

# **Brick Kiln**

A **kiln** is a thermally insulated chamber, or oven, in which a controlled temperature regime is produced. Uses include the hardening, burning or drying materials. Kilns are also used for the firing of materials, such as clay and other raw materials, to form ceramics (including pottery, bricks etc.)

## Types of Kilns

There are two basic types of kilns:

- (1) Continuous kilns and
- (2) Intermittent kilns.

A **continuous** kiln, sometimes called a *tunnel* kiln, is a long structure in which only the central portion is directly heated. From the cool entrance, *material* is slowly transported through the kiln, and its temperature is increased steadily as it approaches the central, hottest part of the kiln. From there, its transportation continues and the temperature is reduced until it exits the kiln at near room temperature. A continuous kiln is the most energy-efficient, because heat given off during cooling is recycled to pre-heat the incoming ware.

In **intermittent** kiln, the *material* to be fired is loaded into the kiln. The kiln is sealed, and the internal temperature increased according to a schedule. After the firing process is completed, both the kiln and the material are cooled.

## Updraft Kilns

∇ Updraft kilns are those in which the flame is introduced into the bottom of the kiln, at or below floor level, and exhausted out the top. Updraft kilns consist of three basic components: the firebox, the damper, and the stack area.

∇ The firebox is where the flame enters. The damper is at the top of the kiln and controls the exhaust (and by association, the kiln's atmosphere). The stack area is where the pots are set and is between the firebox and damper.

∇ Although an updraft kiln tends to be less fuel efficient than a downdraft kiln, most commercially built fuel-burning kilns are updrafts. This is mainly due to their simplicity to build, pack, and ship.



Fig : Updraft kilns

## Downdraft Kilns

∇ Downdraft kilns are designed to force the flame and heated air to circulate through the kiln. Flame is introduced at the bottom of the kiln and naturally flows upward. The construction forces the flame back downward, to exhaust at the bottom of the kiln.

∇ Downdraft kilns consist of four main components: the firebox, the stack area, the damper, and the chimney. The addition of the chimney helps create draw, or air flow.

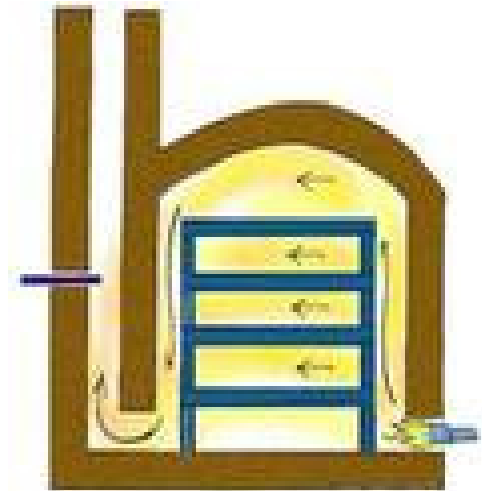
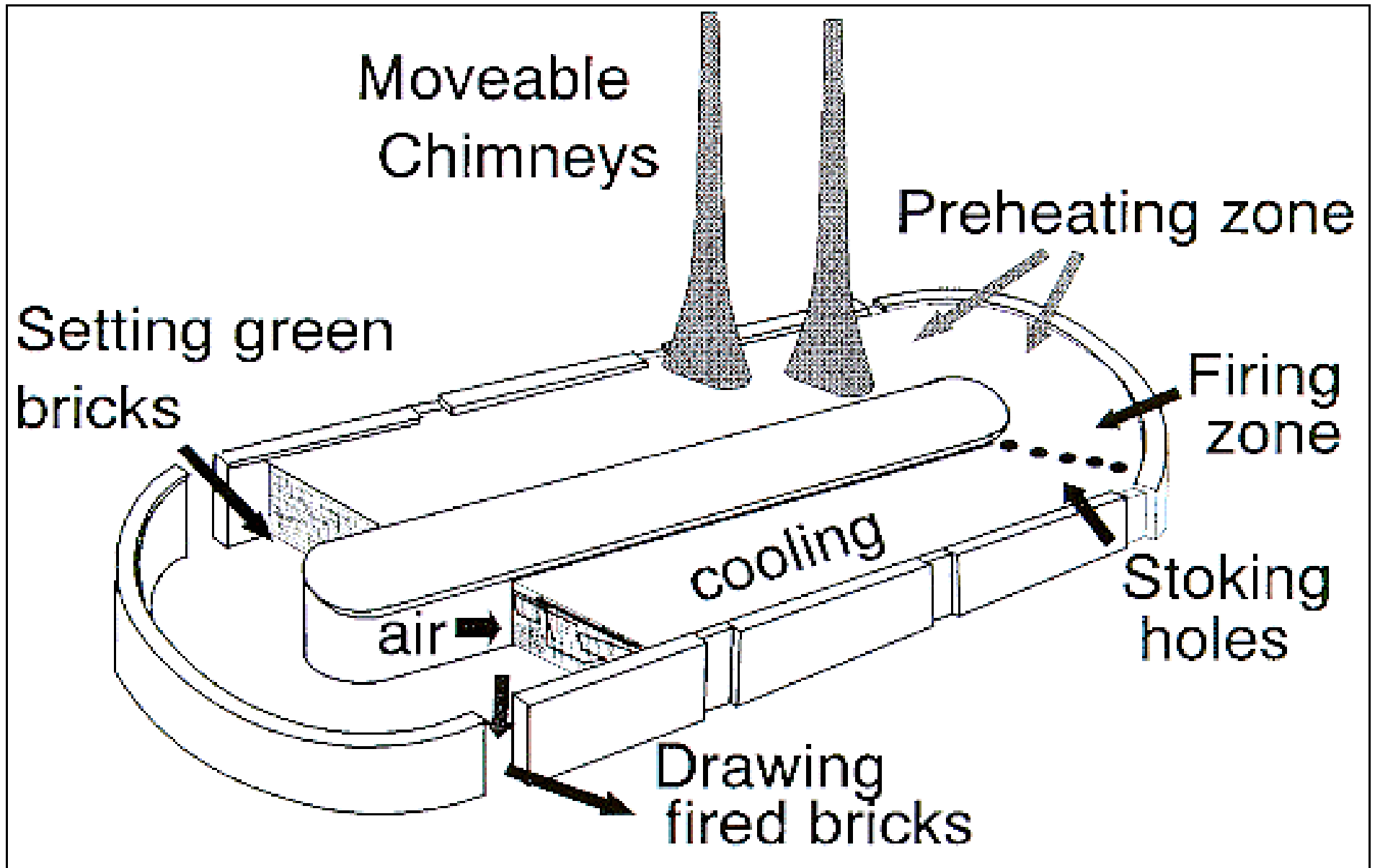


Fig : Updraft kilns

## BULL'S TRENCH KILN

- ◆ The kiln can be made circular or elliptical in shape. It is constructed on dry land, by digging a trench, 6 - 9 m wide, 2 - 2.5 m deep, and 100 - 150 m long. Gaps are left in the outer wall for easy access to the trench during setting and drawing of bricks.
- ◆ The raw bricks to be fired are set in rows, two to three bricks wide, with holes in between that allow feeding of coal and a sufficient flow of air through the setting. A linking layer of bricks is made across the width of the kiln and half way up, to stabilize the setting. On top of the bricks, two layers of bricks, covered with ash or brick dust, seal the setting. A large piece of canvas, paper or metal sheet is placed vertically across the brick setting to block air from entering from the wrong side of the chimneys. The trench contains 200 - 300,000 bricks at a time.
- ◆ Chimneys, 6 - 10 m high, made of sheet metal, are placed on top of the brick setting. They are moved around as the firing progresses and they have to be light, so that the firing crew can carry them. In order to maintain sufficient draught and the chimneys are placed closer to the firing zone. Circular Bull's trench kilns use only one chimney, whereas the larger elliptical kilns need two chimneys.
- ◆ The firing in a Bull's trench kiln is continuous, day and night. Raw bricks are loaded and finished bricks are drawn all the time. The fuel saving is achieved by reusing part of the energy that is otherwise lost in intermittent kilns. The air for combustion is drawn through the already fired but still hot bricks. The cooling bricks transfer their heat to the combustion air, pre-heating it before it enters the firing zone. After combustion, the hot exhaust gases pass through the yet unfired bricks on their way to the chimneys. This pre-heats the bricks, so less fuel is needed to bring the bricks to the maximum temperature. Once every 24 hours the chimneys are moved forward 5 to 7 m. Daily output is 15 - 25,000 bricks.

## Design of a Bull's Trench Kiln



## **Advantages of the Bull's Trench Kiln**

More fuel efficiency compared to intermittent kilns.

Low initial investment.

High capacity.

## **Disadvantages of the Bull's Trench Kiln**

The kiln is fired continuously and has to be loaded with a constant number of bricks every day. This demands a good organization of the brick production, and the production cannot easily be adjusted to fluctuations in the brick market.

The firing crew needs long time experience.

Its moveable chimneys have a short working life.

The moveable chimneys' exhaust temperature is high, causing a less than optimum firing condition and fuel economy.

# The Hoffmann Kiln

➤ The Hoffmann kilns were in the form of a great circular ring chamber, with massive walls and a large chimney at the centre, to which underground radial flues converged from the inside walls of each of the twelve chambers. The chambers were barrel arched (like a railway tunnel), and in the roof arches there were several small feed holes through which fine coal could be fed into spaces made among the bricks to be fired. Around the outer wall or the kiln were the twelve openings for loading and unloading the individual firing chambers. These chambers were separated from each other by very large metal dampers, that could be raised and lowered as the fire moved around the kiln from chamber to chamber.

➤ Once the kiln is lit it is allowed to go out, and the sequence of operation is continuous. With the kiln in full operation two chambers will be open, and the other ten sealed up at the door and by the inter connecting steel dampers. If the chambers are numbered from 1 to 12, then bricks are being unloaded from 12 and load in 1. The *damper* is closed between 1 and 12, but open between all other chambers. Air is drawn through the open door of 2 and through the bricks in 3, 4, 5, and 6, cooling them down and at the same time being heated itself. The temperatures of the chambers increase from 3 to 6, with the temperature at 6 being close to the firing temperature.

➤ Chamber 7 is being fired, with fuel being fed at intervals through the roof, which is immediately ignited by the hot air from 6. The products of combustion pass on to 8, 9, 10, and 11 drying and pre-firing the bricks in these chambers. In 8, the bricks are at the pre-firing stage, and in 11 they are going through the water smoking stage. From 11 the combustion gases pass through the flue and up the central chimney. All the other 11 flues from the other chambers are closed off with dampers. At regular intervals, the firing zone is moved forward and the corresponding changes made to the dampers between the chambers and into the chimney. The chambers being loaded and unloaded move forward in sequence, and this way heat is extracted from the cooling bricks and also from the hot combustion gases.

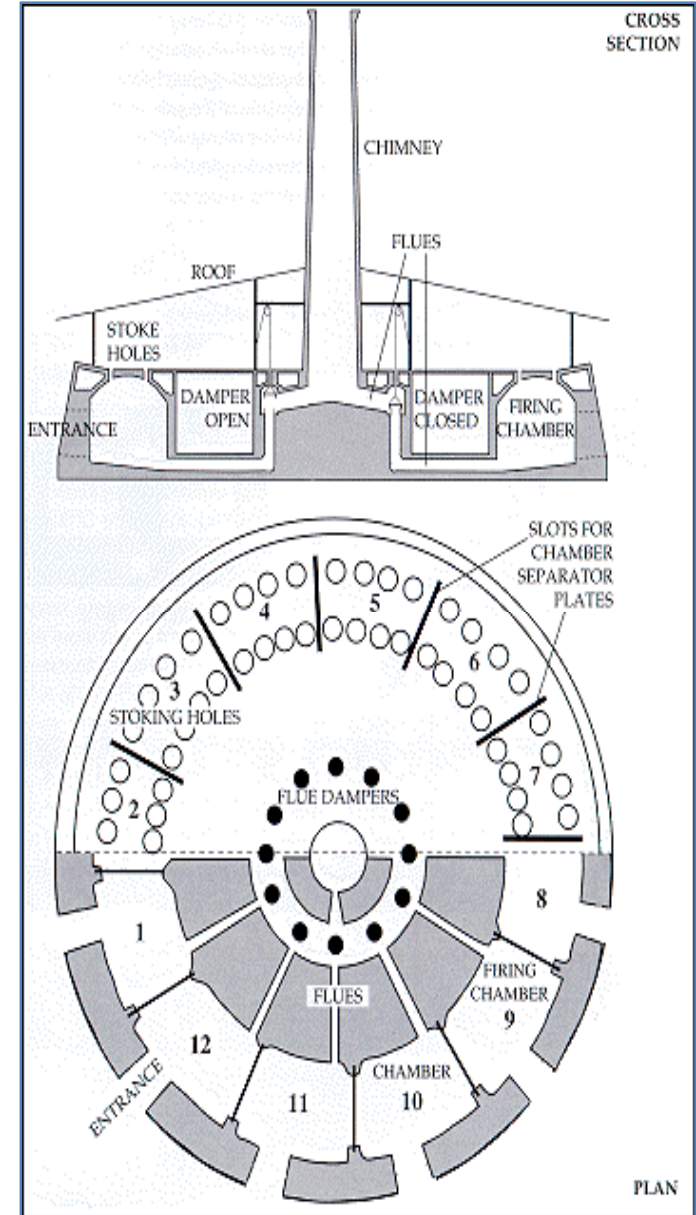


Fig : The circular Hoffmann kiln

## Advantages of Hoffman kilns

They are fuel efficient, because the direct stoking into the bricks and their use of waste heat to dry and preheat the raw bricks before firing..

They have the capacity to fire very large quantities of bricks evenly and with minimal wastage.

The use of the down or cross draught system, with the fuel being burnt at regular intervals amongst the bricks, provides an even firing throughout the kiln.

The firing is controllable by the use of the dampers and careful stoking.

A variety of biomass fuels can be used successfully, for example, sawdust and wood processing waste, rice husk etc.

## Disadvantages of Hoffman kilns

They have a large mass that absorbs a lot of heat as the firing zone moves forward through the cold kiln. This is compensated by the fact that some of the residual heat in the kiln and fired bricks is used to pre-heat the air for combustion.

They are expensive to built and require regular maintenance.

They occupy a lot of space; because of this the are often built in the clay pit after all the usable clay has been extracted, so as not to occupy large areas of clay reserves.

Direct stoking affects the quality of the bricks directly beneath the stoke holes. These bricks can be over fired and are usually discoloured. This can be avoided by incorporating firing trenches beneath the stoking holes, along the sides and in the centre of the firing chamber. These trenches contain the burning fuel and prevent localised brick spoilage in the kiln. The fitting of firing trenches, however, means that the capacity of the kiln is reduced to produce a higher quantity of evenly fired bricks.