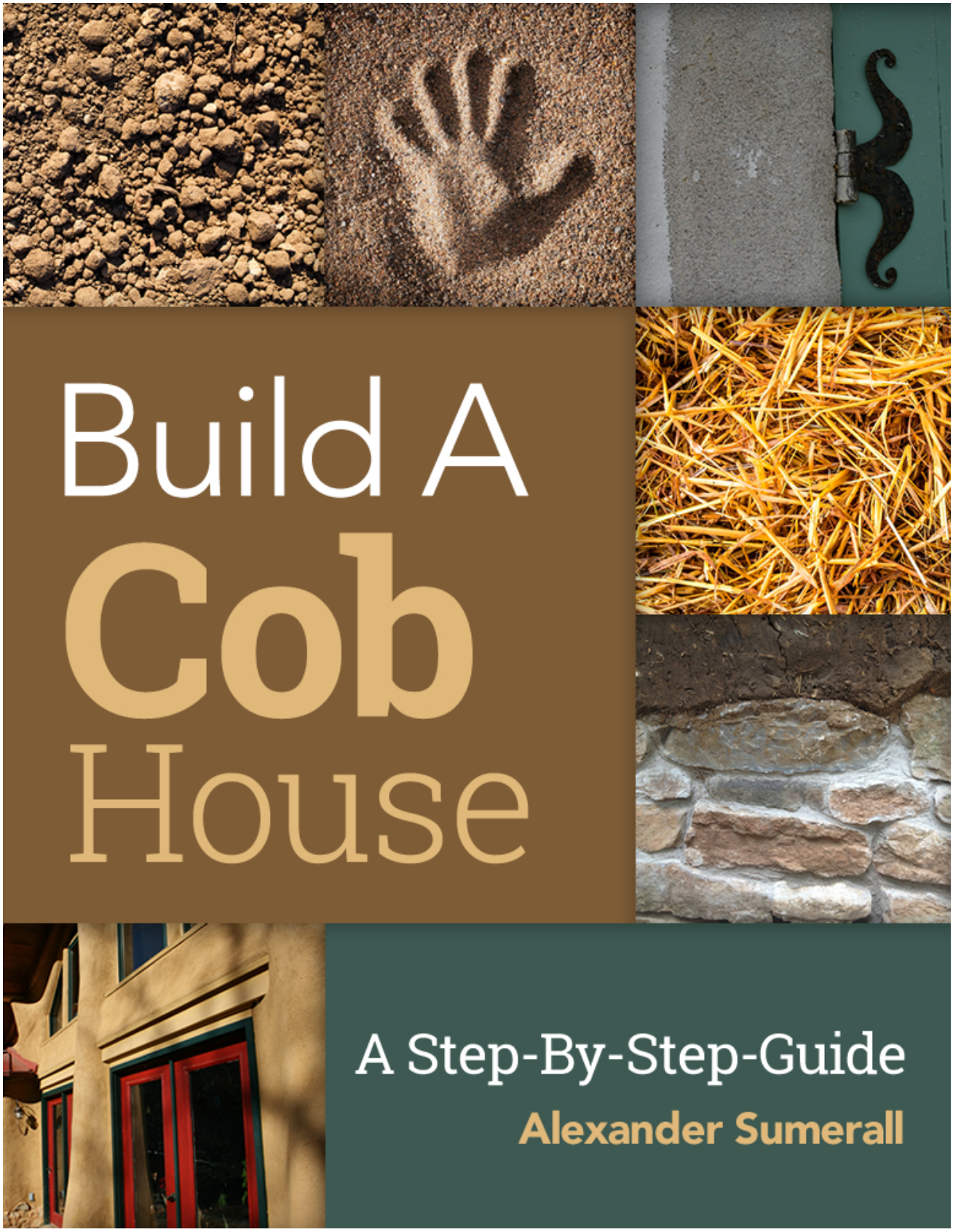


Table of Contents

- **Testing and Selecting Soil**
  - Soil Tests

- **Site Preparation**
  - Tools
  - Materials
  - Layout

- **Foundations – Basic Principles**
  - What is the foundation? Why is it so important?
  - Rubble Trench
  - Stem Walls

- **Rubble Trench Foundations**
  - What is a rubble trench foundation?
  - Instructions for Building

- **How to Make Cob – Tarp Method**

- **Analyzing Cob Test Bricks**

- **Mixing Cob with a Tractor**
  - The Purpose of Mixing Cob with a Tractor
  - What You Will Need
  - How to Mix Cob with a Tractor

- **Cob Mixing – Problem and Solution**

- **Building Cob Walls – Properties and Dynamics**
  - The Basic Process
  - Monolithic Building
  - Spine and Ribs
  - How Thick Should Cob Walls Be?
  - How High Can You Build?
  - Vertical and Tapered Walls
  - How High Can You Build Each Day?
  - Working Up High

- **Building Cob Walls – The 4 Step Method**
  - Place
  - Knead
  - Stomp
  - Trim

- **Windows and Doors**
  - Lintels
  - Frames

  - Deadman Anchors and Installing Frames
  - Non-Opening Fixed Windows

- **Roofing**
  - Basic Roof Components
  - Gable Roofs
  - Ceilings

- **Natural Finishes**
  - Earthen Plaster
  - Lime Plaster
  - Lime Wash
  - Tadelakt

- **Installing Utility Lines – Electricity and Water**
  - Electrical Lines
  - Water Lines
  - Foundation Integration
  - Access

- **Beginner Cob Projects**
  - Cob Oven
  - Cob Bench
  - Cob Garden Wall
  - Cob Dog House or Play House

- **How to Get Training and Learn More**

Introduction to Cob and Natural Building

What is Cob?

Cob is a building material made out of clay-rich soil, aggregate, fiber, and water that is pliable and can be sculpted into walls for buildings. Many people are familiar with a similar building material called "adobe", which has similarities, but cob does not use bricks or forms as adobe does. Cob is more of a free-form material, and to build with cob is more like sculpting than it is building. Cob has been used and tested for thousands of years all over the world, and has proven to be a very viable building material.

Until recently, cob has been virtually unknown to people in modernized places. About twenty years ago, there were no cob builders in North America. But since the 1980s there has been a revival in cob building as the interest has risen in sustainability and the use of local resources. People all over the world are now learning and reviving this ancient building technique.

This revival is coming at a very opportune time as well. As materials and resources become more scarce, prices are rising and construction is becoming more expensive. Cob and other natural building materials are offering great alternatives to these expensive industrially produced materials. They are generally far less expensive and the materials are normally much more available.

Cob offers answers and solutions to many of the problems that ail our buildings today, and people are very excited and enthusiastic about building homes out of cob. Cob is making a comeback and its even gaining popularity in regions where it doesn't have a past history. Building with cob is not about returning to the past. It's about moving forward to a more sustainable, healthier, and wiser future for building.

What is Natural Building?

Natural Building is the term used to cover a wide range of building systems and materials that put emphasis on sustainability, renewable resources, healthy living environments, lessened environmental impact, and heightened architectural design.

The term Natural Building is generally referred to whenever talking about constructing buildings out of natural, non-processed materials such as earth, straw,

or stone. Its very elemental in its nature, but at the same time is a very conscious and planned building science. The core of Natural Building stems from very old and ancient building practices. Today, it is a fusion of ancient and modern to create something beautiful, functional, and healthy to live in.

- Major emphasis on **sustainability**
- Use of **natural**, **renewable** materials
- **Healthy** living environments
- **Less** environmental impact
- **Heightened** architectural design

How else does it differ from conventional building?

- Heightened emphasis on architectural design aesthetics. Escapes the boxed, cookie-cutter styles of most modern buildings and reaches for traditional styles, creativity, and interesting design.
- Building compactly and minimizing the ecological footprint. Not necessarily always building smaller buildings, but designing spaces more efficiently without wasting square footage.
- Utilizing orientation, climate, site conditions. Conventional buildings almost never take these factors into consideration. You can find almost identical homes in the deserts of Arizona and the frigid tundra of Alaska, and they're both at a comfortable room temperature. Conventional homes like these are basically hooked up to life support systems to make them livable. On the other hand, Natural Building emphasizes using natural energy sources and designing according to climate and site in order to create comfortable living spaces.

Vernacular Architecture

Natural Building has much of its roots in vernacular architecture from peoples all around the world.

> *"Vernacular architecture is a category of architecture based on local needs and construction materials, and reflecting local traditions.*
>
> *It tends to evolve over time to reflect the environmental, cultural, technological, and historical context in which it exists." (Source: Wikipedia)*

- Based on addressing people's basic need for shelter
- Makes use of natural resources in the locale
- Traditional architecture methods
- Adapted to local region and culture

- Focused on connectivity of community

Each bio-region will have its own expression of architecture based on materials available and climate. This runs parallel to the principles of Natural Building where a building should be reflected by the local climate, resources, and cultural context.

Material Qualities

- Readily available
- Locally-sourced
- Bio-Regional
- Affordable
- Economical
- Sustainable
- Non-toxic

Building Methods

- More accessible
- Done with hands and simple tools
- More user-friendly

Building Principles

Some of the core principles of Natural Building are:

- Longevity
- Functional
- Ecology of design
- Aesthetic vs. Function (balance)
- Culturally specific
- People-centered
- Harmonious with the landscape

Building Materials

There are several building systems and materials that fall under the umbrella of Natural Building. Some of the main ones are:

- Adobe
- Cob

- Rammed Earth
- Earth bag (superadobe)
- Straw bale
- Light straw-clay (slip straw)
- Timber framing
- Stone

Earthen Building

The very earth that we walk upon every day is the same thing that people have been using to construct magnificent buildings with for thousands of years. Some estimated two thirds of all people on the planet today still live in earthen dwellings. There is absolutely nothing new about earthen construction, but to the western world we have lost so much sight on how the world functions outside of our domains that we see earthen building as strange and unfounded.

Most people in modern society have such misunderstandings and misconceptions about earthen building that they shun it and view it as dirty and primitive. They wonder why anyone would want to live in a mud hut! If only they knew the beauty that this common material could produce!

The time for earthen building to reemerge and blend with modern society is coming closer. To show people what is possible for the future of building, we can first take a look at the past and present time for a few examples.

Walled City of Shibam

The city of Shibam is located in Yemen and is famous for its high rise mud-brick tower homes. The city was established in the 16th century and is still standing strong today. The people still build with the same traditional methods as their ancestors did.

The country of Yemen is filled with many extraordinary examples of earthen building like these.

Sultan Al Kathiri Palace

The Sultan Al Kathiri Palace, built in the 1920's, serves as one of the most prominent landmarks in Yemen.

(Photo credit: JialiangGao, www.peace-on-earth.org)

City of Bam

The city of Bam is located in Iran with a history dating back about two thousand years to the Parthian Empire.

(Photo credit: Wikipedia - Bam, Iran)

Advantages of Earth Construction

There are several important advantages to earthen construction methods. These advantages apply across the board for: cob, adobe, rammed earth, as well as earth bag construction.

Low Cost

The raw materials required for earthen building are widely available around the world at little to no cost. (Soil, Sand, Straw, Water) Earthen building materials also don’t require any high energy processing or manufacturing activities like wood, cement, and fired bricks do.

Despite the cost of the materials being low, prices for earthen buildings vary dramatically around the world. Luxury earthen homes in the American southwest can cost hundreds of thousands or even millions of dollars. At the low end of the price spectrum, somewhere on the other side of the world, you might be able purchase a smaller earthen dwelling for about the cost of your Starbucks latte and afternoon meal.

Earthen construction is perfect for the do-it-yourself builder though. The material cost is low, and there is usually very little outside labor that has to be paid for. An electrician and plumber may be necessary for some help on the job, but otherwise

you can do the vast majority of the labor on your own. If you put in the labor to build with earthen materials then you will save a considerable amount of money.

Indoor Temperature Regulation

Soil from the earth has proven to be a very suitable and successful building material throughout the world's many climates because of its ability to regulate indoor temperatures. Earth is a poor conductor of heat, has low thermal conductivity, and has high thermal mass.

Beauty

Earth buildings have been constructed all around the world and have many unique styles. They tend to be more attractive and colorful compared to their counterparts built with wood, stone, or fired brick.

Flexibility

The plasticity of earth materials allows for decorative ornamentation and roundness of corners and openings giving a soft feeling.

Strength

When dry, earthen buildings are extremely strong and durable resembling that of stone. Fortifications used to be made with these materials because they were so strong. Bullets can barely penetrate a thick earthen wall and they are nearly impossible to dig through.

The strength comes from the density of the soil under compression. This density also makes earthen walls soundproof. We also can't forget to mention, earthen walls are fireproof too!

Earthen buildings have lasted intact for thousands of years. There are also cob homes in the United Kingdom that are hundreds of years old.

Characteristics of Cob Homes

A cob home will have a very distinct and unique quality to it that you will not find among conventional homes. Living in a cob house is more than just being in a shelter. It includes a unique experience that is both uplifting and healthy to the inhabitants.

Here are some concepts and advantages of cob homes to consider:

Small

Cob homes can be built to any size, but they are typically known to be small and size efficient. There are many reasons that they are often built to “tiny home” standards. Most builders and residents of cob homes understand and appreciate keeping things simple and down to earth. You won’t often find cob homes built to mimic the McMansions of conventional mainstream designs.

Cob homes are also labor intensive to construct and they are often built by the owners. It is usually more intelligent and efficient to only build to the size of your everyday needs.

Local

Building with cob falls under the umbrella of Natural Building. So it follows the principle of using natural resources which can usually be found in the local area. A cob house can be built from the earth right beneath the building site, and whatever natural resources (sand, gravel, stones, timber, etc) not available on site can usually be sourced locally.

Artistic

People are drawn to cob homes in a large part due to their beauty and creative designs. Builders are not limited to ninety degree angles and they can sculpt and mold cob to whatever shape they desire. There is so much room for creativity and flexibility of design when it comes to building with cob that you can’t have with most other building techniques. You can more freely use your imagination when building with cob. A cob home could be considered a place of shelter but could also be considered as artwork.

Natural

The main ingredients for making cob are: soil, sand, and straw. These are all natural resources. A cob house is not mainly composed of synthetic materials, but is built instead out of natural materials found in nature.

Social

Building a cob home can involve your community and friends to come together in the construction. You do not have to be an expert to help in the building process either. Even children can help build in many instances. Building with cob can be a good social activity and is good for strengthening a community.

High Standards

A house made out of cob is actually a high standard home when done right. Many uninformed people would label a house made out of materials such as mud as a poor living environment like something that would be found in a third-world

country. However, this is just not the case. On the contrary, a standard conventionally built home could easily be considered low standard if you think about all of their negative health effects they can have upon their inhabitants.

Energy Efficient

With a cob house, you will not have to heat or cool your home with as much electricity.

Cob is a "thermal mass" that absorbs sunlight and warms the building over the course of the day. This is called passive solar heating. It will keep the inside of the building warm in the winter and cool in the summer. The thick cob walls act as a natural temperature regulator for the interior of the building.

Can Be Less Expensive

The primary materials for cob are: clay-rich soil, sand, and straw. These are very easily accessible and cheap resources to acquire. Other parts like windows and doors can also be salvaged or purchased as used from restoration depots or dumps.

People have built high quality cob homes for as little as a few thousand dollars. But it all really depends on what you want your home to be like. Cob homes can be built for much less if you decide to be frugal and want to lead a simple life.

Owner Built

Cob houses can usually be built by the owner. You don't need a degree in architecture to design one or to be a structural engineer to build a simple cob home. Many people can build their own homes just after taking a comprehensive cob building workshop.

Its very rewarding to be able to build your own home with your own planning and labor.

Healthy

Unlike conventional homes which are constructed with synthetic, industrially produced materials, cob homes are built primarily out of natural, non-toxic materials when the principles of Natural Building are followed.

Conventional homes and buildings are full of indoor air pollutants and off-gassing of chemicals contained in the building materials. Cob homes do not have this same problem. In fact, cob actually "breathes" through its tiny pores and keeps air fresh and clear. If you suffer from indoor allergies then living in a cob house could significantly improve your quality of life by filtering out the toxins or triggers that may cause them.

Strong

The straw in cob is like a natural re-bar which helps to hold the whole structure together as one monolithic piece. This makes cob homes more solid and resistant to earthquakes.

Many cob homes have lasted for hundreds of years with minimal upkeep, whereas conventional stick-framed structures generally survive only a few generations. Build a cob home for your family and it will last for many generations to come.

Acoustic Privacy

Earthen walls have very good sound-absorbing properties that keep it quiet inside, both from exterior noises and noise generated in the same building.

Termite Proof

Since cob is a mixture of soil, aggregate, and straw it is not attractive to termites. To add to that, cob homes have not been known to become burrowing grounds for insects or animals either.

Fire Proof

Cob does not catch fire. However, still be aware of your ceiling or roof as it likely won't be flame resistant like the body of the cob home.

Selecting a Building Site

Surveying and analyzing for site selection is a critical first step in building a home. It should arguably be done before any building design, layout, or construction takes place because it can have a large influence on the home design.

One great advantage that you have as an owner-builder, instead of a commercial builder, is that you can take the time to acquaint yourself with your site's climate and the character of the site's landscape and environment. Knowing how these features can interact with your building is important.

Selecting a site can get intricate with all of the variables to consider, but its really not as difficult as it might seem. However, its not just as simple as picking out a location that you think is the most pretty or picturesque. You will soon discover that no two sites are ever exactly the same, and each one will require an individual analysis.

Here are some of the major things to consider when selecting a site for your home.

Slope

The slope of the land will be a major factor in selecting your building site. The steepness of the slope across the site will affect how you build your foundation and what earthworks you might need to perform.

Its harder to build on a steep slope for various reasons. It requires a foundation built to compensate for the grade of the slope, it can hinder road access, and steep slopes can also block sunlight.

Sunlight

Whether you want sunlight on your site will depend a lot on your climate. Hot, desert climates are places where you are probably going to design to limit sunlight exposure on certain areas on and around your home. However, for temperate and cold climates you are going to be interested in strategically aligning your home to capture sunlight for warmth in those colder months.

There are a lot of things that you can change about a building, but the alignment it has to the sun is not possible to change later. Be familiar with the sun paths in the sky at your site location and come up with a solar design strategy. Its best to spend as much time as possible at your site to observe the sun patterns.

Placing your building according to your solar design strategy is one of the most important siting tasks.

For a solar design strategy, you want to know things like if there are trees or buildings that could obstruct the sunlight from getting through and causing shading on your building. In cold climates, its not good to have sunlight obstructions to the south since you get the most daily sunlight coming from this direction.

Determining sunlight exposure is easy if you’re building in flat open land. Just use a compass to orient to your building’s passive solar design, but it can be more tricky when you’re in the hills.

If you’re in a cold climate especially look out for things that will obstruct the sunlight in the late fall, winter, and early spring when the sun path is lowest and this solar heat is most needed.

The sun's path on the winter solstice (December 21st) is the lowest that it will be for the year. Observing the sun path on this day will help you to determine if you'll get full sun all year or if you'll have obstructions. This winter solstice sun path marks the bottom of your "solar window". The top of your solar window can be observed on June 21st which is the summer solstice.

If you're in a hot climate, you can use the same principles to shade your home in a hot climate using landscape features.

Water

Water can also play a big role in selecting an appropriate site. Water can be a great blessing to have, but it can be a detriment to your building if you're not careful in selecting the right location.

Observe the contours of the land on and around your site. Don't build where water will naturally flow unless you plan to make physical changes to the landscape to redirect water.

A site that has a slight slope will also drain better than a completely flat site.

Avoid sites that slope inward toward your building as this will only pool water in around your foundation. Its best that the water can naturally drain away from your building.

If you have high grounds or hills around your building site, also look for drainage channels or signs of erosion and water overflow. These can indicate large amounts of water drainage onto your site during heavy rainfalls.

Also, be sure not to build in a flood plain zone. Land that lies near to a river, stream, or other drainage route can be designated as flood plains. Its also wise to ask neighbors if there have been any floods in the area in the past 100 years and where they may have reached to in elevation.

Soil

You want your building to stay in place and set on a foundation that doesn't move. This requires that you have a stable soil structure beneath your foundation. The soil should be solid and dry with load-bearing capacity.

Determining the type of soil that you have can be determined by digging a hole where you want to build. Dense clay is a good subsoil and foundation for just about any modestly sized home that you could think of.

Loose and airy subsoil is not as adequate, but look at other buildings in the same area that are built on similar soil types and see how they are holding up. You can also see how large and heavy these buildings are and how they're doing seated on top of this type of soil.

If you're building a small structure then its more than likely that the subsoil will be adequate to support your lightweight building.

Wet soil should raise a red flag. If you dig down and find water then you are best to find a different location that isn't wet.

Only build on undisturbed soil. This means soil that has never been excavated, cultivated for crops, or been leveled with fill dirt. You could dig past the deepest point of cultivation or past the fill line to set your foundation but this requires more work and can make your foundation more expensive.

The main take-away is to only build where you have solid, undisturbed ground and don't settle for less. Your foundation is too important to cut corners on. If you're not sure about your soil being appropriate to build on then I recommend consulting a builder or engineer in your area for some expert advice and soil reports.

Access

Most importantly, you want to make sure that you will have road access to your building site. Also make sure that the roads are wide enough and supportive enough for heavy trucks to deliver materials if that's what you are going to need.

Keep in mind that building up on high hills or peaks can have the most beautiful views, but remember that these are usually the most difficult places to get access to and building roads up steep hills can be very expensive work.

Resources

The site that you select may also be determined by what natural resources are nearby or underneath you that can be used to build your home with.

Remember to test the subsoil compositions at your proposed building site to see if it can be used to make cob.

Also be aware of your utility locations such as water, electricity, and sewage.

Restrictions

There are a few main things to pay attention to in the category of restrictions.

Be aware of your property lines so that you don't cross them. If you're building close to a property line then know the setbacks for buildings in your area. Setbacks determine the minimum distance each house wall must be away from the nearest property line or street. The setback distance will vary by city and the zoning category as it pertains to that city.

Some places, such as those with subdivision or neighborhood covenants and homeowners associations, have regulations that push you to build to a conformed building style like everyone else in that area.

Also check with your city or county zoning regulations and investigate your local building codes. However, these are things that are just going to lead to red tape and extra expenses in most places.

If you're building in a rural area these things are worth looking into as there are usually far fewer restrictions and requirements or none at all. However, there are no official building codes for cob buildings yet, and going through the building department will only result in delayed progress and extra expense.

Designing Your Cob House

Designing a home is an art and skill in itself. It encompasses a wide variety of subjects and takes into account many different variables. At the same time, design it is not rocket science and is a skill that anyone can learn and understand. How much time and effort it takes to design your home will depend on the complexity of your building, its systems, and your approach.

Its very important to develop a vision for your home and have a design. You don't need to have blueprints, 3D renderings, or anything fancy, but you do need to

know consciously and confidently in your mind what you're trying to construct. Building something without this vision can easily lead to failure.

You should also know, and it might be a comfort if building a home seems overwhelming to you, that there is no right or wrong way to design a home. Your house design will be what you make of it. This is an opportunity to let your imagination run free, to create a warm, happy living space that you can call home. Envision what you want to live in and apply some basic guidelines and principles and you will be amazed at what you can create, both living and functional.

Modern architectural design has directed itself toward the mastery of the natural environment. Contrarily, a major focus with natural building is the application and combination of natural forces to create a harmonious living space. Many of these design principles will be discussed throughout the course.

In this article, I'll overview some basic design principles that you may want to consider for your cob home.

Selecting a Site

The first step to intelligently and efficiently building your cob house will be to select a location to build on. A few of the main points to consider with site selection are: water drainage, sunlight exposure, sub-surface geology, road access, and any legal restrictions that may prevent you from building what you want there.

I'll be walking you through the site selection process with more details soon. For now, just start thinking about some areas you might like to build on.

Design Considerations

With cob you are liberated from ninety degree angles, boxes, and rectangles which are the norm in most modern architecture.

You do not need to be an architect or professional builder to design and construct a cob house. You just need to have common sense and a determination to get things done. Building with cob is a very vernacular and intuitive building style that common people have used all over the world for millennia.

Conventional materials like brick and wood don't allow you to create the shapes and forms that cob can. Cob is malleable and sculpting which allows you to create a

living space unique and personal to you. No two cob buildings are ever exactly the same.

Building Appearances

The appearance and aesthetics of your cob home will be based on your personal preferences and possibly the surrounding environment.

The resources and materials located and retrieved from your site can also influence the style and appearance of your building. One of the aims of Natural Building is to blend in with the local environment and rely heavily on locally sourced materials.

Cob has characteristics that allow it to be built into many different and unique forms. Its plasticity lets the builder mold and shape their building without limitations like ninety degree angles and boxes. It is quite unlike any other construction material or method of building. With cob, circular and curvilinear buildings can be made too.

Cob lends itself to certain building properties: thick walls, solid, monolithic structure, tapered walls, rounded corners, arched openings, and curves.

Passive Solar

Passive solar design is about designing a building so that it can effectively use the sun's energy to create warmth and light inside a structure. Because cob has a high thermal mass, a cob home has an amazing ability to regulate indoor air temperature. For example, during cold months as the temperatures drop low at night time, the temperature inside the building will self-regulate and rise by release of heat storage from the cob walls to the inside the building. This heat storage is what's called thermal mass.

If you want to take full advantage of passive solar then observe and make sure that your building site will receive plenty of sunlight from the south. Usually, a home build according to passive solar design will be south-facing.

Size

If you are building your first cob house then I recommend that you try to keep your house small. Think quality over quantity. If you keep the building small you will save a lot of money to buy nicer materials and get finer craftsmanship.

Many first time cob builders have tried to bite off more cob than they can chew and ended up with failing projects. Only build as big as you can be guaranteed to finish in one or two building seasons. Building with cob can be very labor intensive and can take a long time. Just keep this in mind when designing.

This is not to say that you can't build large cob homes. Famous cob builder, Kevin McCabe, has constructed a 10,000 square foot cob home (or citadel) in Devon, England. With all of his experience, resources, and might it took him over 3 years to construct it. It really proves that cob can be built up to any scale that you desire.

Ceiling height

One thing that's not thought of a lot of times when designing a house is the ceiling heights. Think about how your ceiling heights should be in relation to each room or alcove. It can change the feel of a room. Ceiling heights are typically 8 to 10 feet high.

Limit the number of doors

Keep one door per room, unless you are trying to make a corridor. It will ruin your experience if you have people constantly going in and out through various doorways in your rooms.

Wall Nooks and Alcoves

One of the fun things about cob homes are the little nooks and alcoves that you can construct into them. They give cob homes some added character and feeling.

Wall nooks are little spaces or cavities that can be carved into cob walls and used to put decorations, candles, books, or other items.

Alcoves are small spaces that are separated from the main body of a space. They work best if the alcove's floor is higher or lower than the main room they come off of. You can make a sleeping alcove, an alcove for cooking, a cozy reading alcove, a coffee table alcove, or a window seat alcove.

Level Changes

Another way to add interest to a home and define changes of mood is to use level changes like a step down or a step up into a new room. You can make your kitchen area higher than the adjacent living area, or a step down to get to your cozy reading space.

Roundness

Cob presents the opportunity to create rounded spaces and sculptures. You can round off your walls to give more comfort to your spaces. Ceilings can also be designed to be lower on one end of the house and higher on the other. Sculpt your spaces to accommodate their functions and moods.

Thermal Mass and Insulation

Earth soil has proven to be a very suitable and successful building material throughout the world's many climates. Consider that nearly half the world's population lives in earthen dwellings. Whether the climate is harsh and arid or temperate with seasonal changes, earthen buildings are winners because of their thermal mass and heat-cool retention.

Note: Many people use the terms "thermal mass" and "thermal retention" interchangeably.

Have you ever been in your garden on a hot day and started digging down into the soil and felt the coolness beneath the ground? The temperature beneath the ground is drastically cooler on a hot summer day than above ground where you're standing.

Also, when its cold outside you will discover warmth beneath the ground.

This is why many desert animals live underground. They can survive the blazing heat and winter freezes by burrowing and living underground.

Insulation

One of the few downsides to cob is that its a poor insulator. This goes for any dense and heavy earthen building material. Light and airy materials make for good insulation.

The two main ingredients in cob, soil and sand, have little conductive heat loss resistance (low R-value). The other highly insulative ingredient, straw, is included in such small amounts that it doesn't usually increase the R-value of the cob.

The theoretical R-value for cob is R-3 for every foot of thickness. Meaning, your cob walls would have to be several meters thick to compare to a strawbale wall which can be R-35 for the thickness of one bale.

But what earthen materials lack in insulation properties they make up for with thermal retention.

Thermal Mass

Cob is also a very poor conductor of heat and has very low thermal conductivity. Meaning, heat from outside has a much harder and longer time to transfer through

your walls and inside your home. Cob (and other earthen materials) will absorb heat, retain it, and then dissipate it back out slowly. Most modern, conventional building materials have opposite attributes. Materials like concrete and fired brick absorb and release heat very quickly.

Cob homes have an amazing ability to regulate the indoor air temperature. Compare the indoor temperature fluctuations between a cob home and a concrete or cinder block home and you will be astonished at the results!

Cob is a suitable building material for hot or cold climates due to its ability to keep indoor temperatures stable. Depending on your comfort levels, this can eliminate the need for centralized heating systems and air conditioning. That's some great energy saving potential right there!

> *"A mud house with walls 2 ft (0.6 m) thick, a well-insulated roof, and minimum-heat-gain doors and windows would have an indoor temperature range varying no more than about 6° – 8° F (3.3° – 4.4° C) year-round in most of the USA without central heating and air conditioning!"*
>
> *- Glorious Mud, Gus W. Van Beek*

Cob's high thermal mass makes it possible for your walls to actually absorb sunlight heat, retain it throughout the day, and then release that heat to the inside of the home as outdoor temperatures lower. Thermal mass plays a big part in designing your passive solar design.

Many people wonder if they can build a cob home where the winters are cold and frigid. I would not truthfully say that cob is your best option for a cold climate if you're worried about your home getting too cold, but I would also not tell you to rule cob out as a viable option either. If you're building with cob in a cold climate, the building's indoor temperature performance will depend on proper solar siting and passive solar design.

There are many alternative natural building materials to cob, but you will have to weigh the pros and cons of each one for your specific needs and wants.

Later in the course I'll talk about hybrid building systems that let you take advantage of more than one type of building material. For example, if you live in a colder climate you could build certain sections of your home using cob and other particular sections with a highly insulative material such as strawbale.

So in conclusion, cob has some amazing temperature regulating properties! It has poor insulation value but makes up for it with its thermal retention. Cob is also a good energy saving material for homes.

Passive Solar Design

Passive solar design is a fundamental concept to understand for building a cob home. Its about designing a building so that it can effectively use the sunlight energy to create warmth inside the structure. To benefit from the sun's radiation for heating, we have to site and orient our homes so that sunlight enters.

We spoke about thermal mass in a previous lesson. This thermal mass is what allows the walls to absorb the sun's radiant heat throughout the day and then transmit it back out into the building space to regulate the indoor temperature. As the temperatures drop low at night time, the temperature inside the building will self-regulate by the heat storage being released from the thermal mass of the cob to the inside the building.

Passive solar design, at its core, is easy to learn, and the basic principles and concepts will take you a long way. I say this so that you don't become intimidated by the thought of any real complexity. By the end of this lesson, you should have a good understanding of passive solar and how to apply it to your building design.

There's only one working part in this mechanism for passive solar energy. That is the Earth's rotation. Passive solar design is something to work into your design with thoughtful consideration, but once your building is up you just leave the rest of the work to the planet and its rotation.

Facing South

Just simply orienting your home to the south (in the Northern Hemisphere), without thought to any other solar design points, can cut your energy bills for heating by 30 percent. This is one reason why passive solar design is so important to apply. You can further increase your energy savings with proper window placements and thermal mass walls.

Going back to site selection for a point here, you want to choose a south-facing site for your building. A south, southeast, east, or southwest downward slope will also open up more "solar window" for sunlight exposure to your structure.

The point is to make sure that your site has an unobstructed sky view mainly to the south. Choose a site with unobstructed sunlight exposure from about 10 A.M. to 3 P.M. for as many days of the year as possible. More sunlight will increase your passive solar potential.

Its most important that there are not obstructions that will block the sun in the cold months of the year when you need the heat.

Face solar south (True South), where the sun reaches its highest point in the day. To find True South, the most accurate way is to first find out what the magnetic declination in your geographical area is. There are some websites that can tell you this based on your location, such as this one.

For example, in Atlanta, Georgia my current magnetic declination is (4° 58′ W). This number is considered as a negative since its to the west so I subtract about 4 degrees to get true south. If its to the east then you add. If my compass points to south at 180 degrees then True South is at about 176 degrees.

If you don't have a compass you can do this. When the sun is at its highest point in the sky at "solar noon", look for any shadow that is being cast by a perfectly vertical object such as a telephone pole. This will show you the True North-South axis line.

Finding True South is not the most important thing, especially when the declination is minor, but it can make your passive solar design more efficient aligning your building to True South instead of Magnetic South.

For the most optimal solar gain, orient the long axis of your home as perpendicular as possible to True South. And as a rule of thumb, don't orient beyond 22 ½ degrees east or west of True South.

The True South direction should be where the south wall of your building is placed and aligned to.

From this direction, extend your arms straight out, at right angles to each other. Your hands will point southeast and southwest. Within your arms, you want about 80 percent of the sky to be visible and unobstructed above the arc of the winter sun's path and below the line of the summer sun's path, which is about 45 degrees above the winter arc.

Again, this might all sound complicated and if it does just stick to the basic premise that your south facing wall should point relatively southward (does not need to be exactly to True South) and that you want to have an open view for the sunlight to shine on your south facing wall as much as possible in the winter months.

Window Placement

The orientation of the building and the placement of windows are important design elements that need be taken into consideration when using passive solar. The intelligent placement of windows is important so that you can get the right amount of sunlight to penetrate inside the building. The sunlight that you want to capture will mainly come from the south, southeast, and sometimes from the east. If you're in the Southern Hemisphere, you would put the windows on the north side instead.

With passive solar design you want to situate your main living spaces of the building between solar south and southwest, with larger and predominate windows placed between the southeast and southwest walls.

Also keep in mind that the sun rises and sets in different locations as the sun "moves" throughout the year. During the winter, the sun rises in the southeast and sets in the southwest. In the summer, the sun will rise more to the northeast and set to the northwest.

Here are a few points for placing windows:

- Don't place your windows too high. This prevents overheating in the summer, when the sun is high in the sky, and it ensures that low winter sunlight enters the building.
- Don't place windows in the north wall as this will just provide a point for heat to escape from inside your building. You don't get the same passive solar benefits on the north wall since the sun is not shining from that direction.
- Some windows can be placed in the east wall to allow morning sunlight in.
- Only add small windows in the west wall and don't add too many. Big windows in the west facing walls can create overheating in the summer time as the sun goes down.
- Be stingy with adding windows unless your climate is mild. Any glass that's not adding to solar heating is constantly letting heat escape when you want to keep warm. Glass is also constantly adding heat to your building when it's too hot outside.
- At the winter solstice, when the sun is at its lowest point in the year, sunlight can penetrate more than twenty feet inside of a building. Keep this in mind when designing. You may opt for a more open floor plan because of this.
- Skylights are nice, but not very intelligent for passive solar design. They let in too much sunlight during the summers and also let precious heat escape during the winters.

More things to consider with passive solar:

- Orient the long side of your house toward the south to get as much sunlight exposure as possible.

- Build roof overhangs to prevent excess sunlight penetration during the hotter months of the year. Since the sun is higher in the sky, the overhangs will block most of the sun rays from entering inside.

- It makes sense to design the inside of your house according to the sun's orientation throughout the day. You can place your bedroom and/or breakfast area on the east/southeast side to capture the morning sunlight. You can place your workspace or living space to the south to capture the most daylight sun exposure, and then, for example, you can put a small nook on the west side to relax in during the evenings. Be aware that sunlight creates a bad glare on computer screens though. Its good to have a sun-free room for things like this.

- Given the outlook of our future situation on the planet, using passive solar design is a big piece to consider when designing your home. You will save heavily on heating costs and might not have to rely as much on fossil fuels to heat your home. The long term benefits of using passive solar design are so big that you would be robbing and shortchanging yourself doing otherwise. A cob home can freely collect heat during the day and warm you at night without costing you any money.

Passive Cooling

As we've looked at in previous lessons, the temperature inside of your building can be controlled by paying attention to building site, orientation, passive solar design, wind paths, and surrounding trees.

With passive solar design we learned that we are able to heat a building with the sun's rays. If we look to nature once again, we will find that we can also cool our buildings naturally and eliminate the need for air conditioning in our homes.

Air conditioning systems have really been implemented to correct flaws in our basic design of buildings. Our modern homes tend to fight against the environment surrounding it instead of working with it.

The modern home today is basically hooked up to a life support system of centralized heating and cooling. We can have the same house in Arizona and one in Alaska and they'll both be the same temperature inside because of the technically engineered and energy consuming systems installed.

With enough thermal mass, insulation in targeted places, good solar design, and ventilation you will have a house that is cool on all of the hot days of the year whether you're in a temperate or arid climate.

Ventilation and Insulation

You need to have adequate ventilation and insulation to keep your building cool. The cooling effect should be kept in mind when designing insulation and ventilation systems. They should both work together to reinforce the other.

The basic rule of thumb is to keep air flow circulating through your building. Ventilate roofs and attics so that air doesn't become trapped in them. You can install soffit vents or cupulas to let hot air flow up and out of your building.

As a general rule, don't use a black rooftop. It absorbs a lot of heat and can make the surface of your roof reach over 150 degrees Fahrenheit on a bright summer day in most of the United States. In contrast, a white or other light colored roof can reflect up to 70 percent of the sun's heat onto your roof.

You can also insulate your ceilings for summer cooling. This prevents heat from coming in through the roof.

Decrease Summer Solar Gain

By knowing the principles of passive solar design, we know that the sun is high in the sky in the summer so roof overhangs should be long enough to keep the sun from penetrating into the building.

Limit the number of windows on the east and west sides of your structure. They let in a lot of sunlight that can overheat your building. Be mindful of putting large windows or sliding glass doors on these sides. You can install shutters or curtains on these windows if you need to though.

Another option is to build patios on the east and west sides and cover them with arbors. The vegetation on the arbors will then shade these sides of your building from the sun.

Thermal Mass and Cooling

Thermal mass which is a heat battery in the winter months acts as a cold storage in the summer months. In arid climates, where the summer nights become cool this is especially effective.

Thick mass walls like cob help to buffer the inside temperature. Hot air from the outside will slowly move through the walls during the day, but it will reverse its direction back to the outside as night comes on. The cool outdoor temperature of the night will force the hot air to vent out.

If your region's summer nights are in the 70s and 80s then you may not get as much temperature regulation from mass walls. These temperatures are too high to cool thick mass walls like cob so you may look at a hybrid building or put more weight on other things to cool your home, such as: thinner mass walls, shade trees, air circulation, and a light colored finish on the building's exterior.

Hybrid Building Systems

Cob is a very versatile and adaptive building material. It has a long list of advantages for home building. Cob does not have to be a standalone building material though. It integrates very well with other materials and systems. If you want to use cob to its greater advantages and replace cob where it falls short, you can build a hybrid building system.

A Disadvantage of Cob

Probably the most noted disadvantage of cob and earthen building materials is their lack of insulation value. There is no clearly defined R-value for cob, but many people will range it at around R3 per 12 inches of cob. This is very low.

Compare the R-value of cob to that of a strawbale wall, which comes in somewhere at around R35. That's a huge difference!

Insulation value is not always the be-all-end-all to a comfortable living space. It depends on your location and climate.

If you experience cold winters then you can consider a hybrid building design.

High Insulation Alternatives

There are a lot of highly insulating building materials that you can choose from if you decide to build a hybrid cob home. In this lesson, we'll look at a few natural building materials that you can use.

Strawbale

Strawbale is a commonly used natural building material to complement a cob structure. Strawbale walls are thick and highly insulating. You get the highest R-value for natural materials, and the thermal retention properties of cob all in one building.

Straw-Clay

Straw-clay, also referred to as light-straw-clay, is a mixture of straw and mud slip that is packed into forms to create infill for walls. A 12 inch thick straw-clay wall has an R-value of about 26.

Hempcrete

Hempcrete is a combination of hemp cores and lime binder that is both lightweight and insulating. It has a cement-like consistency but hempcrete weighs about a seventh of the weight of concrete.

Hempcrete is not a structural building material, like straw-clay, and is used as infill between framing. It is either compacted into forms or built in brick form.

A 12 inch thick hempcrete wall has an R-value of about 25.

Hybrid Building Design

A hybrid building design is actually quite simple after you understand passive solar design principles. The purpose of creating a hybrid design is to keep the inside of the building warmer during the cold seasons.

We know that we get the most sunlight exposure from the south and the east. For this reason, its best to keep both the south and the east walls as cob. This way, they are able to absorb maximum sunlight into their thermal mass to heat the inside of the building.

The north side is the coldest side and does not receive any direct sunlight exposure. This is the primary wall that you would want to change the building material on. Put

a high insulation material on the northern side of the building. This will prevent colder air from coming in and your indoor heat from escaping.

Its also common in hybrid design to replace the west wall with a high insulating material as well. This side of the building received little sunlight in the winter months and can be a cold spot.

The most important side to keep as cob is the southern side though. This is where you can take full advantage of cob's thermal mass properties. You might lose some heat because of cob's poor insulation, but you gain back more through the thermal mass advantages if you've designed according to passive solar design.

Cob Ingredients - Soil, Sand, and Straw

Cob can't be purchased in bags at the hardware store so you have to process the materials and make it yourself. Your first step in making cob will be to find good ingredients.

You will need four basic ingredients to make cob:

1. Soil
2. Sand
3. Straw
4. Water

All of these materials are readily available throughout the United States, Canada, the UK, Australia, New Zealand, Europe, and pretty much all over the world. There is a good reason that people have built with earthen materials throughout the world since the dawn of civilization.

Soil

Cob is made from the soil right beneath your feet. Excavate the subsoil right beneath the thin layer of topsoil and this is the main ingredient for cob. The topsoil is the thin layer of dark dirt that contains mostly organic matter. The subsoil beneath has very little organic material and is where you'll find the clay-rich soil suitable for cob.

Many people have the misconception that you need to have *clay* to make cob. This is true, but you only need a soil that is roughly composed of 15-25% clay content. This is considered clay-rich soil. The rest of the soil is made up of sand, silt, and other aggregates. Using a pure clay would require you to add back in the 75-85% aggregate. It would not be practical and would require buying more sand to adjust it to the correct ratio. A heavy amount of clay in the soil is actually less desirable because it shrinks and cracks when it dries out and is unsatisfactory for earthen construction.

Soil for cob is generally easy to find in abundance and can generally be found all around the world. One good way to acquire the soil you need is to use what's excavated from your foundation trenches. You can also look at construction sites where this excavates soil is considered a 'waste product' and is hauled off to be dumped in a landfill. This costs them a lot of money and they might just be happy enough to deliver it to you for free!

The clay is a binder and its purpose is to hold the sand (aggregate) together. The clay is composed of microscopic platelets that act as suctions between the aggregate particles when they're made wet.

Something important to understand is that clay expands when its made wet and it contracts when its dried out. This is why you can't build a house out of pure clay. It needs the aggregate and straw fibers to give it stability and to prevent cracking.

This is also why, in reality, a cob house is more like a giant sand castle that is bound together in a unified mass by clay particles.

Note: Some grassland areas of the Midwestern United States and sandy areas of the Florida peninsula have a lack of clay in their soils. These soils can be too loose and crumbly for optimal cob. This does not mean that you can't find appropriate soils in these regions, but you may have to look harder than most.

Sand

The terms sand and aggregate can be used interchangeably, but most people refer to this ingredient as sand. Its also easier to talk to people about purchasing sand.

The majority of your cob mixture is actually composed of sand and other aggregates found in the soil. It usually hovers somewhere around 80%. The other 20% is your clay. This ratio will differ depending on where you get your subsoil from though, and that's why the vast majority of times its going to be essential to add additional sand into your cob mixture. There are some rare areas that you will find soil that naturally contains the right amount of aggregate-to-clay ratio to make cob, but this is not usually the case.

One of the main guidelines for choosing sand for your cob mixture is to use a rough and coarse sand that has many different particle sizes included in it. A rough-edged sand helps the particles to lock together better and will prevent serious cracking.

Rounded sand that is found on beach shores is not appropriate for cob because the particles don't bond together with any strength. Its like trying to stack a bunch of beach balls on top of each other, but they just keep rolling away.

If you live in the United States you will find sand for sale under many different names. Some common sands that you might encounter are masonry sand and concrete sand. These are typically used as ingredients for cement and are widely available. Sometimes they fall under different names by region of the country though.

Concrete sand is a great choice for cob. It is rough and holds a variety of particle sizes even including some small pebbles. Using this sand will help prevent serious cracking.

Masonry sand is a finer version of concrete sand and I've found that its usually a bit too finely sifted for large cob constructions because it tends to not bind as well leaving large cracks in walls.

You can buy sand rather inexpensively in large quantities by the truck load. You might spend a few hundred dollars for a truck load of sand plus the cost to transport it to your site, but considering that sand can be one of the main ingredients in cob the cost is still comparatively very low. The actual delivery charge can easily cost you more than the sand itself so it's a good idea to order in bulk. You may have extra sand left over depending on what you're building, but you can always use the extra sand for other projects. If you're building a small cob house of a couple hundred square feet you might as well get a full dump truck load, which is usually 10 cubic yards. Anything larger will most likely require more than one truck load.

You can purchase sand at landscape supply depots and gravel yards. There is usually at least one for every small town or city in the United States so these businesses are easy to find.

Straw

Straw is the component of cob referred to as the fiber. It acts as a natural rebar like the metal rebar would function in cement. It adds tensile and shear strength to cob walls and holds a cob structure together as a single monolithic piece.

Use straw that is fresh and not brittle or rotten. Make sure that it has been kept dry before purchasing it too. Sometimes a bale of straw might look okay on the outside, but it's a good idea to examine some of the stock for mold or mildew by opening up a bale to see the inside portions.

Look for bales of straw that have long strands. Six to twelve inches is an appropriate range. If its too short you are losing out on the benefits of this ingredient for cob.

Test the quality of straw by taking a strand in your hands and bending and pulling it to check its strength or brittleness. You can also take a couple more strands, put them all together, and try to tug the pieces of straw apart. Straw is much stronger when put together and it should be very difficult to break them with your own strength.

Many people are worried that the straw will rot inside of their cob walls over time. Straw and other similar fibers have been used in cob and there are many buildings that have lasted for hundreds of years without any decomposition of the fibers inside. Even after this much time, its still yellow and strong because there is very little oxygen or moisture available inside of dried cob for microorganisms to cause rotting and the straw is thus preserved inside.

Another important point to make here is that you should never use hay as a substitute for straw. They are very different things. Hay is a pre-harvest food product such as grass, alfalfa, or clover for livestock animals to eat. Straw is the post-harvest 'waste product' that does not contain any food value. It is the stem left over usually from oats, wheat, or barley.

Wheat stems are hollow and have great tensile strength. On the other hand, hay has lower tensile strength and will decompose. Hay has seeds in it and is still living

whereas straw is just the left over chaff and has no food value to it. Hay is prone to sprouting and could make your cob walls look like a giant chia pet! It is also prone to rotting. As they say, hay is for horses. Don't use it for cob!

Wheat straw is a great option for your fiber ingredient. Its widely available in the United States and many other countries. It usually costs between $3 to $5 for a bale. Oat and rye straws also make for strong cob mixes.

You can find straw at farm feed stores, farmers, or sometimes at local home improvement stores such as Lowes or Home Depot. It's also a good idea to search online for people selling straw bales. Craigslist is a good site to find these deals.

Always try to store straw indoors if possible. It's risky to store it outdoors for any length of time. If you do keep it outdoors, store it up off the ground and keep it well ventilated. Covering your straw with tarps is good, but tarps usually leak and build up condensation underneath them. Store it underneath some leak-proof roofing material if you have it available. If you have sheets of plywood or steel roofing you can lay that on top to cover it. Its very important to keep the straw dry to maintain its integrity.

Water

Water is the final ingredient that you will need for making cob. There's nothing particularly special about the kind of water that you use though. If you're getting it from your water lines then you have nothing to worry about. But if you're collecting it from a pond or open body of water then just make sure that you remove any leaves or other organic matter from it first.

The water is a crucial ingredient in cob because it is what turns your soil, sand, and straw into a gooey, thick building material. You may also remember that the clay first needs to be made wet in order to coat the aggregate particles and create the suction and binding.

Note:

Cob is a very forgiving building material in many ways. Don't feel overwhelmed at the need to get the perfect and ideal ingredients in every way. Use what you have available to you in your local area. Chances are high that what you have will make an adequate cob mixture. It doesn't have to be perfect.

Testing and Selecting Soil

A good building soil has approximately 15-25% clay content and less than 30% silt. There are many kinds of suitable soil types: clay, sandy clay, sandy clay loam, clay loam, and loam. There can be a lot of complexity and things to think about with finding a good soil and it can be overwhelming to those who are new to earthen building. But just take a deep breath and relax!

In the end, its all very intuitive and you will learn to distinguish suitable soil for cob mostly by sight and feel. With some experience, all of the categories, numbers, and percentages won't even pass through your mind. You can stop thinking analytically and just judge its quality with your senses of touch and sight.

The aggregate (sand) and silt portions of soil will stay the same size whether they are wet or dry. These tiny aggregates need the clay to bind them together like a mortar. The clay by itself expands when its wet and contracts when its dry, thus making it unstable on its own. This is why you have to test your soils and determine their composition. You have to find a soil that will allow you to create the right balanced ratio.

Places to Look for Clay-Rich Soil

First, check the soil at your building site. The closer you can source your soil the better and more efficient you will be. Soil can be a lot of work to transport.

Do soil tests in different locations around your property: tops of hills, places where water pools after a storm, places where the ground cracks when its dry, or generally anywhere beneath your feet.

Soil Tests

There are lots of ways to test soil and analyze its suitability for cob. This is a list of some of the simple field tests that you can perform. Its not really practical to make your soil testing any more complex than these methods. Again, you will eventually gain a sensory discernment for what good soil is and you won't even need to use these tests the majority of the time.

Snake Test

Make a small ball of moistened soil, roll it out to make a "snake", and wrap it around one of your fingers. If you have a high clay content then you should not have much cracking in the snake.

Ribbon Test

Take a ball of soil in your hand and stretch it out between your thumb and index finger to make a ribbon. See how long you can stretch the soil out before it breaks off. If the soil stretches a few inches then you likely have a medium to high clay content. You can also do this with moistened soil. It should stretch and stay together even longer like this.

Arm Test

You can perform this simple test if you have hair on your forearms. That may sound silly, but this test can determine if there is clay in your soil. Just smear a bit of wet soil onto your arm, let it dry out, and then try to rub it off. If it pulls on the hair of your arm then that means there is clay in the soil. If it just rubs right off and feels dusty then that usually means that it's a sandy or silty soil. Note: This test can also be performed on a hairy leg.

Jar Test

The jar test is, in my opinion, the most complex soil test that you should need to perform. Its still quite simple too!

To get an accurate soil sample for this test never use topsoil, only use subsoil, remove stones from the sample, and break up any soil clumps before performing this test.

1. Select a variety spots for soil sampling. Dig down through the topsoil until you reach a clear subsoil layer. The subsoil layer will have a range of distinct colors such as: oranges, pinks, grays, and browns, and it is easy to distinguish from the topsoil layer. Subsoil is also harder to dig through than the soft topsoil.

2. Use one jar for each test (32 oz. mason jars work great), and fill each one with soil samples making sure not to include any topsoil or stones that could distort your results.

3. Fill your jars one-third to one half full with subsoil samples and break up any clumps with a stick or tool.

4. Add clear water into jars. Fill to just below the top of the jar.

5. Tighten the lid on the jars and shake each one vigorously for about thirty seconds to a minute making sure that all the clumps are well broken up.

6. Set your jars on a level surface and let the sedimentation take place. For the most accurate results, don't move the jars for at least 48 hours. Complete

settlement can take days or even weeks depending on the type of clay, but it can also sometimes only take 30 minute to an hour. The clay settles out the slowest so its best to wait long enough for an accurate reading. If the water becomes clear within 15 minutes then there is a good chance that there is not enough clay content in the soil.

7. Once your sedimentation has occurred and everything has settled out the water should become clear and you should be able to distinguish the layers clearly in each jar to determine the amount of each component in the soil. Take a marker and mark out each individual layer on your samples without disturbing the soil inside.

You can measure the top layer of clay and divide it by the total height of all the material in the jar to get an approximate percentage of the clay. You can also do this math with the sand and silt.

Site Preparation

Site preparation is the first step in the building process. At this point, your site probably looks the same way as when you first chose it, natural and undisturbed. This will change once you begin to make building preparations.

Begin by clearing a level pad for your building

Remove the topsoil and vegetation. Also be sure to remove things from the ground that could be hazardous or that you might trip over like protruding stumps or roots.

Tools

Set up a tools station where you organize and store your tools for easy access during the construction of your cob building.

A table, a canopy, or build a temporary shed.

Materials

Locate your materials strategically around your building site and decide where to store them.

Have some areas designated for piles of sand and excavated soil for cob mixing. If you plan to be mixing cob manually or with your feet then its a good idea to keep

these materials close to your building site. If you're mixing with a tractor or backhoe then you can set up your mixing station and materials further away.

Layout

Transfer your design floor plan onto the ground where you want your building to be. There are many ways to go about doing this.

I first start out by placing wooden stakes into the ground to mark the corners and ends of the **interior** perimeter of the building. Make sure that your measurements are accurate between stakes as this determines the correct size and shape of your structure. Also make sure that your corners are "square" at ninety degree angles.

Next, do the same thing and place stakes for the **exterior** perimeters of your building. Again, check for accuracy of your measurements. You also want to keep in mind the distance between your interior and exterior outlines as this will determine the width of your foundation trenches. Its always best to make your foundation trenches slightly wider than the width of your foundation stem wall, whether you're building with stone or other foundation materials.

Now that your stakes are up and accurately placed, tie string lines from one stake to the other to mark the perimeters of your building. Do this for the interior and exterior perimeters.

Now you can see with more perspective where your building is going to be. Use spray paint and paint the ground underneath each string line, tracing the building's perimeter onto the ground surface. Painting the outline onto the ground is very helpful if you will be digging the foundation trenches out with a backhoe, since you will need to remove the strings and stakes for this to be done. If you are digging the trenches manually then you do not have to paint the outline, but its still helpful to keep things accurate.

At this point, you should have your building floor plan transferred onto the surface of your building site. Now you're ready to start working on the foundation.

Foundations – Basic Principles

What is the foundation? Why is it so important?

The first part of building your cob home will be the foundation. This is the first detail to consider for building any structure, and the information presented in this

section is relevant to just about any natural building you might construct. The foundation is a unified, stable base which holds the weight of your walls, upper floors, roof, and any live loads. It also distributes the weight of the house over a large area and prevents it from sinking into the ground, which can be catastrophic to a building's structure. You must build on solid, dry ground.

Foundations can be built using a variety of materials, such as: stone, concrete, and gravel. A good foundation is vital to the life of your building and it should be given the consideration it deserves as a critical piece of the structure.

Foundations for cob buildings can include the rubble trench below ground and the above-ground stem wall that holds the cob walls. The rubble trench below ground level works with the stem wall to further distribute the weight of the building evenly, to provide water drainage around the structure, and to anchor the building into the ground which limits movement of the building's walls.

The stem wall, which sits above ground on top of the rubble trench, extends up at least 1 ½ feet. The stem wall acts as protection for the walls and floors from water damage. It acts as a moisture break so that water does not seep up from the ground into the walls. Water runoff along the ground is not able to touch the cob portion of the walls, and water splash back from rainfall cannot reach that high.

Its important for your foundation to protect your walls from water since your cob walls will deteriorate if they are soaked by it. Even in arid climates, it is not recommended to build the cob walls starting at the ground level as this shortens the life of the structure.

Especially for massive earthen building, the importance of foundations cannot be overemphasized. Do your due diligence and plan for a solid, strong foundation. If your foundation is well designed, your building will enjoy a much longer life.

From here on, we will be focusing on how to build a simple, yet effective, continuous (monolithic) foundation consisting of a rubble trench and a stem wall.

Rubble Trench

Remember that a rubble trench foundation is a trench located underneath the stem wall foundation that is filled in with drainage gravel. It acts as a drainage system and a load-bearing pad for the building to rest on.

Stem Walls

The stem wall is the above-ground portion of your foundation that acts as a moisture break between the ground and the walls. There are many material options for building stem walls. Here are some good options to consider:

Concrete

Concrete has been used for thousands of years by builders for good reasons. It is a great material for foundations. It has versatility, strength, it is widely available, uses natural ingredients, and it can be poured into almost any shape that you want.

Many natural builders decide not to use concrete because of its high embodied energy. This means that it requires a high amount of energy and fossil fuels to be burned for its production, transport, and application. This is true, but don't rule out using concrete because of this. If the material is not abused, it has many benefits.

A more environmentally-friendly use of concrete is to build your stem wall with pieces of salvaged concrete (also known as Urbanite). These pieces of urbanite can be stacked like stones.

Stone

Stone is a good natural option if you are not interested in or unfamiliar with using concrete. Stone also has an appealing aesthetic look to it when put together, and it nicely complements the earthen tones and organic shapes of cob.

Building with stone is a labor intensive process and can take a long time. It also requires some skill, but you will feel a great sense of accomplishment after you're done!

Learn the details on how to build a stone stem wall in our self-study video course.

Bricks or Blocks

Fired bricks or concrete blocks are another good option for stem wall construction. They are easily stackable and go up quickly. Its best to create two separate walls with a gap in between. Then fill the gap with gravel or an insulative material such as perlite or vermiculite.

Gravel Bags

This method of stem wall construction comes from superadobe (earthbag) construction. It consists of filling polypropylene bags with drainage gravel, tying the end of the bag shut, stacking the filled bags like bricks, and then tamping them down. Its economical, quick, and easy.

Rammed Earth Tires

You can also use salvaged tires to build your stem wall. Stagger the tires like you would build with bricks, building layer by layer. Each tire is filled with dirt and then

the dirt is pounded with a sledge hammer into the tire cavity. This creates a massive and strong stem wall.

Rubble Trench Foundations

What is a rubble trench foundation?

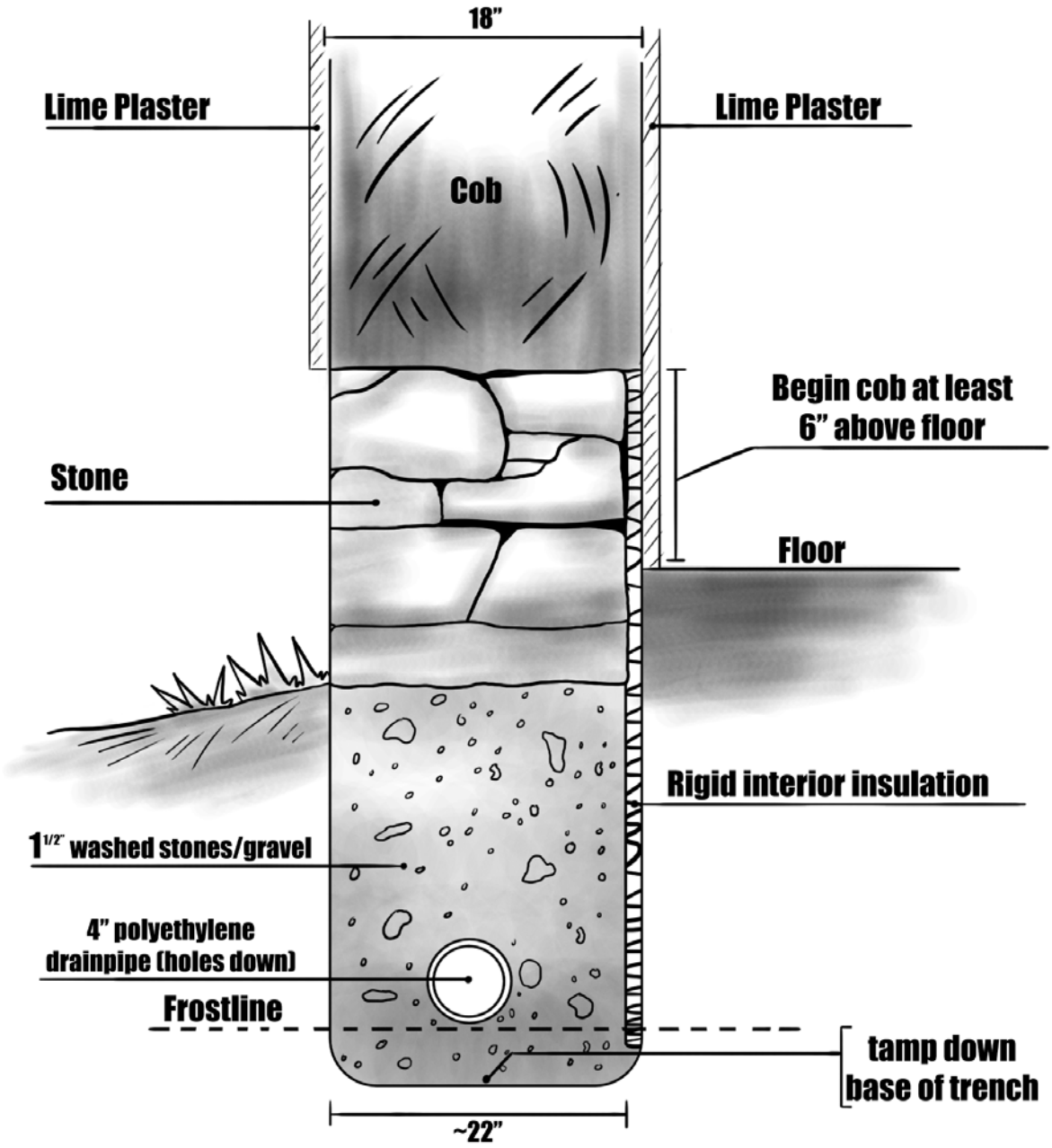
A rubble trench foundation is a simple and effective system for a long lasting foundation. A rubble trench foundation is a trench located underneath the stem wall foundation that is filled in with gravel. It acts as a drainage system, and it also gives your building a more solid, load-bearing pad to rest on. Rubble trench foundations are also an economical alternative to concrete foundation footings.

PROS

- Inexpensive
- Withstands the tests of time
- No concrete necessary
- Easy to learn and construct
- Reliable
- Suitable for most climates

CONS

- Less wind resistance (compared to foundation wall anchored deep into the ground)
- Less seismic resistance (since foundation stem wall usually not anchored deep into the ground)
- Not suited for building in weaker soils that are not well packed (rare)



Instructions for Building

Once you've removed all the topsoil and organic matter and marked out the perimeter of your building, you need to dig your trenches.

Begin by excavating the perimeter foundation trenches slightly wider than the walls will be. This can easily be done with a backhoe, but can also be done by manual labor if need be. For an 18" thick cob wall, make a 24" wide rubble trench. For a 2' thick cob wall, make a 2'6" wide rubble trench. So, add an extra 3" onto both the interior and exterior of the trench. If your stem wall tapers in as it rises, then remember to make your trenches slightly wider than the bottom of your stem wall and don't base the trench width off the thickness of the cob walls. Stone stem walls usually have a taper to them, so keep this in mind.

Your foundation trenches should extend down below your frost line. The frost line is the deepest level to which the soil freezes during the winter time.

Drainage of water is very important because freezing water and soil beneath your building can cause lifting of your foundation, sometimes referred to as "heaving". This is because water expands when it freezes and can cause cracks in your foundation and walls.

The depth of your rubble trenches will depend on the climate that you live in. They are usually no less than a foot deep, but they can be several feet deep in very cold climates. If your cob building is in an area with mild winters where the ground doesn't freeze, a depth of 12 to 18 inches is usually deep enough.

If you're building in a wet and cold climate its best to install a perforated drainage pipe at the base of your rubble trench. The pipe will help channel water away from your foundation so that it doesn't accumulate there.

You should also dig an exit trench pointing away from your building toward the lower grounds. This will act as a drainage point for your rubble trench foundation.

Make sure that the bottom of your trench is sloping downward toward the exit point extending away from the building. You can test your drainage slope by dumping a few buckets of water into the trench and seeing if the water runs directly down to the exit point. Or you can wait for a heavy rain to see whether your trenches fill up with standing water, or if it naturally drains out.

Lastly, make sure that the walls of your trenches are roughly vertical and that the trench floors are compacted down.

At this point you can lay your utility ducts in the bottom of your rubble trench before you fill it in. These ducts can be used for electrical cables, water pipes, and

phone lines later on. Utility ducts are curved, flexible pieces of pipe. Just make sure that your utility pipes don't raise up your perforated drainage pipes trapping water. Once installed, plug up each end of the utility pipe so no debris gets inside during construction.

Next, fill your trenches with about 2 to 3 inches of drainage gravel and compact it down thoroughly. 1 ½ inch drainage gravel works well.

On top of your compacted drainage gravel, lay a 4" diameter perforated drainage pipe circling the whole perimeter of your building. Make sure that it also extends at least 10 feet away from your building out the exit trench. This will direct the water that comes down around your building to a different area.

Its also a good idea to wrap your drainage pipe with landscaping paper. This will prevent any silt or soil from clogging up your pipe in the future. Another good practice is to wrap the whole trench sides and floor with landscaping paper, and then wrapping the ends up over the top of the trench. This is an even safer option to prevent your rubble trench from getting clogged with soil over time.

Next, you want to fill in the rest of your trenches with gravel. Fill the trenches in 6 inch increments, tamping in between each layer. If you are short on time or laborers, you can fill in the trenches all the way in one go, but you don't get as thorough of a compaction this way. Keep filling until you reach about 6 to 8 inches from the top. You leave a gap here so that your stem wall integrates into the ground.

After you complete your rubble trench foundation, you will be ready to build your stem wall foundation.

How to Make Cob – Tarp Method

There are many ways to mix cob. One of the most common and regularly-practiced techniques is called the "tarp method" of cob mixing.

This is one of the most basic and most practical ways of making cob. It is said to have been developed in 1994 by a cobber in North America named Becky Bee.

This can be done by yourself or with one other person. You will need a large tarp and 4 or 5 five gallon buckets. This process can be done solo, but is best done with two people.

1. Get all of your materials close to your building site. Sand, clay subsoil, straw, water, tarp, and buckets.

2. Lay out your tarp on a flat space. This is where you'll be mixing.

3. Put your dry ingredients (clay subsoil and sand) in the middle of your tarp in a pile. Your ratio will always differ depending on where your materials come from. You will probably need to experiment with the first few batches to determine how much clay and sand are needed for a good mix.

   Here are some common ratios:

Sand	Clay
2	1
2	2
3	1

4. Now you want to mix the dry materials together on the tarp. Have each person grab two corners of the tarp and both people walk forward to the center of the mix, folding the tarp in half. The dry material should be together in the center of the tarp. Put the tarp back in its starting position and lay it out flat on the ground again. Go to the other end of the tarp and repeat the process of turning the dry materials over. Do this 3-4 times or until the dry materials are mixed thoroughly. Put the dry ingredients back to the center and lay the tarp flat again.

5. Pile up your dry ingredients in the middle of your tarp and dig out a small crater. It will look like a tiny volcano. Add a little bit of water into the volcano crater. Its always best to add too little water than too much! It is a whole lot easier to add more water than to try and fix adding too much. You will have to first experiment to determine how much water you will need in your mix. Sometimes a standard ratio of five parts dry ingredients to one part water will be good. But you can't always stick to this standard. You very well might need more or less. You'll figure out how much water to put through experience. Remember not to add too much water though. It might be easier to mix, but it will not hold up as well when you start building and will slump sometimes. A wet mix of cob can also crack more as it dries. However, if you do add too much water you can either leave the batch to dry out in the sun, add more straw to soak up some excess water, or add more dry ingredients.

6. Use your feet to push the outsides of the dry material into the center of the crater filled with water. Once you cover the water, start stomping on the pile. You can do it by yourself or with others depending on how much room there is on the tarp. Twist your heels into the mixture for the best mixing. You can

also jog or dance on top of it as a mixing technique! The goal is to make sure that all the dry materials are mixed together well and that all the clay and sand are smeared together thoroughly.

7. Next, you will pull the corners of your tarp to fold the mix on top of itself again. Stomp the mix some more, and repeat this a few times until the mix flattens out like a pancake on the tarp. You can add some water to your mix if its hard to get mixed thoroughly together. Just add little bits at a time though. Eventually your whole mix should be forming into what some people call a "burrito" shape when you roll the tarp back and forth. Once it takes this shape you have a good indicator that your cob mix is almost done. At this point you are ready to add straw into the mixture.

8. Stomp on top of the burrito of cob mixture until its flattened again. Take some handfuls of straw and sprinkle it over the flattened mix. Again start to stomp the cob mixture until all of the straw has been covered and smeared with cob. Use the tarp to gather the mix up and turn it over again. Stomp some more until flat. Add more straw and repeat the process. There is no exact amount of straw to use, but one good ratio that people tend to use is one part compressed straw to five parts of dry ingredients. Keep repeating the process until all of the straw is thoroughly distributed and mixed into the cob. You've just made cob!

Analyzing Cob Test Bricks

The purpose of making cob test bricks is to help you determine if you have a suitable cob mixture or not. By examining test bricks you can tell if you have the right ratios of soil to aggregate.

When you're starting out with new cob materials you will want to make several different test batches to discover you're best materials ratio. For each test batch of cob that you make, form a few sets of test bricks from the mixture. The test bricks can be any size. Make a variety of sizes if you want.

You can make your test batches of cob with or without adding straw. For each batch, use a slightly different ratio of soil to aggregate, and keep track of the proportions for each one. Before the bricks dry, you can etch the proportion numbers into the top of the brick using a stick.

Let all of your bricks dry until they are dried all the way through. Its best to dry them in the shade because too much sun can cause your bricks to crack a lot even if it's a good ratio. This can sometimes take a few days. If you made enough bricks, you can break one apart to see if it has dried all the way through though.

When the bricks are fully dried then you can test their strength. Examine for cracking, crumbling, and breakage.

- If there is surface cracking on your bricks that signifies that there is too much clay in the mix or not enough sand. Remember that clay shrinks and sand counters the shrinking.
    - If you have large cracks then you should probably add more sand. This usually happens with very clay-rich soils.
- Test the hardness of your bricks by scratching the surface. Scratching it should not cut deeply or cause it to easily crumble. If they are soft or crumbly then you should probably add more clay-rich soil to the mix.
- If your dry test bricks easily break in half then try adding more straw, or longer straw.

Now take your bricks and attempt to break them by twisting them in your hands. It should be almost impossible to break them with your hands if your mix is good and they are dried all the way through. This is especially true if you have added straw to the mixture.

Your cob bricks (or cob balls) should dry rock solid. They should break cleanly if you hit them lightly with a hammer or they should not break at all.

Making several different test batches of cob, forming test bricks, letting them dry, and then analyzing them can take some extra time, but the ramifications can be substantial. Once you know that you have an appropriate cob mix then you can proceed with the peace of mind knowing that your cob will hold up and not have major cracks.

Mixing Cob with a Tractor

The Purpose of Mixing Cob with a Tractor

You might be wondering “Why would I want to mix cob with a tractor?” There are other good methods of mixing cob with your feet, using a tarp, or in a pit that don’t require the burning of fossil fuels. This is true, and any method of mixing cob without heavy machinery is going to be the purest form of cob mixing with the lowest amount of embodied energy.

But if you’re interested in building a cob home in a speedy time-frame then I highly recommend mixing cob with a tractor (or other machine such as a Bobcat or backhoe). Using this method, the cob mixing process will go approximately one hundred times faster compared to doing it by foot labor. You will spend some fossil

fuels in the process, but you will save an extraordinary amount of human labor and time!

I absolutely think it is worth it to mix your cob with a tractor if you are building any size of cob building. The only main drawback that I have found with tractor mixing is that you will usually not achieve a mix quite as thorough as a carefully stomped batch of foot cob. That's just the reality of it, but it is a compromise that I believe is not going to hurt the integrity of your building.

Note: It is still very important that you mix it appropriately with a tractor and get it mixed thoroughly enough. Don't skimp on the quality just because you are doing it with a tractor.

What You Will Need to Mix Cob with a Tractor

You will need these things to make tractor cob:

The first thing you will need is a tractor. A front-end loader with a bucket. Big ones and small ones will all work. The size of your tractor will determine the amount of cob that you can make in one batch.

The second thing you will need is a relatively level mixing area. There are a couple of ways that you can go about this. The first and most accessible way is to just clear a spot on the ground. Peel off the top soil and organic matter with your tractor to where you have a cleared off spot to mix your cob. If you are more serious, you can make a cement pad to do your mixing on. This is the most efficient surface to work on. It will not get muddied up in the rain, it stays level, and you will not accidentally scoop up extra subsoil from below into your cob mix.

Then you will need your cob ingredients: sand, clay-rich soil, straw, and water. Its best to have a large pile or dump truck load of sand and soil out next to your mixing site. Keep several bales of straw nearby and a hose or water trough for adding large quantities of water.

How to Mix Cob with a Tractor

1. Determine your cob mixing ratio. How much soil versus how much sand will you be putting in your mix. Test your mix ratio with a couple of foot mixed batches first. This process is explained in our previous lessons.

2. Use the tractor and scoop up a bucket full of soil and place it on the middle of your mixing pad. Then pick up a bucket full of sand and place it on the mixing pad. The front-end bucket is your measuring device. Just like how you would use 5-gallon buckets as a measurement tool if you were mixing by foot. Continue to alternate between soil and sand. This will speed up your dry mixing process by getting them together in one big layered pile. So, if my ratio was 1 part soil to 1 part sand, and I wanted to make a quadruple batch I would use 4 buckets of soil and 4 buckets of sand. Alternate between the two materials as you add them to your mixing pad.

3. Once you have all of your materials piled up in the middle of your mixing pad you will need to dry-mix them together. This is the same process you would follow if you were mixing on a tarp. You're just doing it on a larger scale now with a tractor, minus the tarp. There are many techniques as to how exactly you use your tractor to mix. A lot of it will just come with experience. Use your tractor bucket to push, pull, and smear your pile of ingredients. When it starts to flatten or spread out too much push it all back together into a pile. I've found that its not efficient to run over your materials back and forth with the tires. The weight of the machine mixes and mashes your cob ingredients down, but it just tends to make more of a mess. Mash the materials down with your tractor bucket instead. This way you have more control over your pile and don't have to spend nearly as much time cleaning your pile up. Also, do your best not to scoop up soil from underneath your mix (if you don't have a cement pad) since this can distort your materials ratio.

4. Once your dry ingredients are thoroughly mixed together its time to add plenty of water. The amount of water that you add will depend on how large your cob batch is. Keep adding water until your mix starts to get muddy and thick. Its best to have a person or two on the side adding water while the tractor operator mixes.

5. Continue to thoroughly mix your cob ingredients and add water. When everything is mashed and mixed together its time to add straw. If you have experience with making cob then you will know when your mix is done right and its ready for the straw to be added. It should stick to itself and not be sandy or fall apart in your hands.

6. Add enough straw. Some people like more straw, some people like a little less. I would estimate to add 10-15% straw into your mix. Have your helpers on the side continue to add straw as the tractor operator mixes.

7. Remember that its much more difficult to get tractor mixed cob as consistently mixed as foot-mixed cob. So, continue to mix your batch a little extra.

8. Once you deem your cob thoroughly mixed go ahead and gather your pile of cob up into one big pile again. Its time to transport it to your building site! Nice job!

If you want to build any large cob structure, I highly recommend that you employ this method of cob mixing. You will not regret it! You can literally make one large batch of tractor cob in one hour that would take a group of 10 people 2 or 3 days to make by foot.

There are also ways to mix cob using a Bobcat or a backhoe. These machines require variations to this tractor method though and would require separate instructions.

Cob Mixing – Problem and Solution

- If your cob mix sticks to your feet or to the tarp then add more sand.
- If your mix continues to crumble and won't hold together then add more clay and/or water. You might also have too much straw in your mix.
- If your cobs pull apart too easily then add more straw. Keep the straw long.
- If your test bricks crack when drying then add more sand to your mix.
- If your dry test bricks are soft or crumbly then add more clay to your mix.
- If your dry test bricks easily break in half then add more straw, or longer straw.

Building Cob Walls – Properties & Dynamics

When your foundation is complete, you will be at the point where you can begin to form the cob walls. They will sit directly on top of the stem wall foundation and extend up to the roof.

The Basic Process

Building a cob wall is a process of adding layer upon layer of cob until you've reached the desired height. This is why in some countries cob is known as "layered mud."

Each layer of cob is pressed and stomped together and then trimmed and packed to the right shape and angle.

In this lesson, we'll look at some of the properties and dynamics of working on cob walls. In Part 2 of this lesson, we'll go into detail about the techniques involved for building cob walls.

Monolithic Building

A cob building is a monolithic structure. Instead of the building being composed of thousands of individual bricks, a cob building is like one single giant brick. Each layer of cob is attached to the layer above and beneath it. The bonding between layers and the weight of gravity are important for giving cob walls strength.

In a sense, each piece of cob is interconnected with its surrounding pieces, and you have a three-dimensional textile of interwoven straw between each bit of cob.

You can sew cob pieces together either using your fingers or a cobber's thumb. A cobber's thumb is just a stick or other item used to poke holes in the cob. Poking holes into the cob will sew straw between layers. Using a cobber's thumb is not a necessary step to take, but adds extra integration. You will have to decide, based on time and labor, whether to add this step into your building process. Traditionally, this method of "sewing" the layers of cob together was not taken. One layer was simply packed on top of the previous layer.

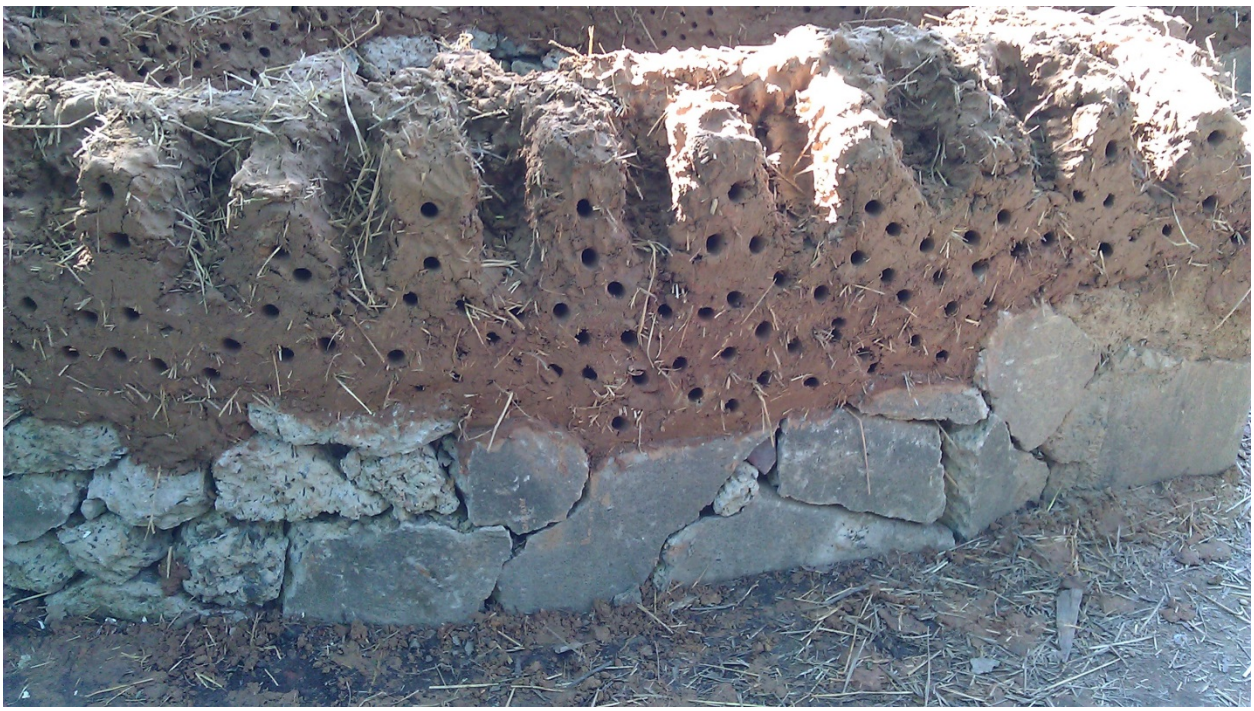
Another optional step in the process that you can implement using the cobber's thumb is to perforate the sides of the walls. These small holes can add further cob integration and they help the walls to dry more quickly and evenly. Some people

also say that the holes help give the first plastering layer a better grip onto the wall.

Using the hands and feet, each piece of cob is smeared, pinched, and stomped together as they are applied to the walls. Stomp or smear together any cracks or gaps between cob pieces so they don't pull apart when dry.

Spine and Ribs

Once you've applied your cob loaves, integrated them together, and perforated the layer with holes its time to make what's called "spine and ribs" to complete the layer. Doing this helps to "key in" the next successive layer of cob to the current layer.



Again, this is an optional step in the process but adds extra integration between layers. The "spine and ribs" technique is more of a North American cobbing technique. It has not been traditionally used in cob construction in Europe or other countries.

When you're done with a layer of cob or if you're finishing up building for the day, make a spine and ribs. Make a ridge of cob loaves down the center of your wall, attached well together and attached well to the top of the wall. On both sides of the ridge attach cob to it at right angles going from the ridge to the edge of the wall on the inside and outside. Between each rib, just leave about one foot of space.

When you start the next layer, you simply continue to add cob to the wall covering the spine and ribs and building higher.

I normally only add a spine and ribs if I'm completing a layer of cob and I won't be back to the project for a few days or longer. Having this "key" is most helpful when the cob has completely dried and you still need to keep building up more. If the top of your cob wall is completely dry, adding more cob layers is okay but you are only relying on the weight of your successive cob layers to hold it there. Having a "key" will give you more integration between the dry layer and newly added layer.

How Thick Should Cob Walls Be?

There is not a minimal thickness for cob walls, but the thinner they are the less load bearing capacity and thermal mass they will have. I recommend a cob wall of 18 to 24 inches as a standard. This gives plenty of load bearing capacity for a one story building and plenty of thermal mass.

If your structure is not relying on the load bearing capacity of the cob walls to hold it up then you might consider going for a thinner wall.

Curved walls have extra strength and can be made thinner. Especially if they are non-load bearing interior walls.

You can also consider building the base of your cob walls just a bit thicker than they will be at the top for stabilization. Keep the walls slightly tapered as they go upward.

How High Can You Build?

It's very rare to see a cob house go up more than two stories tall. In the country of Yemen, there are earthen structures that reach up to seven stories in height. The bases of the walls are built very thick and taper in as they go up.

Another thing to consider if you want to build up high is that building slows down once you get on scaffolding. You are more limited in your movement and materials have to be delivered up from the ground. Some good ways to move cob up to scaffolds is to toss, hoist in buckets, or use a long-handled fork.

If you're building higher than eight feet of cob wall then its best to taper it as you rise. This will give the wall more stability and strength. The taper does not have to be drastic either, but the more you taper in the more stable it will be at the top. The thicker the bottom of the wall is compared to the top, the more easily the wall will be able to support itself.

Vertical and Tapered Walls

For structural reasons, your walls should be close to vertical, or you can use a predetermined taper as you build up. Its good to be consistent in checking your walls as you build up. Don't wait until the end to trim your walls.

Use a level to check whether your walls are staying vertical. If they're not vertical, use a trimming tool to trim off the excess cob. If you need to add more on to the wall to make it vertical add on more straw-rich cob and sew it on with your cobber's thumb. Keep using your level to gauge for vertical alignment.

If you want to taper your walls you can make a special tapering tool. You will make the tool according to the tapering degree that you want. Many cob builders use a 5 degree taper. Duct tape a 4 foot level to a 4 foot piece of 2" x 4" plywood. The piece of 2" x 4" needs to be cut vertically according to your angle. For a 5 degree angle, make it 3½ inches at the top and 1 inch at the bottom. With this tool, if your level shows that you are "vertical" then you know that you are building at a 5 degree taper.

Tapering walls can significantly reduce the amount of cob that you have to mix and gives the top of your walls much less weight to bear compared to the bottom. Tapering walls is often done on the exterior but not on the interior since it makes it awkward for placing furniture.

How High Can You Build Each Day?

It's a general practice among most cob builders to only build up one foot per day. However, this is only a guideline and does not have to be strictly adhered to. How far up you can or should go in a day will depend on certain factors.

If the weather is consistently wet, keep to the "one foot per day" guideline. Building too high in wet, muggy weather will create a higher chance of slooping or collapsing cob. The wet weather does not give the walls a chance to dry fast enough for thick layers of cob to be built up. However, don't be really worried if you go a little over a foot in these types of weather conditions. I've built up four feet of cob in one day when it was rainy and wet, only to have the edge of one of the walls collapse off. It would have been fine if I had only gone two or maybe three feet up instead.

In good weather conditions with lots of sunlight and breezes you can easily build up one or more feet per day. The truth is that in most cases you won't have the time or labor to go higher than one foot per day anyway. Just keep in mind how high you're building each day and give each layer sufficient time to dry.

Each layer does not have to dry completely before you can add the next layer either. Generally, you can apply one layer, let it sit overnight, and then apply the next layer the following morning.

Working Up High

When working with cob, always remember that its best to be working just below your waist level. If you do otherwise you will put unnecessary strain on your lower back or other parts of your body by leaning down or extending too high.

As you work higher on your walls you will come to a point where you will need some form of scaffolding. Get creative with this. There are many things around your work site that you can use to get you started.

For example, you can either use bales of straw or empty barrels with a board laid across them as low level scaffolding for between three to five feet high. Anything higher than this you will need to use ladders, scaffolds, or lean-to trestles.

You can also install support beams right through your cob walls as you build them. Then as you reach higher with your walls you can lay boards across these beams and use them as scaffolding. When you’re through using them, just cut the beams off flush with the wall and plaster over the exposed wood.

Building Cob Walls – The 4 Step Method

Building with cob is a fairly intuitive skill and you can learn to build cob walls quickly. Of course, as with anything, practice makes perfect. But you won't have to get past a high learning curve before you can successfully build a cob wall.

I've broken down the process of building cob walls into four simple steps:

Place

The first step is to take the cob and place it on your wall. When you first begin your wall, you will be placing the cob right on top of the stem wall foundation.

The pieces of cob that you apply to your wall can be any size. It usually works to add pieces that are most manageable for you to carry. Sizes usually vary from handfuls to small watermelon size.

Add the pieces of cob next to each other. You can push each piece up against the next. They'll already begin to form into one piece. We'll integrate the pieces more in the next steps.

Add pieces so that you cover the full width of the wall, and its best to add a little excess around the edges. If you don't put enough cob to cover the full width of your wall you will end up with your walls being too narrow. Any excess cob will "ooze" off the sides and be trimmed off. So its better to add too much than too little.

Knead

Once you have placed your pieces of cob onto the wall, work them together a little bit with your hands. Smear one piece into the adjacent pieces. If there are gaps between pieces, smear them together to get a little more integration. You don't have to be very thorough with this step though because we'll get most of the pieces compressed together in the next step.

This step is especially helpful in connecting the pieces together lightly so that they don't fall apart and off the wall when stomping.

Stomp

Now that you've added the cob and lightly kneaded it together its time to stomp it. Get on top of the cob and stomp it down with your feet.

Many people compress the cob with their hands instead of using their feet. This is not an efficient way to perform this step when you can easily use your body weight and gravity to assist you.

Stomp from the top and you can hit the sides of the wall with the side of your foot. Just make sure that you are balanced well.

Stomping will compact the cob together and build its strength.

Trim

After stomping the cob, you will have some cob "oozing" off the sides of the wall. This might seem like a waste of cob material, but it can easily be trimmed off and reapplied onto the wall.

Trim off the excess cob with your trimming tool. I prefer to use a hay saw, but you can use a hand saw or a machete if you don't have one.

Trim your wall to the shape that you want. At this point, the cob is going to still be soft and malleable making it easy to trim and shape. Depending on the weather conditions, you should be able to easily trim the cob for a few days. Once it gets too dry though it will be impossible to trim so its best to trim as soon as possible.

Windows and Doors

Windows open up your home to the world outside. They are like the eyes through which you see the world. Windows provide many different functions: they light our homes, show outside views, ventilate our homes, and let in heat from the sun.

Cob allows you to be creative with your doors and windows because of the wall thickness and malleability of the material. You can create and install whatever type of door or window that inspires you. Instead of just buying a standard size door or window you can make your own to fit a specific style or function in your home. There are some basic concepts to understand about installing doors and windows into cob walls.

Lintels

When you want to install a door or window you are creating a gap in the cob wall. The cob wall usually needs to extend over the top of this gap. Using a lintel is the way to support the mass of cob over top of the window and door gaps.

Lintels can be made of any strong, stiff material such as: wood, stone, urbanite, and steel. Wood works well for lintels and is the most common material to use for them, but its up to you what material you use.

Look for wood or other materials that will look nice exposed above your opening and give character to your building. The top of the lintel will be covered with cob but the sides will be visible still. You can leave the top side that doesn't look pretty on the top side and finish the other sides nicely for everyone to see.

When you place lintels above your openings, make sure to insert temporary supports below them and keep them there until the cob above is completely dried through and solid.

Another standard rule to follow with lintels is to have the lintel extend four inches into the cob wall on both sides of the opening and add one inch per foot of the windows length.

When you set a lintel onto fresh cob it can settle and sink down which could potentially crack your window or damage your door. First, let your cob dry as much as possible before you put on your lintel.

It is also good practice to place wooden “pads” under the edges of the lintels on both sides. These will help to better distribute the weight of the lintel across the whole width of the wall. You can use a piece of two-by-four or similar sized wood for these.

Frames

For each door and window that you install, you will create a wooden frame that attaches to the cob wall. The windows and doors will fasten inside of these wooden frames. The frames will not be exposed when all the cob and plaster work is complete.

A frame is simply a wooden “box” for your window or door to be attached into. In a conventional stick-framed building, the doors and windows attach into frames just like these. When working with cob walls, the frames are attached into the cob instead of being nailed to the adjacent framing in a stick-frame structure.

Any standard dimensional lumber will work for building window and door frames. Make sure that all of your corners are squared at ninety degrees. Also build your frames about two inches wider on all sides than your actual window or door will be. This will give you plenty of room to insert and adjust them. Use wooden shims to fill these gaps.

Deadman Anchors and Installing Frames

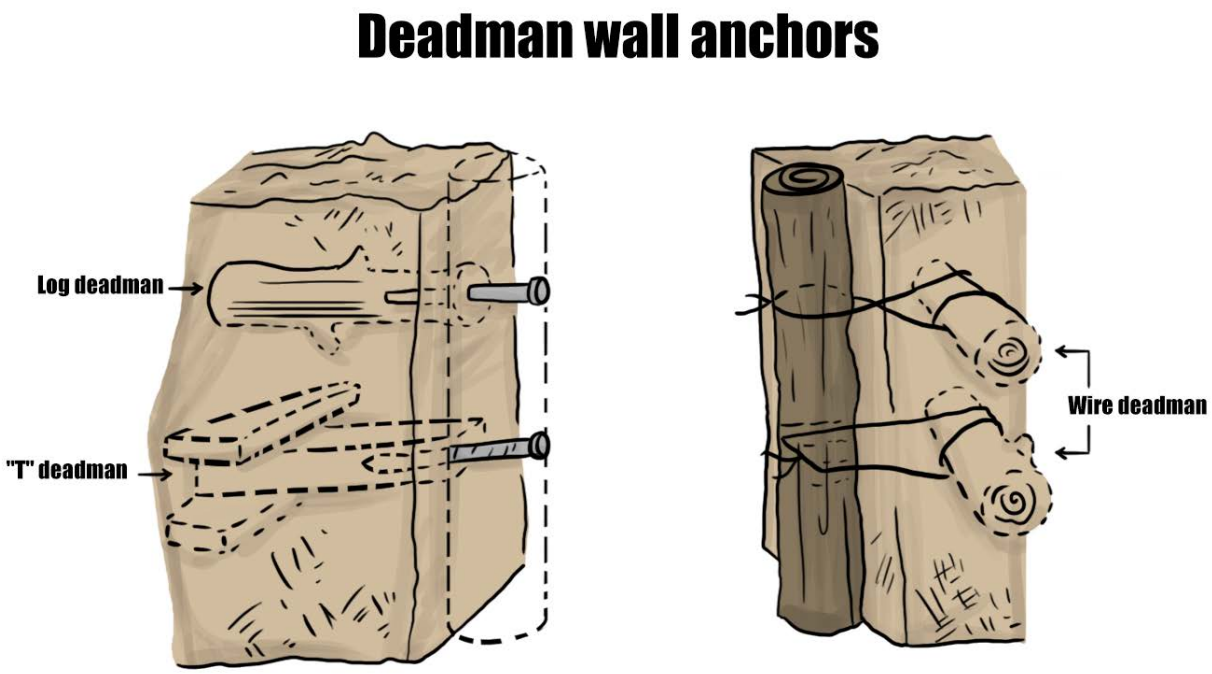
Most of the time, windows and doors are connected to wooden frames to hold them securely in place in a cob wall. With cob building you need to know how to connect these frames to the cob wall.

When installing your frames temporarily cross brace them beforehand since wet cob can put pressure on them and possibly bend them out of place. You will also want to brace doors and tall windows to the ground or something else that's solid.

To actually connect the frame to the cob you will have a few options. You can put nails into the outside of the frames with the heads exposed an inch or two (the nails can be bent too). The nails provide a grip for the cob to hold onto.

For big windows and doors its a good idea to use a stiff piece of wood which is buried in the cob called a "deadman." These can be pieces of two-by-four boards or thick branches.

Its easiest to attach the deadmen to your window and door frames first and then cob around them. You can also build the deadmen into the cob walls and have one face left exposed on the side of the wall. Make sure that the exposed face sits flush to the wall. Window frames, door frames, shelves, cupboards, and cabinets can all be attached to the exposed faces. Install these fixing points wherever you think you will need to fasten something to the wall in the future.



The best way to install doors is to set the door frame in place before you build the cob walls. Connect the bottom of the door frame to the foundation, cross brace and anchor it, then build the cob walls up around the frame burying your deadman anchors as you go.

For doors, attach an anchor near the top and bottom of both sides. This should be enough attachment for lightweight interior doors, but you will want more anchors for any heavy, wide, exterior doors. For these, put an extra anchor near the top hinge and an extra anchor about waist height next to the door handle.

After installing your frames there may be a little bit of shrinkage away from them as the cob dries. These cracks can later be filled in with cob or plaster when the cob has completely dried.

Non-Opening Fixed Windows

You can also install a non-opening window into a cob wall. These types of windows are fixed in place and are built right into the wall without a frame. Use the thickest glass that you can find for these types of windows though. Thin glass tends to crack without a window frame.

Fixed windows can be fun because they allow builders a lot of creativity and artistic freedom. You can make rectangular, circular, oval shaped, or any other shape you want. The piece of glass that you use does not have to be the shape of the window that you want. You can just build the cob around the piece of glass to form the shape you want.

You can even use broken pieces of glass. Just be sure to duct tape the edges so you protect the glass from chipping on the edges and so nobody cuts themselves on it.

Its best to not build your glass too far into the sides of your window opening because the glass will take on a lot of undue pressure and can crack with cob settlement. A quarter of an inch is usually deep enough for your glass to go into the wall.

To install a fixed window, start by building a level site where your window sill will be. Leave room for padding beneath your piece of glass. You can use a piece of foam or other compressible material.

Set your window sill before you put in your glass. The glass and padding can sit on top of the sill. Make your window sill on the outside slope downward away from your window so water does not track inside and under your glass. Your sills can be made of various materials: wood, stone, tiles, or bricks. Also have your window sills overhang off of your walls a few inches so water doesn’t drip onto your walls.

Build the cob wall at least one third of the way up the sides of the window opening to hold the glass in place, and continue to build up around the glass as you complete your walls.

Roofing

A good roof in a rainy climate will be a major factor in whether your cob house lasts through the generations. A cob house does not need a particular type or shape of roof. The roof should meet a few basic qualifications:

1. A good roof should keep the rain and precipitation out of the building and direct it away from the cob walls. This is especially important for cob homes because they are vulnerable to water damage.
2. It should shelter the people inside the building from the outside weather elements and hot sun rays.
3. The roof should be properly insulated to prevent heat loss and heat gain. It should keep heat inside during cold weather and keep unwanted heat out during hot weather.
4. It should be securely fastened to withstand heavy storms and hurricanes.
5. The roof should also be strong enough to carry extra loads from snow, ice, fallen branches, and workers.

You should think about what kind of roof you want and how to build it before you start construction on your building. During the planning phase, design your roof and how it will be held up. There are a lot of factors to consider when designing your roof:

- How much area will the roof cover?
- How much money are you willing to spend?
- How much will the roof weigh?
- Will the roof have good fire resistance?
- What will the angle of the roof be?
- Do you want to collect rainwater from your roof?

Basic Roof Components

Roofs consist of two main components:

- The timber frame structure which gives the roof its strength and shape.

- The outer covering, or skin, that is attached to the framed structure, which protects the building from water and the elements.

There are a few basic parts to a roof. There are many different styles of roofs, but they usually carry these same basic pieces.

Membrane – This is the outermost covering on top of your roof sheathing. For example, an airtight plastic sheeting or tar paper. This membrane is then covered and protected with something such as: shingles, tiles, shakes, thatch, or metal roofing.

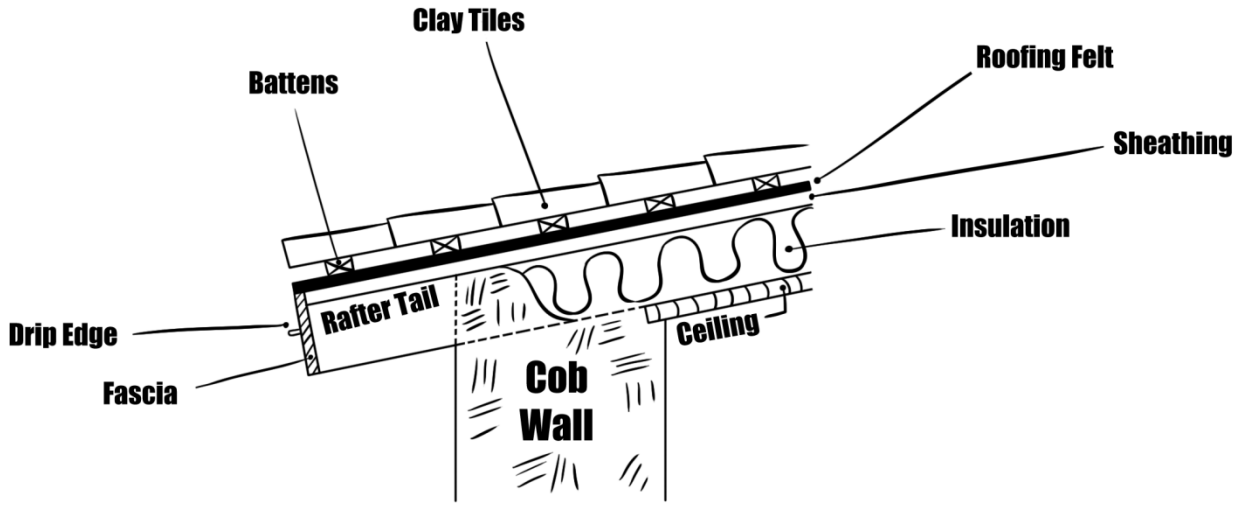
Sheathing – This component supports the membrane above. Some type of wood is usually used for roof sheathing. It is typically made of wooden boards or OSB (oriented strand board). OSB is a synthetic wood material though and is not favored for natural building due to its toxicity.

Rafters – These run the length of the roof and support the sheathing and membrane above them.

Ridge Beam – This supports the highest point of the rafters.

Trusses – A truss eliminates the need for a ridge beam. It is a pair of rafters, a collar tie, and cross bracing that is assembled on the ground and lifted onto the walls.

Eaves – This is the part of the roof that overhangs past the walls. A long eave is good on a cob house to protect from driving rains.



Above is a roof section example covered with wooden battens and clay tiles.

Gable Roofs

In this lesson we will discuss gable roofs. For many reasons, this is a good style of roof for cob homes and they are fairly simple in design. Some advantages to gable roofs are:

- Simple design structure
- They are good for rainy climates because they can provide plenty of protection to the walls from driving rainfall
- They do not always require a lot of wood
- Load bearing cob walls distribute the weight of a gable roof evenly
- Creates more space inside the building with higher ceilings

A basic gable roof consists of a ridge beam spanning the length of the building with paired rafters connected on each side of it. The rafters extend from the ridge beam down to the walls. Sometimes the rafters are attached to collar beams on top of the walls to prevent the rafters from pushing the walls apart.

The ridge beam will extend across the length of the roof and the ends will sit supported on the walls or posts. This leaves space in the roof open for a "cathedral ceiling" and gives you the ability to add in lofts and storage spaces. If your building is too long for a ridge beam to extend all the way across you can use trusses instead.

Roof Pitch

An important thing to consider for your roof is the pitch or angle that it will be built at. This will also affect the way your roof looks. Probably the most important influencer of how your roof will be pitched is what type of roofing material and style you decide to use.

Any kind of roof that uses overlapping pieces like tiles, thatch, shakes, or shingles will need a steep roof of about 35 degrees. If you're building a living roof then you will need to have a pitch less than 25 degrees. If you pitch is too high on a living roof then your roofing materials will fall off the sides. Thatch roofs should have a minimum pitch of 45 degrees and ideally have a pitch of 50 degrees.

Ceilings

Your indoor ceiling acts as a support for your roofing insulation and provides an attractive surface. There are a lot of ways to do a ceiling. You can put the ceiling in

strips between rafters, beneath rafters, on top of rafters (so the rafters still show), between trusses, or suspended down from rafters for more insulation.

Ceilings can be made of:

- Boards
- Plywood
- Drywall
- Bamboo
- Woven bamboo mats
- Fabric or sheets

Natural Finishes

Natural plasters and finishes are a great alternative to the conventional finishing products that are available on the market. The ones that are just riddled with toxic chemicals!

Most people don’t even realize the negative effects that these products have on their health. Indoor air pollution and toxic off gassing is a whole subject unto itself. But by using natural plasters and paints, you avoid the added toxicity of cement stucco, drywall, chemical paints, and the destructive industry that produces them all.

Natural plasters and finishes can be applied to cob walls or even to drywall board! The majority of natural plasters and finishes are made from a combination of these simple ingredients: Clay, sand, straw, lime, kaolin clay, wheat paste, pigments, and water.

Plastering your cob home is like putting the icing on the cake. Once you have built your walls, built your roof, and installed the windows and doors then you can begin to plaster your building. The plaster will protect your walls from rain on the outside, and it will protect your cob walls from any crumbling off on the inside.

A good foundation and a good roof overhang (a good hat and boots, as they say) will protect your cob home from most weather and rain. Some people decide not to plaster the exterior walls of their cob homes and they are fine in many cases, but you will still get deterioration. It is recommended to plaster your walls to protect them from driving rain and frost.

You will also want to plaster the inside of your cob building. Plasters can brighten your home by reflecting natural light inside. Plaster with light and pale colors around windows and lights for better reflection. Use darker colors or colored pigments to set a certain mood. It’s up to you how you color your home so get creative!

Never Use Cement Stucco with Cob

You need to let your cob walls "breathe" freely. Using cement stucco on cob blocks off the ability for air and moisture to pass freely through the tiny pores of the cob structure. The more appropriate terminology for this is called "vapor permeable."

Do not use any impermeable moisture barriers, tar, oil-based paints, or latex-based paints on cob structures. Water vapor that's generated from inside of the building from your kitchen, bathroom, and even breathing needs to eventually make its way outside through the walls.

Moisture will condense behind cement stucco and soak your cob walls, completely destroying the strength and integrity of your structure. This is why it is so important to never use these types of coverings over your cob walls. Always use vapor permeable natural plasters and paints. They are cheaper, more beautiful, and better for your health anyway!

Adding Manure – Animal manure can also be used for natural plasters. It sounds kind of nasty at first, but it has short, natural fibers and digestive enzymes that

help clay to plasticize. Cow and horse manure are the most widely used for this purpose worldwide and have very little odor at all when dry. Try to use fresh manure. Otherwise you can use dry manure, but make sure that the fibers have not decomposed. Both horse and cow manure are safe to use since very few pathogens in their dung can transfer to humans.

Earthen Plaster

Earthen plaster is made with a mixture of clay-rich soil, sand, straw, and water. Because the ingredients are screened and chopped finely, the mixture comes out as a much smoother and wetter mix than cob.

Lime Plaster

Lime plasters have been used for thousands of years. Lime is a vapor permeable material that works very well with cob. Using a lime plaster on cob will give it a skin of thin limestone, which will protect it well from the elements and beautify your home or structure.

Lime can come in many different forms. Ready-made lime putty and quick lime are the best types of lime that you can acquire for plastering a building. However, they are still not readily available in the United States. They are widely used in the UK though. Bagged, hydrated lime and hydraulic lime powder are available in the United States and are still effective.

Hydraulic lime comes in NHL 2, 3.5, and 5 denoting the amount of silica and alumina impurities contained in the mix. This determines the strength and permeability of the lime. NHL 5 is the strongest and gives the most protection from water. It's a great choice to use on things that get very wet. For example, an exposed cob oven with no roof over it is something you would want to use an NHL 5 on. NHL 2 is good for making a lime wash, and NHL 3.5 is suitable for either interior plastering or external plastering of cob walls.

If all you can acquire is hydrated lime powder then you can still make your own lime putty with it. Get a barrel and fill it up no more than two thirds full of water. Pour in your hydrated lime and stir it until it is thick and smooth like a milkshake. When it's all mixed up, pour a layer of water on top of it and tightly close the barrel with a lid. Let it sit for a few weeks to a few months. It is like a fine wine. The longer it sits, the better it will be as a building material. You can let it sit for as long as you want and it won't spoil. Just remember to keep the cover of water over it so that it doesn't dry out and start to set.

Lime plaster is a mixture of lime putty, sand, and water. You use more sand in the mix for scratch coats and less sand in the mix for finish coats.

When working with lime it's important to wear a mask to prevent breathing in any lime dust. Lime is also very caustic so its recommended to wear gloves so that it does not burn your skin! If it gets on your hands or skin wash it immediately with water. You can also rub your hands in vinegar to neutralize the alkalinity of the lime. If any lime gets in your eyes wash them out with water immediately. Please don't forget this, and stay safe.

Lime Wash

Using lime wash is one of the cheaper ways to cover and protect your walls. Lime wash is basically just lime putty watered down to the consistency of milky paint, and you can apply it to your walls with a paintbrush. It can also be made with Natural Hydraulic Lime. You will get the best results with NHL 2 powder.

For added protection to you walls, you may want to apply an earthen plaster first. You will probably need several coats of lime wash to get a white finish over a dark mud color though. Remember to mist your wall with water before applying any lime wash, and always wait 24 hours before applying your next coat of lime wash.

Try not to apply lime wash in direct sunlight or in the rain. A cloudy day is the best day! Cover your lime wash with sheets for 24 hours to protect it from sunlight exposure.

Tadelakt

Tadelakt is a lime-based finishing technique used to beautify and add waterproof functions to your home. It is a water resistant finish so it can be applied to sinks, showers, pools, spas, baths, or to decorate a wall. It's a great alternative to tiles in your bathroom.

Tadelakt is permeable to air but impermeable to water, so tadelakt is still vapor permeable like other natural finishes.

This technique comes from Marrakech, Morocco and has been used by the Berber people of North Africa for centuries on their traditional adobe and rammed earth buildings and casbahs. Tadelakt is believed to have been first used to waterproof their ancient cisterns and their hammams – traditional bathhouses.

Tadelakt is a lime based plaster finish. Olive oil soap is applied onto the fresh lime which creates calcium stearate. (The same thing as soap scum.)

Lime + Soap = Calcium Stearate

Tadelakt is essentially very beautiful soap scum (calcium stearate) and it almost never needs to be cleaned. Lime's high pH value means that tadelakt is both fungicidal and anti-bacterial so it's not unclean.

The tadelakt surface is finalized and polished with an olive oil black soap. This reacts with the lime plaster to create the waterproof surface. A final coat of wax can even be applied to give it further luster.

Installing Utility Lines – Electricity & Water

One often overlooked component to designing a cob house is the installation of electrical and plumbing through the building. Its important to give careful consideration to how these will be put in. You have to understand the dynamics of how these will interact with the cob and how to install them for your own access in case you need to ever make repairs or adjustments.

Unlike a hollow stud-framed wall to lay your wires and pipes through, you are working with a wall of solid mass that can not be opened up once its set and dried.

Electrical Lines

Electrical wiring can be installed as you build the walls up or installed once the walls are done. If you're doing the latter, you will need to have the wiring done before you can plaster the walls. It is very safe to put electrical wiring directly into cob since cob can not catch on fire.

If you install conduit pipes into the cob walls as you build upward then you can feed your wires through them later on. This requires that you have your wiring layout planned before building the walls. This method is recommended for maintenance purposes. Its much easier to access and change wires by installing conduit.

The other option is to carve out channels on the exterior portion of the completed walls, lay the wiring in them, and then cob or plaster over it.

Also carve out pockets for your switch boxes. These can be nailed in place into the cob if you need to secure them better. Nailing is best done once the cob has dried.

Water Lines

Water can be the worst nightmare for a cob structure. Especially leaky pipes inside of your walls. For this reason, its important to think about how you will install your water lines.

Plumbing can be installed through cob walls like wiring conduit can, but this method is not recommended. You won't be able to tell if a pipe is leaking, and if it is you won't have access to the pipe to fix it. Leaky pipes inside of cob walls can cause significant structural damage. For this reason, you should also never put pipe joints inside of cob walls as these are more likely to be your leakage points.

You can also encase your pipes in plastic tubing as another precaution to catch water if one does manage to leak, but this is not a guarantee of safety.

Its better to be safe than sorry in this case. Its best to plan a way to run your water lines without going through the cob walls.

If you do run water pipes inside of walls, keep them toward the inside of the walls or insulate them if you live in a very cold climate. If you're in a very frosty, cold climate also keep any water pipes that run exterior to the building below the frost line. These things will help prevent frozen and ruptured pipes.

Foundation Integration

Water lines and wires can enter from the outside of your cob structure either through the base of your cob walls or underneath your stem wall foundation. You can use a piece of PVC pipe to feed your wires through to the inside.

Depending on how you will have these lines come in, remember to plan your system ahead of time since it will be much more difficult to implement this when your walls or foundation are already under construction.

The water lines can come straight up through the foundation without going through walls. Lay your water lines underneath the stem wall and below the frost line.

Access

Having easy access to your electrical and water lines is something important to factor into your layout and design for these systems.

By using conduit for your wiring you are giving yourself relatively good access to this system. Water pipes should be kept outside of walls and floors as much as possible for their best access.

If you do have lines inside of walls or floors, you can fashion a removable wooden door board to the wall or edge of your floor so that you can easily get to certain points in these systems when you need to.

Another strategy to consider for your home is to layout your rooms that require water to share an adjacent wall with each other. The wall in between these rooms can be built with regular stud framing. This will allow you to run all of your required water lines through a hollow wall and you will have easier access to the system should you ever need to make repairs or adjustments.

Note: If you don't have experience with electrical and plumbing it is best to consult with an expert or someone who has worked with these systems.

Beginner Cob Projects

Lots of people envision building their own cob house or cottage one day. Some people hire an experienced cob builder, but most of the time they build it themselves.

Building with cob is so much easier than modern conventional building. If you can build a sand castle then you can build a cob house! Well, okay… It's not that easy, but you get the point I think.

Anyway, we all need to start learning somewhere. Here are a few cob projects to get you started. This is what I tell people to do when they don't know where to begin.

Stop feeling intimidated about building something you've never done before. Just find your motivation and the will to move your thought into action, and I guarantee that you will surprise yourself at what you can create and achieve.

There is no specific order to do these projects in, and you don't have to do them all. They all rely upon the same basic concepts and skills. Just choose the one that sounds best for you.

Cob Oven

Building a cob oven is a great idea for a first project using cob. There are some more technical details that have to be paid attention to compared to the other projects that are listed below, but there is far less cob that has to be mixed overall.

Building a cob oven will let you get your hands dirty by learning how to make cob, a rubble trench foundation, and a stem wall. These are the same three components of any cob wall that would be used for a cob house.

With a cob oven you will also learn how to make insulation mixes, oven mud, and natural plaster (either lime plaster or earthen plaster).

Cob Bench

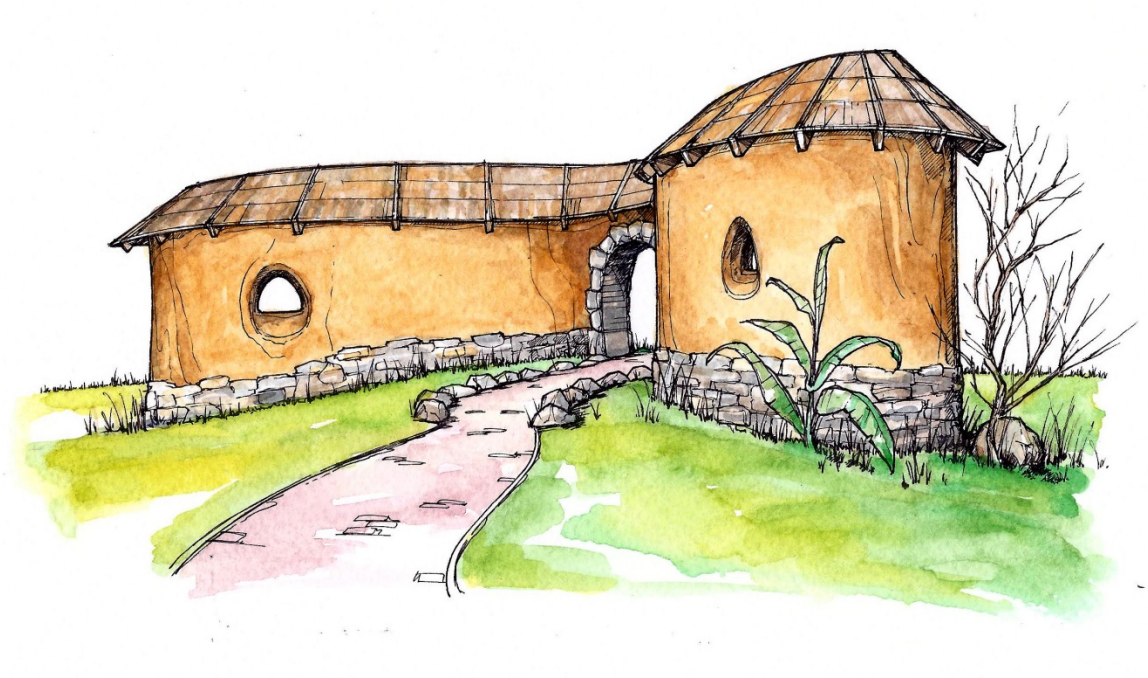
A cob bench is a great starter project for new cob builders. Imagine building a couch out of cob. You can build as big or as small as you want it though, and you can mold it however you want it to look like.

Building a cob bench will teach you the basics of cob building. You will learn how to make cob, how to make a rubble trench foundation, how to build a stem wall, and how to finish with plaster.

If you can build a cob bench then you can easily build a cob wall for a house. The same concepts apply.

Cob Garden Wall

A garden wall is a good project to begin cobbing with too. You will learn how to dig and construct a rubble trench foundation, set a stem wall foundation, mix and apply cob, and to finish with natural plaster. You can also add roofing onto the top of the wall if you want. This is recommended in wet climates.



A cob garden wall can be as long and as high as you want it to be. There are all kinds of places that you could build one. Spruce up your garden or your yard with one.

Cob Dog House or Play House

Another good project you may want to start with is a cob dog house or cob playhouse for children. This project is more advanced than the other ones I listed, but it’s definitely doable if you’re motivated to take the extra steps.

The concepts from the other projects apply here once again.

For this project you will experience:

- How to make cob and build walls
- How to make a rubble trench
- How to make a stem wall foundation
- How to finish with natural plaster

- How to add windows and doors
- How to construct and attach a roof

Want to Learn More?
Get Over 9 Hours of Video Lessons

One of the first recommendations that I make to anyone who is interested in building a cob house is to **get some training**. Whether you will be physically building the house yourself or having someone else do the construction, knowing the details of cob building will guarantee you a **better design** and **fewer mistakes** along the way. And in building, mistakes cost you a lot of money and time so they are best to be avoided when possible.

I recommend that people get as much training and understanding as possible before taking on a large building project. Its best to take a comprehensive cob workshop and any additional Natural Building workshops to supplement the experience.

However, I also understand that getting training can be difficult for a lot of reasons. Most people who want to take cob workshops and get the skills they need to design and build their own cob house tend to run into **three main problems**.

- Workshops are **too expensive** and not affordable for the value gained
- **Not enough time** available, and no time to be away from work
- Workshops are **too far away** and the travel time and costs add to the burden

These three things are preventing a lot of interested people from participating in cob workshops, but I'm going to give you my solution to these problems right here and right now.

I've created an exclusive online classroom where you can log in and have a virtual workshop learning experience from the comfort and convenience of your own home. You will receive **over 9 hours of video lessons** included with this course. The program is self-study and you can learn at your own pace without any stress of travel or deadlines.

If you enjoyed reading this book and you want to take your learning to the next step, then I recommend joining our online cob workshop classroom.

Click here to learn more.

Every topic that you have read about in this book will be covered in detail in the video course as well as many more great topics to further your understanding of cob and Natural Building.

Check out some of these other interesting topics covered in the course:

- How to Build a Traditional Stone Foundation
- How to Square Your Site For Building (Using The Pythagorean Theorem)
- Tools to Build a Cob House
- Stone Masonry Tools and How to Collect Stones
- How to Lay Out a Round Foundation
- How to Build Cob Archways
- Building Codes and Permitting
- How to Build On a Timetable
- How to Trim Cob Walls
- How to Make and Apply Earthen Plaster
- How to Integrate Cob and Straw Bale Walls
- How to Place and Brace Door & Window Frames
- Building Multiple Story Cob Buildings
- How to Attach Roofing to Cob Walls
- How to Host Your Own Cob Workshop
- Plaster and Finishing Tools
- Introduction to 3D Design with SketchUp
- How to Perform a Cob Toss
- Earth Building Materials Overview
- Introduction to Living Roofs
- Straw Alternatives and Mechanized Cob Mixing
- Concrete Bond Beams
- How to Mix and Apply Lime Plaster
- How to Mix and Apply Tadelakt (Moroccan Waterproof Finish)
- How to Protect a Cob House From Moisture
- How to Do a Basement For a Cob House
- How to Build the Roof Before the Cob Walls
- How to Find and Work with Architects and Subcontractors
- Natural Builder’s Property Purchase Checklist

The online course has been made **very affordable** and **convenient** for you to enjoy and experience. Take the next step in your cob building education today.

Click here to get all the course details.

Happy Cobbing!

Alexander Sumerall

Owner/Founder

This Cob House, LLC