



# UNDERGROUND TRENCH KILN

USER MANUAL FOR CONSTRUCTION (FOR IN SITU PRODUCTION)



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
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Swiss Agency for Development  
and Cooperation SDC

**skat** Swiss Resource Centre and  
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**PROECCO** PRoMoting EMployment through  
CLimate Responsive COnstruction

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# 01

## INTRODUCTION

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This manual is a construction guide for masons and builders on how to build an in-situ kiln for small scale bricks production on a building construction site.

An in-situ kiln is meant for onsite bricks production for a large housing or construction project. The kiln is based on the trench or underground kiln design, where the kiln can later be converted and used as a septic tank or water reservoir.

The in-situ kiln requires other temporarily infrastructure such as hangars and water tanks. This manual guides the reader on the step by step construction stages of the in-situ underground kiln.

This manual has three sections:

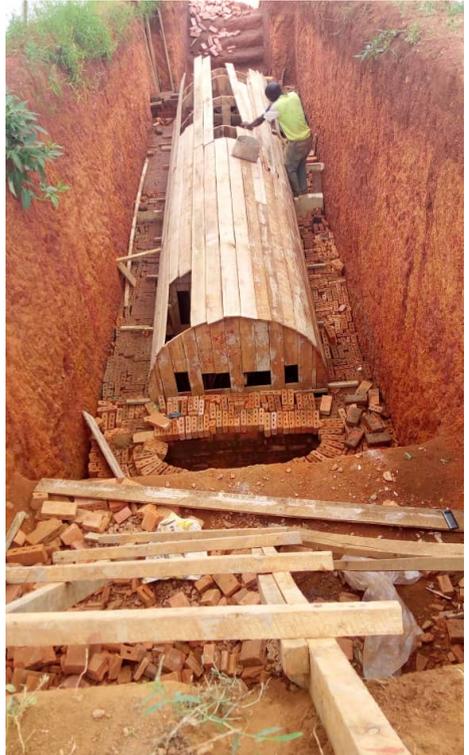
1. The in-situ kiln.
2. The in-situ brick production layout;
3. The construction stages of in-situ kilns.

# 01

## 01.1 - THE IN-SITU KILN

An in-situ kiln is an underground brick kiln constructed on a construction site for firing bricks required for the construction project. The in-situ kiln is ideal for large construction projects where construction costs can be reduced and quality of bricks effectively controlled and monitored on site.

Once the project is completed, the kiln can be converted to a septic tank or an underground water tank.



The underground in situ kiln under construction

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# 01

## 01.2 - ADVANTAGES & DISADVANTAGES OF THE IN-SITU KILN

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### ADVANTAGES

The in-situ kiln has the following advantages:

- Easy to control quality of bricks on site;
- Construction costs are reduced as production of bricks on site is cheaper than buying from a factory;
- Losses in terms of broken or damaged bricks during transportation is eliminated;
- The kiln is designed to use sawdust, coffee or rice husks as fuel for firing the bricks.

### DISADVANTAGES

The in-situ kiln has the following disadvantages:

- Hangars used for moulding and drying of bricks are obsolete after the project has achieved its objectives;
- In-situ kiln is only economical to build on large construction projects requiring thousands of bricks with adequate space for onsite bricks production;
- Requires forward planning as it takes a minimum of 3 months to produce the first batch of bricks, as opposed to buying readymade bricks from brick yards.

# 02

## THE IN-SITU BRICK PRODUCTION LAYOUT

### INTRODUCTION

The in-situ brick making plant requires a minimum area of 600M2.

The area is required for the following functions:

### FUNCTIONS OF IN-SITU BRICK MAKING PLANT REQUIRES AREA



1. Hangar construction - 450 m<sup>2</sup>



2. Underground kiln construction - 80 m<sup>2</sup>



3. Clay bank - 20 m<sup>2</sup>



4. Bricks storage - 30 m<sup>2</sup>



5. Water tanks - 20 m<sup>2</sup>

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## LOCATION OF THE IN-SITU KILN ON THE CONSTRUCTION SITE

The brick making facility should be strategically located away from the main construction, but also in a location where the kiln can later be converted to a septic tank or water reservoir. The location should also be accessible by road for trucks delivering clay and other raw materials.

HANGAR 1



HANGAR 2



PHASE 1 - HOUSING CONSTRUCTION



IN SITU KILN



Kiln located in a strategic location where it can be converted into a septic tank

HANGAR 3



Hangar used for drying bricks

PHASE 2 - HOUSING CONSTRUCTION



Construction of foundations

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# 03

## THE CONSTRUCTION STAGES OF IN-SITU KILNS

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The construction of the in-situ kiln systematically follows a series of stages summarized as follows:

1. Planning for the kiln construction;
2. Setting out the kiln;
3. Excavation of the pit where the kiln will be constructed;
4. Hangar construction;
5. Construction of the kiln floor base;
6. Walls construction to vault level;
7. Vaults construction;
8. Walls construction to kiln top level;
9. Kiln top construction;
10. Fabrication of the steel chimney;
11. Installation of chimney.

This is the detailed planning and preparation of how the kiln will be constructed within a specific period and budget. It involves the following:

- Getting the Kiln and Hangar's design;
- Working out the Bill of Quantities for all the materials required for both the Hangars and Kiln construction;
- Procurement of the construction materials required;
- Engagement of the Kiln construction builders;
- Construction of kiln commencement;

The step by step construction stages of the kiln starts with the setting out and excavation of the hole where the kiln will be constructed.

This is followed with the construction of the Hangar that covers the kiln during construction to protect the kiln from rain water damage.

The rest of the construction steps are presented in a chronological order with the estimated number of days a particular activity will take.

For effective and efficiency construction of the kiln, it's advisable that all construction materials required are delivered before the construction starts.

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**ACTIVITY N°1**

**“LOCATION AND SETTING OUT OF IN-SITU KILN”**

**ESTIMATED DAYS: 0.5 days**



## ACTIVITY N°2

### “EXCAVATION WORKS.”

Kiln construction starts at a designed depth below the ground level.

The stability of the sub-soil at the designed depth must be tested to see if it meets the required strength.

ESTIMATED DAYS: 3 days



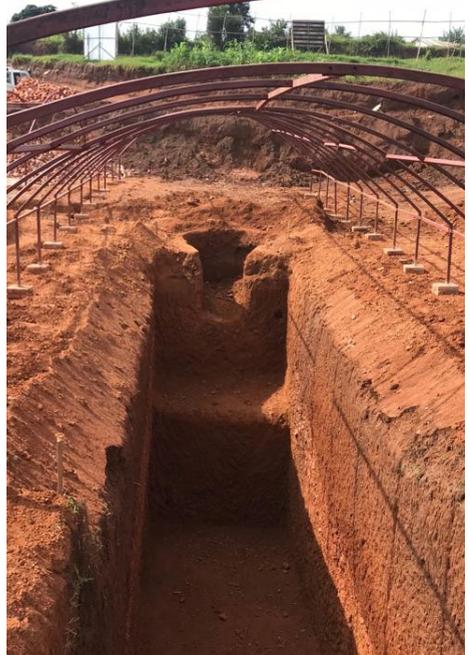
## ACTIVITY N°3

### “CONSTRUCTION OF THE HANGAR”

The construction of the hangar has to be built first before the construction of the kiln commences. This protects the kiln from rain damage during construction.

The hangar is constructed from a framework steel covered with a waterproof tarpaulin.

ESTIMATED DAYS: 5 days



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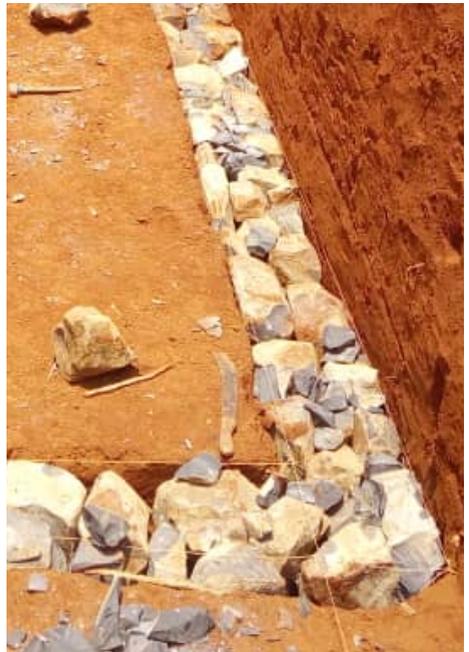
**ACTIVITY N°4 a+b**

**“CONSTRUCTION OF THE FOUNDATION AND FLOOR BASE.”**

This involves:

- a) Compacting the soil at base up to 2g/cm<sup>2</sup>
- b) Where soils have a weak load bearing capacity and presence of water, a trench 40cm wide x30cm deep should be dug and filled with compacted stones to provide water drainage in order to have stable foundation base for the walls. (remind that the stone is not good for fire resistance that is why only use for drainage and the other work done by using bricks).

ESTIMATED DAYS: 0.5 days



**ACTIVITY N°4 c**

“BUILDING FOUNDATION WALLS TO THE OF FLOOR BASE ( COMPACTED SOIL AND GRAVELS LAID ON IT).”

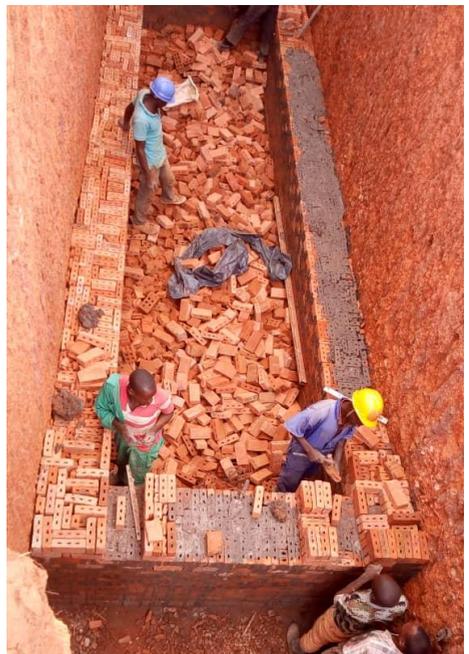
ESTIMATED DAYS: 2 days



**ACTIVITY N°4 d**

“FILLING THE FLOOR BASE WITH BROKEN BRICKS”

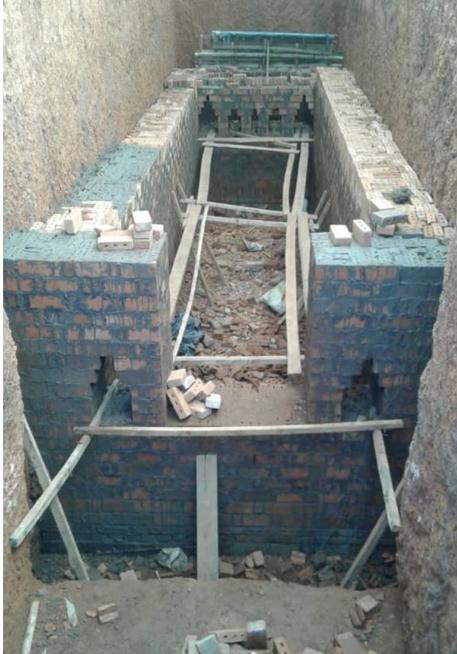
ESTIMATED DAYS: 1 day



**ACTIVITY N°5 a**

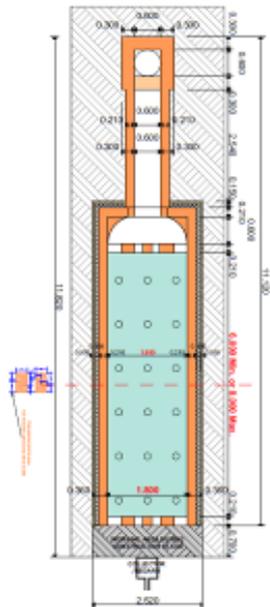
“BUILDING THE KILN WALLS TO VAULT”

ESTIMATED DAYS: 3 days



**ACTIVITY N°5 b**

“CREATING THE EXPANSION JOINT”



**ACTIVITY N°6 a**

**“BUILDING THE VAULTS”**

This starts with making the vaults wooden formwork

**ESTIMATED DAYS: 3 days**



**ACTIVITY N°6 b**

**“BUILDING THE VAULTS”**

The vaults are built using the bricks. The bricks for the vaults should be tapered (trapezium shaped), to make strong vaults.

**ESTIMATED DAYS: 5 days**



**ACTIVITY N°6 c**

**“BUILDING THE VAULTS”**

Inserting fuel feeding holes. Fuel feeding holes are placed in strategic positions as shown on the drawings.



**ACTIVITY N°7**

**“CONSTRUCTION OF KILN TO ROOF TOP”**

ESTIMATED DAYS: 5 days



**ACTIVITY N°8**

**"BUILDING THE SMOKE CHANNELS TOWARDS SMOKE CHIMNEY"**

**ESTIMATED DAYS: 5 days**

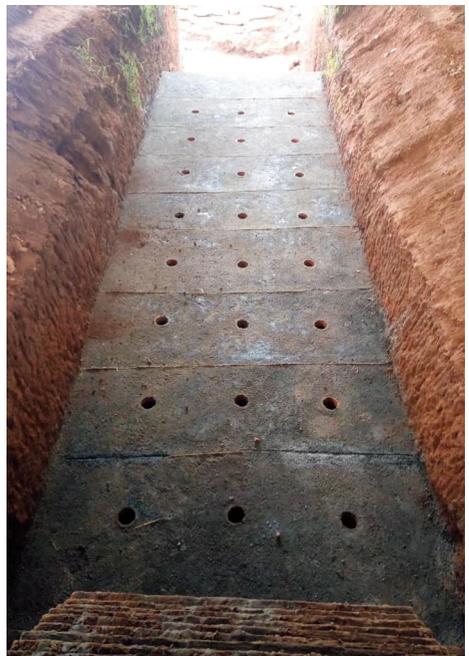


**ACTIVITY N°9**

**"BUILDING THE KILN TOP (ROOF)"**

The kiln top is made from two layers of bricks laid tightly on edge (Do not use Cement mortar but you will use clay mixed with sand). The fuel feeding holes continues through the kiln top and are visible from the top.

**ESTIMATED DAYS: 2 days**



#### ACTIVITY N°10

##### **"FABRICATION OF THE STEEL CHIMNEY"**

The chimney is made from noncorrosive steel (corten) in a metal workshop.

ESTIMATED DAYS: 3 days



#### ACTIVITY N°11

##### **"INSTALLING THE STEEL CHIMNEY TO THE KILN"**

The steel kiln is elevated and placed in position by means of a crane.

The final assembly of the 3-sections of the kiln is done on the site, and the entire chimney lifted by the crane and fitted in position.

ESTIMATED DAYS: 1 day



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