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Shaft Lime Kiln

Technical Bulletin No. 13

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SHAFT LIME KILN

**PAPUA NEW GUINEA
DEPARTMENT OF PUBLIC WORKS
BUILDING RESEARCH STATION**

TECHNICAL BULLETIN No. 13, MARCH, 1974.

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PAPUA NEW GUINEA
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INTRODUCTION

The Shaft Lime Kiln was adopted by the Building Research Station, to meet the needs, where only small quantities of lime are required for building purposes, stabilisation of soils and lime washes.

This Bulletin is directed at a community where the use of lime would be an asset in improving conditions in a District where Limestone is readily available.

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DESCRIPTION

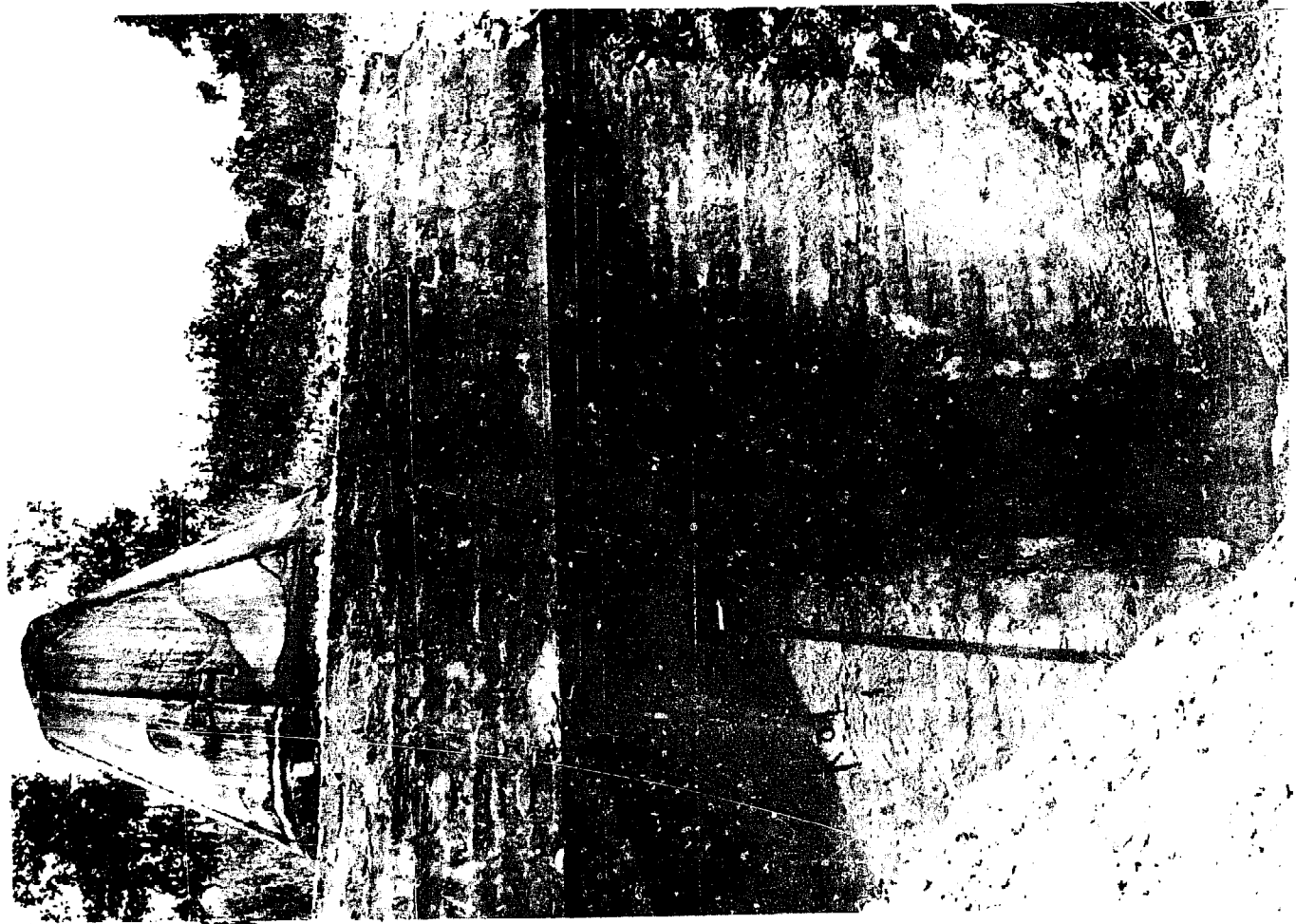
The Shaft Lime Kiln is a vertical circular opening cut into the side of a hill.

The lining can be large boulders of limestone, which are replaced as they burn out or refractorite bricks made from clay in the area. Imported bricks would make the scheme uneconomical.

The capacity of the kiln is Three tons of hydrated lime per burn, which would require one week to produce.

An opening in the front of the kiin gives access for unloading the limestone.

A Brick Grate located at the base, supports the limestone and fuel, it also allows for a draft of air to flow through the kiln to assist in the burning.



SELECTION OF MATERIAL

To ascertain if a stone is limestone, pour a small quantity of diluted hydrochloric acid on the stone, if efflorescence occurs it can be considered for further field testing e.g.

Break a small section of the stone to a powder, (this can be done by hammering) when there is sufficient limestone powder to cover a ten cent piece, place the powder in a container containing a weak solution of hydrochloric acid. If after a short time, only a small quantity of sediment remains it could be considered a possibility for burning.

For clarification, a sample could be sent to the Public Works Research Station, where further testing would be arranged.

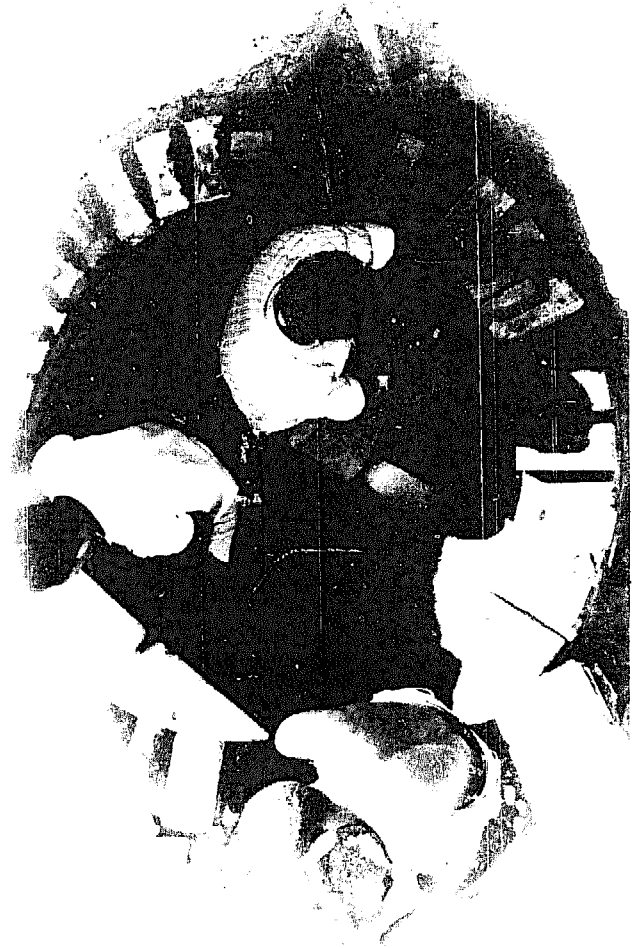
It should be noted that limestones are not always white, they can vary in colour from light and dark greys to pinks and yellows.

CONSTRUCTION

Select a site on a hill, the steeper the excavation required. The site should have top for loading and to the base for unloading.

When excavating, it is advisable to compact the earth at the front of the kiln and rear brick or stone pitched wall, as it has been the earth has been left to form the front liable to collapse after a few burns.

After excavations the lining is placed to an even circle and plumb, a template a segment of a circle is made from timber at fixed plumbing points around the circle lining placed against the template which until the circle is formed to the top of extending past the ground level by 9 in



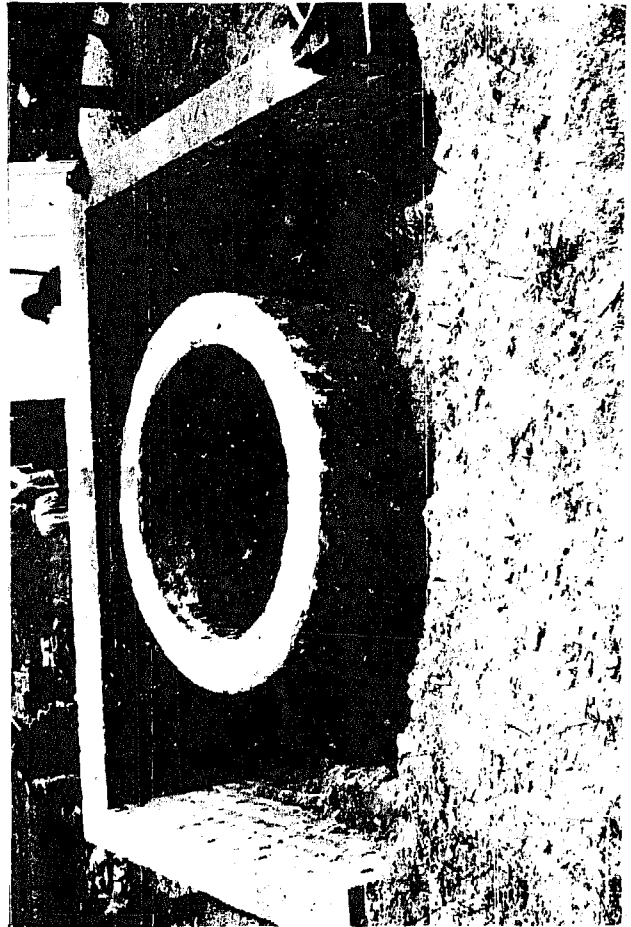
CONSTRUCTION

The top of the unloading opening at the base is covered over with an arch which is formed by laying the lining on a semi circular timber form.

A three brick thick or boulder wall at the front is battered and tied into the sides of the cliff, with holes left at the base for rain water which seeps between the cylinder and walls to escape.

The space between the circular shaft and walls is filled with sand.

A brick grate (appendix "C") is placed at the base of the shaft, this supports the timber fuel and limestone, and also allows a draught to flow through the kiln to assist the burning.



LOADING

Before loading, the access opening at the base is closed off with dry layered bricks or boulders and the cracks filled with clay.

Loading is then carried out by lowering the materials from the top of the kiln.

Prior to loading the limestone is broken to the size of ones fist, say 4 inches diameter.

Timber which burns readily, either off cuts or bush timber, can be used for fuel.

Layers of timber to a depth of 9 inches high is layed on top of the brick grate then one layer of limestone placed on top of the timber. Alternate layers of limestone timber are placed until the kiln is completely filled.

The layers of timber and limestone should be kept level when loading.

The flat iron cone is then placed on the top of the shaft, supported on bricks to give a three inch opening between the cone and the top of the kiln.

FIRING

The underside of the brick grate is filled with an easy combustible material, when this is fired it will ignite the timber in turn above the grate until all the timber is completely incinerated.

Practice will enable the operator to gauge the ratio of timber to limestone to bring the stone to quick lime.



UNLOADING

Care must be taken at this stage, as the burnt limestone is now in a condition where it can cause burns if it comes in contact with the skin.

If irritation occurs wash thoroughly with quantities of water, a smear of oil on the skin will soothe the burns.

If unloading is left long the limestone will slake automatically by the high humidity in the atmosphere and regenerate heat, therefore unloading should take place as soon as it is possible to remove the stone from the kiln.

Remove the bricks or boulders from the opening at the base of the kiln to enable the limestone to be shovelled into barrows and taken to a storage area.

The storage area should be under cover and the stone placed on a substantial floor to eliminate the lime becoming mixed with the ground.

SLAKING

Slaking can be carried out by two methods. One the stone is lightly sprayed with water which breaks the stone to a powder form, this is then shaken through an 1/8" sieve to remove the larger particles of unburnt stone. The powder is then placed in bags or containers until required, this is the most convenient method to handle the lime. This is called hydrated lime.

The other method is to make the lime into a putty, which is done by partly filling a container (say a 44 Gal. drum) with water and adding the stone, care should be taken that the lime water does not splash into the eyes as the stone on contact with the water will boil and become hot, the stone is added slowly and kept stirred, ensuring that it is covered by water at all times, this is left over night and shaken through an 1/8" sieve the following days as the mixture becomes too thick to pass through the sieve more water is added, the waste is unburnt stone.

LIME WASHES

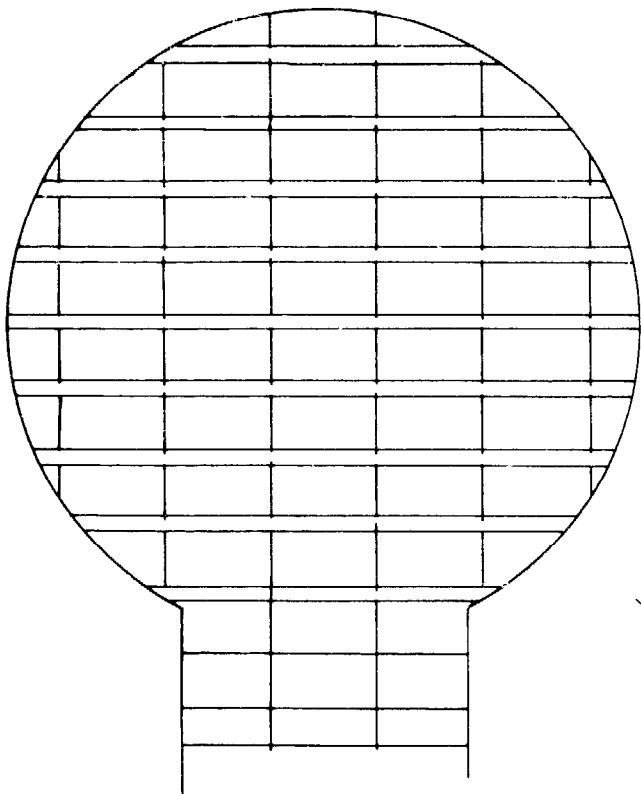
Lime wash can enhance the appearance of a building, and by the addition of linseed oil can assist in waterproofing masonry structures. The wash can be used internally without the linseed oil additive.

The better method is when the limestone is being made into a putty, add 1 gallon of boiled linseed oil to 112 lbs of limestone (as it is boiling). The oil is more readily absorbed into the lime by this method.

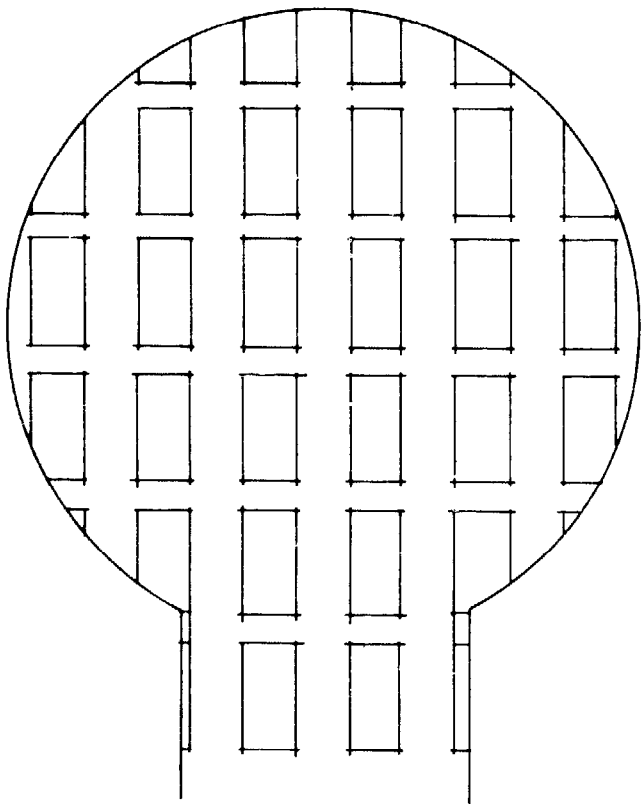
The second method is to boil hydrated lime in water by setting the drum over a fire, when the lime water boils add the boiled linseed oil.

A more durable finish is achieved by the use of sea water.

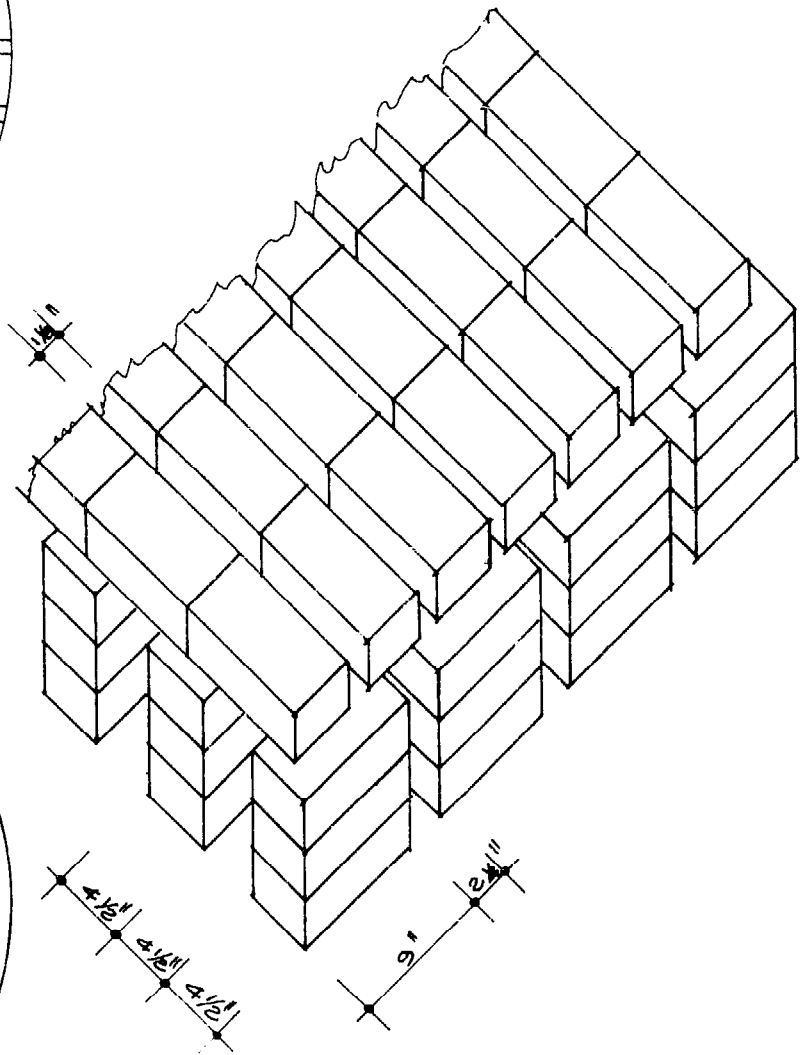
APPENDIX 'C'



COURSE 4.



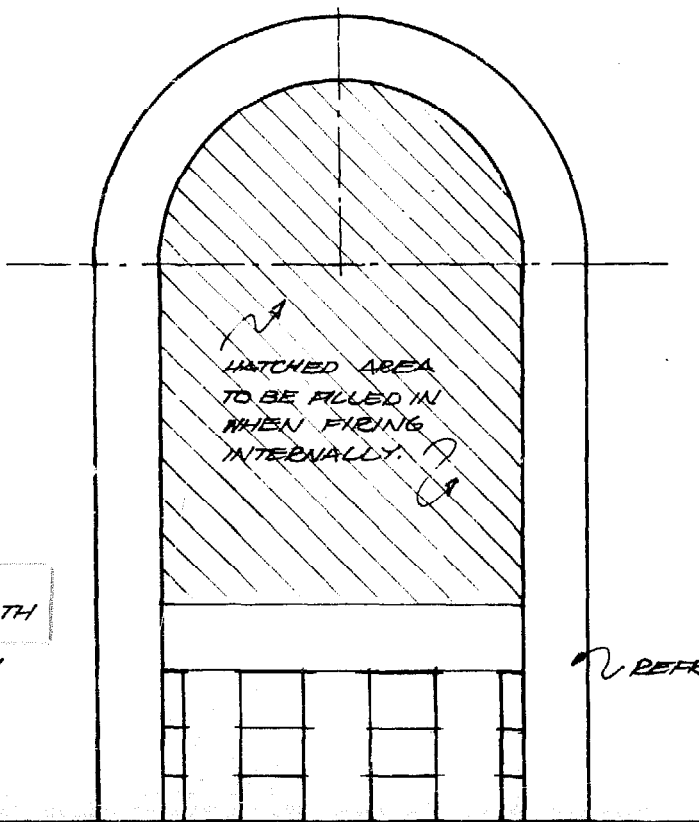
COURSES 1 TO 3



BRICK GRATE FOR
LIME KILN.

APPENDIX 'A'

PART ELE

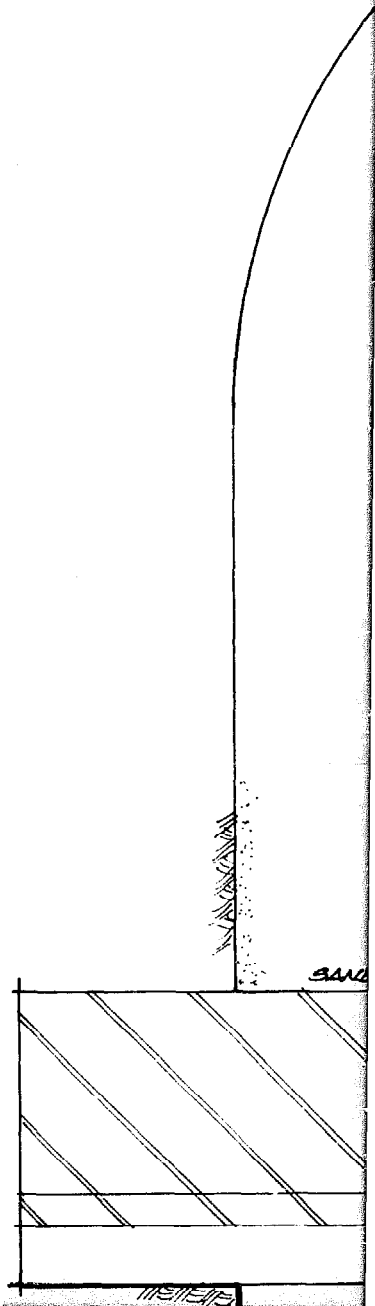


HATCHED AREA
TO BE FILLED IN
WHEN FIRING
INTERNALLY.

STAB EARTH

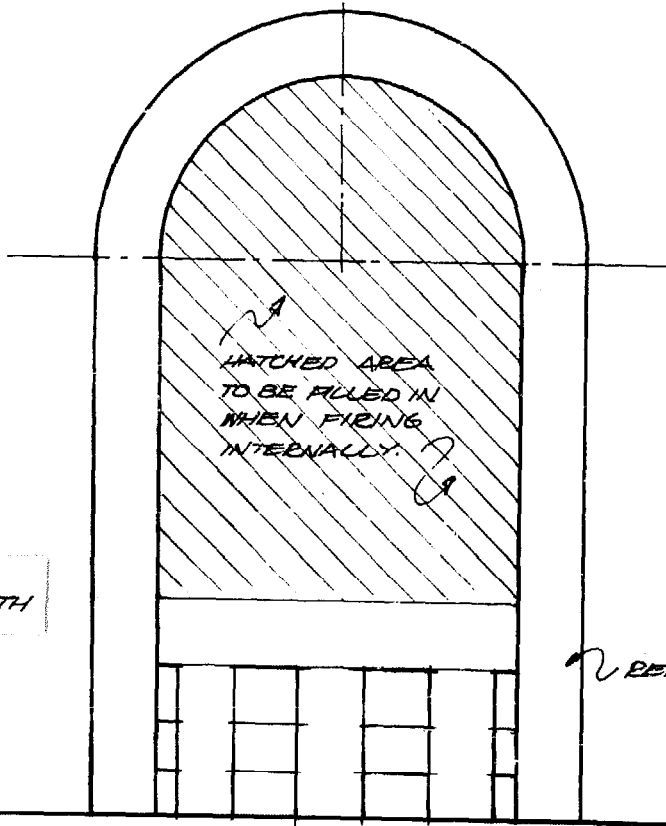
BRICK.

REFRACTORY BRICKS.



SAND

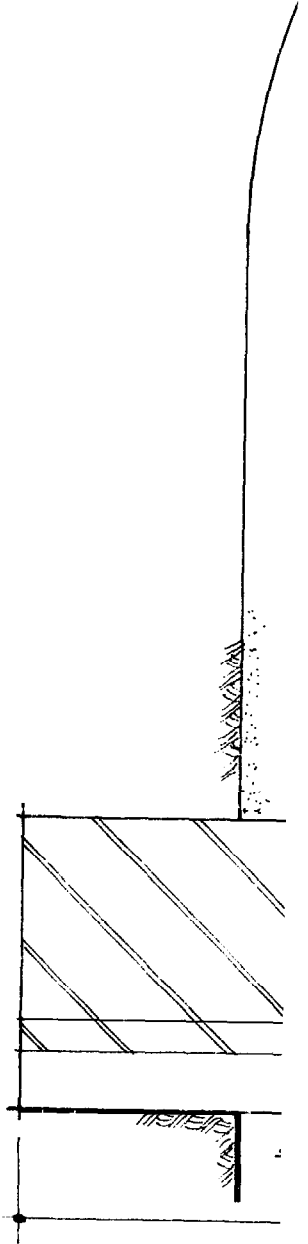
1/16" = 1'



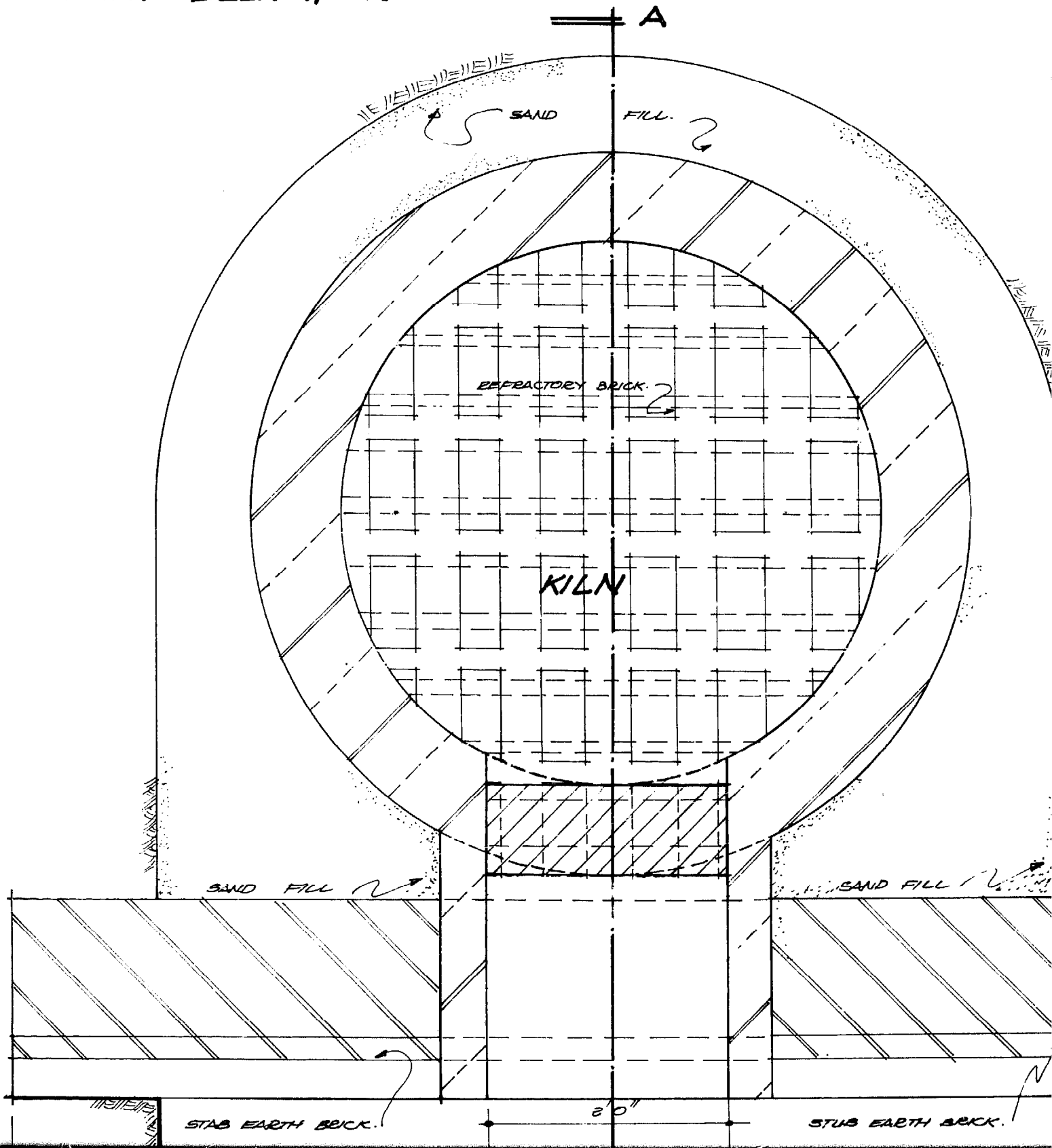
HATCHED AREA
TO BE FILLED IN
WHEN FIRING
INTERNALLY.

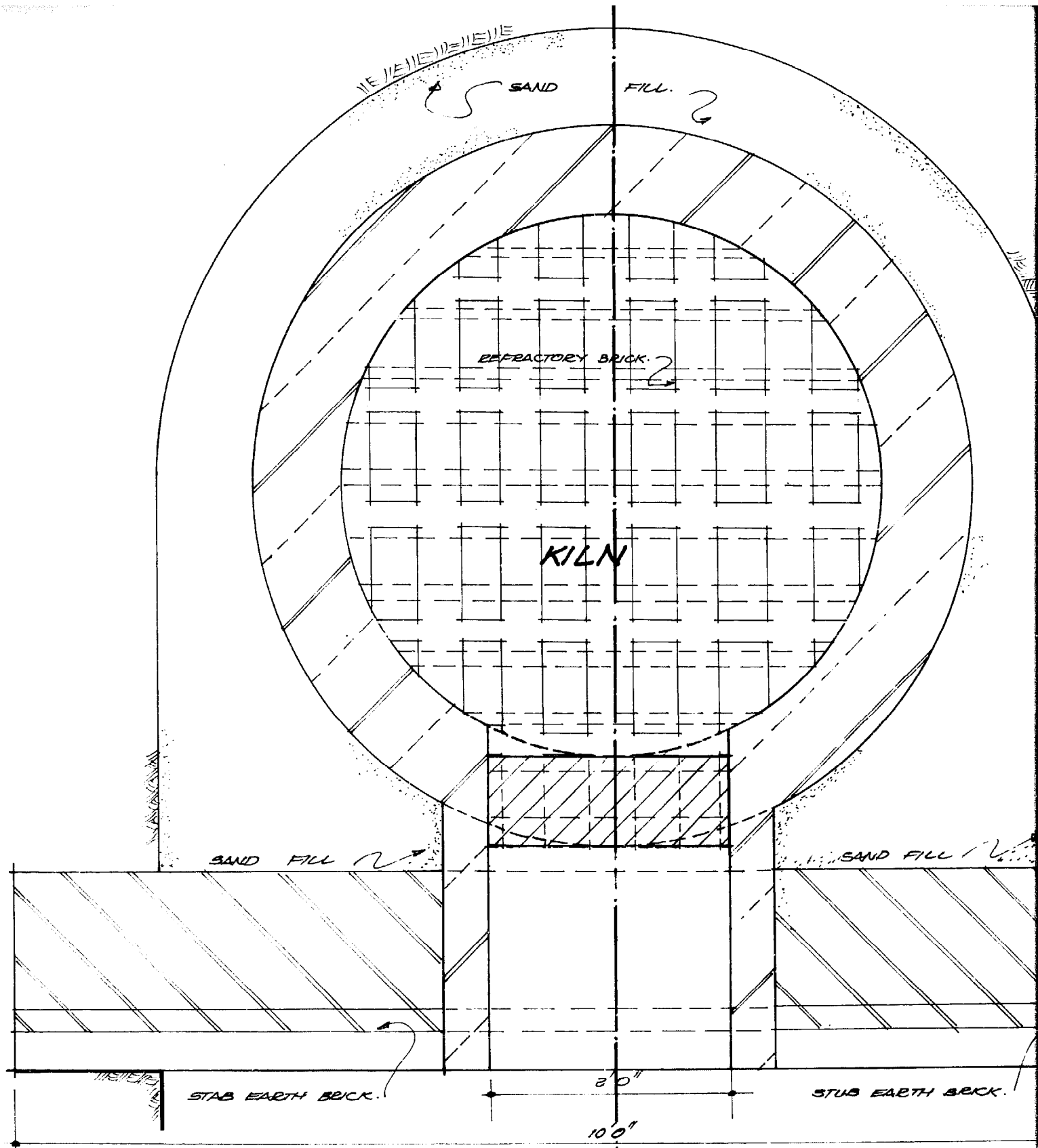
STAB EARTH
BRICK. 1/1

REFRACTORY BRICKS.



PART ELEVATION





PLAN

A

REFRACTORY BRICK

SAND

FILL

REFRACTORY BRICK

KILN

SAND FILL

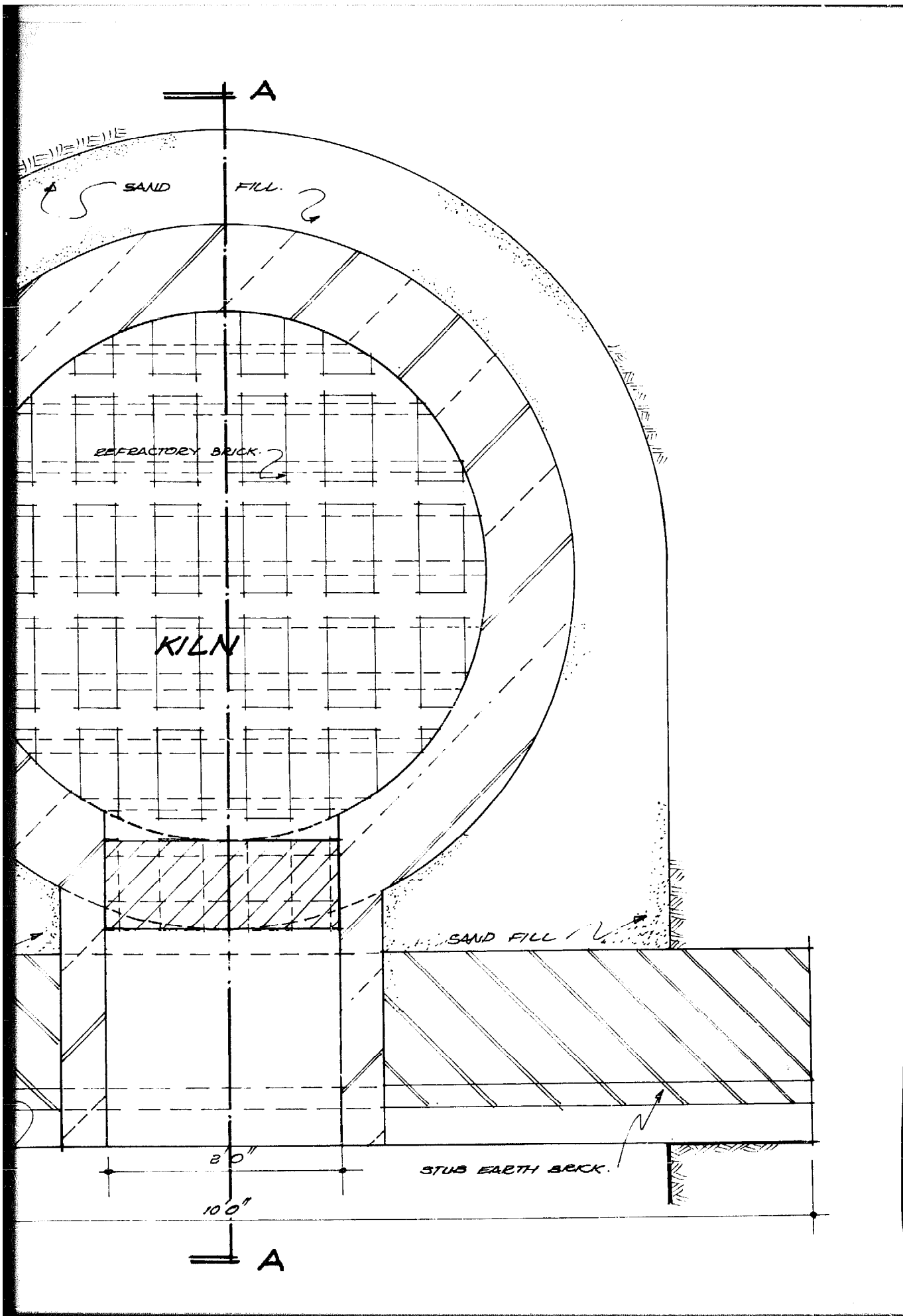
SAND FILL

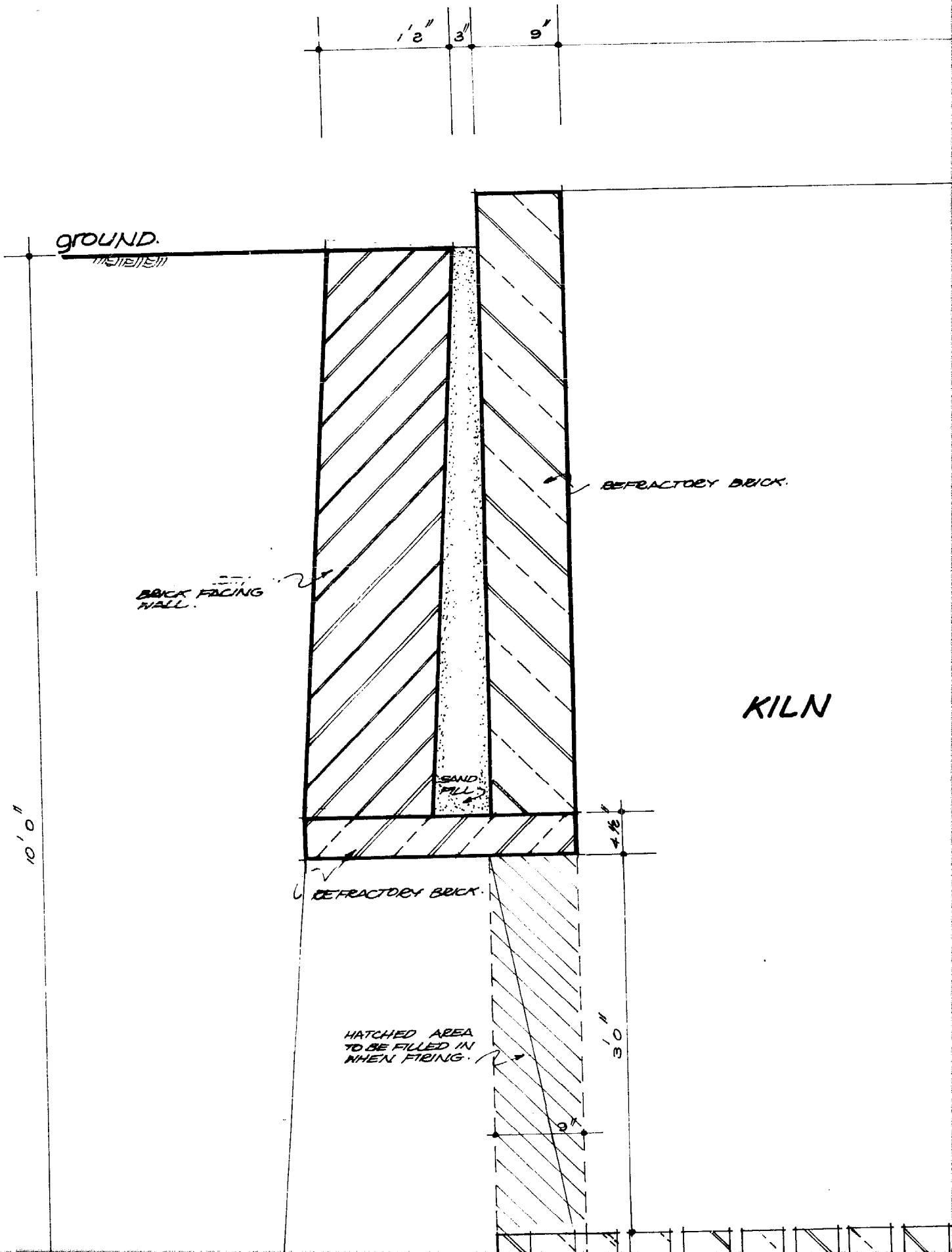
SLAB EARTH BRICK

SLAB EARTH BRICK

2'0"

10'0"





1/2" 3" 9'

GROUND.
—————

BRICK FACING WALL.

REFRACTORY BRICK.

KILN

SAND FILL

10'0"

REFRACTORY BRICK.

HATCHED AREA TO BE FILLED IN WHEN FIRING.

4'6"

3'0"

0'7"

1 1/2" 3" 9"

4' 6" 9" 9"

ground.

REFRACTORY BRICK.

KILN

SAND FILL

SAND FILL

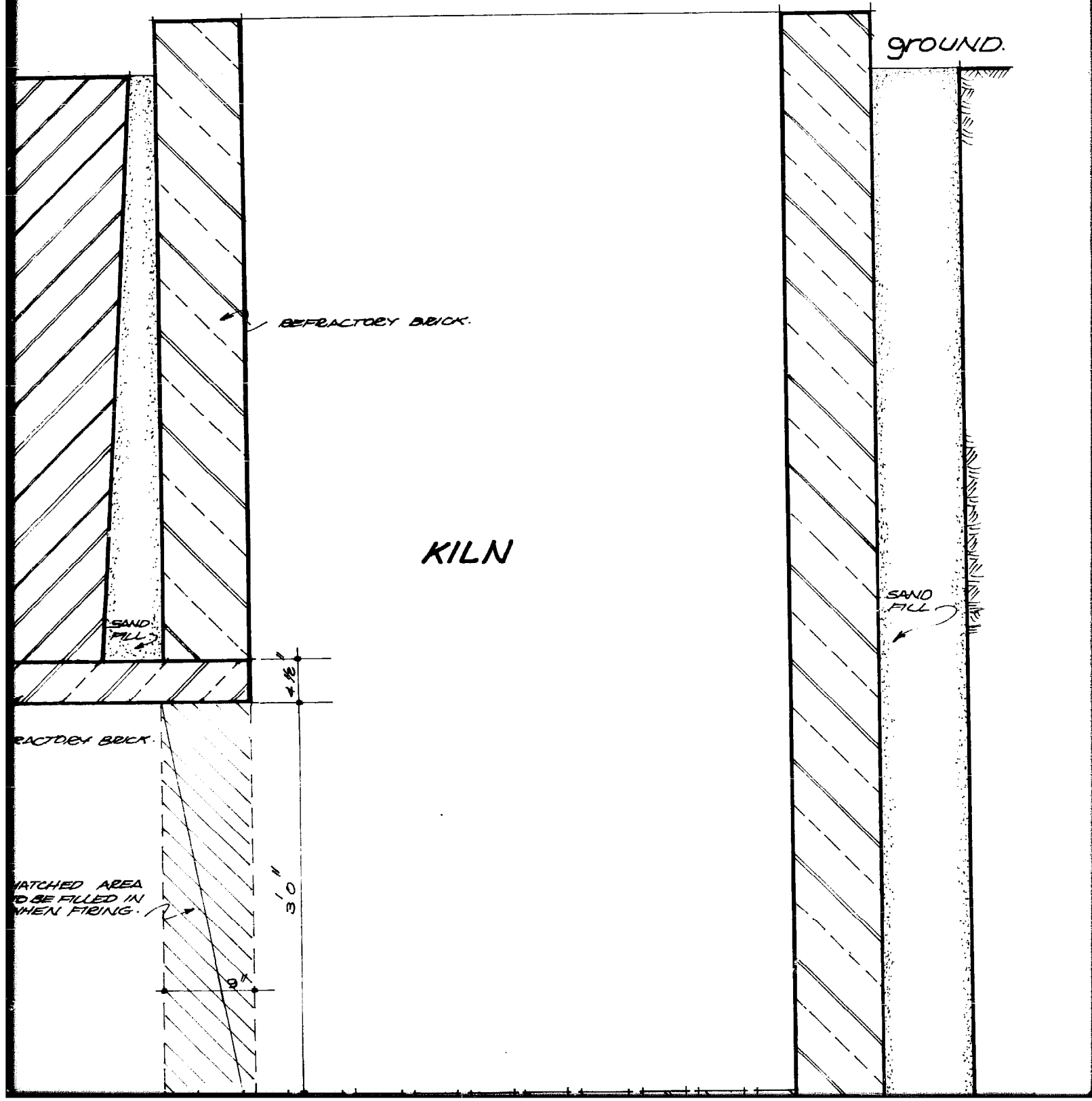
REFRACTORY BRICK.

ATCHED AREA TO BE FILLED IN WHEN FIRING.

4 1/2"

3' 0"

9"



10' 0"

BRICK FACING WALL

REFRACTORY BRICK

KILN

SAND FILL

REFRACTORY BRICK

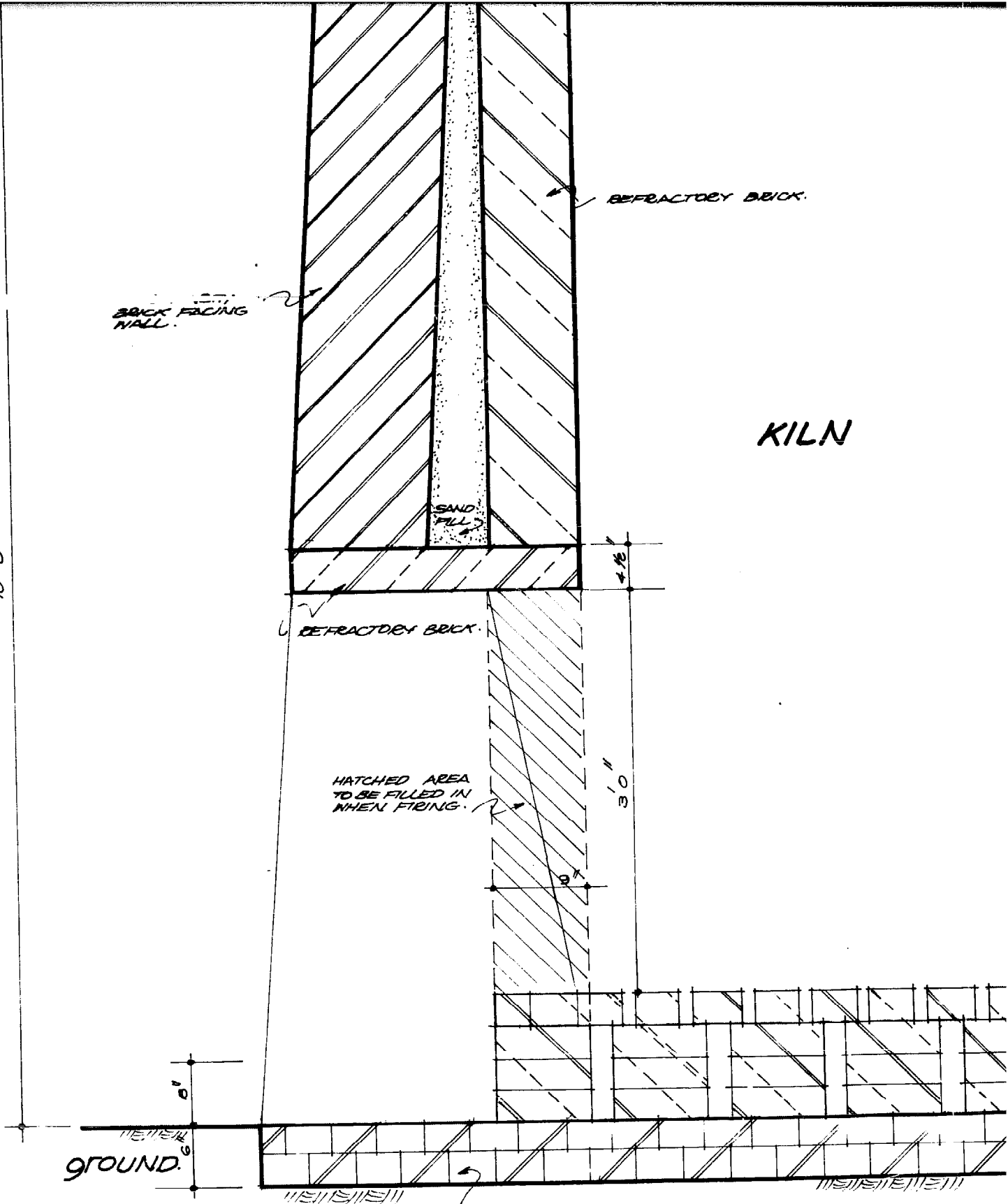
HATCHED AREA TO BE FILLED IN WHEN FIRING

30"

GROUND

STAB EARTH BRICK

SECTION A A



REFRACTORY BRICK.

KILN

SAND FILL

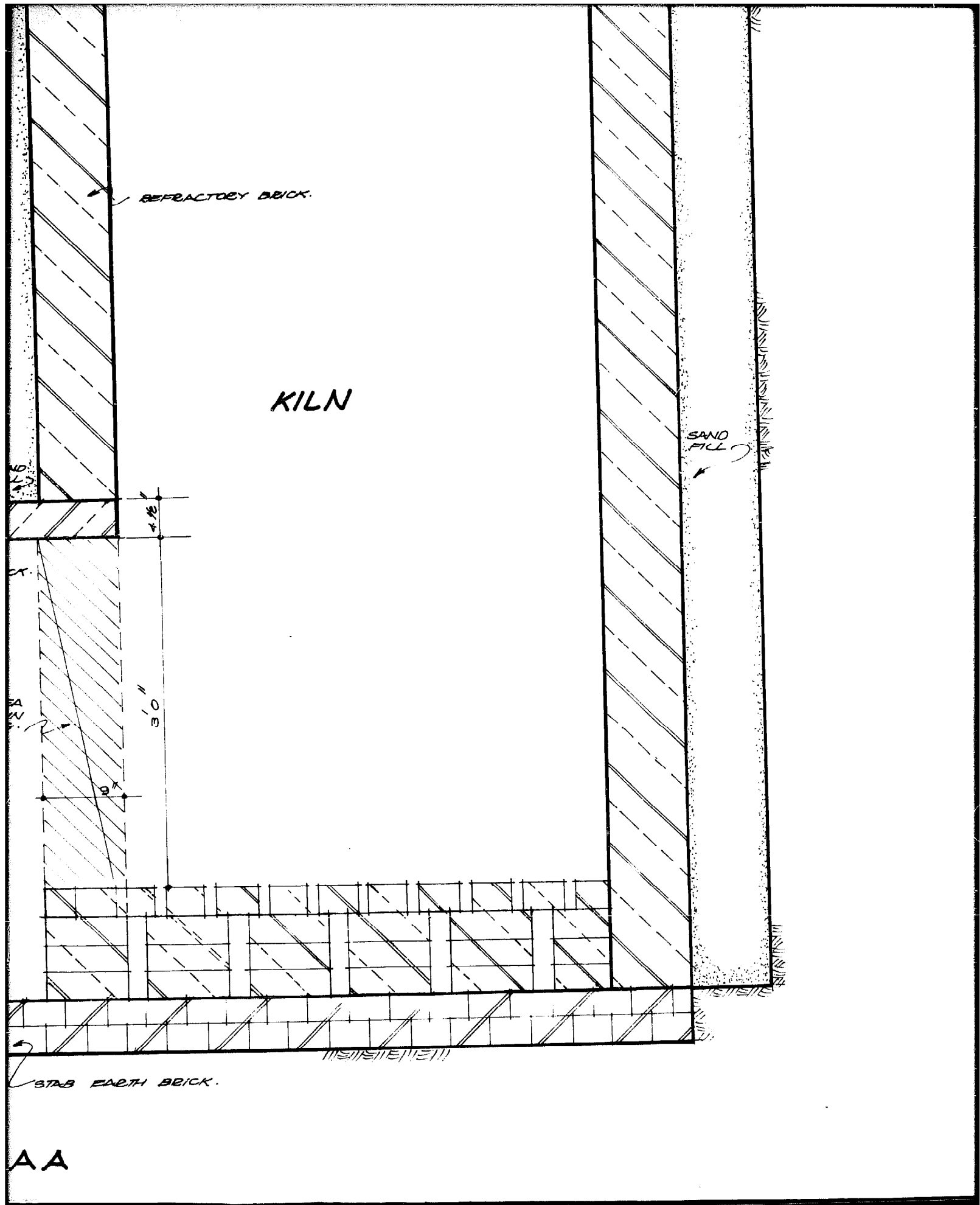
4 1/2"

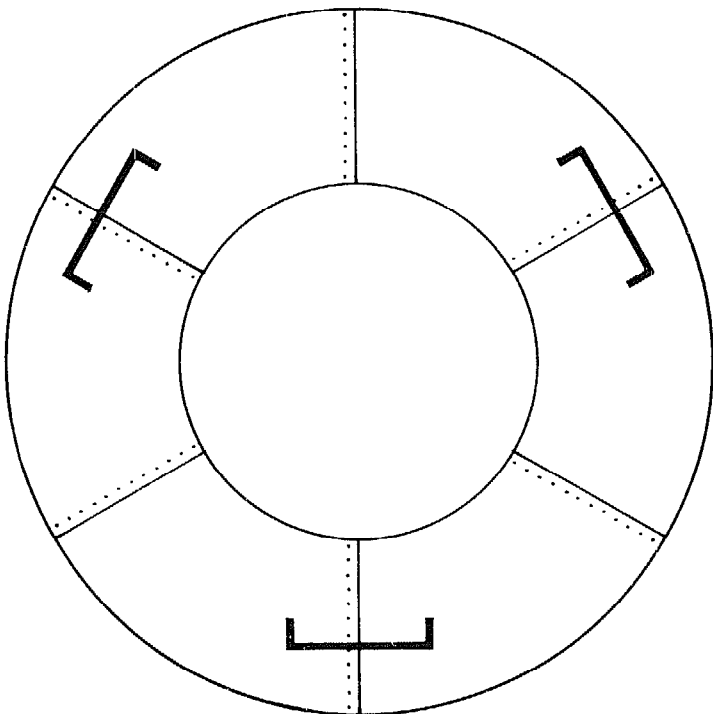
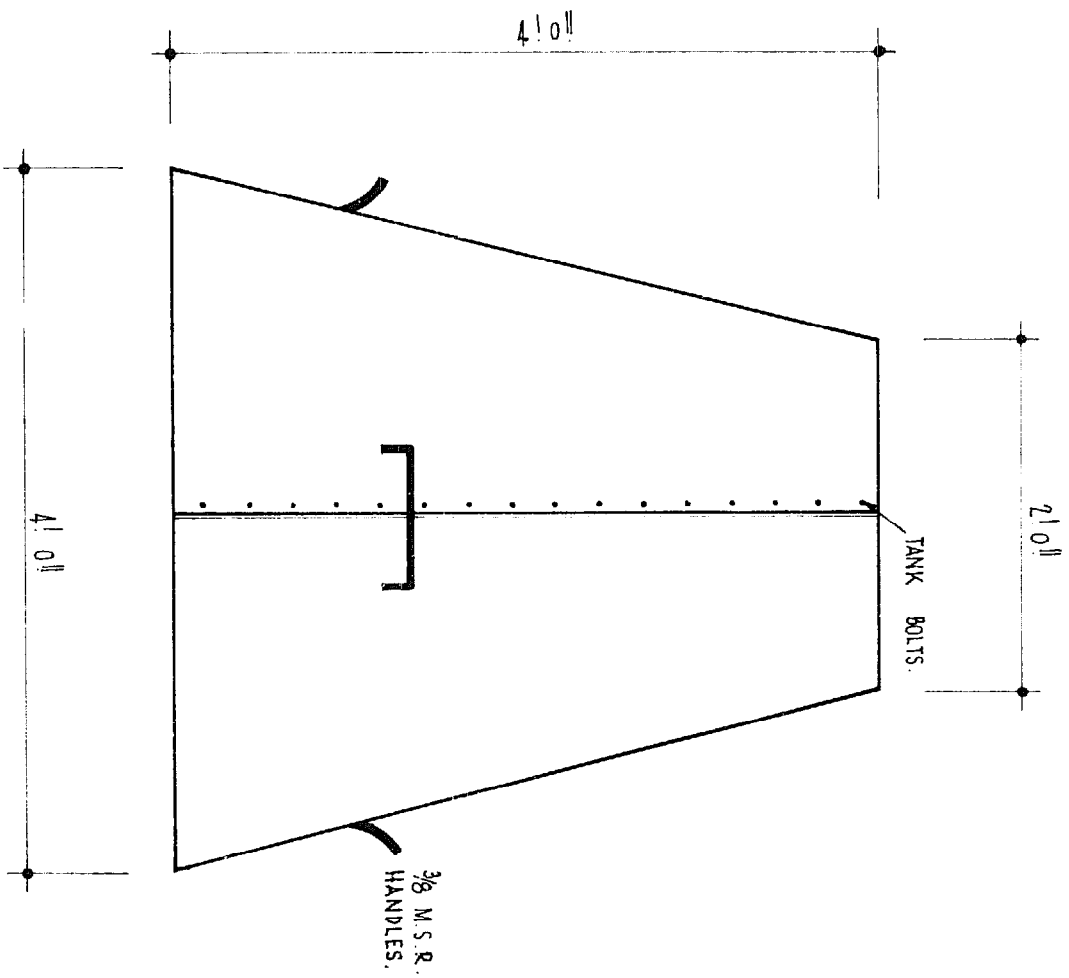
30"

6"

STRONG EARTH BRICK.

AA





APPENDIX 'B'
 FLAT IRON CONE