Introduction

As of September 2009, a 240sf room that will serve as a kitchen to compliment the tire house has walls and a poured concrete flat roof. The purpose of this project is to learn first hand the techniques employed with as well as the drawbacks of earthbag building before building larger structures.

This is a work in progress.

Materials

The main building materials were on-site dirt and polypropylene grain sacks and tubes. Other materials included 4point barbed wire, 2x3 lumber, gravel, tires, pine needles, cement, sand, rebar, tie wire, heat cured bamboo, and dirt bottles.

Soil composition

We considered our dirt by testing it to determine its clay to sand ratio, as well as the clay's stability/expansiveness to see if we should import or stabilize our at hand dirt. Adobe block makers recomend a soil mixture of approximately 70% sand to 30% stable clay be used. If the clay is unstable, a binder such as clay or lime should be used. Fortunatly our soil composition was acceptable without having to add additional material.

It is recommended that the moisture content of the building dirt be around 10%-20%. A simple test of moisture content is to make a small dirt ball in your hand that, when dropped from shoulder height onto a firm surface, breaks into small chunks.

Form and Location

The kitchen was built in a sideways “U” shape with the long walls running into the tire house. The “U” shape was chosen over a rectangular end because of its stronger shape.

Foundation

The foundation is one course of buried tires filled with gravel. The gravel serves as a capillary break to keep the lowest courses of the walls dry. Without it, the compacted dirt in the sacks would wick moisture from the ground, leading to problems including compromised stability/wall integrity, molding, etc. Bamboo stakes were driven into the ground and protruded above the gravel filled tires to tie the first course of earth bags into the ground for added stability.

Proper drainage is paramount for earthen wall integrity. Changes in internal humidity cause a swelling and contracting dynamic, similar to freeze-thaw action that can destroy the clay to sand matrix, which holds the adobe together.
Walls

The walls were built using a technique called superadobe, developed by architect Nader Khalili. Grain sacks and tubes are filled with adobe dirt and compacted into a solid layer with subsequent layers packed on top to form built-up courses of adobe “logs.” These “logs” are more efficient than traditional adobe blocks as they are made in place on the house wall. There is no need for forms, drying time of the mud, nor moving the heavy, fragile blocks. Additionally, super adobe is stronger than traditional adobe for several reasons. Super adobe walls are wider and thus more stable than normal adobe blocks. Super adobe is made with much drier dirt than adobe blocks resulting in a tighter matrix of bonded clay to sand particles, or denser and stronger “rocks”. Super adobe structures are built using two strands of 4-point barbed wire that keeps the bags from sliding on themselves as well as adding tensile strength to the adobe.

A concrete bond beam was poured on top of the bag wall, tying the whole structure together at the top. Additionally, three hollow dirt bottle columns were built at strategic locations along the walls with the centers filled with reinforced concrete for added structural stability where the walls didn’t come out plumb.

Framing Doors and Windows

The door and two windows were formed using wooden box forms. Pieces of 2x3 dimensional lumber were incorporated into the walls flush against the box forms so the frames can be easily anchored to the structure. The arched openings were created from wooden arch forms reused from the tire house and set on top of the box forms. Arched openings are far stronger than horizontal lintels and add a pleasing aesthetic appearance.

A wooden lintel was put into the back wall where a door could be knocked out of the dirt bags for a possible future addition. Pieces of 2x3’s were incorporated into the wall for anchoring the new door.

Roof

A structural four-inch poured concrete flat roof was chosen. Concrete vigas support the load of the roof in the middle of the room. Cut glass bottles were placed in the roof pour to allow natural light into the kitchen.

Patio or Rain Water Harvesting System
A covered patio area that will serve as an outdoor room was built in front of the earthbag kitchen. The patio’s roof, corrugated sheet metal, harvests rainwater into a cistern. Before entering the cistern, the rainwater passes through a first flush system to clean it. Black conduit piping full of water lies on top of the metal roof as a heat sink for a solar shower.

**Dirt bottle water towers**

Two of the dirt bottle columns supporting the earthbag walls continue above the roof and store water. One is connected to the solar shower, the other to the wood stove inside the kitchen. When the wood stove is in use, galvanized pipes built into the stove circulate water from the tower through the fire, heating it.

**Wall finish**

In progress

**Floor**

In progress

**Potential/foreseeable problems**

In progress

**Total Cost/Actual Cost**

In progress

**Innovation and Replication**

In progress

**Implications**

In progress