

Drawing and
Construction Guidelines
**Natural Draught
Zig-Zag Kiln**
2015



About this publication

This construction drawing and guideline document is an output of the design manual and is based on the structural designs of Natural and Induced Draught Zig-Zag kilns proposed therein. The aim of this document is to provide step by step guidance in construction of these types of kilns so that they are structurally safe, earthquake-resistant, energy efficient, lower emitting, worker-friendly for producing better quality bricks.

The step by step process for each items recommended in this construction guideline is based on research and consultation with experts on the subject by MinErgy Pvt Ltd and Federation of Nepal Brick Industries. This document is expected to serve to provide guidance to construction engineers and supervisors in the construction of aforementioned kilns. The content of this document is incorporates both practical experiences and scientific analysis.

The authors of this manual would appreciate if you could share your ideas and work experiences to further improve this construction document.

MinErgy Pvt. Ltd
Federation of Nepal Brick Industries

Disclaimer

This document should not be considered as an absolute and/or universal recommendation of construction drawings and guideline for the structural designs proposed for Natural and Induced Draught Zig-Zag kilns in the design manual. This document has been developed for particular conditions described in the design manual. By utilizing this guideline, you expressly acknowledge and agree that the authors, publishers, suppliers, licensees, legal entity or any person associated with this document are not responsible for the results of your decisions resulting from the use of the document, including, but not limited to, your choosing to seek or not to seek professional/expert opinion or your choosing or not choosing to follow this document in practice.

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Design and layout

Divine Chhaphakhana, Kathmandu

Nepal, 2015

1. Background information

The following detailed information on geo-physical conditions of the site should be collected and analyzed before construction of kiln for efficient construction process.

- a) Level of sub-soil water
- b) Slope of the ground and natural drainage
- c) The subsoil condition especially at the position of chimney
- d) Type of soil with special reference to black cotton soil
- e) Climatic conditions
- f) Vicinity to inhabited area

2. Site considerations

The kiln should preferably be constructed on a high ground, the level of which should be such that rain-water naturally drains away from the kiln and does not flow towards it. Another major consideration of kiln site selection is that at least the chimney should be constructed on firm and stable ground to withstand the total chimney load.

The current trend shows the new brick kilns are establishing in hilly areas. The kilns inside side Kathmandu valley are slowly moving out of the valley to nearby hilly areas. The kiln site shall be the safest place available with respect to natural hazards. These hazards include susceptibility to landslides, erosion and land subsidence. Areas with a high potential of liquefaction during earthquakes should also be avoided. Site selection shall be done so as to minimize the risk against natural hazards. No tall chimneys shall be constructed in hazardous areas. The major considerations for selection of site are explained below:

2.1 Water table

The kiln should preferably be constructed on a high ground, the level of which should be such that rain-water naturally drains away from the kiln and does not flow towards it. The floor level of the trenches of the brick kiln should be such that it is not less than 3 m above the water table of sub-soil water measured during rainy season. In any case floor level should not be more than 1 m below the ground level. Sites with permanent water-logged areas should be avoided. However, construction is allowable if the site is appropriately treated.

2.2 Geological faults or ruptured areas

Geological fault lines or rupture lines that are usually visible to the naked eye and are permanent, deep and active should be avoided. Kiln should be constructed at least 500 m away from these lines.

2.3 Areas susceptible to landslide

Areas likely experience frequent landslides shall be avoided for construction of kiln. The simplest indication of sustained stability of a slope is the upright standing of trees on it. They would be inclined downwards in the case of unstable slopes.

2.4 Boulder hazard

Nepal, being a mountainous country, has many places where boulders roll down bare hill slopes. These boulders can hit and damage the structures. Therefore, structures and buildings shall be constructed in such areas only after the provision of proper prevention by retaining walls and green barriers

2.5 River banks

It is preferable that river banks and areas susceptible to frequent flooding should be avoided. Construction on such areas can be undertaken only after carrying out protection works as suggested by specialists.

2.6 Steep slopes

Generally, soil slopes up to 20° are stable and good for construction. However, construction on steeper slopes is not restricted if there are proper retaining walls for the development.

2.7 Subsoil condition

The soil base on which the foundation rests is of utmost important factor to be considered for the safety of a chimney structure. As per the government regulation, the minimum height of chimney is 17 m for Induced Draught kiln and 30 m for Natural Draught Kiln. To withstand such a massive structure, the subsoil investigation must be carried out and foundation should be designed accordingly.

The proposed design presented here has considered the soil bearing capacity of 100 kN/m². The value, 100 kN/m² is an average value of soft and weak subsoil condition provided by NBC. Since the soil condition varies site to site, the design proposed is just a reference drawing which is not a standard for all cases. Hence, it is strongly recommended to conduct subsoil investigation of site where chimney stands and also consult an experienced civil or a structural engineer for the design of the chimney foundation.

3. Specification of Construction Materials and Application

3.1 Construction Materials:

Brick:

The bricks shall be of a standard rectangular shape, burnt red, hand-formed or machine made, and of crushing strength not less than 3.5 N/mm². The standard brick size of 240 x 115 x 57 mm with 10 mm thickness horizontal and vertical mortar joints is preferable. Tolerance of -10 mm on length, -5 mm on width and ±3 mm on thickness be acceptable.

Cement

The cement shall be any known brand of Grade Ordinary Portland cement conforming to at least 53 Grade. It must be as fresh as possible. Any cement stored in supplier's storeroom for more than one month from the date of receipt from the factory should be either avoided or tested and used only if the test results are found satisfactory. The cement should not be old than a month period of time from site delivery to application. It is advisable to use cement which has obtained the NS mark if independent tests are not carried out.

Rapid Hardening Portland Cement (RHPC)

Rapid hardening cement is similar to Ordinary Portland cement but with higher tri-calcium silicate (C3S) content and finer grinding. It gains strength more quickly than OPC, though the final strength is only slightly higher. This type of cement is also called as High-Early Strength Portland Cement. The one-day strength of this cement is equal to the three-day strength of OPC with the same water-cement ratio

- It is used where formwork has to be removed as early as possible in order to reuse it.
- It is used where high early strength is required.
- It is generally used for constructing road pavements, where it is important to open the road to traffic quickly.
- It is used in industries which manufacture concrete products like slabs, posts, electric poles, block fence, etc. because moulds can be released quickly.
- It is used for cold weather concreting because rapid evolution of heat during hydration protects the concrete against freezing.

Sand

Sand shall consist of a siliceous material having hard strong, durable, uncoated particles. It shall be free from undesirable amounts of dust lumps, soft or flaky particles, shale, salts, organic matter, loam, mica or other deleterious substances. The weight of voided shell in fine aggregate should not exceed the five percent by weight of dry fine aggregate.

Aggregate

Aggregates shall consist of crushed or broken stone and shall be hard, strong, dense, durable, clean of proper grading and free from any coating likely to prevent the adhesion of mortar. The aggregate must be well graded with 40 mm down. The nominal maximum size of coarse aggregate should be as large as possible within the limits specified but in no case greater than one-fourth of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the formwork.

Steel

The steel grade must of Fe415 or as defined by the structural engineer and complying the NS standard. The steel shall be clean and free from material that may cause corrosion of the reinforcement or the disintegration of the concrete and form pitting, loose rust mill scale, paint, oil, grease and other material that may impair the bond between the concrete and reinforcement. The steel shall be stored properly at least 15 cm above the ground and must protect from moisture.

Mud

The mud shall neither be completely dry nor contain excess water. Moist mud from the borrow pit may be stacked in layers to form a wall. The mud used as mud mortar shall be free from organic materials. It shall also be free from pebbles and other hard materials which would upset the mortar thickness. The sand content in the mud shall not be more than 30 % in order that a satisfactory cohesiveness is attained. Dry mud shall be thoroughly kneaded with water to achieve a dense paste.

Water:

The water must be potable water which must be free from iron and other soluble chemicals for curing and mixing purpose.

4. Application Methods:

Mud brick masonry

The mud brick masonry must follow all the masonry rules. The mud mortar should be kneaded with water for better workability. The quantity of water required depends on the quality and moisture content of the original mud. Excessive water content results in shrinkage cracks and other strength-related problems.

As far as possible, such walls shall not be allowed to dry in direct sunlight, it being always better to leave the walls covered in order to reduce shrinkage cracks. After the completion of a layer not exceeding 300 mm, it shall be left for two to four days for drying before another layer is added on top of it. The top surface shall be moistened for a few minutes prior to adding successive layers for better bonding.

Concrete

The concrete must comply the concrete grade defined by the design. The grade of concrete used in footing, columns, beams and slabs must not less than crushing strength of 20N/mm² (M20) at 28 days as per specified in detail design and drawing.

The concrete mixing and placing must follow the basic technical requirement mentioned below:

- The mix ratio of concrete is at least 1:1.5:3 of cement: sand: aggregate to achieve concrete grade of M20.
- The cement concrete must be mixed mechanically with volumetric ratio or ratio by weight as per the guidance provided by site engineer.
- The water cement ratio should be within the range of 0.5 to 0.6 for concrete mixing process.
- The concrete mix should be approved by the site engineer prior to the application.
- The concrete should be laid within the 30 minutes of mixing. The concrete mix beyond the 30 minutes from the mixing should not be allowed to apply.
- The concrete must be applied using mechanical vibration. The dropping of concrete height should not be greater than 2 m to avoid the segregation. The application of concrete must be done in presence and approval of site engineer.
- The concrete mixing and placing must be executed strictly in presence of civil engineer.

Formwork

The formwork shall be designed and constructed so as to remain sufficiently rigid during placing and compaction of concrete, and shall be such as to prevent loss of slurry from the concrete.

Formworks shall not be released until the concrete has achieved strength of at least twice the strength to which the concrete may be subjected at the time of removal of formwork. The strength referred to shall be that of concrete using the same cement and aggregates and admixture, if any, with the same proportions and cured under conditions of temperature and moisture similar to those existing on the work.

While the above criteria of strength shall be the guiding factor for removal of formwork, in normal circumstances where ambient temperature does not fall below 15oC and where ordinary portland cement is used and adequate curing is done, following striking period may deem to satisfy the guideline given below:

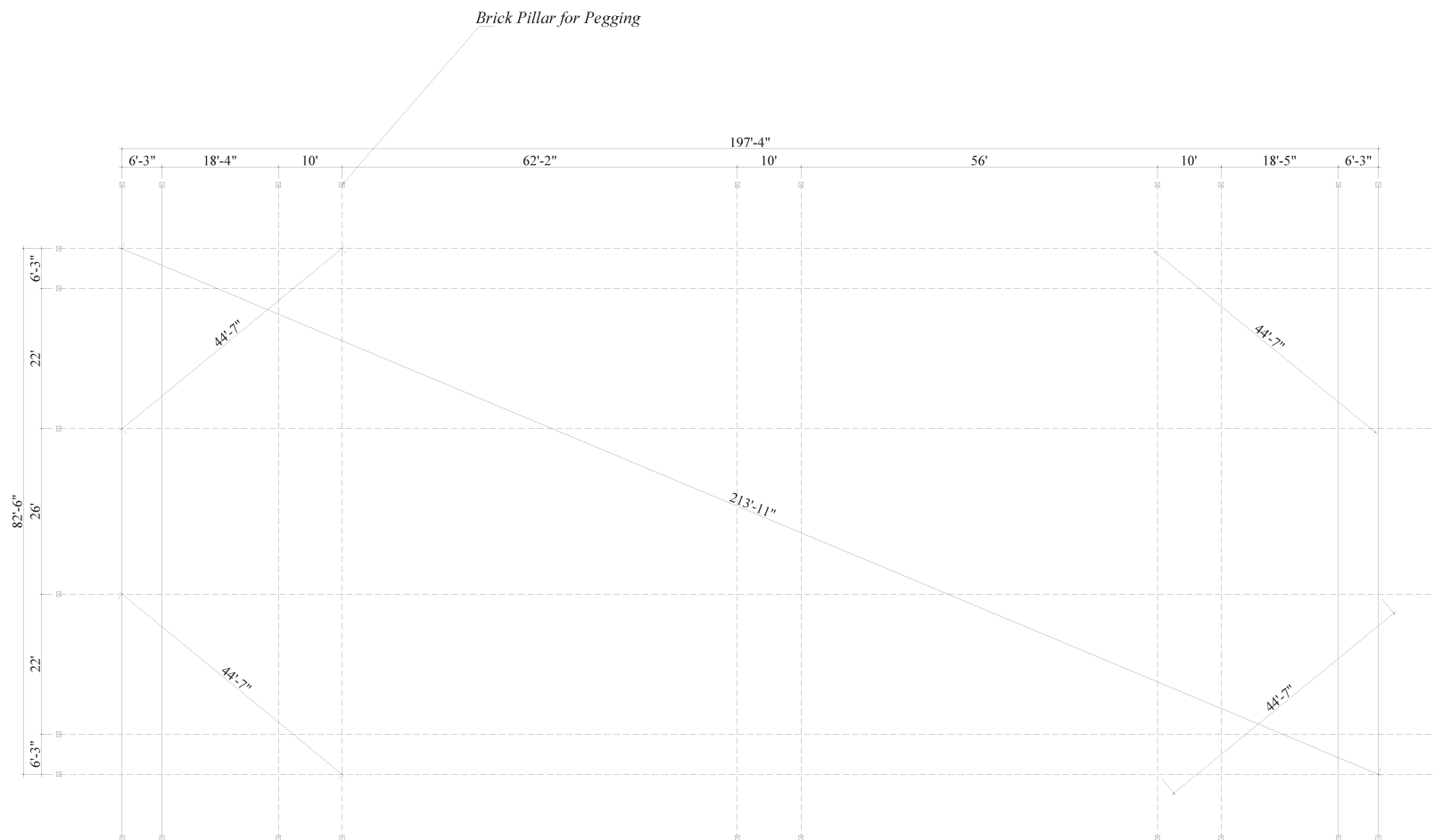
Type of Formwork	Minimum Period Before Striking Formwork
Vertical formwork to columns, walls, beams	16-24 h
Props to beams and arches: Spanning up to 6m Spanning over 6m	14 days 21 days

Curing

Curing is the process of preventing the loss of moisture from the concrete by exposing surfaces of concrete continuously in a damp or wet condition by ponding or by covering with a layer of sacking or similar materials and kept constantly wet. The number of days required for curing for various conditions is given below:

- At least 7 days from the date of placing concrete in case of Ordinary Portland Cement (OPC)
- At least 10 days where mineral admixture or blended cements are used.
- The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather conditions.
- In the case of concrete where mineral admixtures or blended cements are used, it is recommended that above minimum periods maybe extended to 14 days.
- For the concrete containing Portland pozzolana cement, Protland slag cement or mineral admixture, period of curing must be increased.
- For the precast slabs (especially for cover of Mangaal hole) must be cured at least for 28 days under completely submerged under water.

Approved curing compounds may be used in lieu of moist curing with the permission of the engineer-in-charge.



CONSTRUCTION LAYOUT

CONSTRUCTION GUIDELINES

Site layout

General

- The kiln has to be constructed by taking the wind direction into consideration.
- The construction site should have a proper road access.
- The production layout and the precise location of kiln structure must be finalized before commencing of layout.
- The use of sophisticated equipments like Theodolite (a kind of equipment) is preferred for precise layout of such a large scale construction.
- The layout must be done in presence of experienced engineer or technician.
- Complete set of working drawing must be in place before starting layout
- All the layout tools and equipments like thread, peg, nail, hammer, markers, plumb bob, measuring tape, pen, note, etc

Procedure

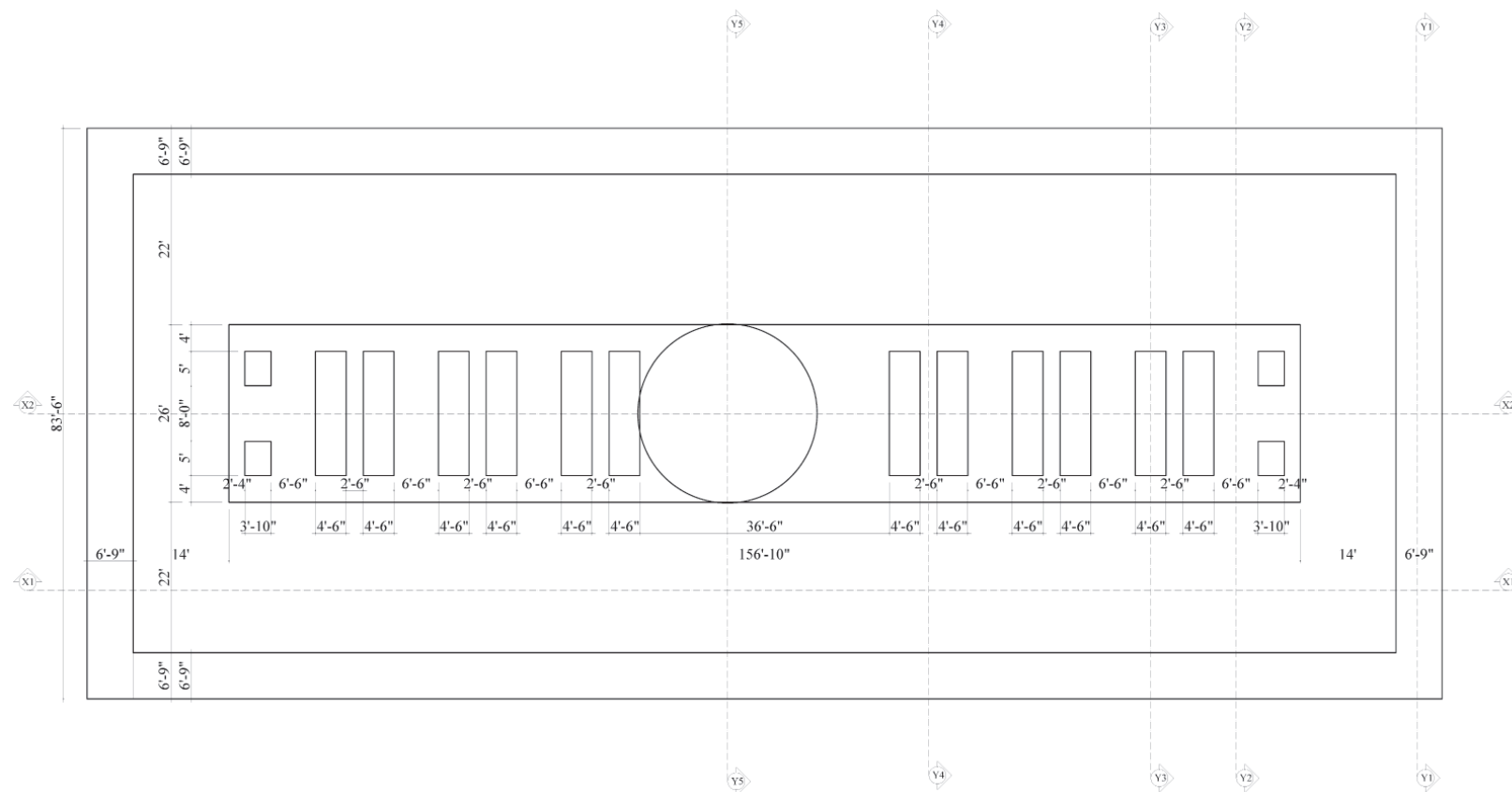
- Fix the reference line parallel to the long wall of kiln but at least 1 m away from long wall.
- Fix the 2nd reference line perpendicular to the 1st reference line with the help of theodolite or use 3-4-5 method which
- Complete one reference rectangle and check the diagonals.
- Since the length of kiln is very larger, the multiple numbers of reference rectangles can be made.
- Construct the permanent brick masonry pillars at the corners of reference rectangles and mark on the pillar.
- OR drive a long peg with nail on it.
- These cement brick masonry pillars/pegs must be erected at least 1m away from the proposed kiln construction site plan
- Tie the thread along the reference rectangles.
- Transfer the detailed measurements of the kiln dimension into the thread.
- Use lime powder or flour powder to mark the layout on ground.

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

Construction Layout

Sheet No.	Scale
001	1 : 200



TRENCH PLAN

CONSTRUCTION GUIDELINES

Earthwork in excavation for foundations

- The Earthwork in excavation for foundation includes excavation work for Outer wall, Miyana Wall and Chimney.
- The excavation depth for Outer wall and Miyana is 1'6" where as the excavation depth for chimney foundation is 7'-6".
- The type of footing for outer wall and Miyana wall is strip footing where as the type of footing provided for raft is called isolated footing.
- The width of excavation is 4'-6" for Miyana wall, 6'-9" for outer wall and 26'0" diameter for chimney foundation. Refer working drawing for more details.
- The foundation trench shall have a uniform width and the sides of trench should be properly dressed.
- The foundation bed shall be at the same level throughout the foundation.
- There should not be loose soil should remain on the foundation base and the foundation base must be dry.
- The pumping water should be done in case of water logging during construction period and should be dried before starting soling work.
- The foundation base must be leveled and rammed properly and the pit has to be excavated vertically.
- The excavated soil must be stacked on sides of trench such that it does not fall to the trench.
- The detailed drawing must be on hand before commencing the foundation work.
- The excavation work must be done in presence of experienced engineer or technician

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

Trench Plan

Sheet No.

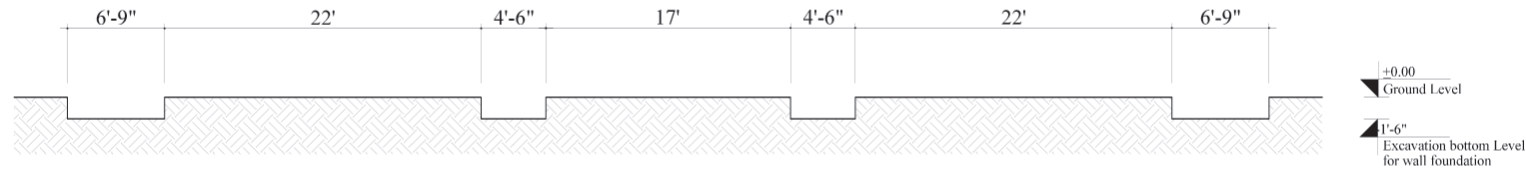
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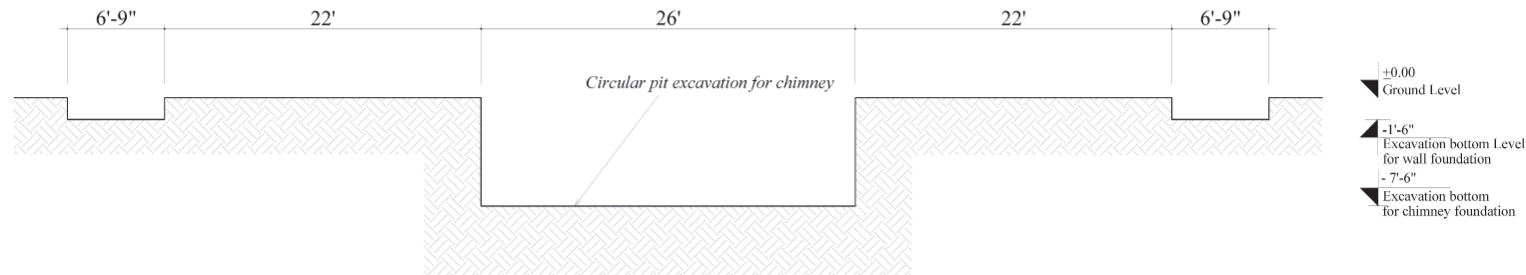
1 : 200



SECTION AT Y1-Y1



SECTION AT Y2-Y2



SECTION AT Y3-Y3

CONSTRUCTION GUIDELINES

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

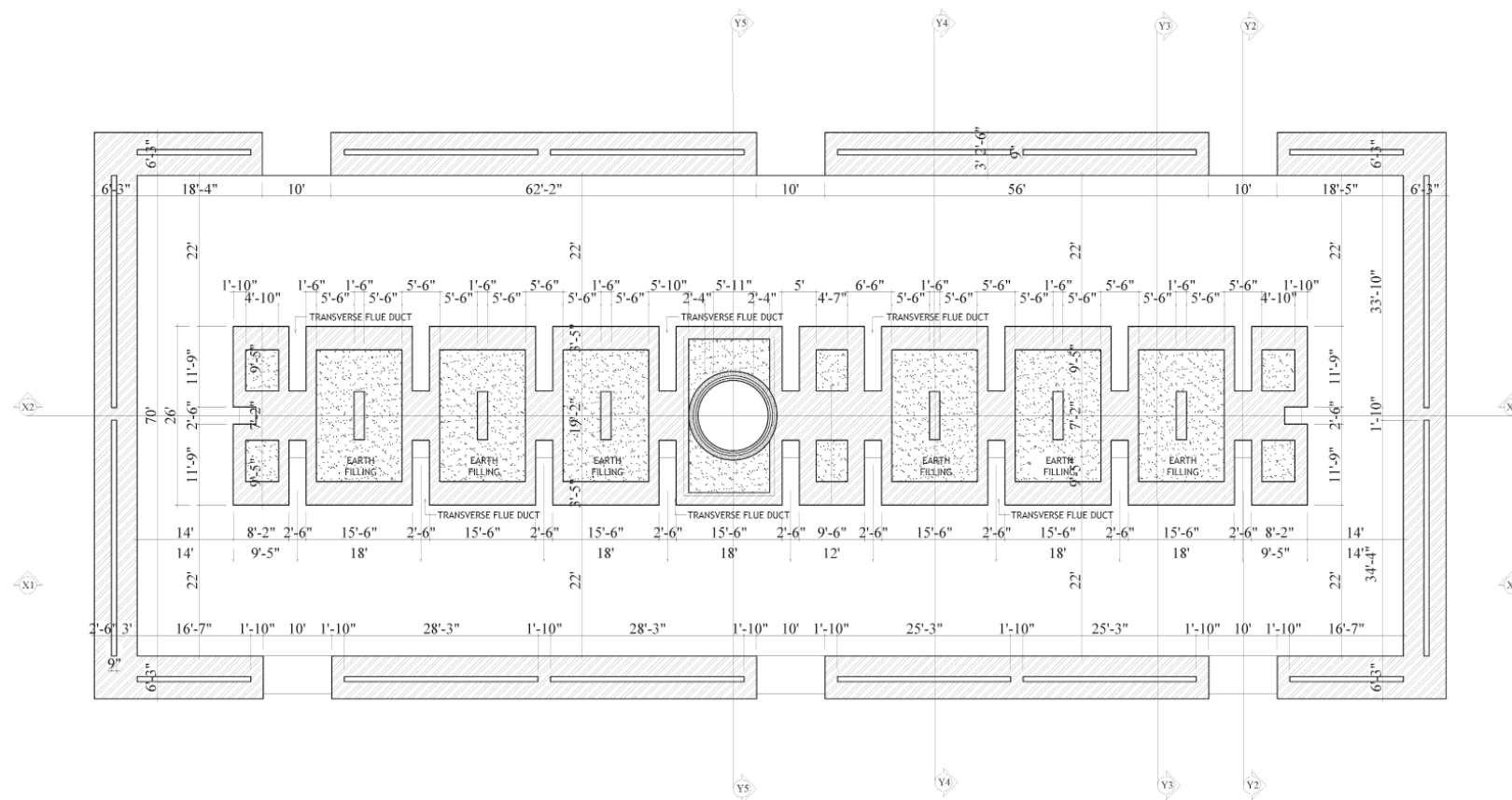
Trench Section

Sheet No.

003

Scale

1 : 100



PLAN AT LEVEL : 0'-0"

CONSTRUCTION GUIDELINES

Brick work in mud mortar in Miyan wall

- All brick works can be in mud mortar.
- Brick work of Miyan foundation starts with thickness of 6 bricks at the bottom which gradually decreases and ends with thickness of 2 bricks wall at the top.
- The masonry wall is provided with various thicknesses at various heights. (refer drawings)
- The cross wall links the either sides of Miyan wall. The inlet holes in the cross wall which connects side wall with main wall through shunt system. The thickness of cross wall is 18 inches. Refer drawing for more detail.
- The 2nd class brick can be used for the wall construction.
- The broken brick together with full sized bricks can be used in the masonry below ground level.

Brick work in mud mortar in outer wall

- All brick works can be in mud mortar.
- The outer wall is basically is a double wall structure with cavity in between. Refer drawing for details and dimensions.
- Brick work of foundation will start with 4 brick thickness and will continue up to 2'6" height.
- The internal cavity should be filled with rabis or silt or any type of soil with good insulation properties with proper compaction
- The linking walls of 14 inch thickness should be constructed at the interval of 5 feet distance.
- The 2nd class brick can be used for the wall construction.
- The broken brick together with full sized bricks can be used in the masonry below ground level.

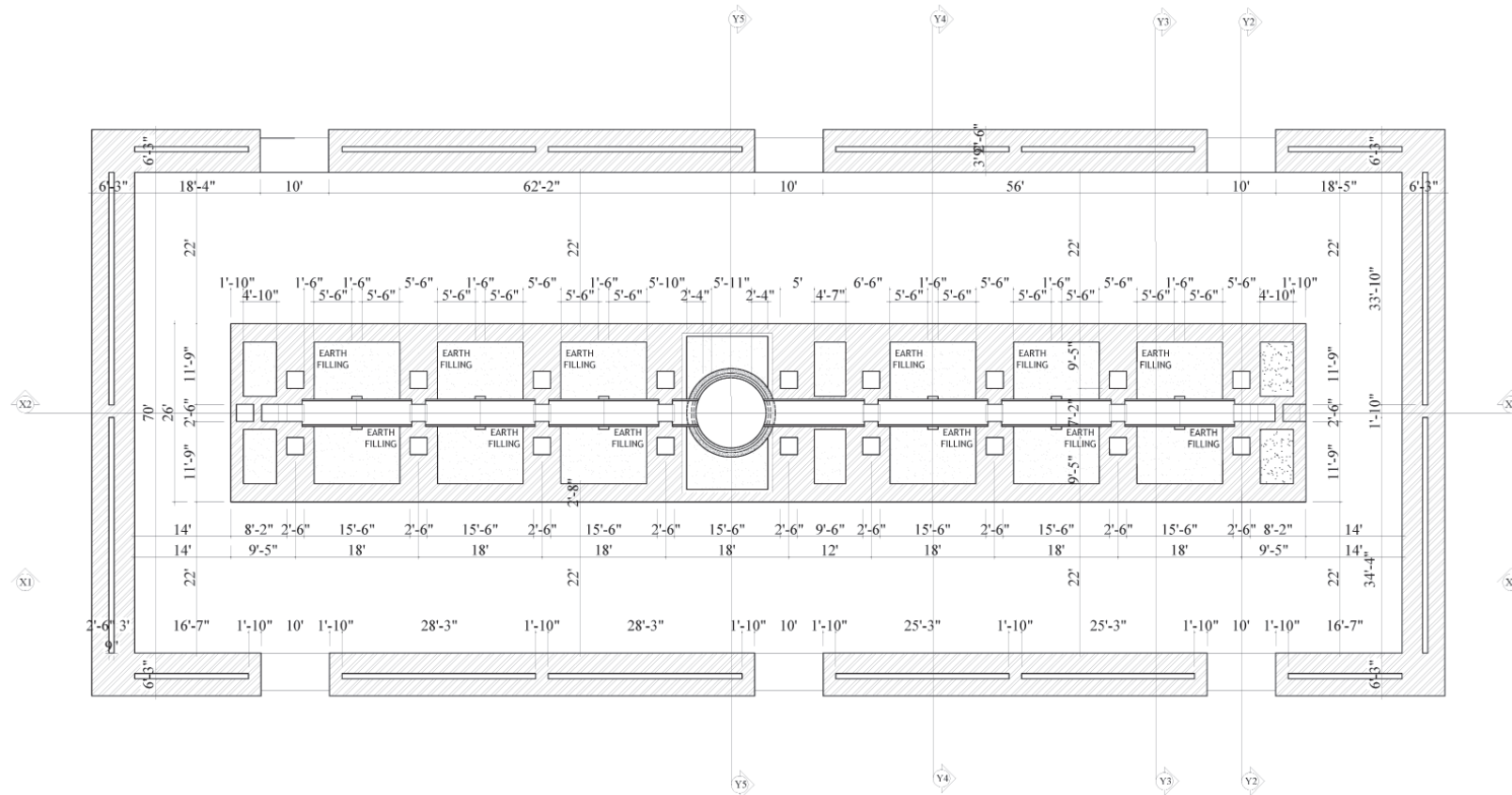
NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

Wall Plan at level ± 0.00

Sheet No.	Scale
004	1 : 200

CONSTRUCTION GUIDELINES



PLAN AT LEVEL : 5'-3"

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

Wall Plan at +5'3"

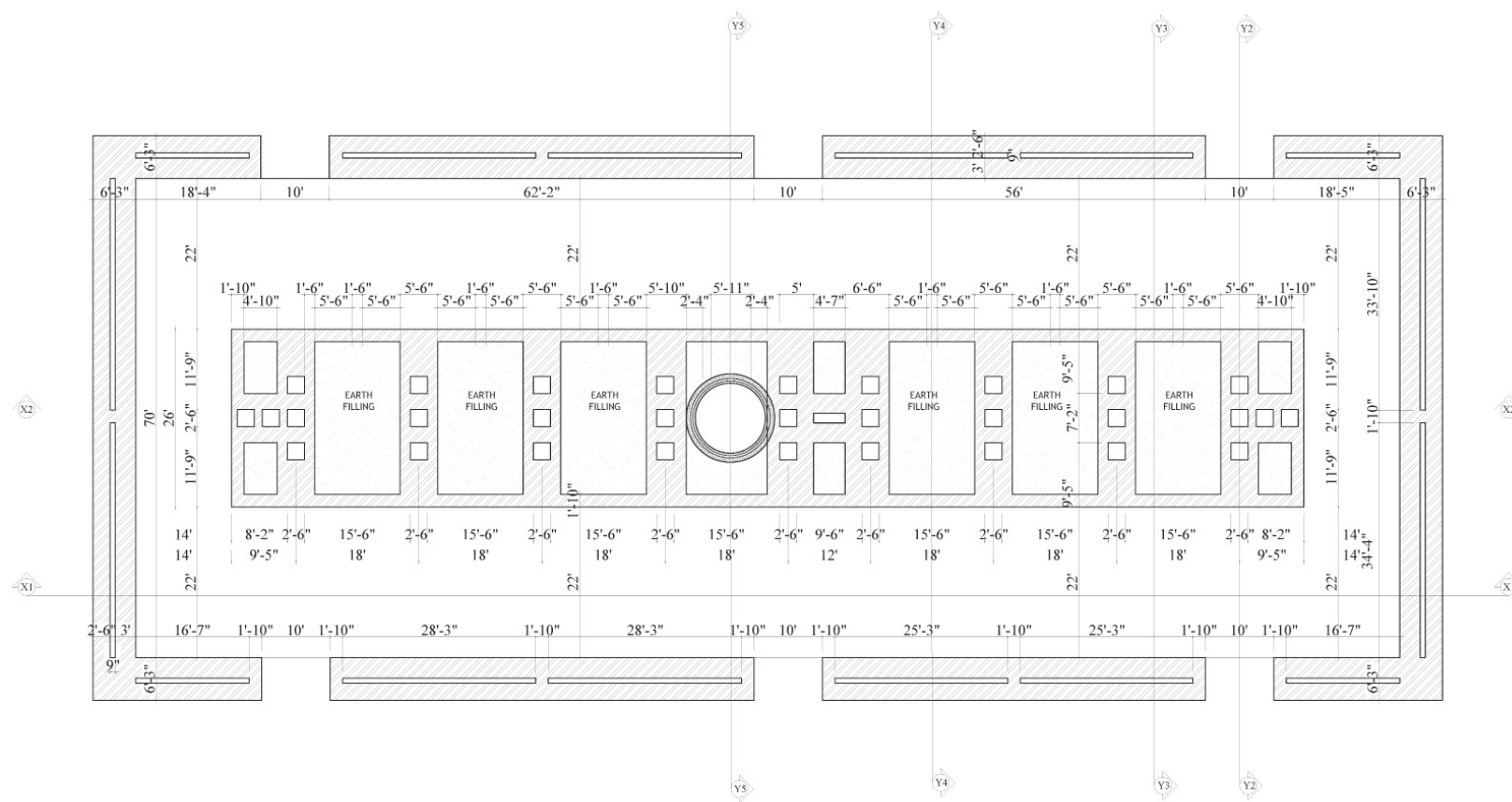
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005

Scale

1 : 200

CONSTRUCTION GUIDELINES



PLAN AT LEVEL : 9'-3"

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

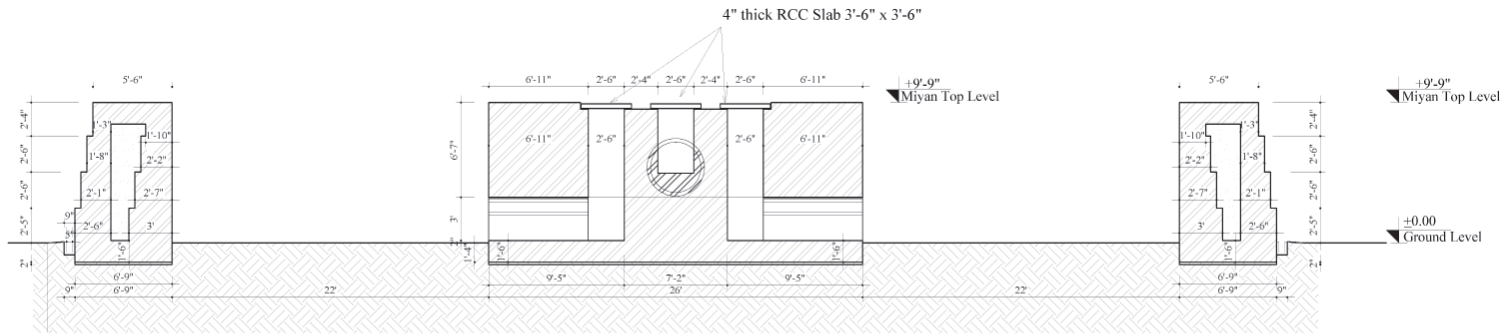
Wall Plan at +9'3"

Sheet No.

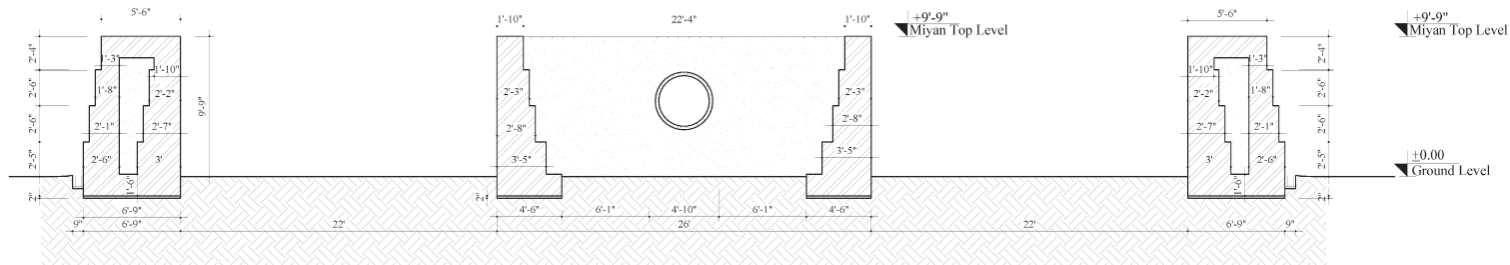
006

Scale

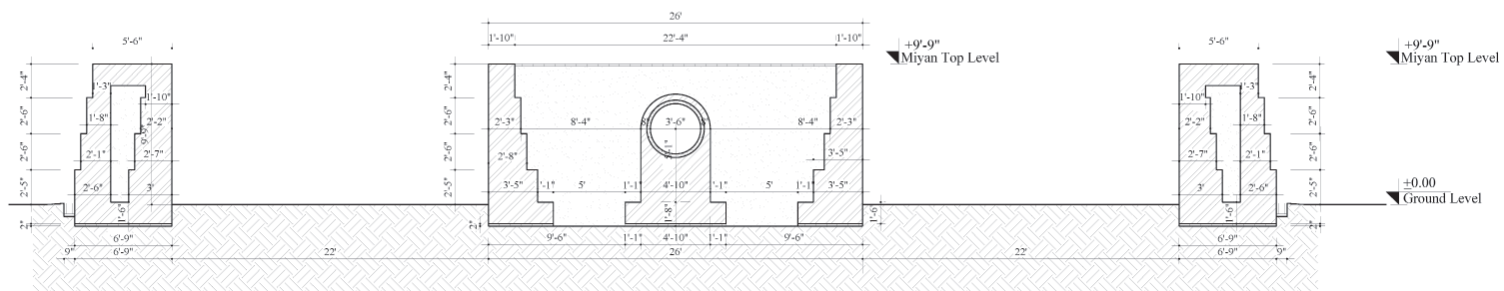
1 : 200



KILN SECTION AT Y2-Y2



KILN SECTION AT Y3-Y3



KILN SECTION AT Y4-Y4

CONSTRUCTION GUIDELINES

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

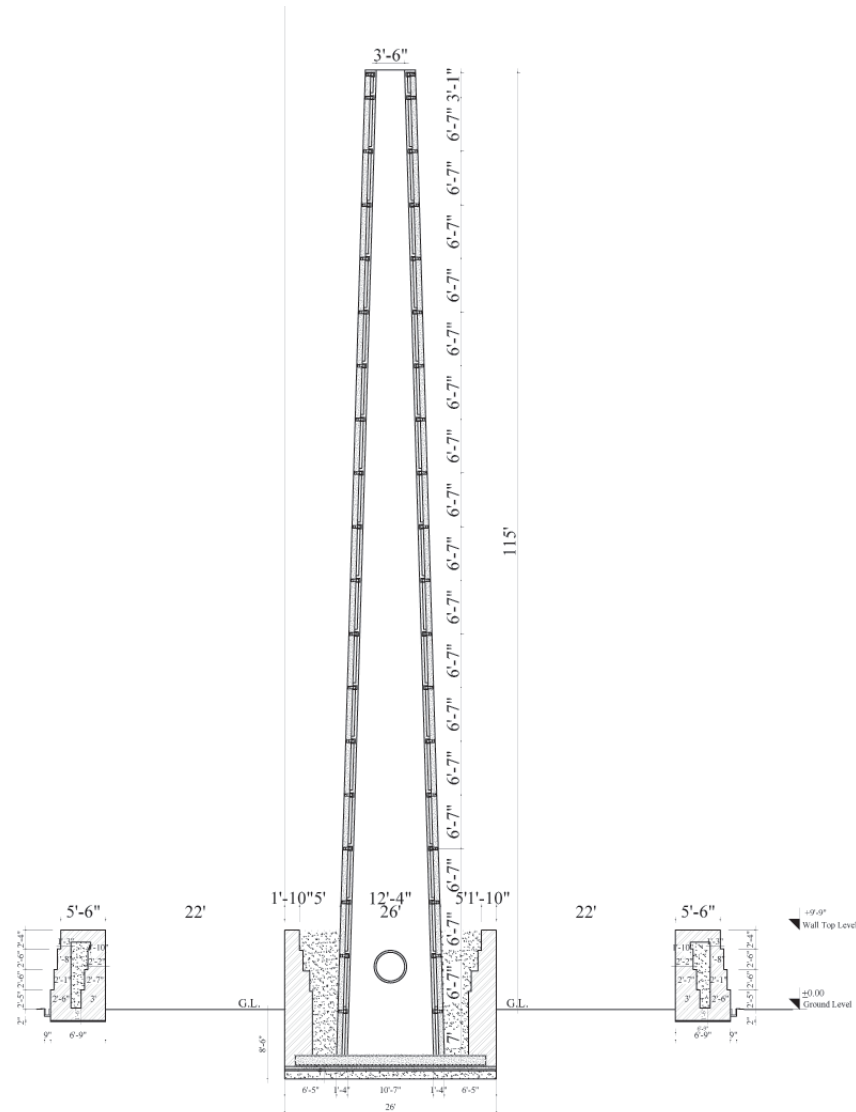
Kiln Section

Sheet No.

007

Scale

1 : 100



KILN SECTION AT Y5-Y5

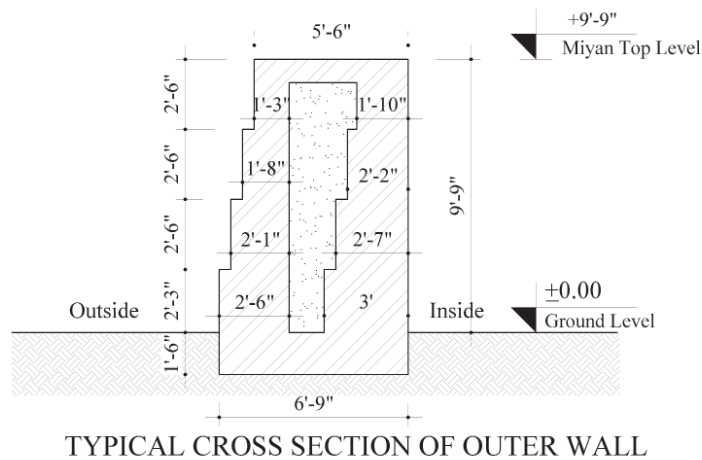
CONSTRUCTION GUIDELINES

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :
Kiln Section

Sheet No.	Scale
008	not in scale

CONSTRUCTION GUIDELINES

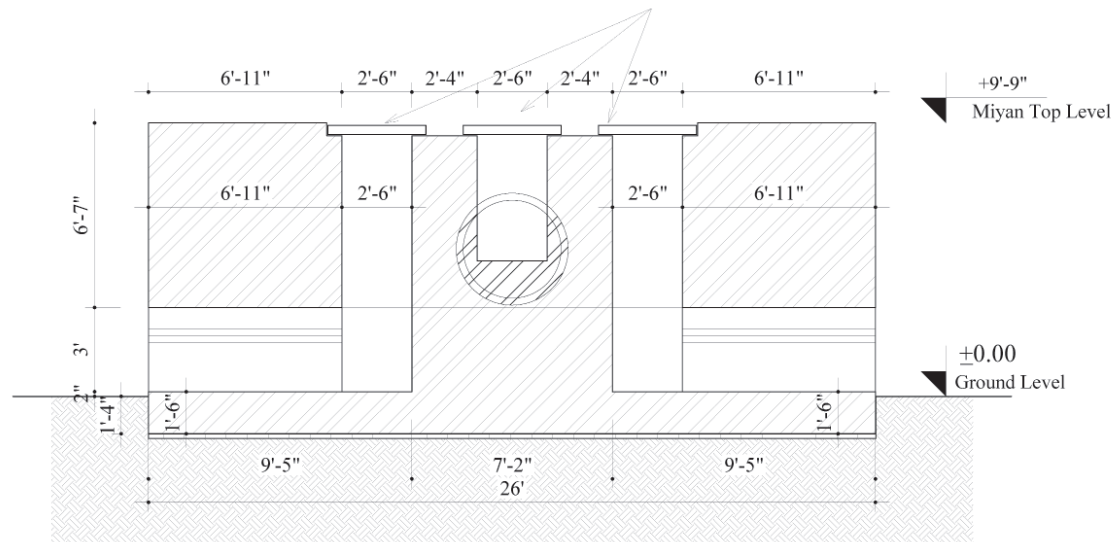


RECOMMENDED DUG FLOOR

- FLAT BRICK SOLING
- BRICK ON EDGE SOLING
- 6" THK SAND BED
- ALUMINUM FOIL/SHEET
- 6"THK SAND BED
- RAMMED EARTH

DUG FLOOR

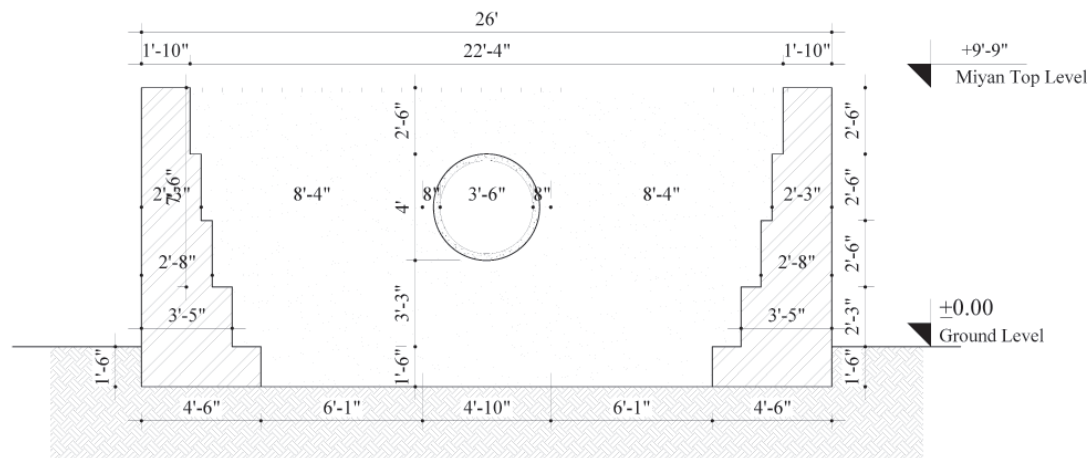
4" thick RCC Slab 3'-6" x 3'-6"



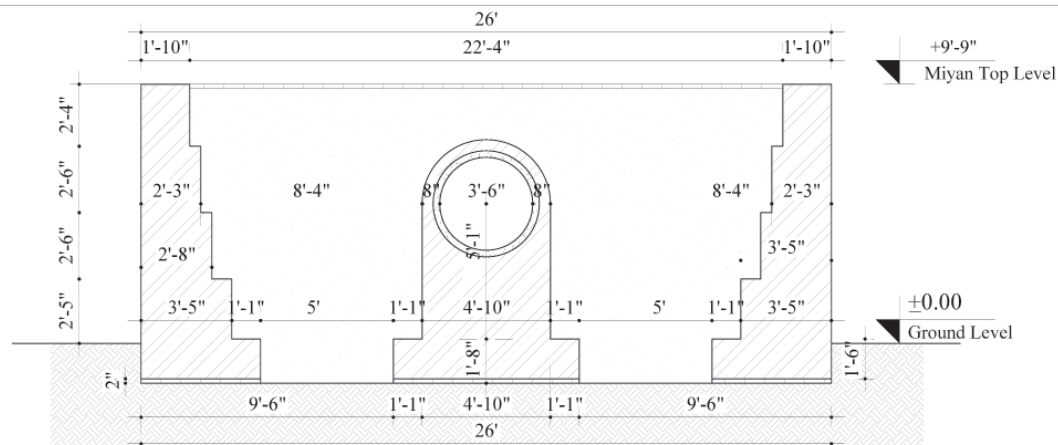
NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :
Wall Section

Sheet No.	Scale
009	1 : 50



CROSS SECTION OF MIYAN
AT SECTION Y3-Y3



CROSS SECTION OF MIYAN
AT SECTION Y4-Y4

CONSTRUCTION GUIDELINES

Dug Floor

- The floor level of the trenches of the brick kiln should be such that it is not less than 3 m above the water table of sub-soil water measured during rainy season. In any case floor level should not be more than 1 m below the ground level.
- The first layer of dug floor layers will be sand of 1'0" thickness
- A thin layer of aluminum foil will be placed exactly at the center of sand layer
- Above the sand, two layers of soling will be provided, one layer with brick on edge and another layer with brick on flat. Refer the detail drawings.

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

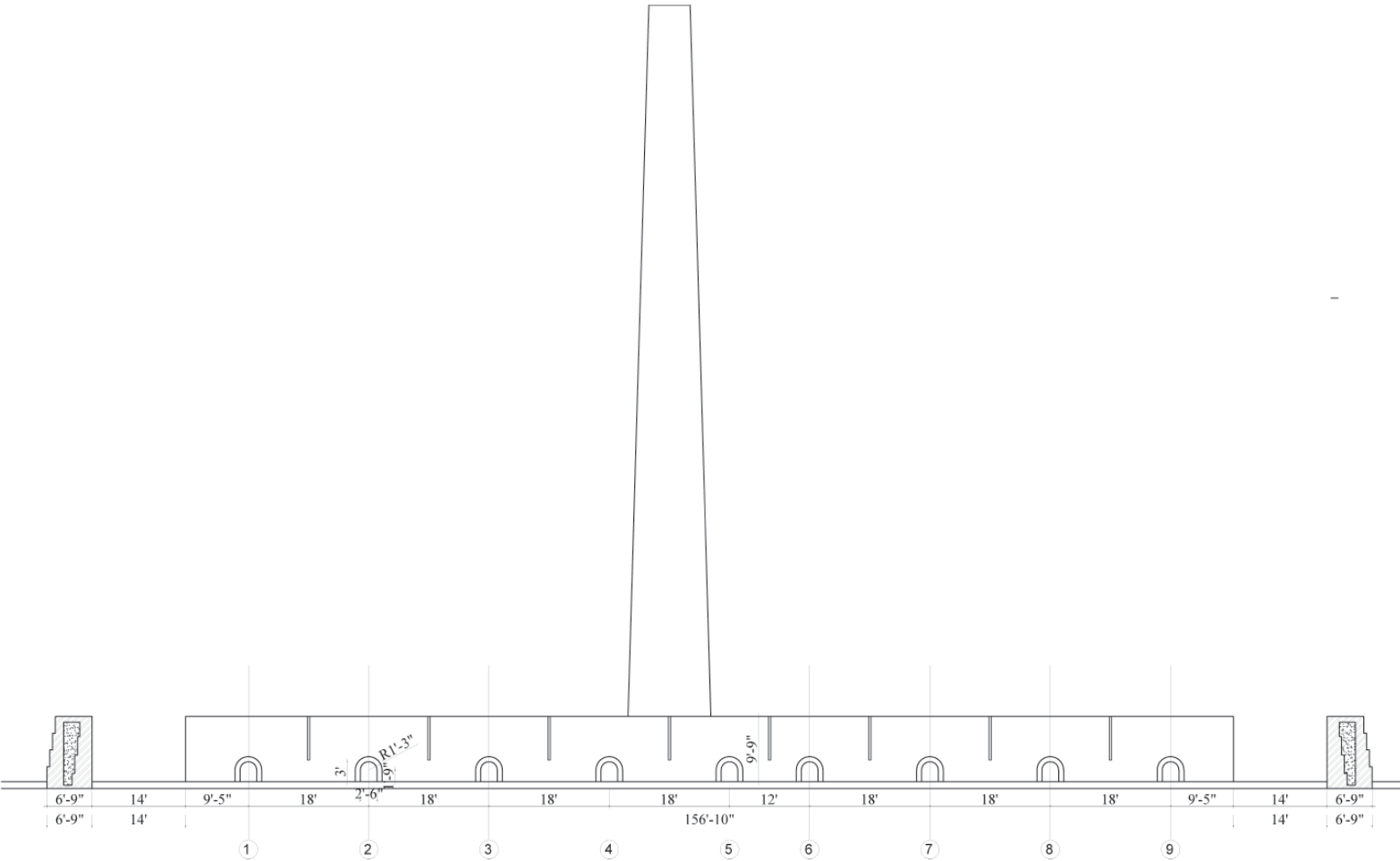
Wall Section

Sheet No.

010

Scale

1 : 50



KILN SECTION AT X1-X1

CONSTRUCTION GUIDELINES

Dug Floor

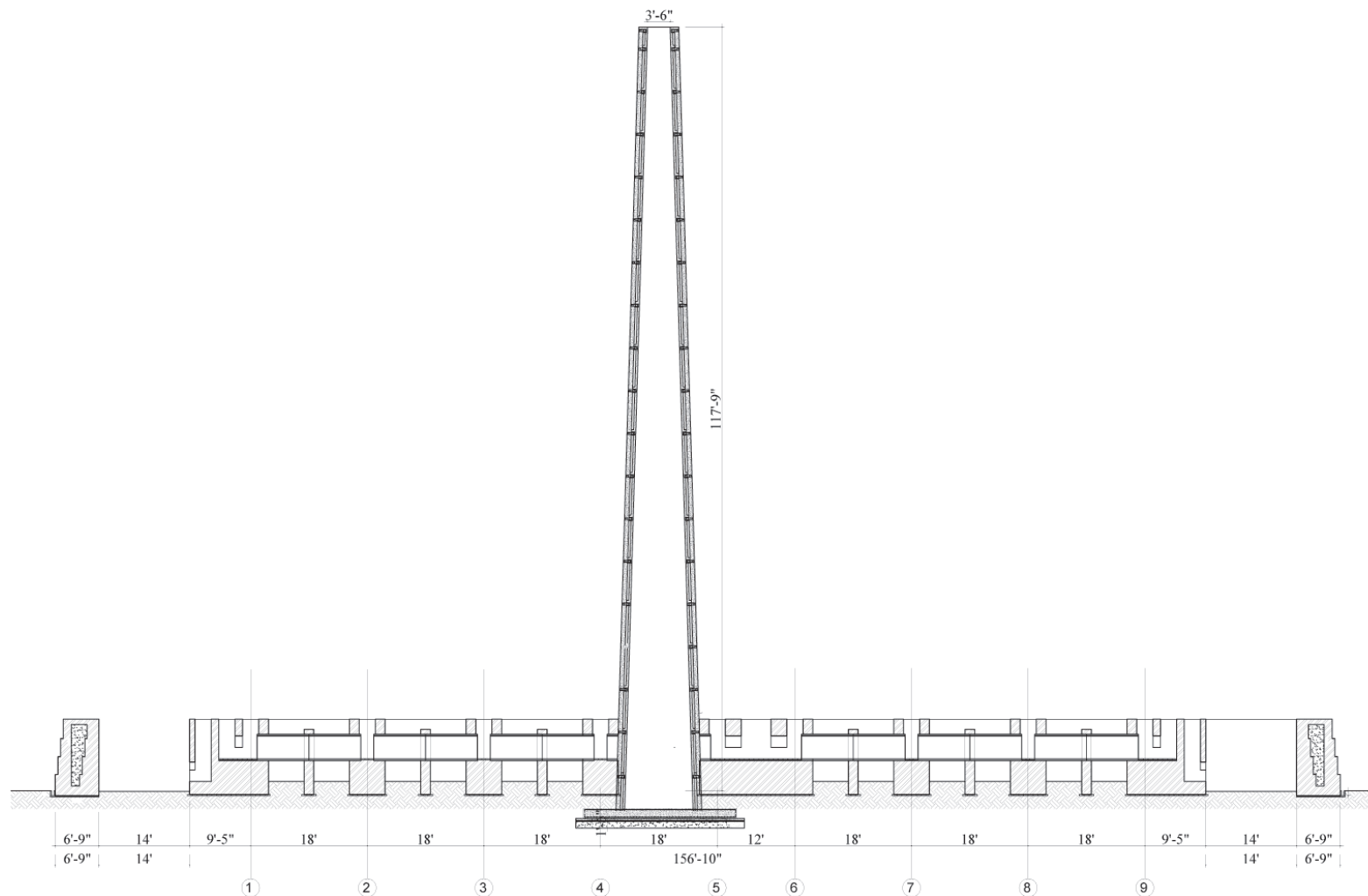
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- The first layer of dug floor layers will be sand of 1'0" thickness
- A thin layer of aluminum foil will be placed exactly at the center of sand layer
- Above the sand, two layers of soling will be provided, one layer with brick on edge and another layer with brick on flat. Refer the detail drawings.

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :
Kiln Section

Sheet No.	Scale
011	1 : 200

CONSTRUCTION GUIDELINES

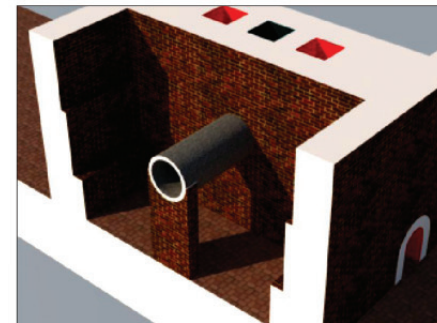
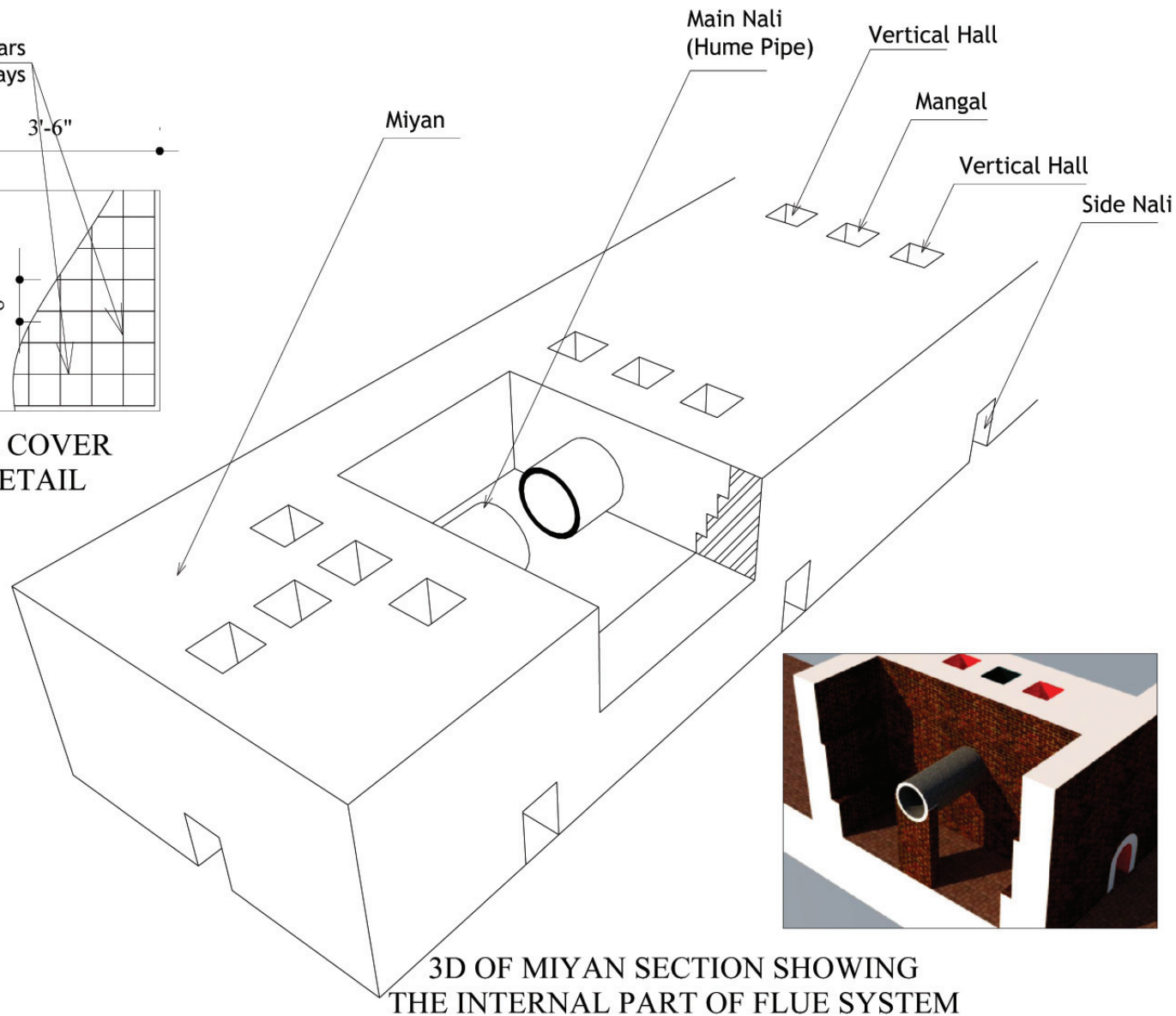
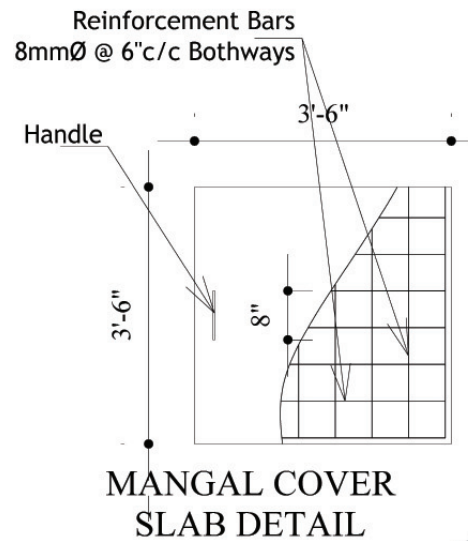


KILN SECTION AT X2-X2

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :
Kiln Section

Sheet No.	Scale
012	1 : 200

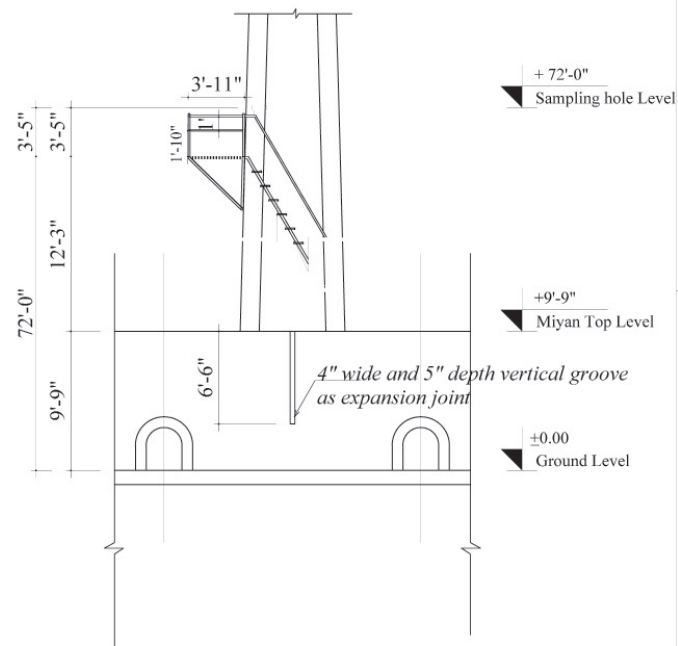


CONSTRUCTION GUIDELINES

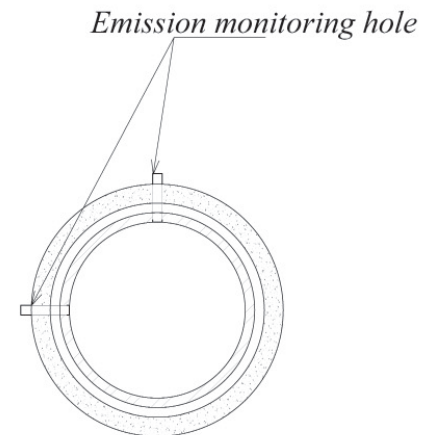
NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :
Flue Duct System Detail

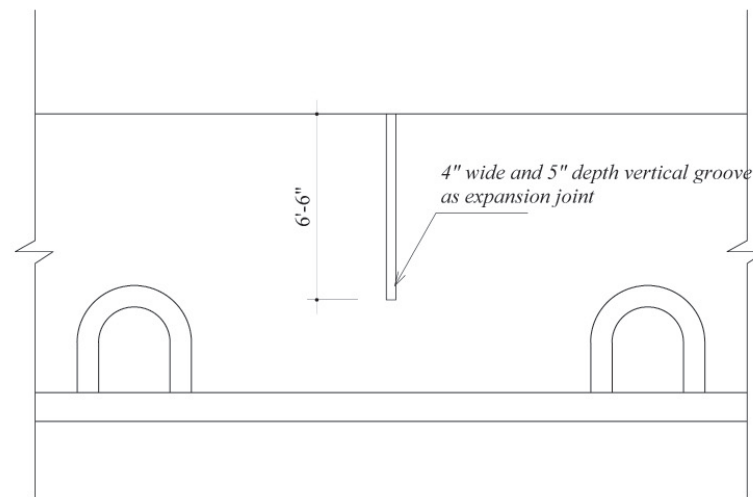
Sheet No.	Scale
013	1 : 50



STACK EMISSION MONITORING
PLATFORM DETAIL



EMISSION MONITORING PROBE
HOLE POSITION



EXPANSION JOINT DETAIL

CONSTRUCTION GUIDELINES

SPECIFICATION OF HUME PIPE

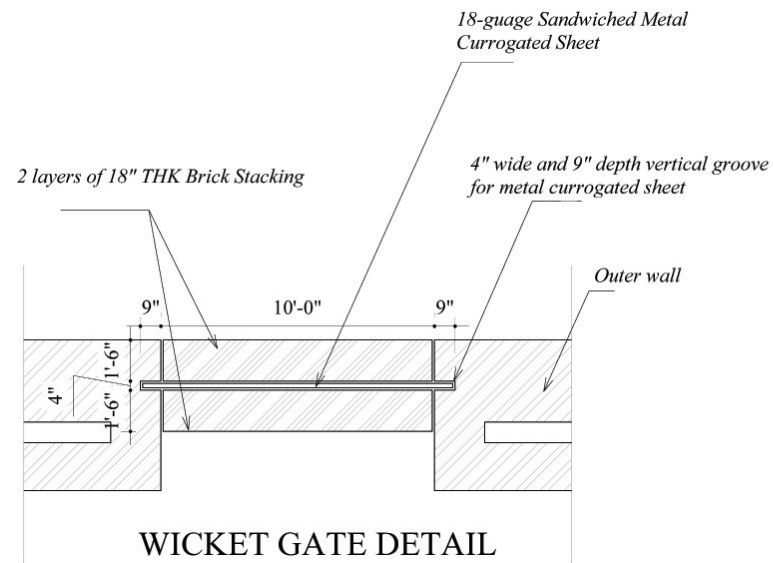
Hume pipes of Medium Density-NP3 with length 2500 should be used as main nali in the proposed kiln. The specification of the Hume Pipe is as follows:

- Must comply the Indian Standard Specification (I.S.458-1988)
- Concrete mix grade should be above M30
- Casting of Hume Pipe is done using the Hume Pipe making machine.
- Density: Optimum water cement ratio and high density is preferred
- Joints: Socket and Spigot joint is preferred.

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title : Stack Emission
Monitoring Probe Hole Detail
& Expansion Joint Detail

Sheet No.	Scale
014	1 : 50



SCALE:
1:50



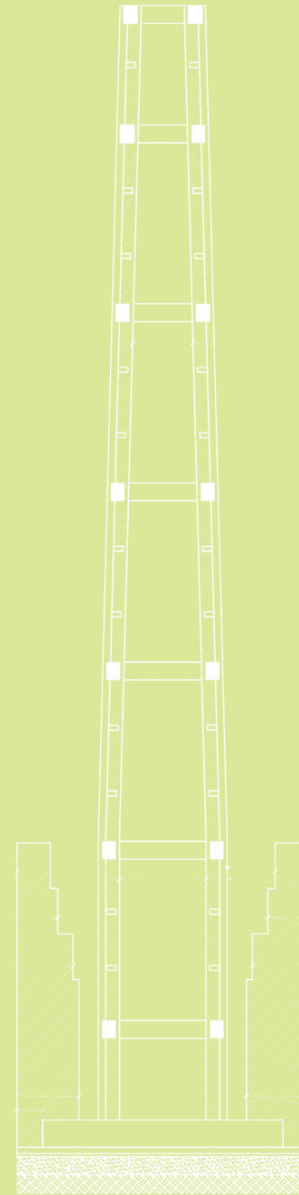
CONSTRUCTION GUIDELINES

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :
Wicket Gate Detail

Sheet No.	Scale
015	1 : 50

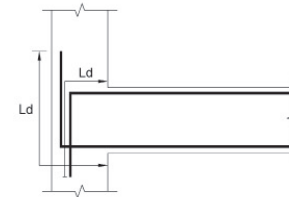
Drawing of Chimney



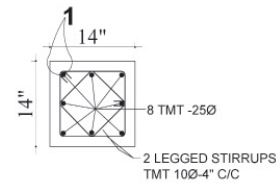
General Notes:

- DO NOT SCALE FROM THE DRAWINGS
- STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH RELEVANT ARCHITECTURAL DRAWINGS AND IN ANY CONFLICT REFER ARCHITECTURAL DRAWINGS FOR DIMENSIONS.
- UNLESS SPECIFIED OTHERWISE, ALL LEVELS SHOWN IN STRUCTURAL DRAWINGS ARE STRUCTURAL LEVELS ONLY.
- DO NOT SCALE FOLLOW WRITTEN DIMENSION ONLY
- ALL DIMENSION & LEVEL ARE IN MILLIMETER UNLESS NOTED OTHERWISE.
ALL DIMENSION TO BE VERIFIED ON SITE & APPROVED BY THE ENGINEER
- GRADE OF CONCRETE MIX SHALL BE M-20 FOR COLUMNS
RAFT, WALLS, BEAMS, ETC.
UNLESS NOTED OTHERWISE CONFORMING TO IS:456-2000.
- REINFORCEMENT SHALL BE HIGH STRENGTH DEFORMED BARS OF GRADE Fe:415
CONFORMING TO IS: 1786-1985.
- CLEAR COVER TO BARS
 - FOR CONCRETE MEMBERS IN CONTACT WITH SOIL = 2"
 - FOR LONGITUDINAL (VERTICAL) BARS IN COLUMN = 2"
 - FOR MAIN BARS IN BEAMS = 2"
- BARS IN COLUMNS SHALL BE SPliced ONLY AT MID HEIGHT OF COLUMN.
- BARS SPlicing IN BEAM SHALL BE AVOIDED IN THE SPAN WHERE INTERMEDIATE BEAM IS CONNECTED AND SHALL BE ONLY AS SHOWN ON DWG.
- DEVELOPMENT / LAP LENGTH (L_d) FOR BARS.

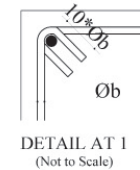
BAR DIA-(mm)	8	10	12	16	20	25	28	32
FOR M20 L _d	1'-7"	2'-0"	2'-4"	3'-1"	3'-10"	4'-10"	5'-5"	6'-2"
- PROVIDE SHEAR REINFORCEMENT AT 4" C/C AT LAP LOCATIONS.
- Z = DEPTH OF BEAM.
- ANY DISCREPANCY NOTED BETWEEN DETAILS IN THE DRAWINGS/SPECIFICATIONS, THE MATTER SHALL BE BROUGHT TO THE NOTICE OF CONCERNED ENGINEER PRIOR TO CONSTRUCTION AND GOT RECONCILED BEFORE EXECUTION.



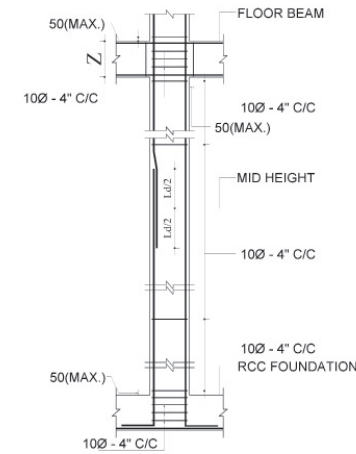
TYPICAL END DETAILS FOR BEAM REINFORCEMENT



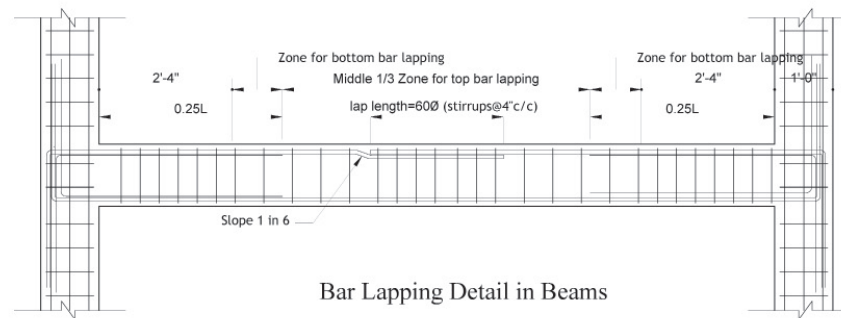
TYPICAL COLUMN [14" X 14"]



DETAIL AT 1
(Not to Scale)



TYPICAL COLUMN SHEAR REINFORCEMENT DETAIL



Bar Lapping Detail in Beams

CONSTRUCTION GUIDELINES

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

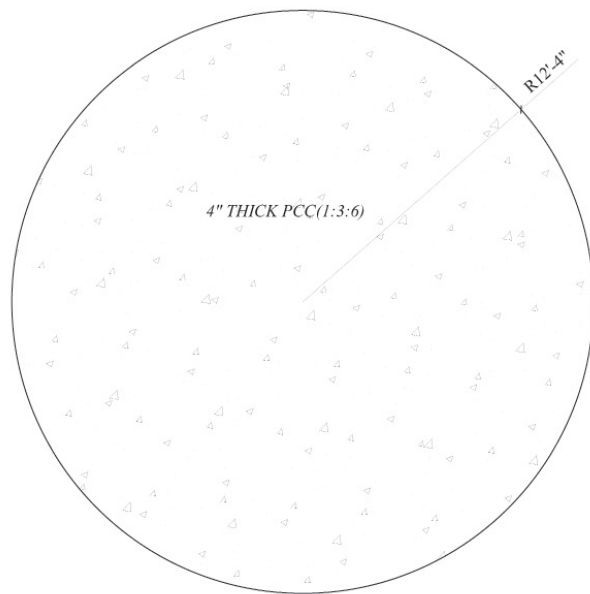
Reinforcement Detail

Sheet No.

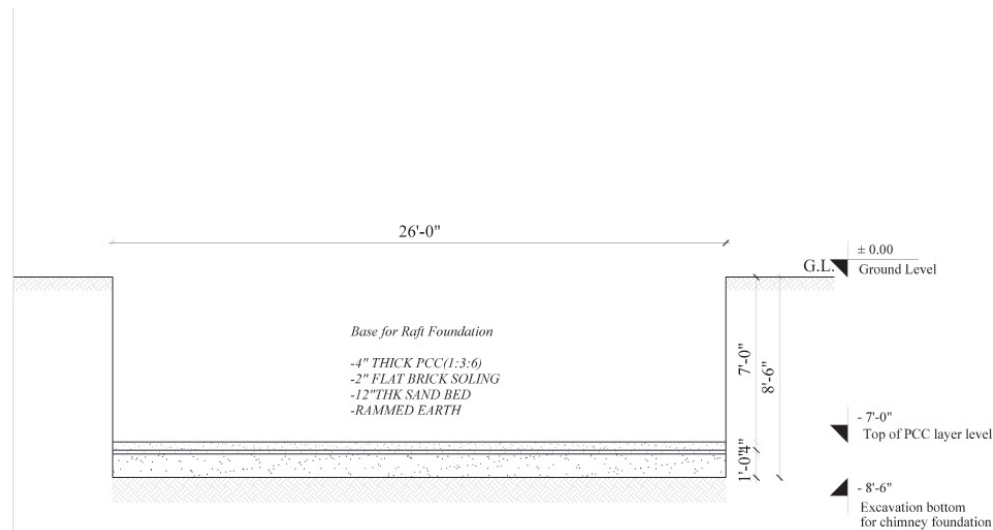
016

Scale

not in scale



Foundation Excavation Plan



Section of Foundation

CONSTRUCTION GUIDELINES

Foundation work for Chimney

Sand filling

- A layer of sand should be filled on excavated chimney foundation
- The thickness of sand layer should be at least 1'-0".
- The sand layer should be gently compacted and be leveled properly.

Brick Soling

- A single layer of flat brick soling should be provided on top of sand layer.
- The joint of brick soling must be completely filled with proper sprinkling of water

Plain Cement Concrete

- A thickness of PCC layer should be at least 4 inches.
- The mix ratio of concrete should be at least 1:3:6 i.e. one cement, three sand and six aggregate
- Before laying concrete, the brick soling must be completely soaked with water.
- The mixing of concrete must be mechanical mixing using mixer machines.
- By any case if it is not possible to bring mixture machines then it is strongly recommended to execute hand mixing properly with three times dry mixing and three times wet mixing.
- The concrete must be cured for at least 7 days.

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

Foundation Detail

Sheet No.

017

Scale

1 : 50

CONSTRUCTION GUIDELINES

Reinforced cement concrete (RCC) work

Raft Foundation

- The minimum grade of concrete is M20 for raft.
- The mix ratio of concrete is at least 1:1.5:3 of cement: sand: aggregate to achieve concrete grade of M20.
- The steel grade is Fe415.
- The thickness of raft foundation is at least 1'6".
- There are two layer of reinforcement in the raft footing; i. Bottom layer and ii. Top layer.
- Bottom layer reinforcement is provided by 16 mm Φ (diameter) bars laid @ 6" center to center at both ways. Similarly, top layer reinforcement is provided by 12 mm Φ bars laid @ 6" center to center at both ways.
- Sufficient number of chairs should be provided to maintain the uniform gap between top and bottom reinforcement layers.
- The minimum thickness of clear cover should be 50 mm in all sides of raft.
- The ductility detailing must be strictly followed.
- The curing of RCC work must be done at least for 21 days.
- All other details should be as per the specification and drawings provided.
- The presence of site engineer/technical personal is mandatory in whole process of raft foundation works.

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

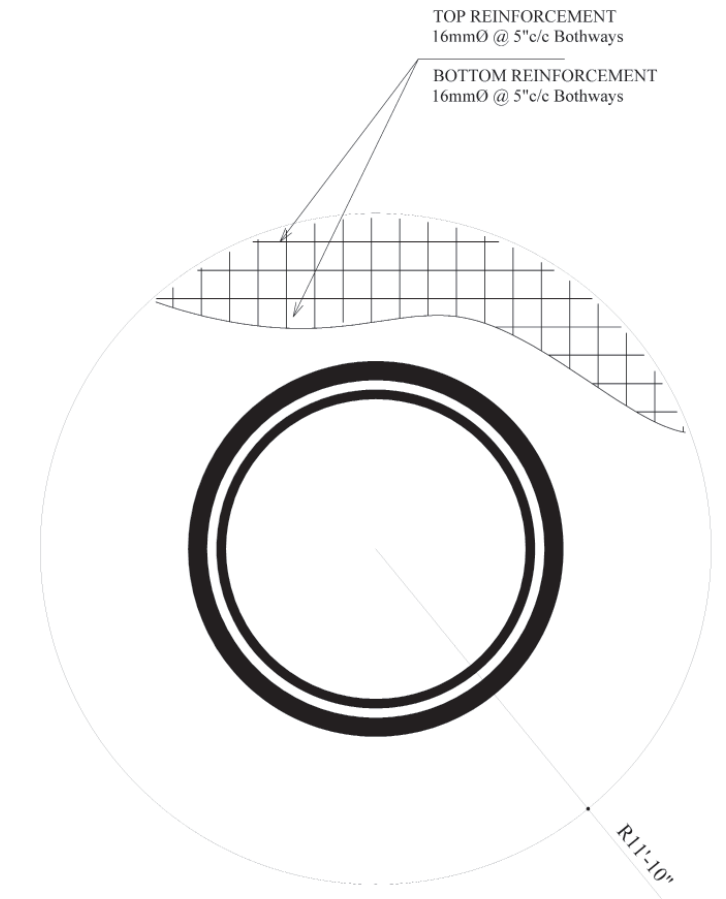
Reft Foundation Detail

Sheet No.

018

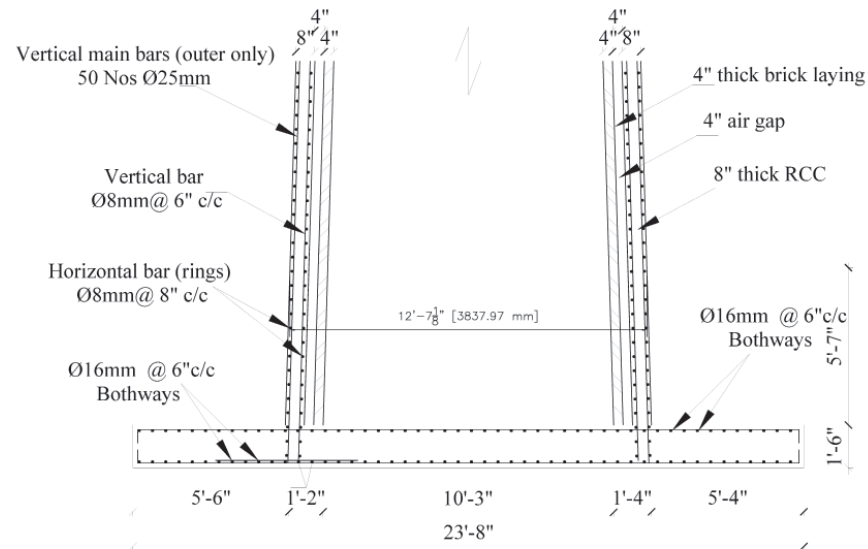
Scale

1 : 50



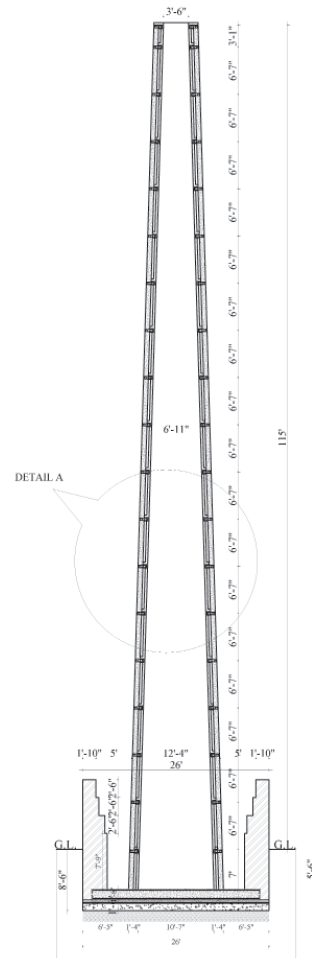
CHIMNEY FOUNDATION SECTIONAL DETAIL

SCALE
1:50



PLAN OF CHAIMNEY RAFT FOUNDATION

SCALE
1:50



SCALE
1:200

Vertical main bars (outer only)
50 Nos Ø25mm

Vertical bar
Ø8mm@ 6" c/c

Horizontal bar (rings)
Ø8mm@ 8" c/c

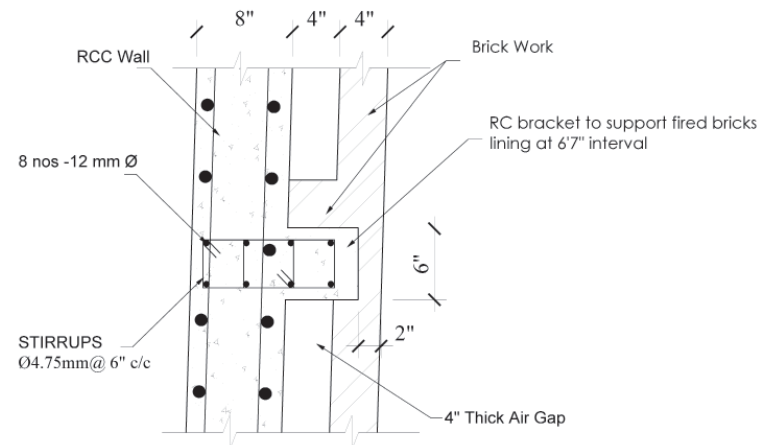
6'-7"

DETAIL A

RC bracket to support fired
bricks lining at 6'-7" interval

SCALE
1:50

SCALE
1:50



SCALE
1:10

SCALE
1:10

CONSTRUCTION GUIDELINES

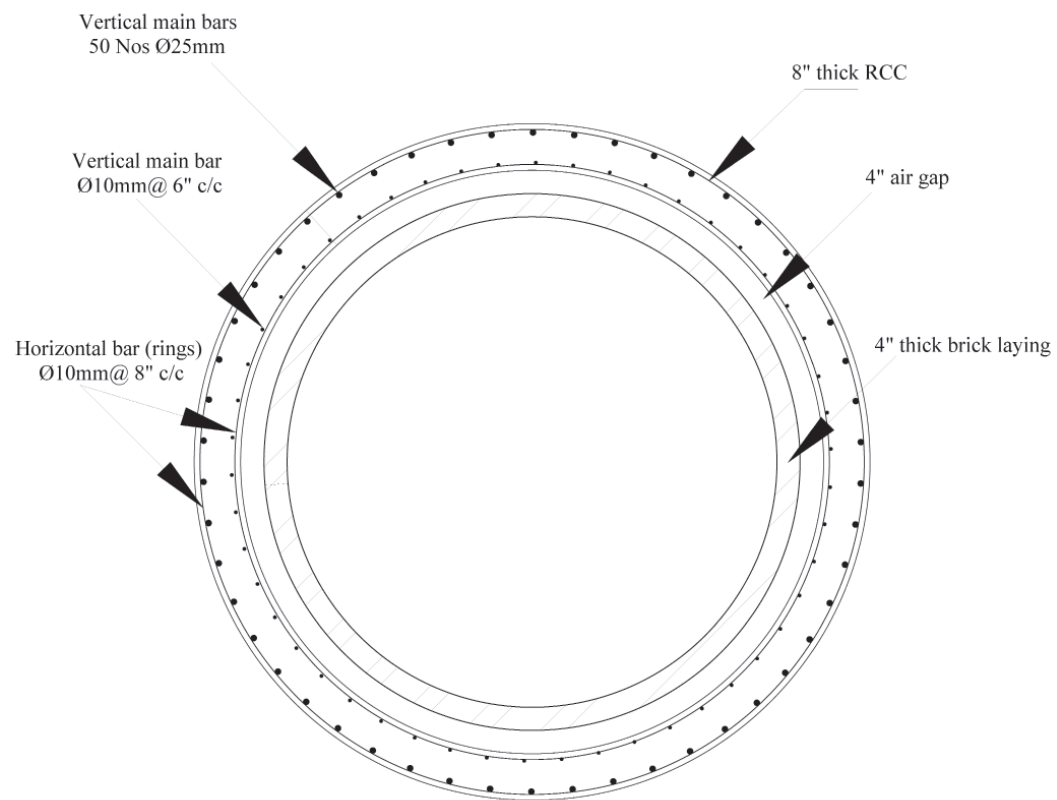
NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :
Chimney Details

Sheet No.

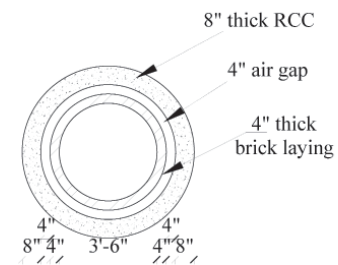
Scale

019



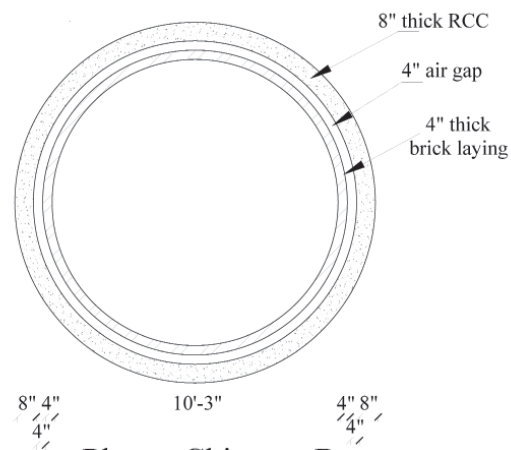
Typical Sectional Plan of Chimney

SCALE
1:20



Plan at Chimney Top

SCALE
1:50



Plan at Chimney Bottom

SCALE
1:50

CONSTRUCTION GUIDELINES

NATURAL DRAUGHT ZIG-ZAG KILN

Drawing Title :

Raft Foundation Details

Sheet No.

020

Scale

1:50

Bill of Quantity

Natural Draught Zig Zag Kiln

1. Miyana wall and internal wall

S.N.	Particulars of Items	Quantity	Unit	Rate	Amount	Remarks
A	Materials					
1	Bricks				-	
	<i>Bricks for soling</i>	9,649.00	Nos	4.00	38,596.00	
	<i>2nd class bricks</i>	290,027.00	Nos	8.00	2,320,216.00	
2	42" dai. Hume Pipe,NP2 3" thickness	14.00	Nos	22,500.00	315,000.00	
B	Labor					
1	Skilled	912.00	Mandays	1,200.00	1,094,400.00	
2	Unskilled	1,879.00	Mandays	700.00	1,315,300.00	
	TOTAL				5,083,512.00	

2. Outer wall

S.N.	Particulars of Items	Quantity	Unit	Rate	Amount	Remarks
A	Materials					
1	Bricks					
	<i>2nd class bricks</i>	396,019.00	Nos	8.00	3,168,152.00	
B	Labor					
1	Skilled	1,088.00	Mandays	1200.00	1,305,600.00	
2	Unskilled	1,849.00	Mandays	700.00	1,294,300.00	
	TOTAL				5,768,052.00	

3. Dug floor

S.N.	Particulars of Items	Quantity	Unit	Rate	Amount	Remarks
A	Materials					
1	Sand	286.52	Cum	3,180.00	911,125.42	
2	Bricks (use of brick bats only)	67,570.00	Nos	4.00	270,280.00	
3	Aluminium Foil	260.47	Sqm	40.00	10,418.82	
4	Compaction of dug surface	1.00	LS	100000.00	100,000.00	
B	Labor					
1	Skilled	427.00	Mandays	1200.00	512,400.00	
2	Unskilled	1,036.00	Mandays	700.00	725,200.00	
	TOTAL				2,529,424.23	

4. Chimney

S.N.	Particulars of Items	Quantity	Unit	Rate	Amount	Remarks
A	Materials					
1	Cement	619.00	bags	870.00	538,530.00	
2	Sand	49.61	cum	3,180.00	157,768.88	
3	Aggregate	62.82	cum	3,180.00	199,774.23	
4	Bricks					
	<i>Bricks for soling</i>	1,865.00	no.	4.00	7,460.00	
	<i>1st Class bricks</i>	4,668.00	no.	12.00	56,016.00	
5	Steel	12,620.68	kg	90.00	1,135,860.88	
6	Form work	627.14	Sqm	1,100.00	689,851.30	
7	Grouting work	1.00	LS		200,000.00	
8	Antishulphur Chemical	1.00	LS		100,000.00	
B	Labor					
1	Skilled	621.00	Mandays	1,200.00	745,200.00	
2	Unskilled	1,982.00	Mandays	700.00	1,387,400.00	
	TOTAL				5,217,861.29	
C	Contingencies @3%				156,535.84	
	GRAND TOTAL				5,374,397.13	



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