improvement before we continue drying the cooktop. So we will make a batch of slip, bond into the honeycombed areas and reinsert the pots for another week until adequately dried.

Principle #1: When trying to combine an earthen material to a non-earthen material (especially a smooth one), sometimes a fine layer of slip will help make the connection.

2. Preparing to build the Greenhouse/Animal Shelter

For New Hampshire's notoriously short growing season, the greenhouse is essential to help us create the conditions that allow us to stretch out the growing season. The windows allow sunlight in but keep the heated air circulating within it (also known as the 'greenhouse effect'). Our farm animals, the goats and the chickens, could also use some heat in the colder months… so we figure that by bringing the plants and the animals together, they'll efficiently be able to share the heat. In the permaculture way of thinking, you are encouraged to "stack your functions," which means that any system is improved if the function of its components are maximized (Can you think of examples of plants or animals in the farm system that do this? e.g. here on the farm, our chickens eat pests, eat weeds, and give us eggs!). So we thought it would be appropriate to unite the heating of the animals and plants into a single building. Plants and animals need each other – the animals breathe in oxygen and breathe out carbon dioxide, while the plants breathe in carbon dioxide and breathe out oxygen; the manure from the animals can be used to nurture the plants; and both need water to survive. In short, bringing them together not only benefits one another, but benefits us, because we can focus our attention and resources in one place (you sure don't want to be running around more than necessary in the cold months!). Having said that, here is our design:





At this point in the construction, we need to complete the foundations and start making the adobe bricks.

Concrete foundations

Concrete is a substance used extensively in construction today. There are positive and negative qualities to this material. The production of the material is polluting. It is estimated that 10% of CO2 emissions come from concrete production. The material is very caustic (pH 11) until it has hardened. After the material has hardened, it is relatively benign and actually recommended as a building material for people who are the hyper-allergenic. Fresh (green) concrete hardens rapidly in a couple days but takes up to 25 years to fully cure. The estimated lifetime of concrete is around 400 years.

We order concrete from Persons concrete (726-8951). They deliver by the yard. A yard is 27 cubic feet. Concrete costs about $75 a yard. They will make the mix according to your need so specify whether it is footing or a slab pour.

All concrete needs reinforcement. This reinforcement is conventionally provided by the use of hardened steel rods commonly known as re-rod. The rod is submerged in the pour atleast 2 inches from the edge of the concrete so that moisture can not penetrate and rust the metal. The rod is tied together in a grid to provide the maximum support with the least use of materials.

A concrete foundation requires a stable compacted base and a solid form system to hold the weight of the material. The walls of the form must be solid to hold the weight of the concrete. A poor form will collapse and make a terrible mess. Concrete is permanent so take your time getting ready because it will be there for your lifetime unless you jack hammer it out. OOOchh!!

a. Site Evaluation and Design

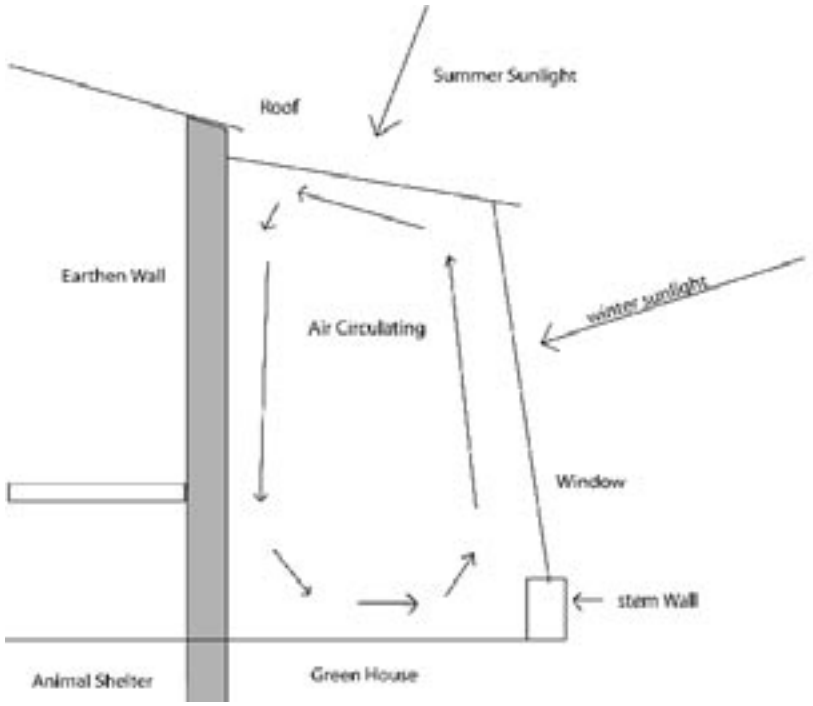
When considering *where* to build, it's important to have in mind *what* it is you want to build. Environmentally-sensitive building pays particular attention to how the functions of the building will suit a specific site.

Principle #2: Site and function go hand-in-hand.

In this case, our planned building has a double-function: as a greenhouse and an animal shelter for the winter. We need places for the plants to grow and the animals to live, as well as a way to trap sunlight and manage the flow of heat between them.

Our site – The placement of this building takes into careful consideration several factors. For one, because it will need relatively **frequent attention** (more than once a day), it is beneficial to be placed **near** to our main building (the Community Building). In addition, all natural buildings benefit from improved **drainage**.This building is on a **slope** that will take water and melting snow away from the building.

Using the Sun's Bountiful Energy - Since the winter sun moves closer along the southern horizon in the winter season, we want most of our windows facing the south. In the summer months, when it's hot, the sun will be directly overhead. During the hot months the sunken foundation and thermal mass of the walls will moderate the intense solar energy.



Materials - In addition, we need a way to trap the sun's energy. As light enters from the south, it will hit the back wall of our greenhouse, where we need a material that will hang on to that heat. It just so happens that earthen materials are excellent for this. Mud, like water, is considered **thermal mass**, which means that it absorbs and releases heat well. Straw, on the other hand, is an **insulator**, which means that it creates a barrier against heat. In natural buildings, you can use a spectrum of more earth or more straw to give you the thermal mass to insulator ratio that you want.

Principle #3: A natural building design should consider the ratio of mud and straw, given that one is thermal mass and the other an insulator (respectively), to achieve the desired effect.

On one end of the spectrum is straw bale construction, which incorporates the most straw and is the best insulator. On the other end is adobe, which uses the least amount of straw and contains more earth for thermal mass.

Based on these considerations, we decided that adobe was the best material to use on the back of the greenhouse. During the day, the adobe will take in the sun's heat and, as a property of thermal mass, will emit that heat during the cooler nights. We will continue with our discussion on adobe later in the "Making and Using Adobe Bricks" section. The northern wall of the animal shelter, because it will not be exposed to the sun, would do better with a more insulating mix and higher straw content.

It is also important to note that the lower half of the animal shelter is partly dug into the ground. This provides us with several advantages. For one, although it takes some work to dig down, it saves you construction material and time for the building up process. It is harder to build a taller wall. In addition, it also helps with the temperature management, because when you are below ground you are less prone to temperature fluctuations (in a sense it "grounds" the temperature, much like for the purpose of neutralizing an electrical current).

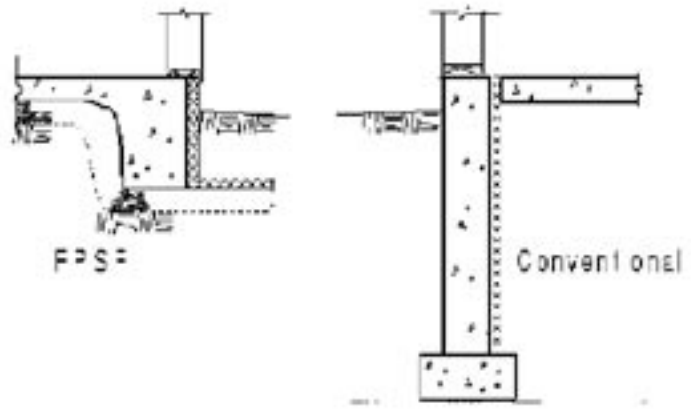
Lastly, it is important to have an idea of what the **soil content** is where you plan to make the building. You should take into consideration how far the materials you plan to use will have to be moved.. Ideally, you could use the soil directly beneath where you plan to set the foundations, since this is the most minimum impact form of building. If you have to import materials from other locations, consider whether it is accessible by wheelbarrow, or the costs of using fossil fuels. We will go into what ideal soil is for construction in the "Making Adobe Bricks" section later. As it turns out, the soil we dug up from the foundations can be used in the making of the adobe bricks, so we will be using it in our mix.

b. Laying the Foundations

One of the most important factors to think about to make your natural building last longer is the wetness factor. It is said that a building with "a good hat and boots" will be able to hold off water. The hat is an appropriately designed roof, but since we are working on the boots here, or the foundations, we will focus primarily on this aspect. The purpose of the foundation is to provide support for the load of the structure as well as to protect the walls from water. The concrete foundation serves as a permanent base from which to build. The foundation must resist the freeze thaw cycle as well as bring the walls up safely above the level at which rain or ground water could damage the base of the earthen walls There are two ways to go on this – sink the foundations below the frost line or float it.

Alaskan Slab

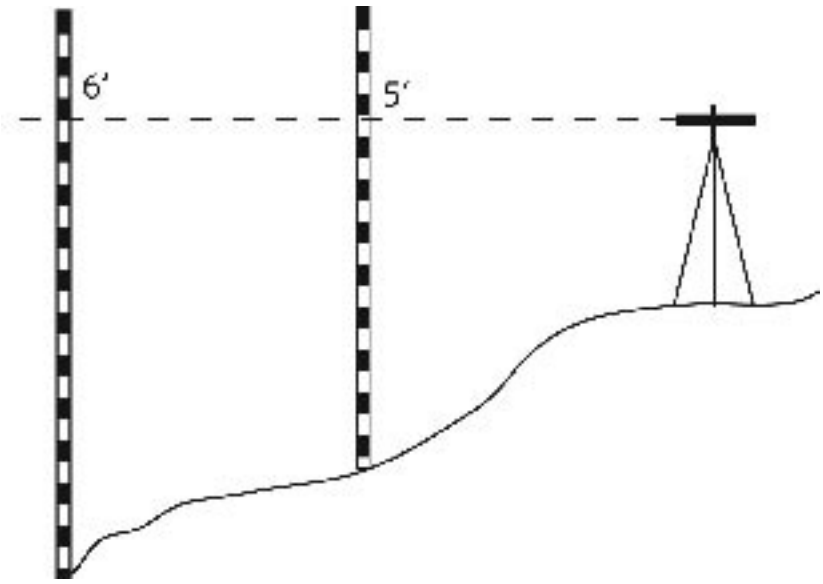
Conventional Footing Stem Wall System



The greenhouse/animal husbandry building foundation is formed as a sunken Alaskan Slab. It is a half circle with the curve facing south. The diameter is 18" on the east/west axis and the outside wall is 9' from the center of that wall. The perimeter of the slab is 16.1" deep for 16" towards teh center and teh rest of the slab will be a nominal 7". We are ordering 3 yards of concrete approximately .5 yards more than calculated. The rebar grid is positioned 3 inches down from the height of the concrete.

c. Using the Transit

The transit is a precise building instrument. It should be treated with care to insure a long working life. Set up and storage must be done meticulously for continued accuracy. When properly set up the instrument shows the same level (height) in a 360 degree circle. Thus you can establish a fixed point of reference and evaluate all other elevations in relation to that set point. This illustration shows how if the rod reads 5ft at B and 6ft at C then there is a 1' drop in elevation between the two points. If C reads 7ft and we do not want a 2 ft drop between B&C then we would add material until we reached the desired slope.



Goal #3: Learn to use the Transit.

d. Making Adobe Bricks

Adobe bricks are made of earth, water, and usually straw that are molded and dried in the sun. They have a long history of use, especially in this country by the indigenous peoples of the Southwest and Northern Mexico. The Taos Pueblo in New Mexico is the longest continually lived-in structure in the U.S. with over a thousand years of inhabitants in the same adobe buildings (with regular repair, of course). It is useful for building homes in places with hot days and cold nights, where it can maintain the temperature inside with very little fluctuation, due to its thermal mass character. But, remember, that it is not a great insulator. Compared to cob, an adobe construction is more time-efficient, because you can make all the bricks you need beforehand and, with a little earthen mortar mix, put up a wall in a short amount of time with your ready-made bricks. Cob is difficult to mix and requires gradual construction to allow it to dry, although it is a stronger material.

Soil types – Any given soil is composed of many different components:

- **Topsoil** – this is the dark top layer of soil made up mostly of decayed organic material and living microorganisms. This stuff isn't great for building with but great for growing things, so make

sure you give it to your garden. Most of the stuff you want is in the subsoil.

- **Stones and Pebbles** – you will invariably find these in just about all soils. They're fine in the brick-mix, but if you're mixing underfoot it's a pain to have them, so it might be best to screen them.
- **Sand** – this is the more coarse material that makes up most of any earthen building mix. Earthen building mixes that are too sandy are crumbly.
- **Silt** – this is made up of the finest sand particles and is bad for the structural integrity of any earthen building mix, yet is often hard to avoid. Don't use soils high in silt.
- **Clay** – is composed of microscopic flat plates that bond with water molecules. This property is what gives it its sticky consistency. Earthen building mixes that are too clayey will tend to crack, due to its tendency to shrink when dry.

The "ideal mix" is an opinion that varies between individuals, but **70% sand to 30% clay** is a pretty good ratio. This brings us to:

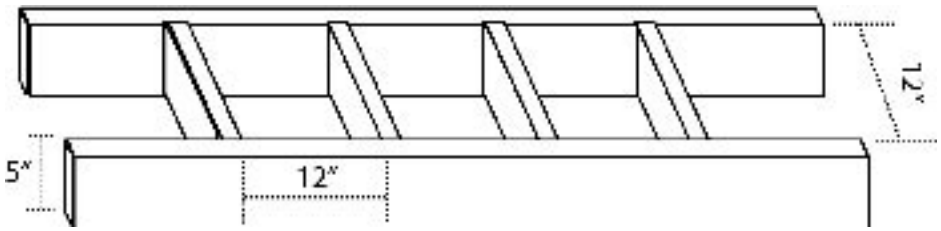
Principle #4: In the adobe brick, we can think of the sand particles as the bricks held together by a mortar, which is the clay, and unified by the straw that acts like rebar.

Testing Soil – So when you're ready to look for your soil, you should go out, armed with a couple jars and a shovel. The shovel is necessary to try to get through to the subsoil, where most of the good stuff for building is. Unless, of course, you're digging your foundations, in which case you already have potentially usable subsoil exposed. Fill your individual jars about half way with your soil samples (ideally they would be screened, too), then fill them with water and a spoon of salt. After you shake long and hard, set the jar down immediately and begin counting. At five seconds, most of your usable coarse sand has settled. After everything has settled, which may take a couple days, you can see all the layers of material in your soil, in this order: sand, fine sand, silt, clay, and organic material will be floating on the surface.

From there, you can get an idea of how a mix of your soils might work. If you find that one sample is very clayey and the other is very sandy, you should experiment with mixing them. As we were digging our foundations, we found that the top layer of orange subsoil was the most ideal composition. Beneath that there was a more compact gray layer that was a lot more sandy, which would require some clay amendments if mixed on its own. Whatever the case, you will find that earthen materials are, in general, very forgiving, and will often work within wide margins of variation.

The next step is to turn your soil into **mud**, which means adding water! Sometimes the mud is a lot easier to work with when it has been soaked in water for several days, but it is not necessary. Don't submerge the soil completely in the water, you want just enough to get it wet, because it is more difficult to get rid of water than to add it. The best and most fun way to mix is underfoot, by doing a little jig, perhaps with a partner. Do this in a pit made either above ground with bales and a tarp or in a dug pit. The mud will make all kinds of joyful squeals and throw kisses as you massage it under foot. When you sense that the mud is well mixed, begin adding the straw, until you can put your foot into it and it leaves a pretty well-formed footprint that holds its shape. Determining the right mix really just comes from experience, playing around with ratios of soil, water, and straw, and possibly making bricks that don't work.

The Brick Molds – When you are designing these the number of brick compartments is up to you, depending on how much space you're working with and the number of people.



An Example of a Brick Mold Design

Site Preparation – One downside of making adobe bricks is that they require plenty of flat space to dry. You will need to clear a space to make your bricks. Wherever it is, consider its proximity to the mixing pits, access to sunlight, drainage, and good circulation.

Once you have your mix, mold, and site ready, wheelbarrow some of the mix to your brick field. Make sure the area of ground beneath the mold is flat, then fill each compartment with the mix, and pressing the mix into corners as you do so to strengthen them. Fill them each to the top but don't worry about flattening them perfectly because an uneven surface will actually help with aeration and will also provide a surface for the mortar to key into when you're building.

Depending on whether you live in a humid or dry environment, the bricks could require anywhere between a couple days to several weeks to completely dry. Even then, we assume there won't be any rain. It's best to make your bricks in the driest season. If you need to cover your bricks, make sure you take the cover off as soon as possible, because circulation is arguably the single most important component for drying, and condensation could eat away at your bricks.

As your bricks dry, you will know if the bricks are too sandy if they become crumbly. If they are too clayey, they will show cracks. It is important to determine whether the crack is just a superficial one, which is common, or is actually a structural one.

When your bricks are dry enough that you can lift them gently without denting or compensating their structure, lift them off of their flat surface and place them on edge, to allow greater circulation and faster drying. This will also free up space on your brick field to make more bricks if you need to. When they are completely dry, you can begin stacking them (and maybe cover them), to make use of your space.

Goal #4: Make as many adobe bricks as possible!

Labor cost and out of pocket expenses:

To date 170 hours of labor have gone into site and foundation preparation. Stone delivery, four hours of excavation and the purchase of rebar and other foundation materials total $896.95.