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## Earth Blocks

Earth blocks, also called 'adobe', have been used in building throughout the world for thousands of years. The materials are widely available, cheap and provide strong and long lasting blocks with which to build.

# what are the main ingredients?

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- The three main ingredients of earthen blocks are:
  - ▣ clay-earth
  - ▣ sand
  - ▣ fiber
- Other ingredients can be added to strengthen the mix such as flour paste or manure
- Water is used to make the mix workable but it evaporates whilst drying, leaving a hard, strong block
- Understanding the function of each of the main components will help you create a mix that makes solid and long lasting blocks

# Soil & clay

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sticky

binding

water resistant

cracks without  
sand or straw

found in  
subsoil &  
wetlands

- Clay is the binding agent & water protector in earthen blocks
  - ▣ Being rather sticky, clay binds to the sand & straw in earthen blocks & holds the mix together
  - ▣ Clay resists water & can prevent moisture from penetrating the wall
    - (this is why clay is often used to line dams so it can act as a natural lining)
- Too much clay in an earthen block will cause cracking
  - ▣ Sand & straw in a clay block can help eliminate cracking, while the clay bonds the sand & straw together
  - ▣ The clay content in your adobe block needs to be around 15 – 25%
- Our main source of clay is found in subsoil & in wetlands
  - ▣ NB never use topsoil because it contains organic matter which may decompose & has little binding capacity



water  
clay  
silt  
sand

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## how much clay is in your subsoil?

The jar test allows you to find out the proportions of clay, silt & sand in your earth. First, fill a clear glass jar one-third full with earth. Pick out small rocks & organic matter, such as roots or seeds. Break up any lumps. Next, add water, filling the jar two-thirds of the way to the top. If you add a teaspoon of salt to the mix, it will speed up the decomposition of clay, which as you will see take the longest to settle. Next, screw the lid onto the jar tightly & shake hard for a few minutes. Put the jar down on a flat surface & wait for the contents to settle. If the water in your jar clears quickly that's a sign that there's not much clay in your earth. If it remains cloudy after the sand & silt have settled out, then your in luck, you have clay in your subsoil! After your clay settles, measure the thickness of each layer to determine the relative proportions of clay, silt & sand.



# Sand

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structure

strength

bulk

stable

strong

anti-cracking

remove  
organic  
matter

- ❑ In an earthen block, sand provides structure, strength & bulk
- ❑ In blocks, sand particles are bound together by clay
- ❑ Combined, sand & clay make a stable & strong material
- ❑ Sand doesn't expand or contract so it prevents cracking in blocks
- ❑ Sand should be run through an 1/8-inch metal screen to remove small stones & organic matter
- ❑ The sand levels will vary from soil to soil, so the addition of river sand will depend on the site
- ❑ Sandy material should make up approx 60% - 70% of total

# Fiber

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cheap

strengthens

reinforces

binds

flexible

clean to  
prevent mould

- Fiber is the third ingredient of earthen blocks
  - ▣ dry straw
  - ▣ hemp fiber
  - ▣ animal hair (wool)
  - ▣ horse manure
  - ▣ coconut fiber
  - ▣ sisal fiber
- Straw is the most common fiber used because it is widely available, easy to work with, effective & relatively inexpensive
- Fiber forms a reinforcing meshwork, which helps to bind the mix together
- It also provides some flexibility which, when combined with sand, helps stop the clay from cracking the block
- The fiber **MUST** be clean & dry otherwise it will mould & deteriorate

# Water

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- ❑ The addition of water is what will make the mix workable and bind the different parts together. When it evaporates it leaves behind a strong, dry block.
- ❑ Too much and the mix will become too weak with not enough actual substance, taking a long time to dry out and not having enough density.
- ❑ Too little and the different elements will not properly combine together, resulting in a weak, crumbly block.
- ❑ It is easier to add water little by little, rather than adding too much and having to add dry material or even let the mix dry out!

# Block mould

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- This can be as simple as a home made wooden frame or a welded steel mould. At Guba, we had a steel mould made up with a double block as it would be more durable and easier to clean and maintain.
- Handles on either side make removal of the mould easier

The inside measurements for each side of the mould were roughly 400mm x 200mm x 100mm





# Block mould sizing

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Ease of  
brickwork

Good strength

Manageable  
weight

Quick drying

- The mould (and so the blocks) was made 400mm x 200mm x 100mm for a number of reasons:
  - ▣ Having the width exactly half the length meant that for more complex structures it would be possible to build a double skin wall and interlock the two easily.
  - ▣ A single skin wall should not have a width below 200mm for strength reasons.
  - ▣ A thickness above 100mm for a brick this size would make it heavy and difficult to use, with the possibility of injury and breakages.
  - ▣ A thickness above 100mm would also increase the drying time and make it harder to tell if the block was completely dry throughout.

# Tools needed

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spade

hoe

gumboots

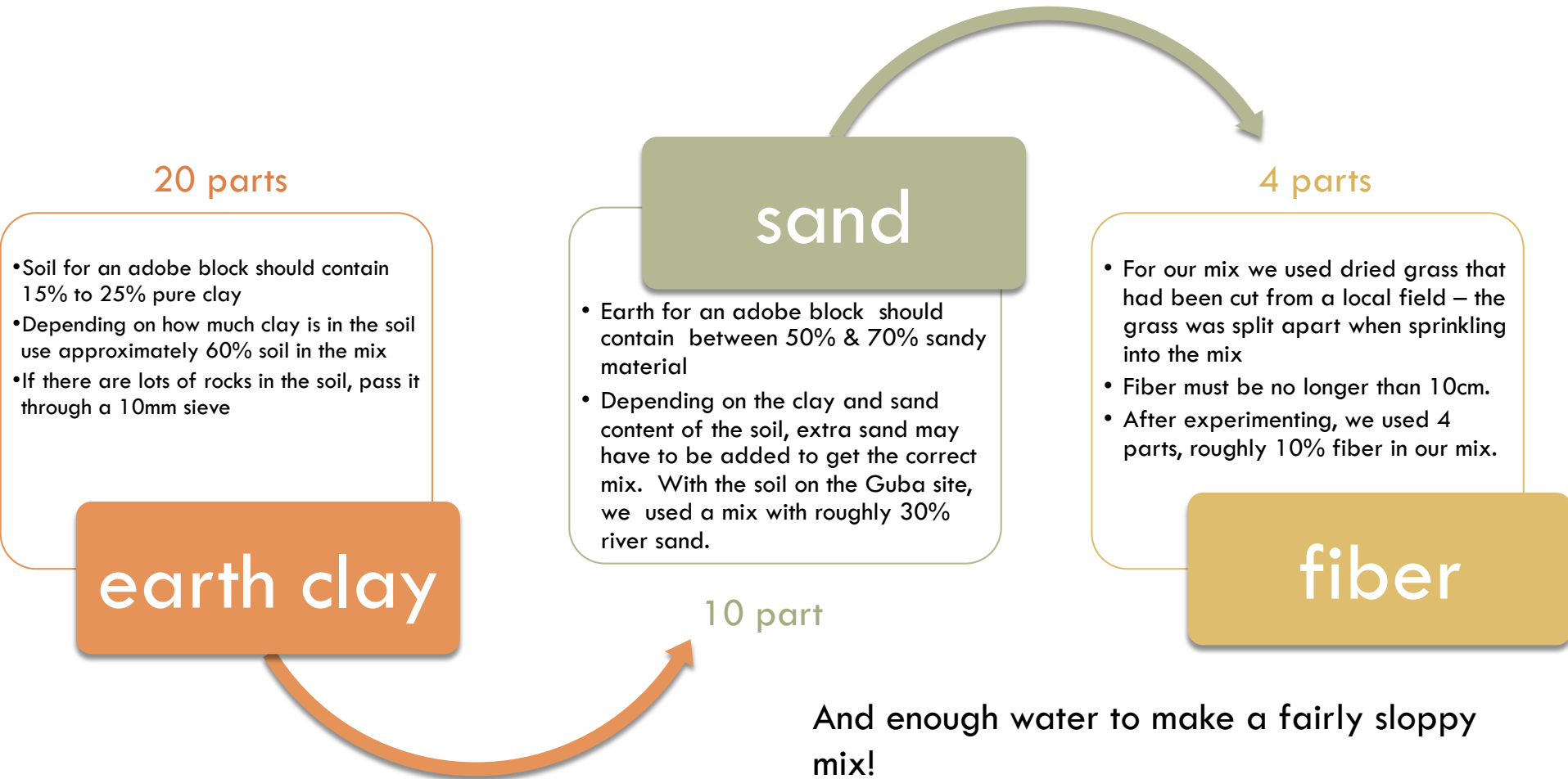
bucket

sieve

- Typically for making adobe blocks, tools will consist of a combination of mixing instruments including :
  - ▣ Spade
  - ▣ Hoe
  - ▣ Sieve
  - ▣ Hose, bucket or watering can for water
  - ▣ Gumboots (the gumboot mixing dance is very effective!)

# Guba's Adobe block mix

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# The Guba Mixing process

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- Make a flat circle with a layer of earth, then lay the sand on top, followed by the layer of grass.
- At this point there are 2 options :
  - ▣ 1) Soak the whole mix with water before mixing it up with feet, forks and hoes. Check the water content. Does the mix feel too stiff when mixing with feet? Add water if needed until it is a sloppy, loose consistency but not so wet that it runs everywhere. Make a pile of the mix and stamp down, or 'dance' again with feet. Typically the mix is piled up then walked on 2 or 3 times, until all the fibres are evenly spread and coated in the mix. The mix must then be left overnight for the water to properly soak into the clay particles. Add more water and mix once again when needed.
  - ▣ 2) Soak the whole mix thoroughly and leave overnight for the water to get into the clay particles without mixing. The following day (or even couple of days after), mix together as above, adding water as necessary.

# Mixing process continued...



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- ❑ Clear and level an area of flat ground. A plastic sheet is very helpful as this will help stop the blocks sticking to the ground.
- ❑ Shovel and throw the mix into the block mould, pressing with hands to get the mix into all the corners. When full, use the spade to smooth and flatten the mould. Scrape the excess mix off. Should any gaps appear fill them with mix.
- ❑ Immediately remove the mould.
- ❑ Leave the bricks to dry outside with where the breeze will help. If the sun is very hot, provide shade or cover with grass to help stop the bricks from cracking. Turn the bricks after a few days to ensure even drying on all sides.
- ❑ Try to have the long axis in line with the sun. When the blocks dry they shrink, if the blocks are horizontal to the sun they may bend and warp a little



# How long does it take?

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- As with many things, the length of time it takes to make earth blocks will depend on a number factors:
  - ▣ How hard you work!
  - ▣ Experience
  - ▣ How many people there are
  - ▣ Weather conditions
- As a rough guide, 2 experienced, hard working block makers at Guba made roughly 85 blocks per day, (including preparing the mix). This number could be greatly increased with good teamwork, for example with a team of 4 people split into 2 mixing and 2 making the blocks.