

**Craft in Architecture:**  
**The Making of a Coffee Mill and a Study of Form Generation**



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**Thesis submitted to the faculty of the Virginia Polytechnic Institute and  
State University in partial fulfillment of the requirements for the degree of:**

**Master of Architecture  
in Architecture**

Approved by:

  
Hans Christian Rott, Chairman

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H. Scott Gartner

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keywords: coffee, mill, grinder, portafilter, craft, carpentry, cabinetmaking,  
espresso, house



# Craft in Architecture: The Making of a Coffee Mill and a Study of Form Generation

Joshua Tunick

## Abstract

The connection of craft and architecture is a subject that has interested me since I began my architecture education some seventeen years ago. Although my path led me away from, then back to architecture, craft and making has remained a passion of mine through the years; specifically, the role of the individual craftsman in architecture.

It is my contention that as we move further and further into a machine made world, we lose an understanding of, and an appreciation for variation. Everything in our lives is homogenous. People believe that coffee should taste the way that it does at Starbucks, and Starbucks became the monolith that it is by ensuring that their coffee tastes the same no matter where you are in the world.

The craftsman never strives for homogeneity or simple duplication; it is anathema to his being. The cabinetmaker knows he will never find two pieces of wood that are the same, and he knows he can never produce two identical products, no matter his skill. He finds joy in this, and he is fulfilled.

The barista, given control of the quality of the beans' roast, the grind, the tamp, and the pressure of the extraction will never make two shots the same. This variation makes every cup a unique experience, and provides an endless opportunity to experiment and refine.

I began with a house, and a study of how one generates form in architecture. I ended with a handcrafted coffee mill and portafilter. I utilized the craft of cabinetmaking that I have studied for over a decade, to produce tools for the barista to take full control of his craft.

Whether a piece of furniture, or a shot of espresso - what the hands of a skilled craftsman can create when they are given the tools and the freedom to put their skills and intuition to full use, is something extraordinary, something unique, and something exceeding what the best machine can produce under ideal conditions. This is a lesson I strive to always remember, and one I endeavor to pass on to my children. Now more than ever this idea seems very much at risk of extinction.

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## Coffee Mill

### Grinding Chamber

The mill body is a 4" x 4" x 4" cube constructed of walnut salvaged from a dilapidated barn in West Virginia.

Four 1/2" thick sides are joined by 1/8" finger joints, with 1/4" inch finger joints at the top and bottom of each side. Each corner of the assembled cube is mitered at 45 degrees to achieve a 1/16" line of end grain down each vertical edge.

3/8" x 3/8" square openings are made in each face, with each square's base beginning at the half-way point of each side. These square openings join 3/8" dados, 1/4" deep in each interior face. The square openings reveal mating square projections on the aluminum funnel / lower bushing piece, which sits in the 3/8" wide dados inside of the mill body and locks the four sides of the body square to each other.

A 1/2" wide aluminum brace is let into the funnel, and holds the lower oil impregnated brass bushing. This lower bushing accepts the 3/8" stainless steel axle. It is this lower bushing that allows the axle to rotate with no perceivable play. This is essential for a repeatable, consistent grind.





## Drawer

The ground coffee slides down the sides of the aluminum funnel into a drawer housed in the base. The drawer has an interior 45 degree miter beginning  $\frac{3}{16}$ " in from the outer drawer edge. The remaining  $\frac{3}{16}$ " of the  $\frac{3}{8}$ " thick drawer side slides into  $\frac{3}{16}$ " deep channels in the back and sides of the mill body. This creates a seal that keeps grounds from migrating behind the drawer into the channels, and ensures all grounds are captured into the drawer.

The back corners of the drawer are notched around the interior projections of the box joints, so as not to jeopardize the integrity of the mill body.

A  $\frac{1}{4}$ " lip on the bottom of the drawer allows for its easy removal from the mill body, and maintains the symmetry of the mill's base. The front sides of the drawer are mitered at 45 degrees to maintain the  $\frac{1}{16}$ " vertical end grain line at the corners.



## Axle and Burrs

The 3/8" stainless steel axle steps up to 9/16" to mate with the opening in the lower burr. 1/2" inside diameter stainless steel snap rings above and below the lower burr hold it in place vertically, while a 1/8" stainless steel key fits into mating slots on the axle and the lower burr, forming the connection that allows the burr to rotate with the axle.

The axle itself is adjusted up and down with the threaded jam nuts positioned above the upper bushing housed in the bean loading chamber. The vertical movement of the axle positions the lower burr closer or further away from the upper burr, allowing for a complete range of grind adjustment, from French press coarse, to Turkish coffee fine.

Other than assembly bolts, the burrs and jam nuts are the only parts not custom made for the mill. The burrs are Mazzer part 186C and are designed for use in their 110 volt commercial duty Robur conical grinder.

Flat burrs are much less expensive to produce and are now the standard in the coffee industry. A few companies, like Mazzer, continue to make a conical burr for their top of the line grinders because they have shown to produce a more consistent and elongated fine\*, and therefore a superior shot of espresso.

The Mazzer Robur, and its 186C conical burr is considered to be the finest commercial grinder, and highest quality burr available today. The burr is designed to be replaced after approximately one-thousand pounds of beans. In the extremely slow speeds used in a hand crank application, the burr should last indefinitely, though the mill is designed to allow for easy replacement.

\* a fine is a single coffee ground

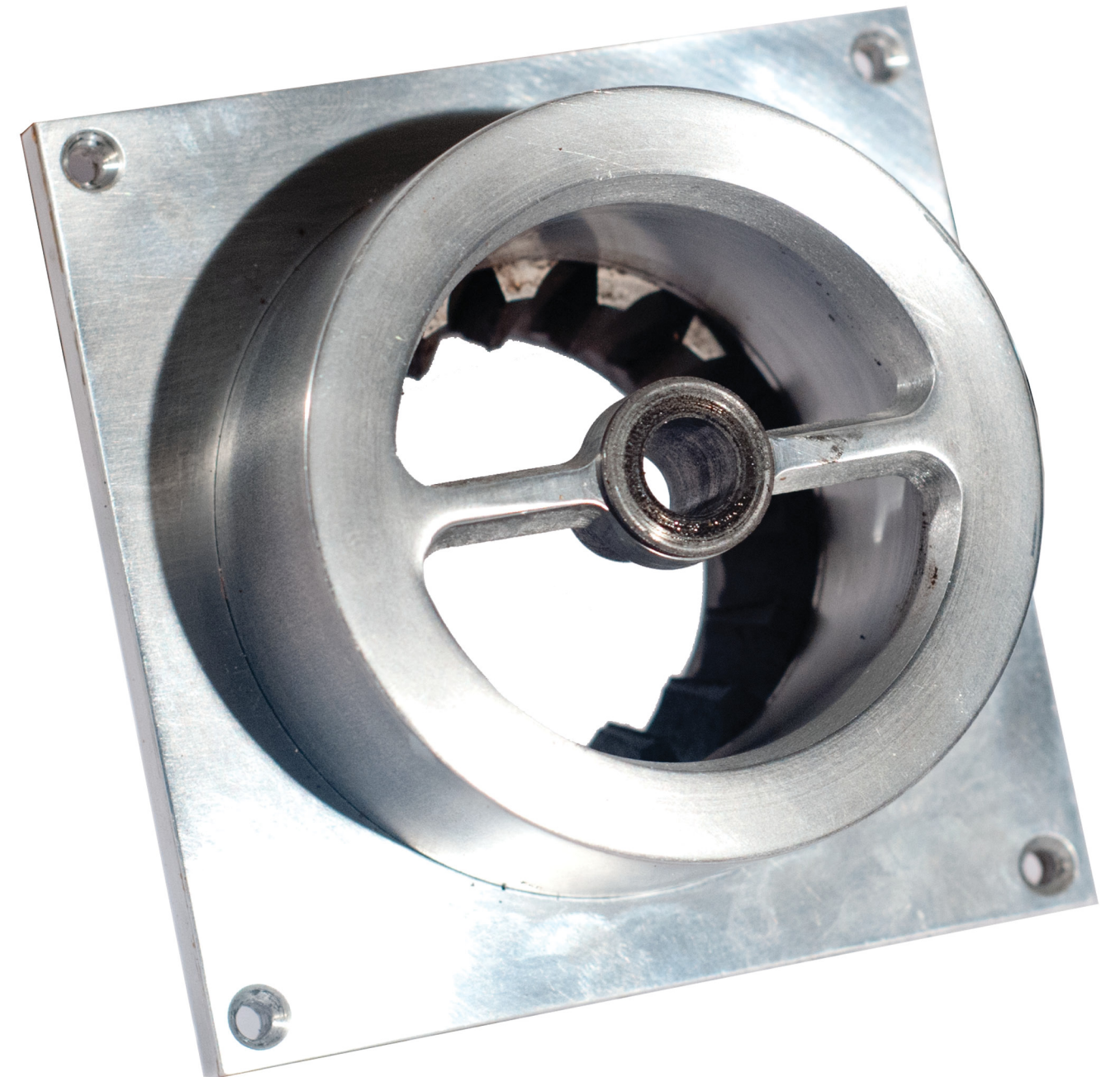




## Top Assembly

Three stainless steel bolts fix the upper burr to the bean loading chamber; a 1/4" thick by 3 - 3/4" square aluminum plate is sandwiched in between. This aluminum plate slides into a mating slot carved out of the mill body. The slot is 3/16" deep, providing for a 1/16" reveal of the plate in elevation, while the 3 - 3/4" square dimension provides for a 1/16" reveal in plan.

The bean loading chamber is machined from a solid piece of 3" aluminum with a tapered edge on the inside diameter. A tapered bridge piece holds the upper oil impregnated brass bushing. The tapered sides of the bridge and chamber allow for the insertion of the 3/16" thick walnut bean chamber caps. The caps can be lifted out by their stainless steel handles, which describe a 1/4" thick circle, 1/4" less in diameter than the interior diameter of the bean loading chamber. The caps keep the beans inside of the chamber while grinding, and are easily removed for loading.



## Adjustment

Where the shaft exits the top assembly through the brass bushing, two jam nuts are locked against each other onto the axle. The lower black oxide jam nut rests against the top of the brass bushing.

Circular slots in the jam nuts accept the stainless steel and walnut adjustment keys. The keys are used to loosen the nuts off of each other, then to tighten them back against each other when the proper burr position is found. Threading the lower jam nut in or out adjusts the position of the lower burr in relation to the upper burr.

The axle and jam nuts are threaded  $3/8 - 16$ .





## Handle

The 6" long stainless steel handle is threaded onto the top of the axle, where it steps down to 3/16 - 16 threads. A 3/8" tall by 3/8" diameter stainless steel cap is threaded on after the handle, maintaining the appearance of a 3/8" shaft diameter in all visible areas of the mill.

A 2" tall walnut knob is attached at the other end of the handle. A flanged brass bushing rests against the underside of the handle and fits into a mating channel in the knob. The inside core of the brass bushing is threaded and accommodates a black oxide bolt inserted through the top of the walnut knob. Thread locker keeps the bolt and bushing joined, forcing the knob and handle to rotate around each other at the bushing - handle intersection, allowing for smooth and consistent motion.



## Portafilter

The portafilter body is machined from a solid 3" piece of stainless steel. The inside surface is bored smooth to 2 - 1/8". A 1/16" deep groove is then milled to house a wire spring. The spring holds the stock La Pavoni filter basket securely in place, allowing for maximum heat transfer and easy puck\* removal.

Stainless steel was chosen for, among other reasons, its superior heat retention properties. The portafilter body is designed to maintain as much thickness of material as possible to maximize heat retention. The thickest sections have a 2 - 9/16" outside diameter and are almost 1/4" thick.

A 1/16" deep socket is created in the lower section of the outside of the portafilter body to hide the intersection of the stainless steel body-to-handle connection piece. This connection is further hidden by securing the piece to the portafilter body prior to final boring and polishing of the inside surface of the portafilter body. This machines the connection piece to the exact inside diameter and curvature of the body and produces an almost invisible connection. It also creates a small burr between the pieces, making it unlikely to ever come loose.

The handle is turned from salvaged walnut, its end slightly flared to fit better in the hand of the user. A brass bushing secured inside the handle allows the final connection to the threaded end of the body-to-handle connection piece. Its threads are 3/8 -16.

\* a puck is the dry disk of spent coffee grounds left in the basket after a shot is pulled





## Preparing a Shot

With one or both bean chamber caps removed, insert appropriate amount of coffee beans into the bean loading chamber. Replace caps. In a seated position, hold the mill between your knees and rotate the handle in a clockwise motion until all of the beans are ground. Tap the side of the mill to ensure that all of the beans have fallen. Rotate the handle again, then tap again, to coax all of the grounds down into the drawer.

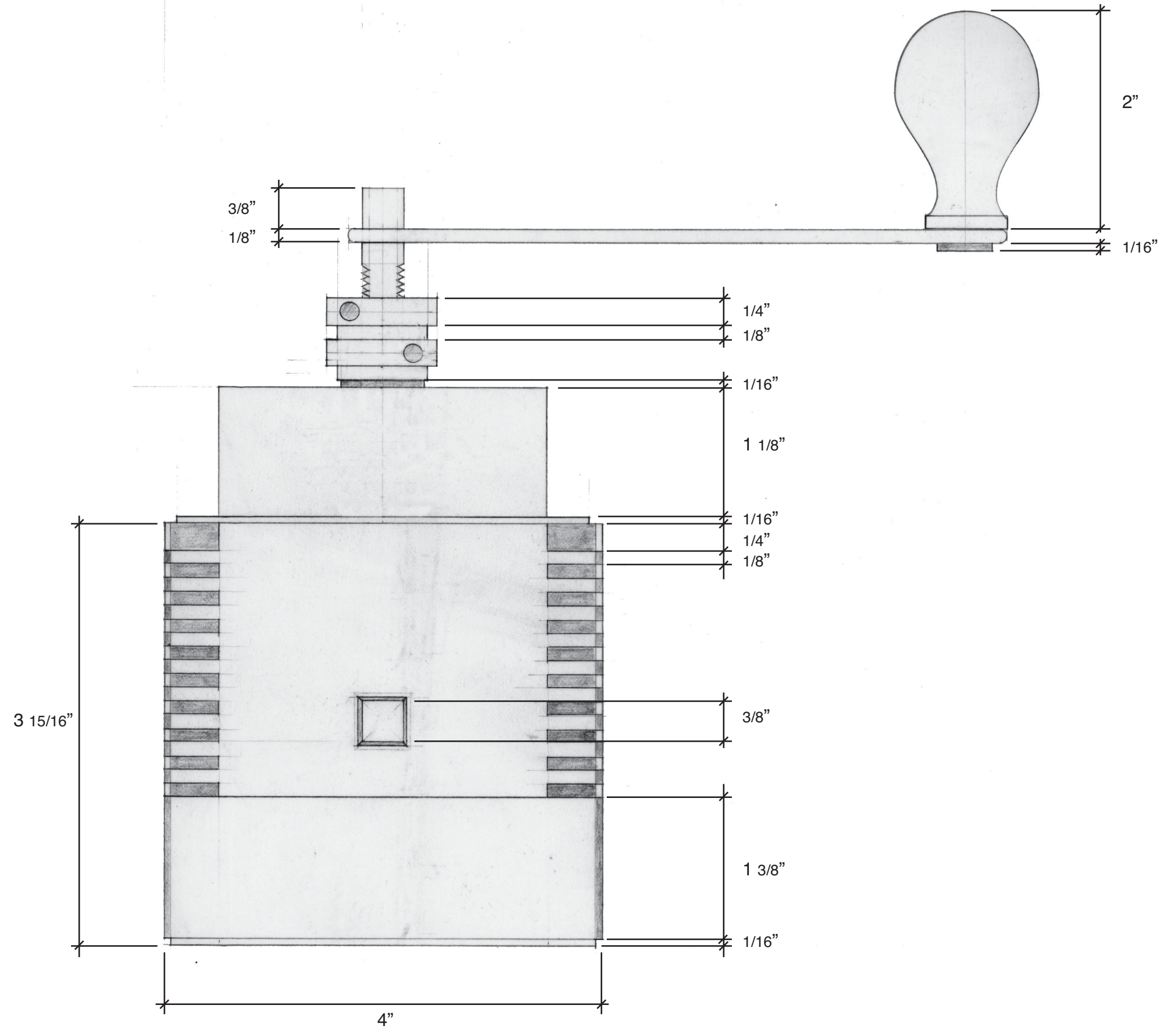
Remove the drawer. Place the aluminum funnel into the portafilter basket and direct the grounds from the drawer into the basket. Level the grounds in the basket then tamp with 30 pounds of pressure to prepare the shot. Brush off any errant grounds from the top of the portafilter then insert into the espresso machine.



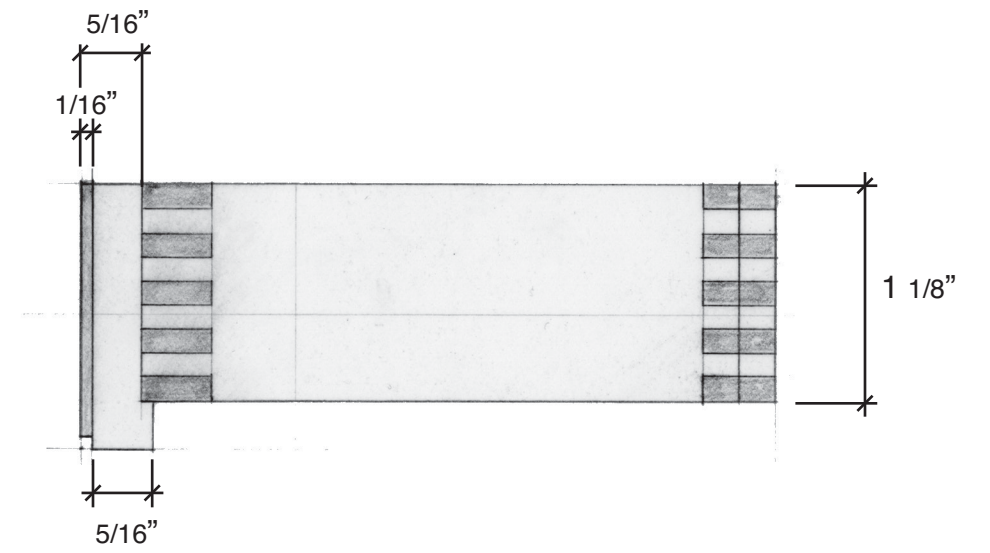
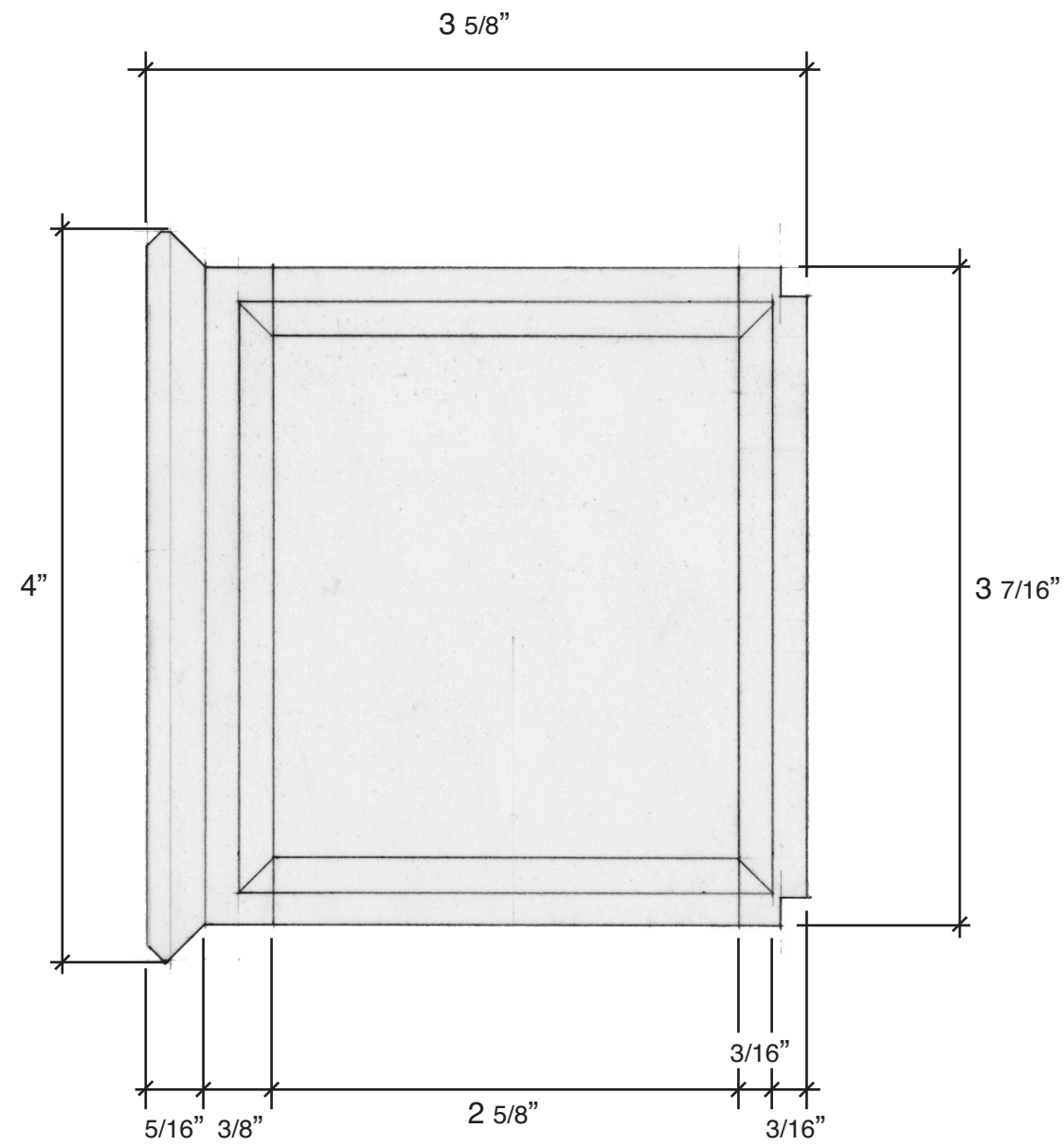


## Measured Drawings

Coffee Mill - Front Elevation View

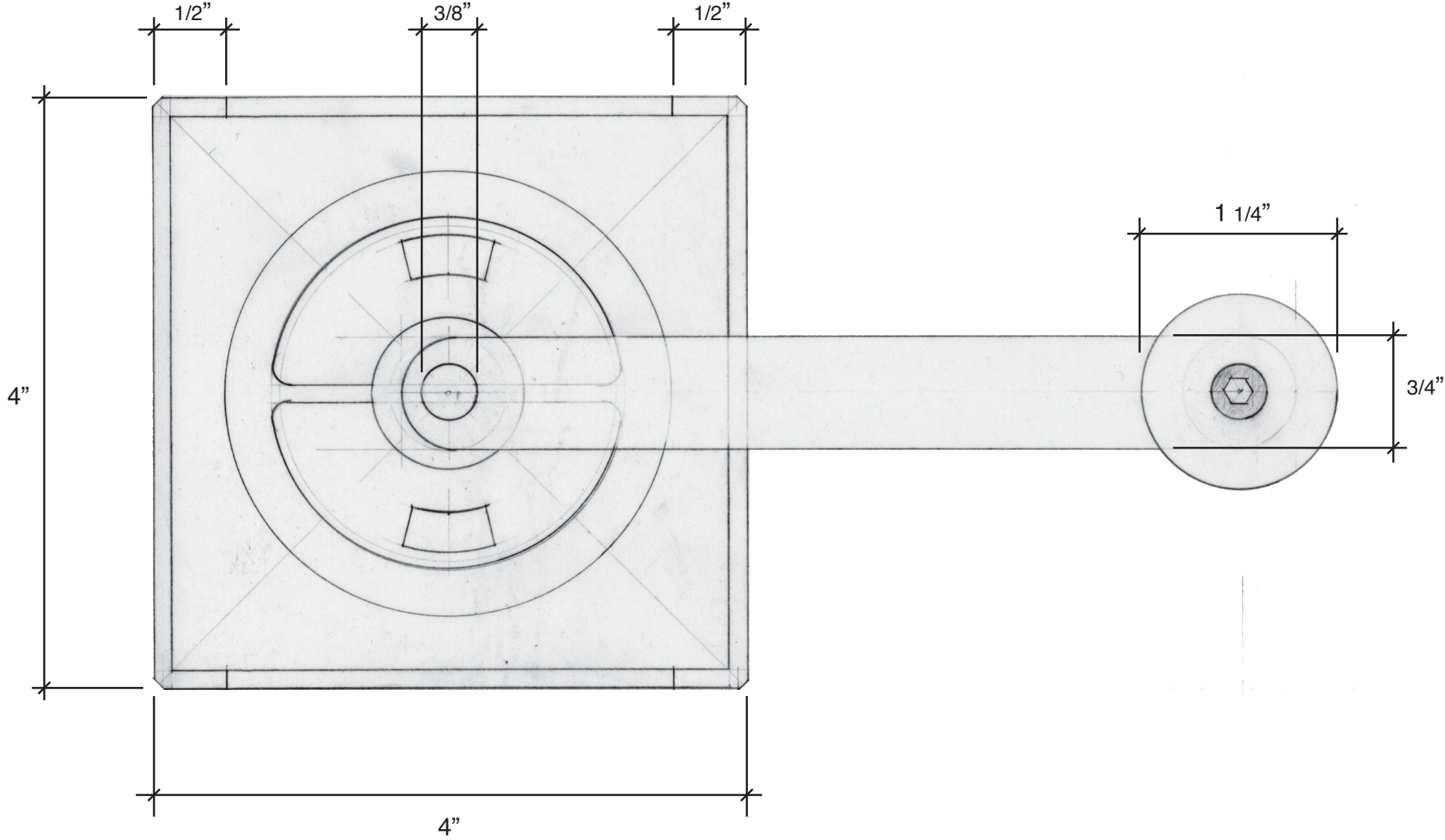


# Drawer - Plan & Side Elevation Views

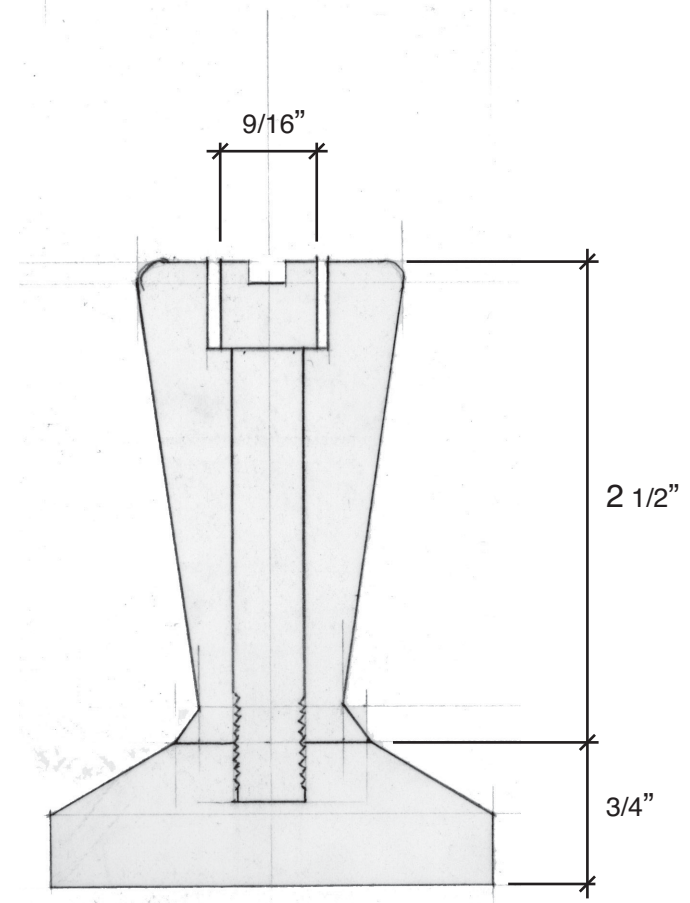
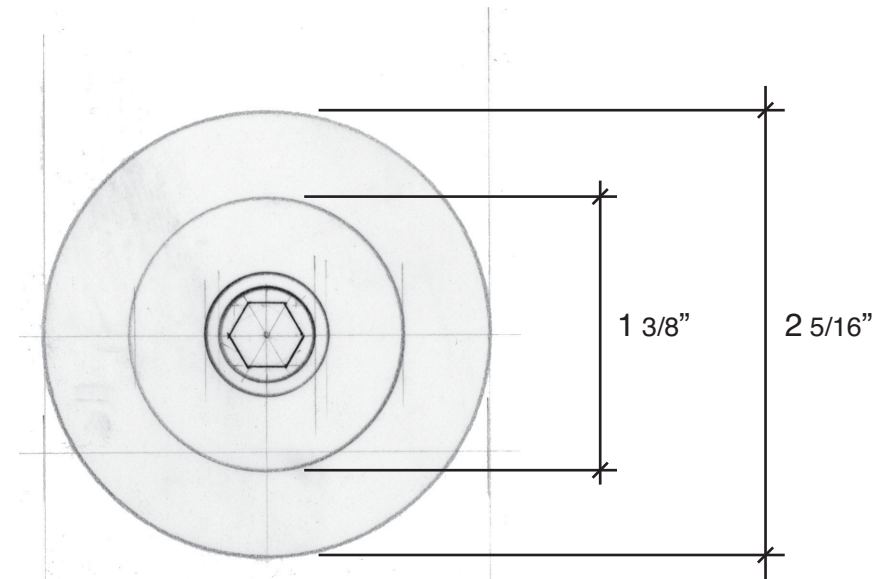
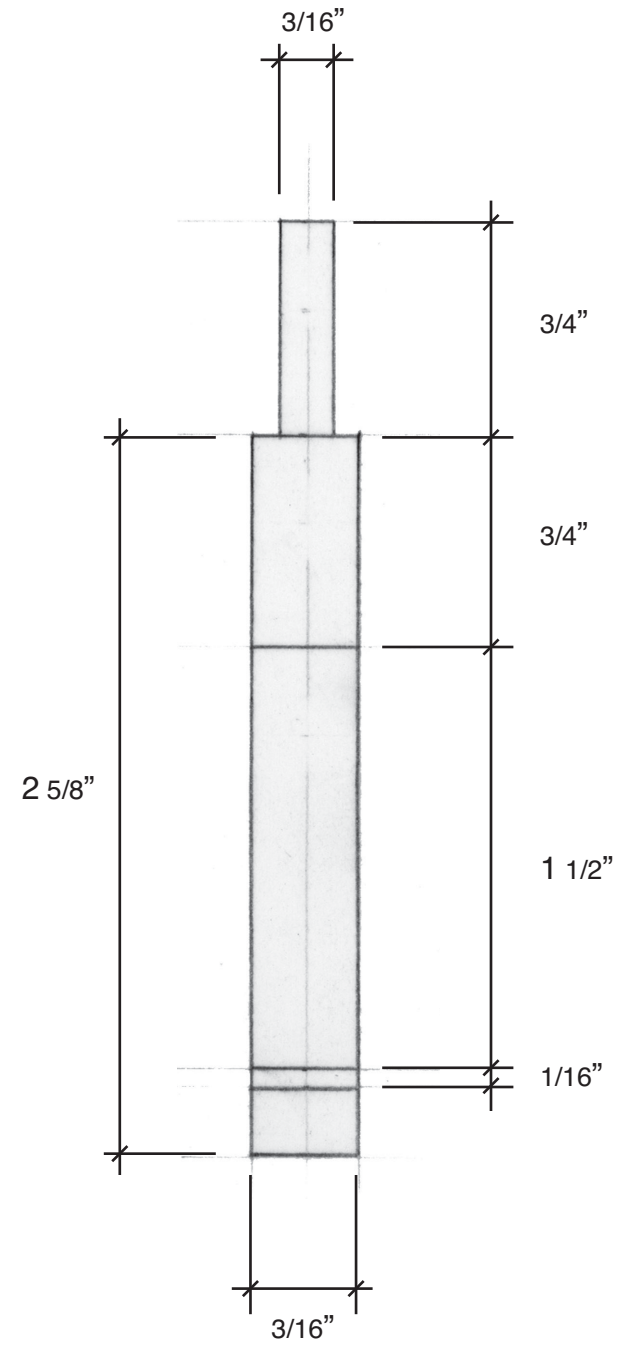




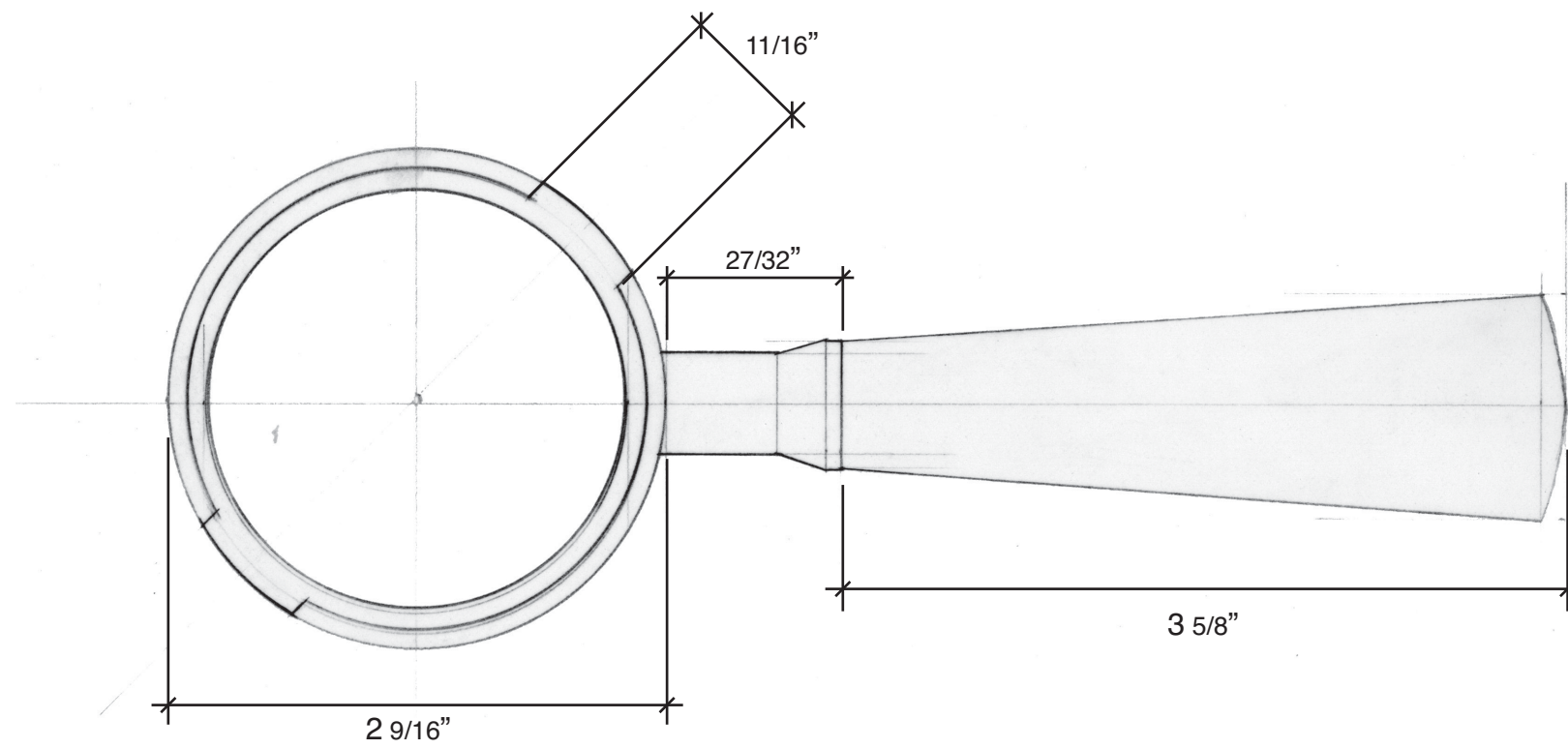
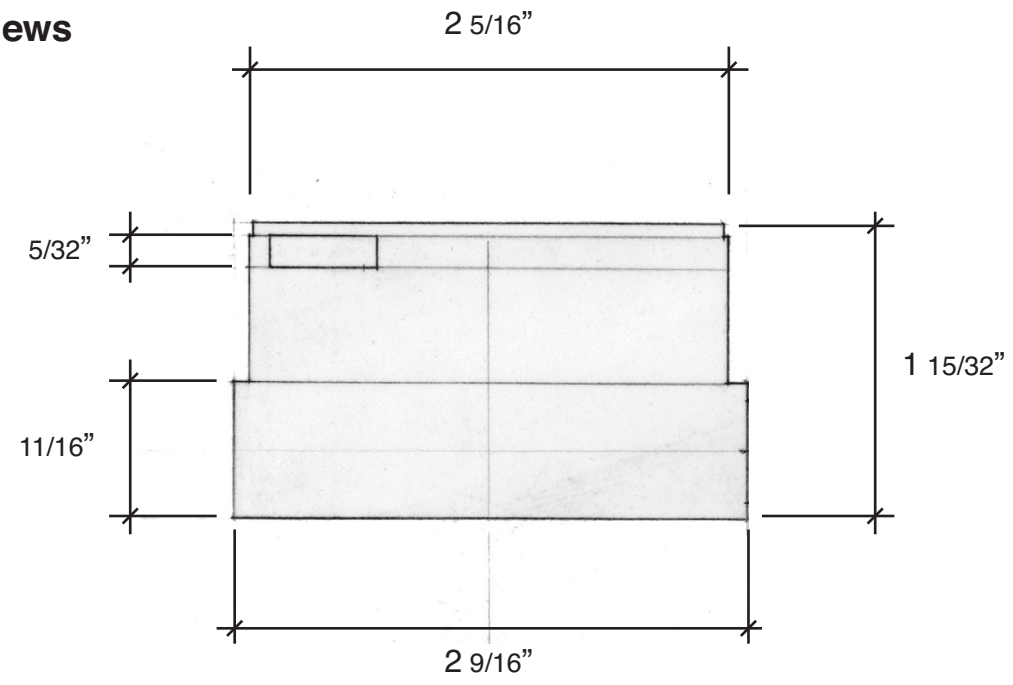
Coffee Mill - Plan View



# Adjustment Key & Tamper



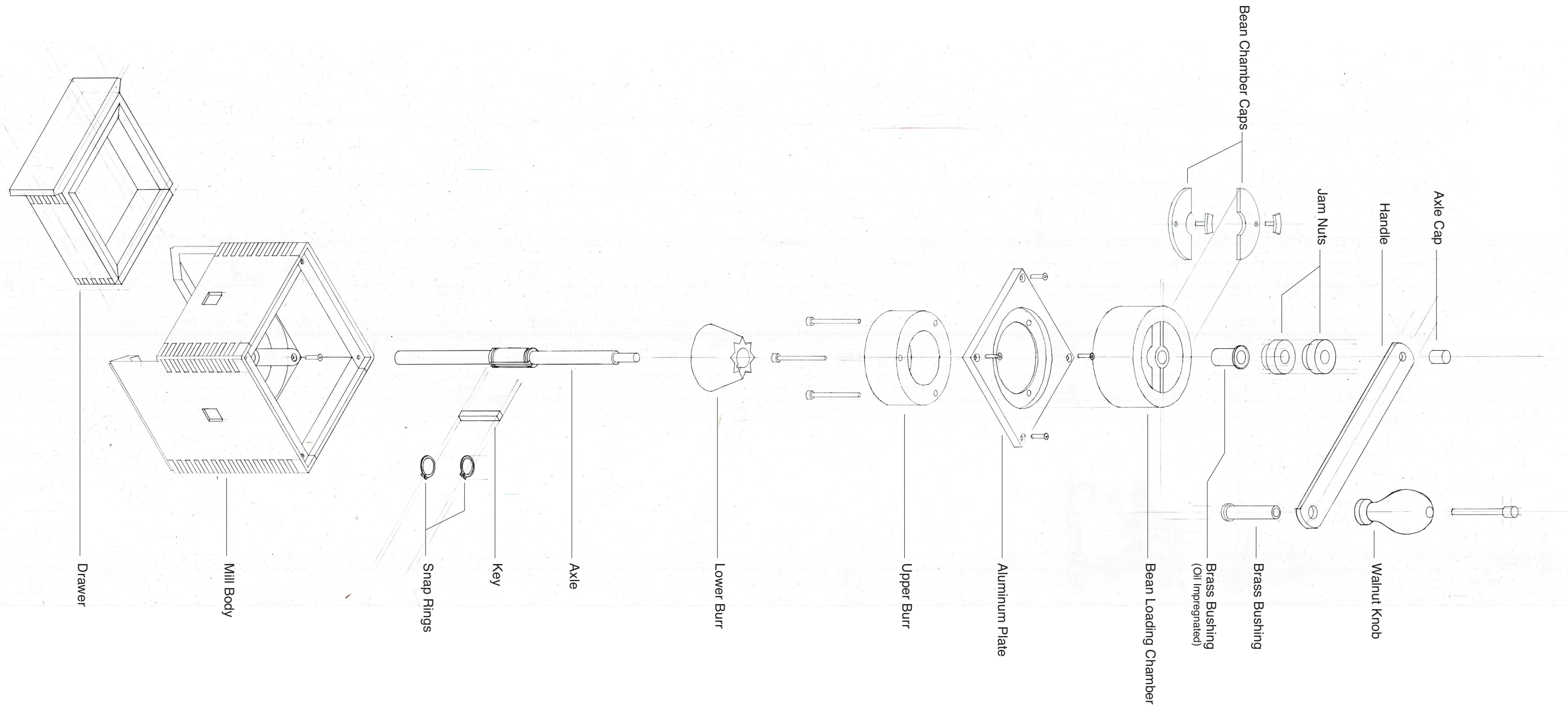
Portafilter - Front Elevation & Plan Views



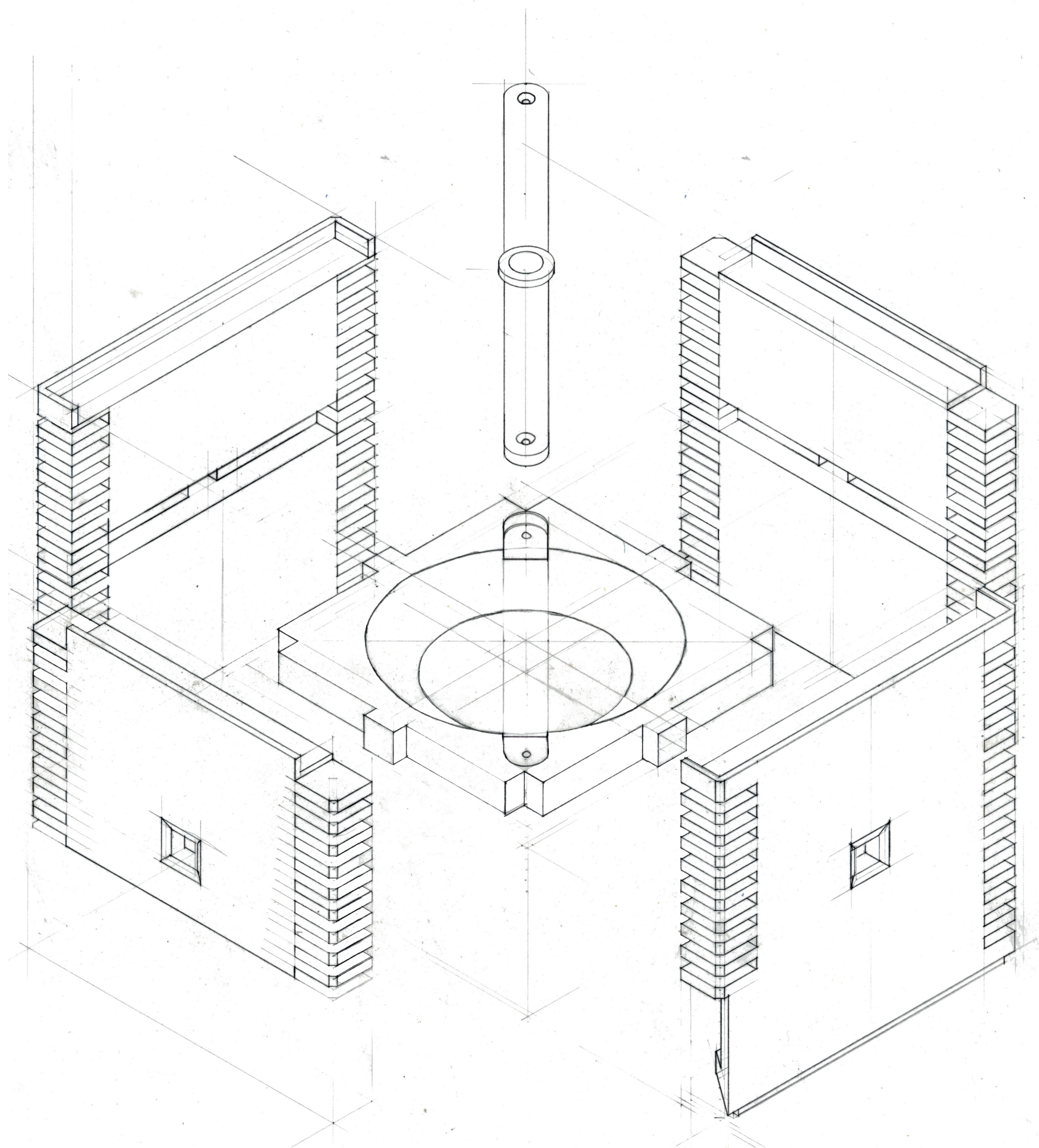
## Exploded Diagrams



# Mill & Grinding Mechanism



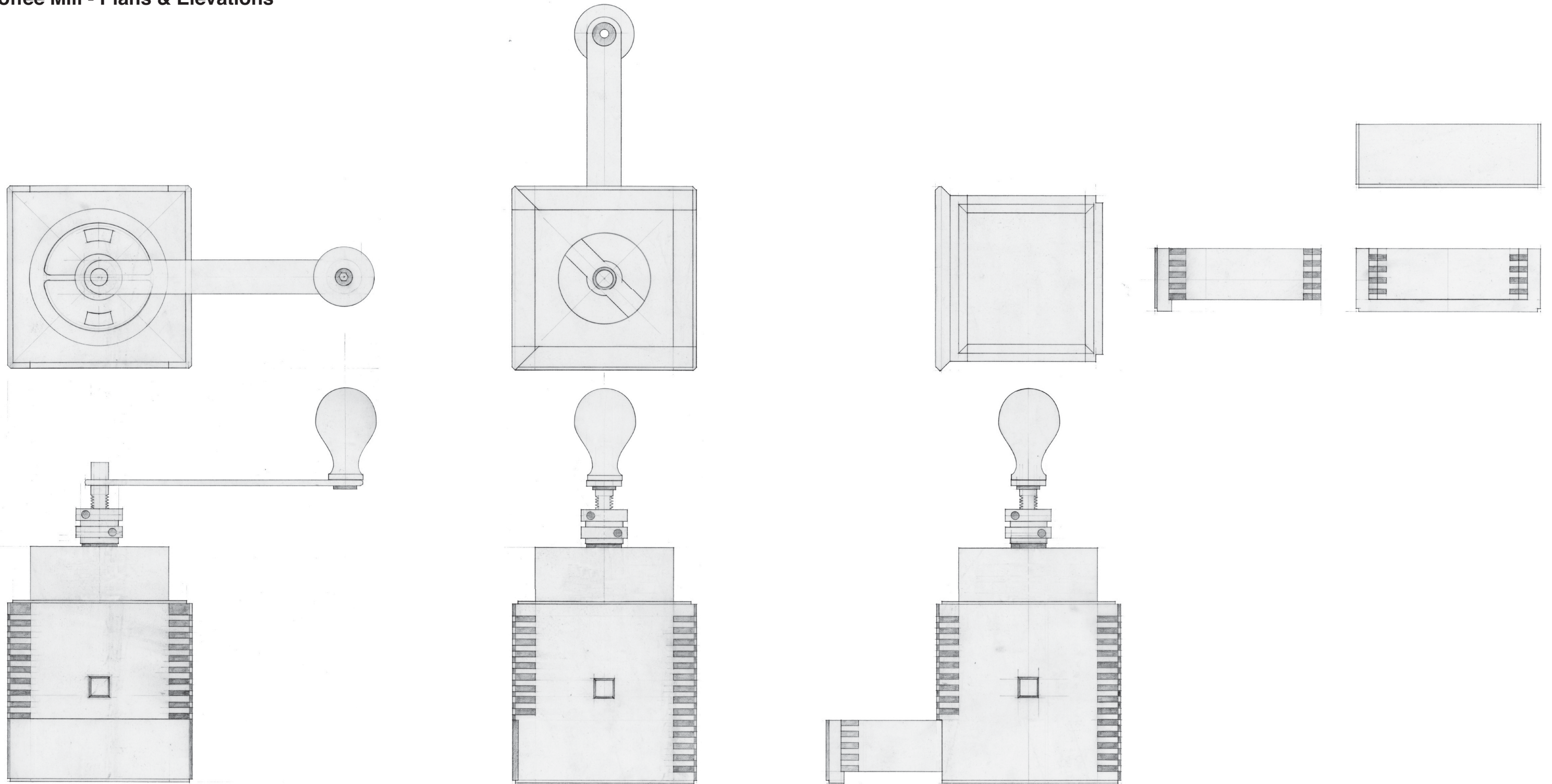
Mill Body & Interior Funnel



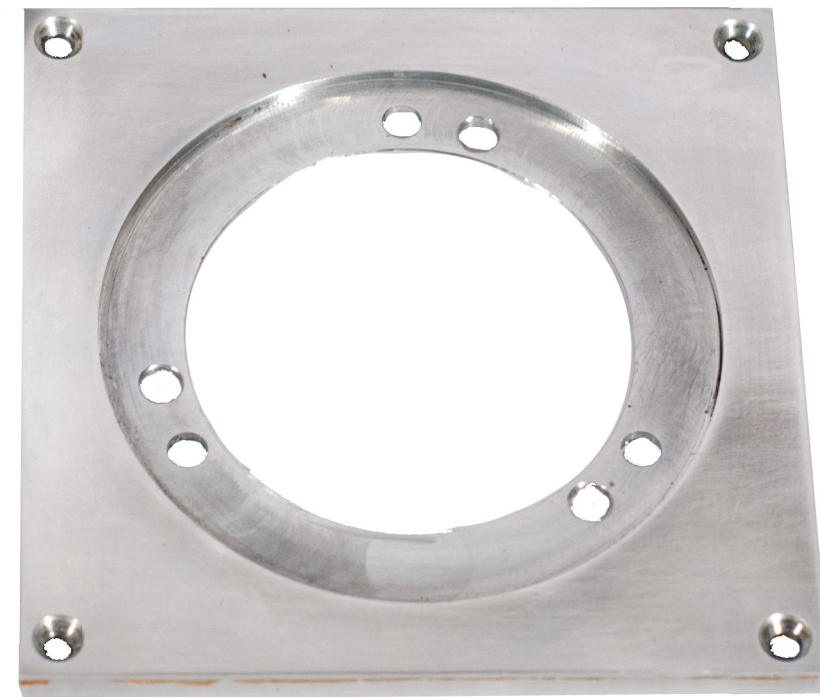
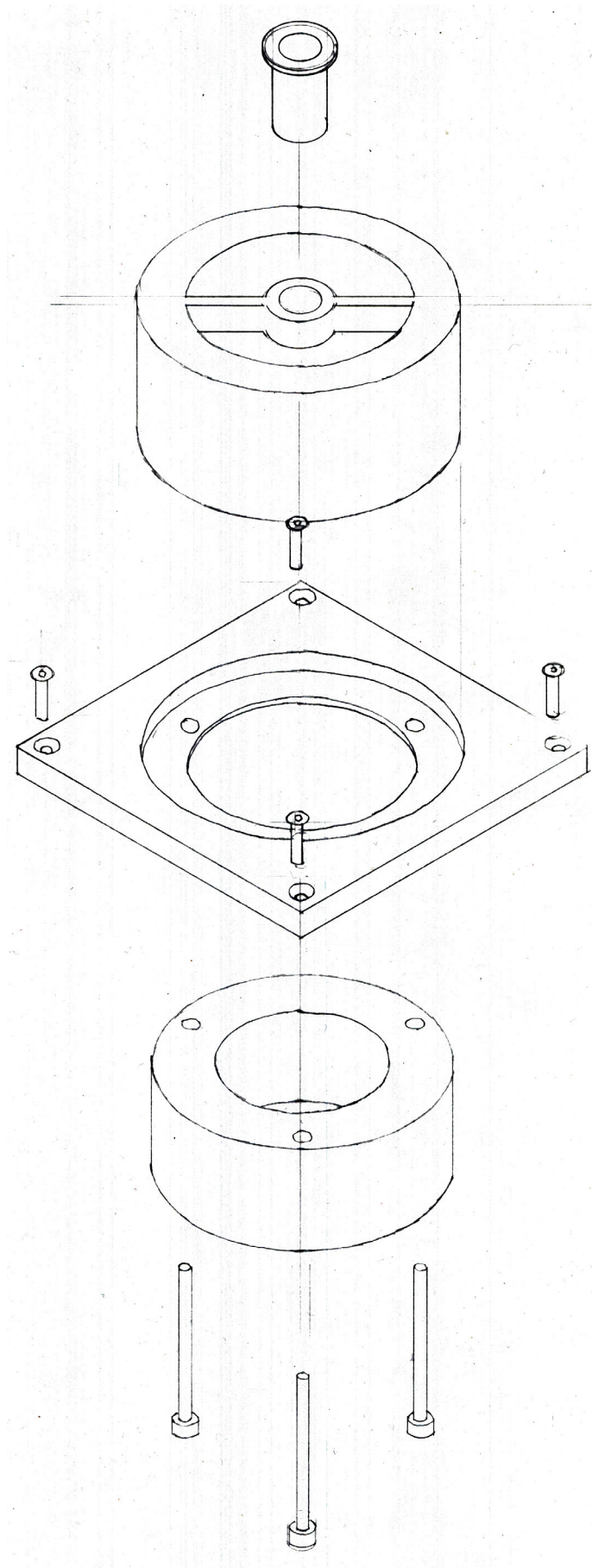
**Drawings - Coffee Mill**



# Coffee Mill - Plans & Elevations

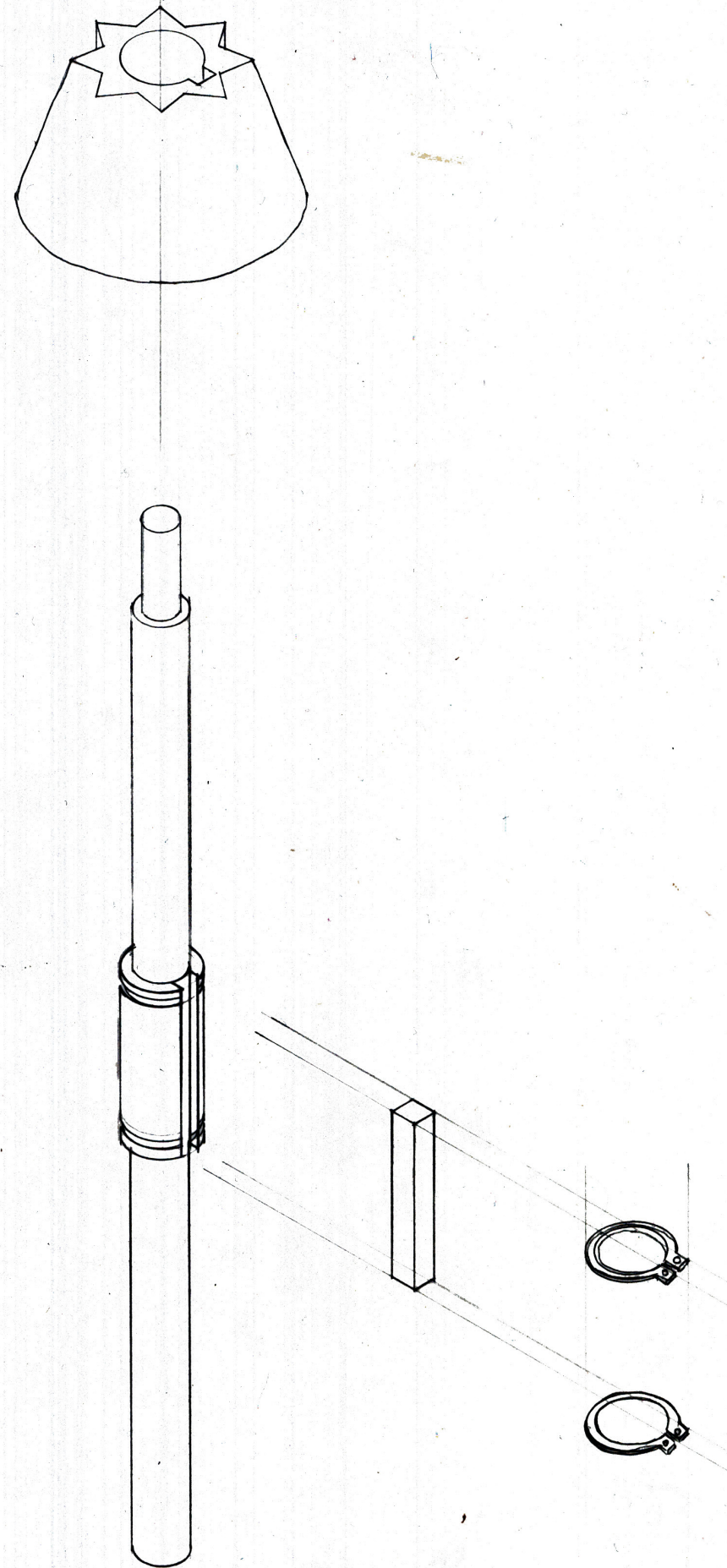


Upper Assembly





Lower Burr & Axle Assembly

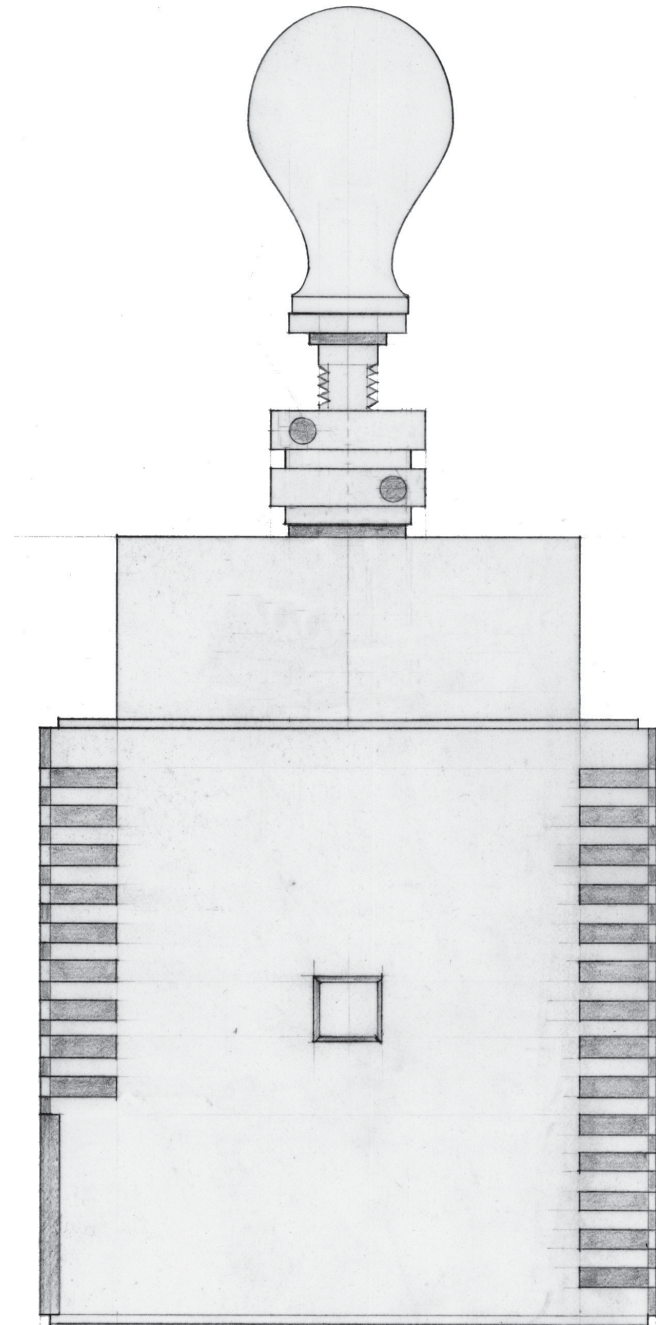


Coffee Mill - Front Elevation View

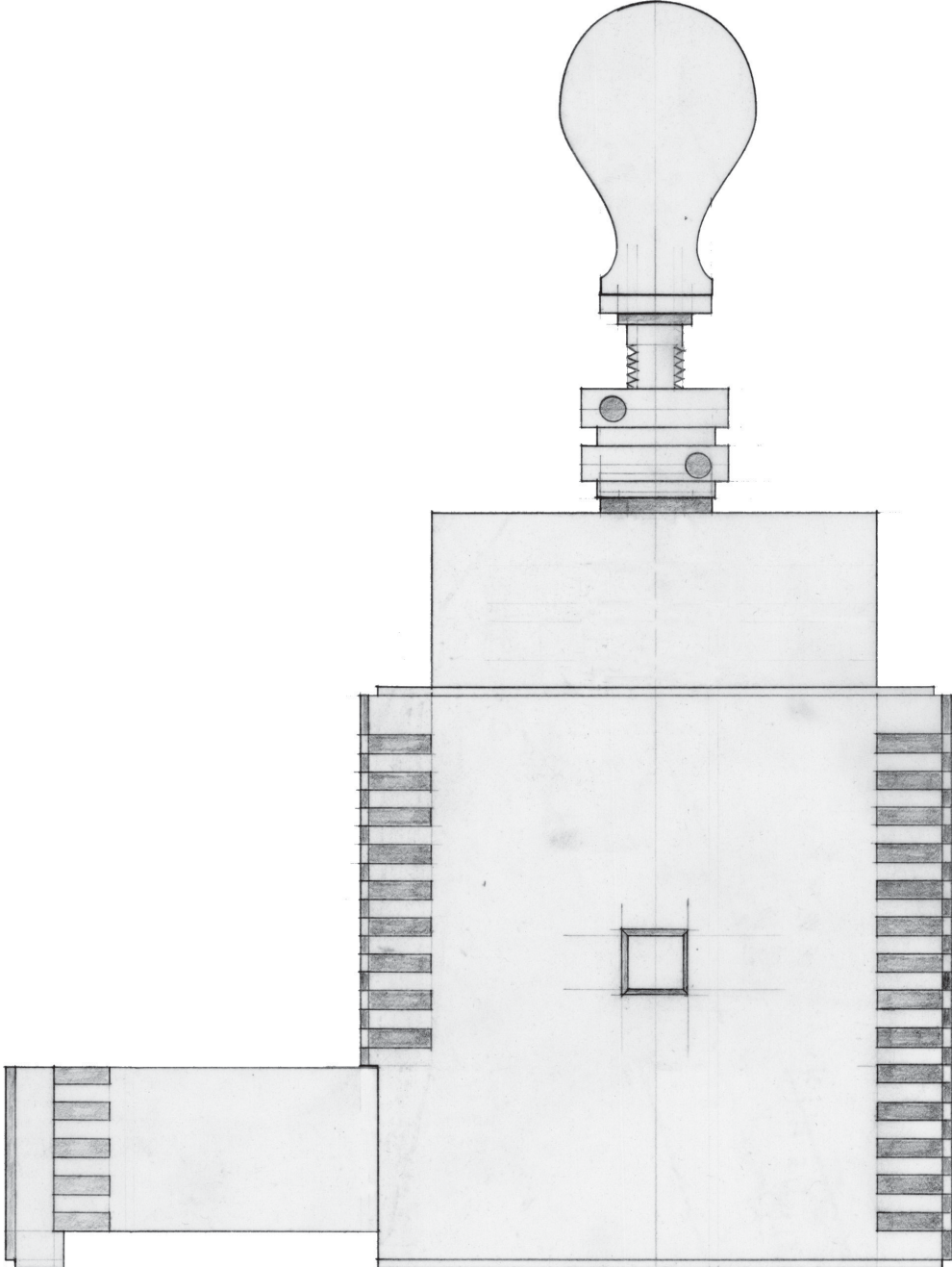




Coffee Mill - Side Elevation View

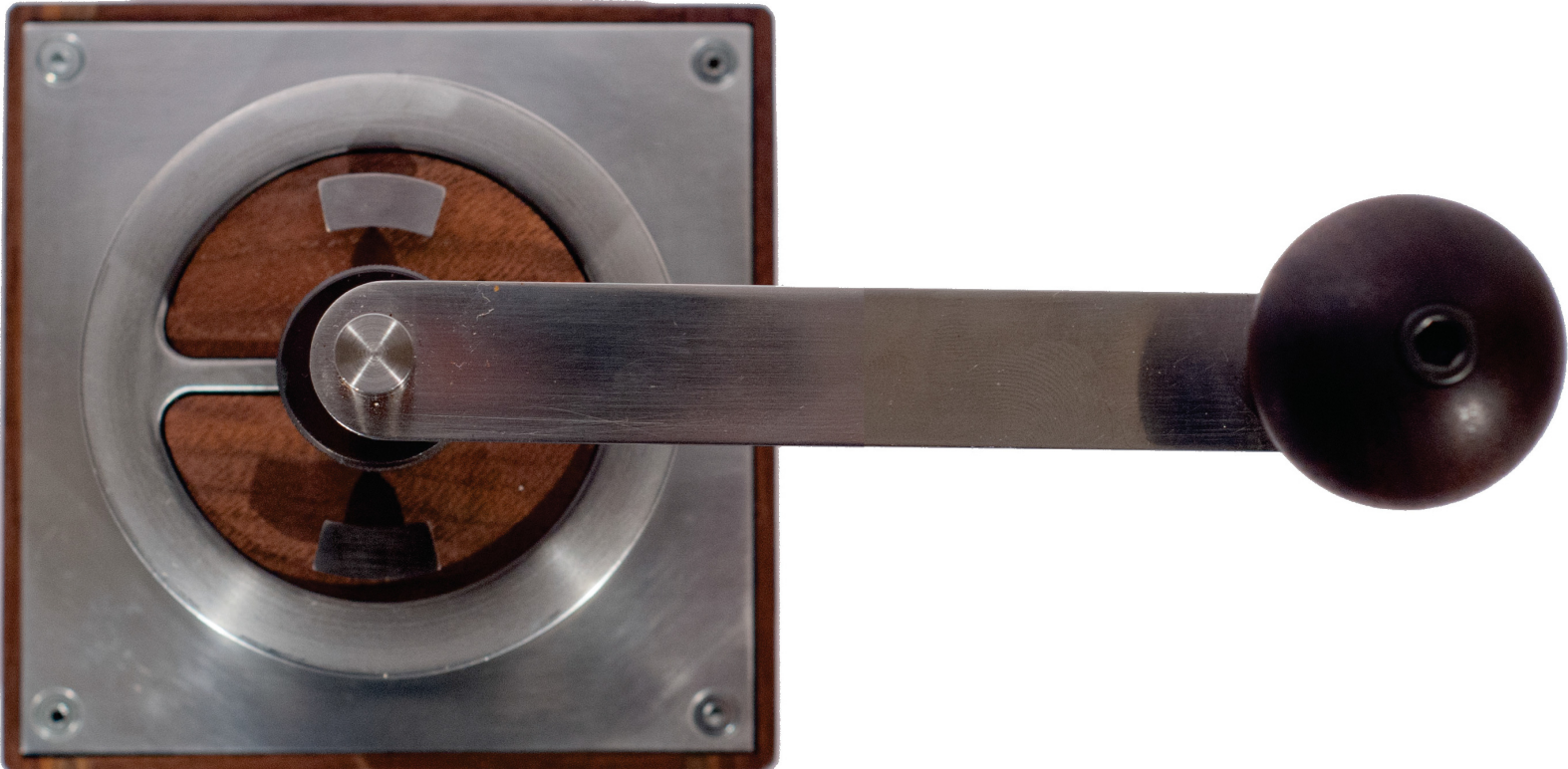
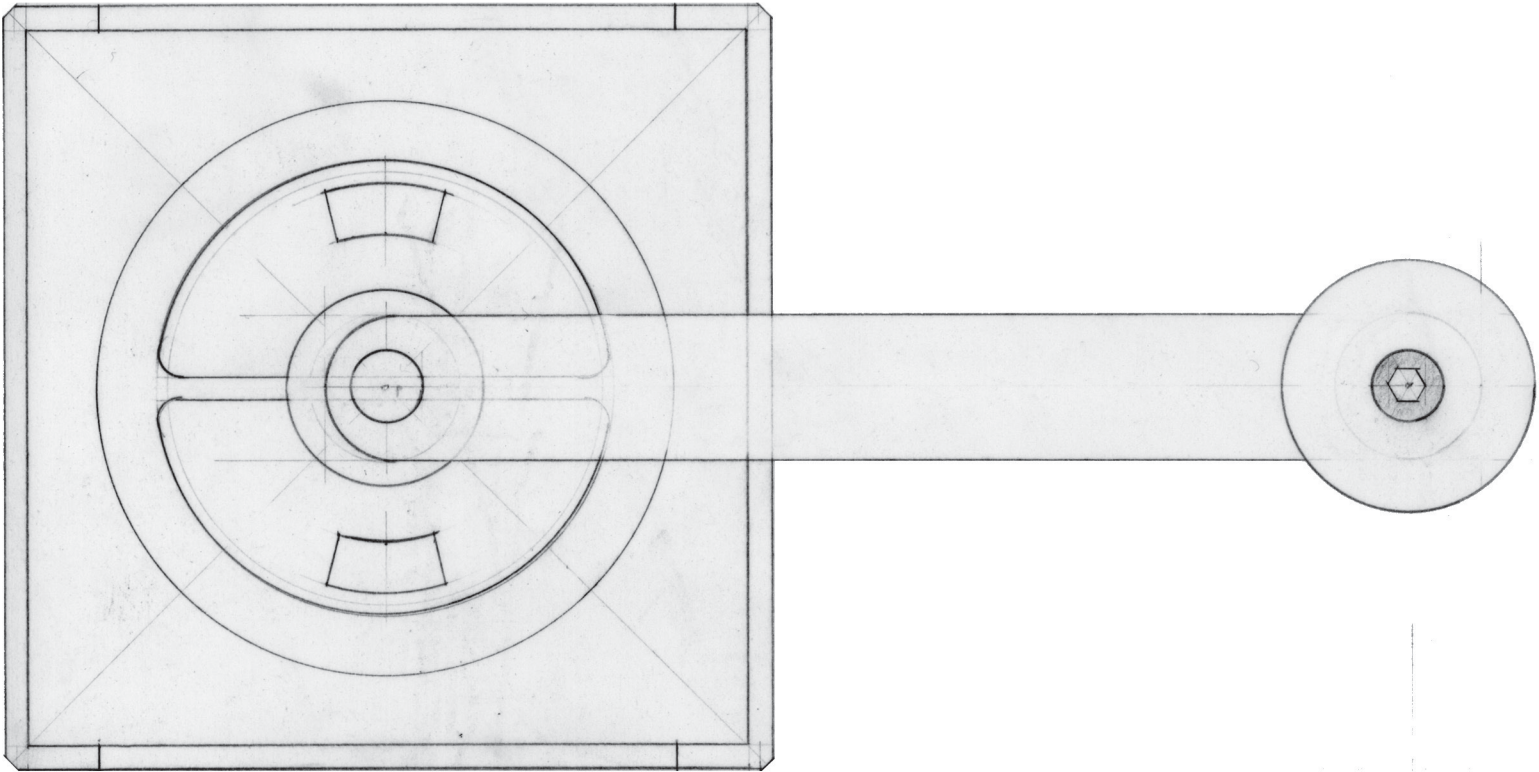


Coffee Mill - Side Elevation View w/ Drawer



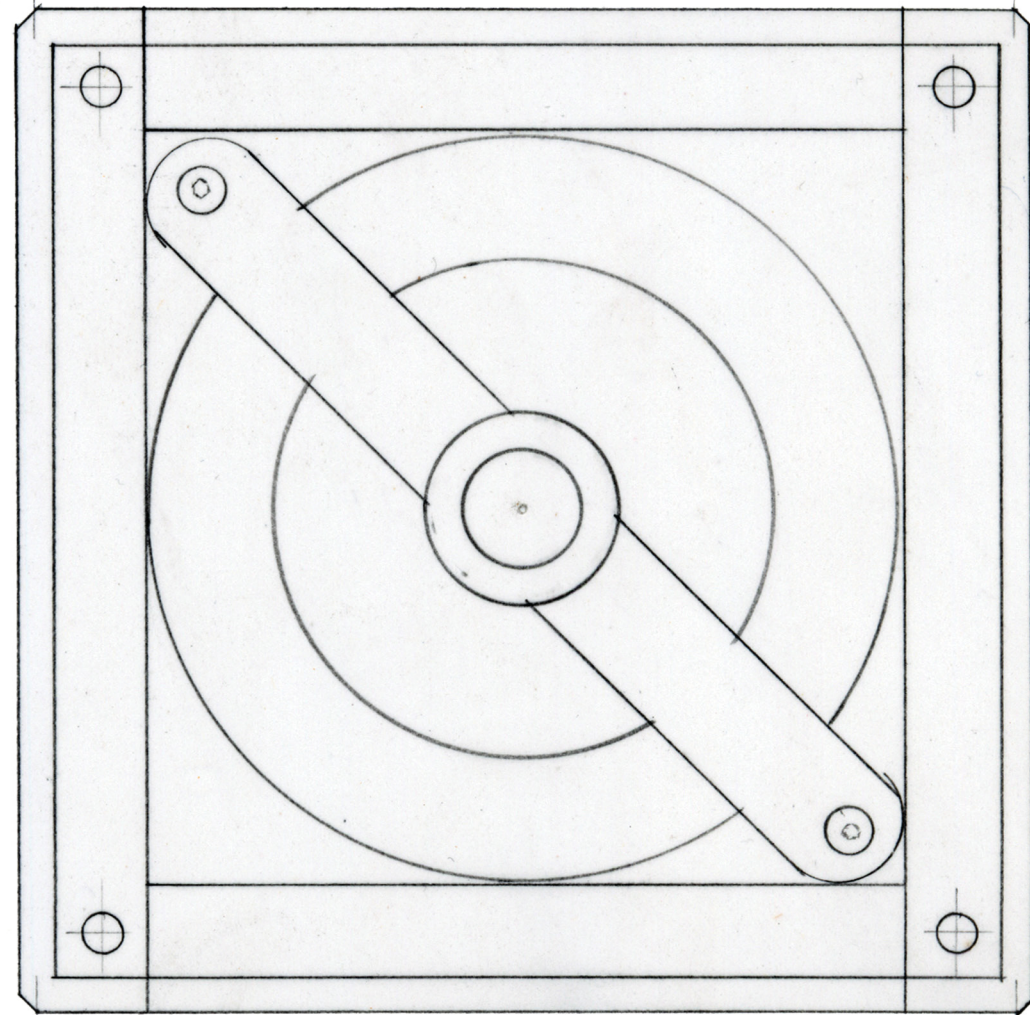


Coffee Mill - Top Plan View



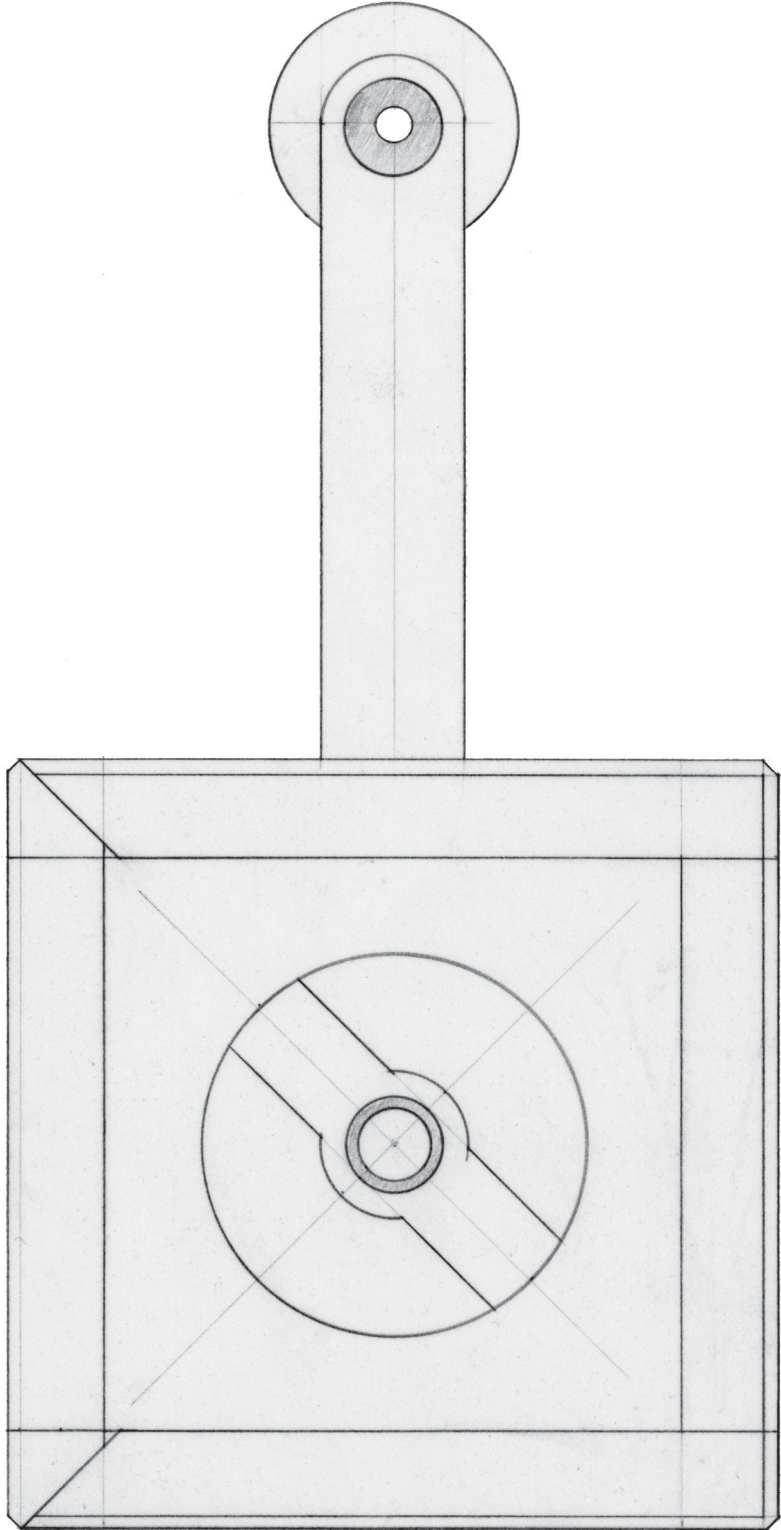


Coffee Mill - Top Plan View w/ Grinding Assembly Removed



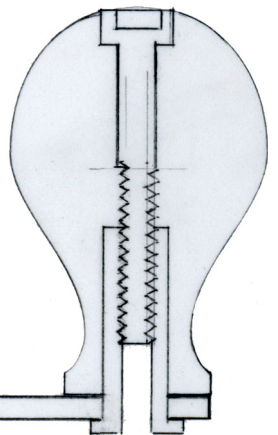
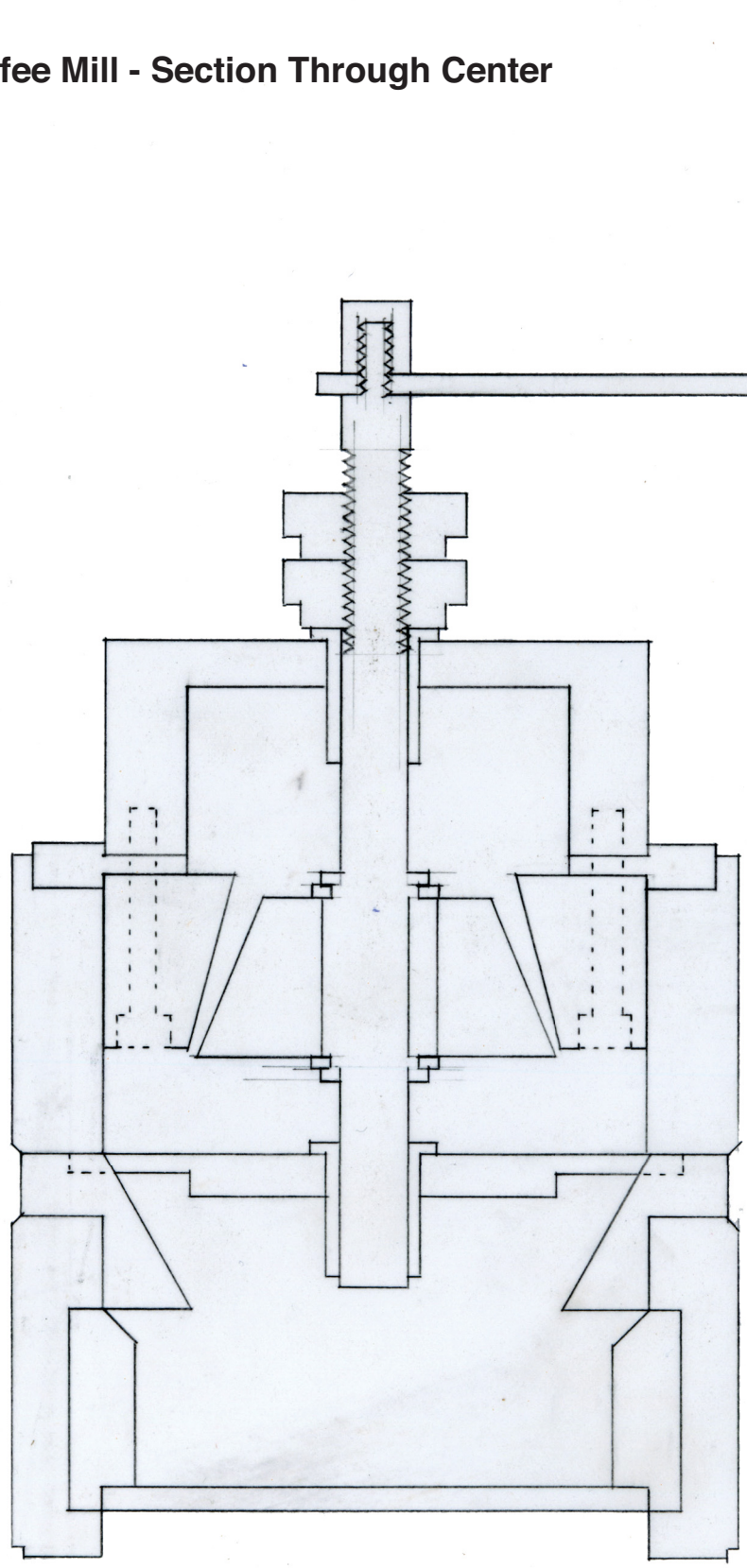


Coffee Mill - Underside Plan View w/ Drawer Removed



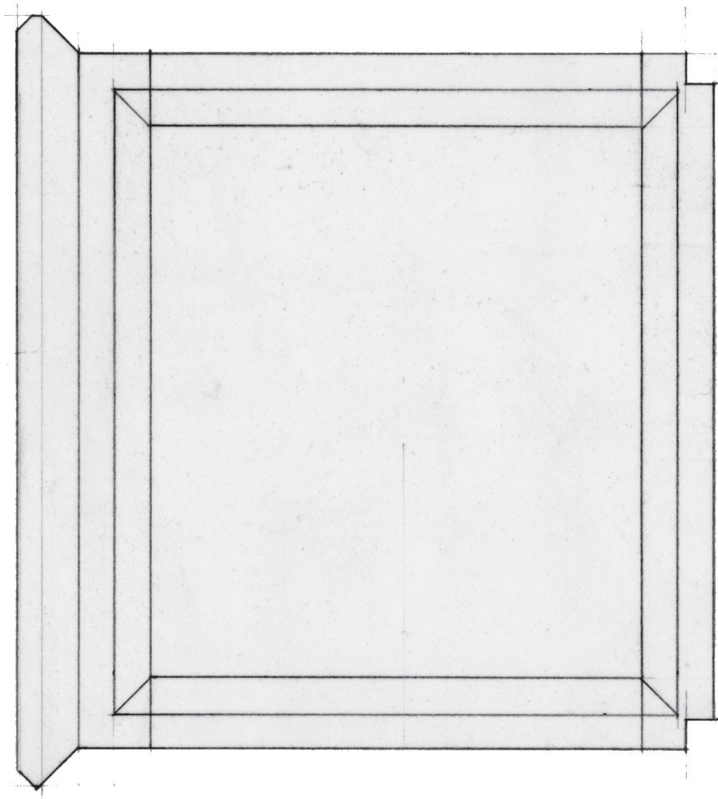


Coffee Mill - Section Through Center





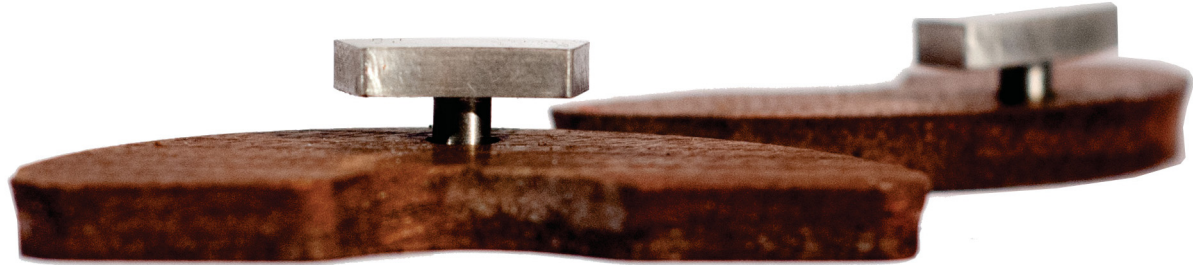
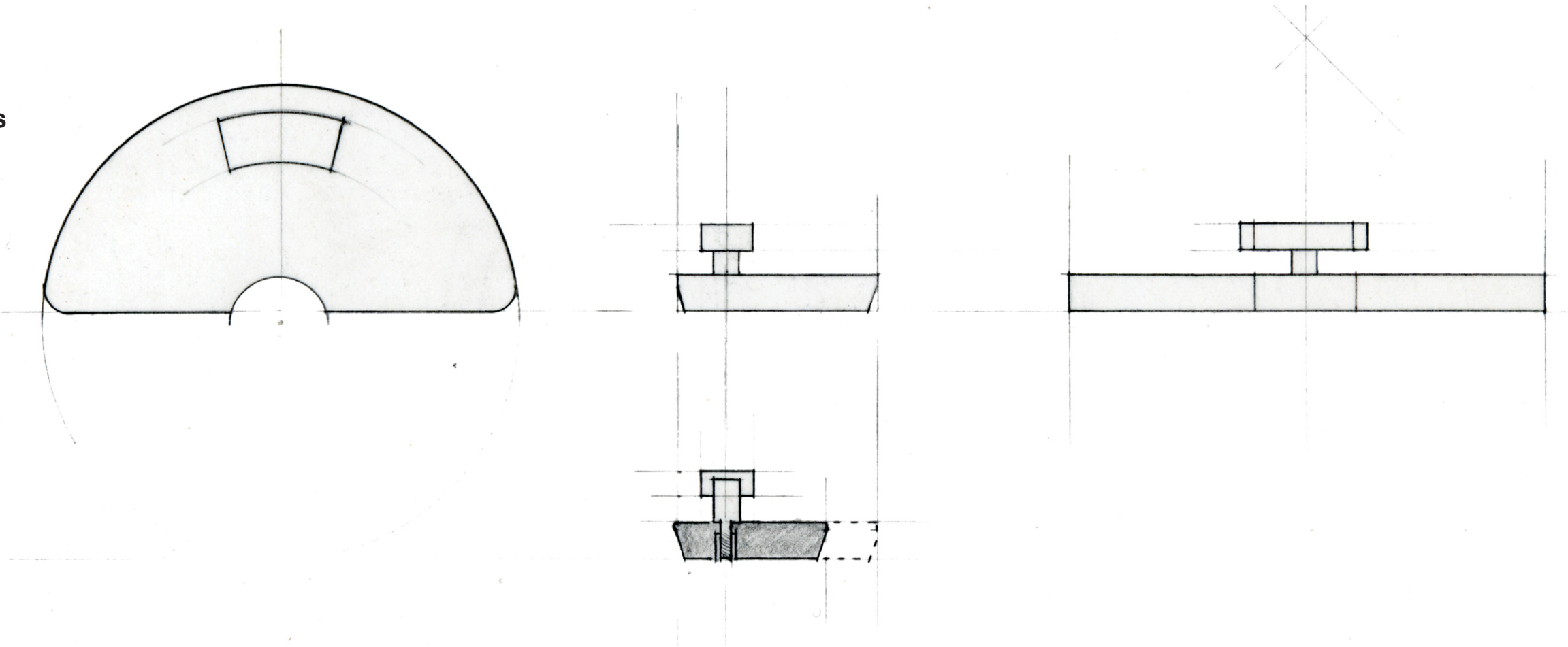
**Drawer - Plan View**



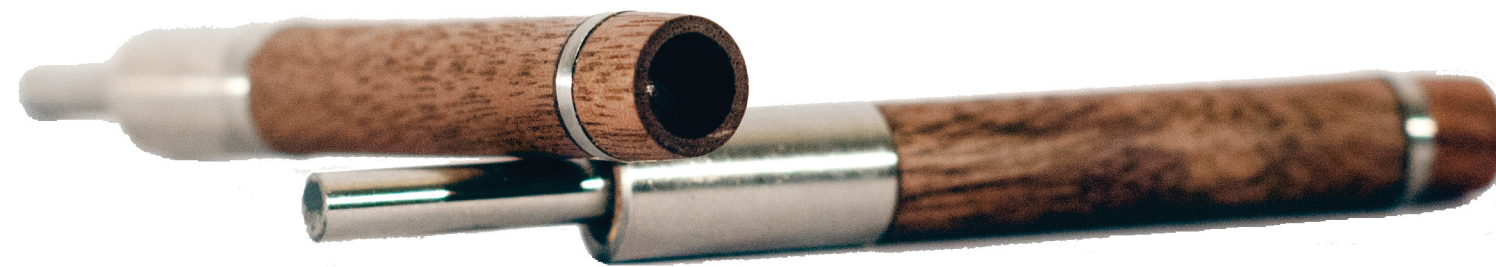
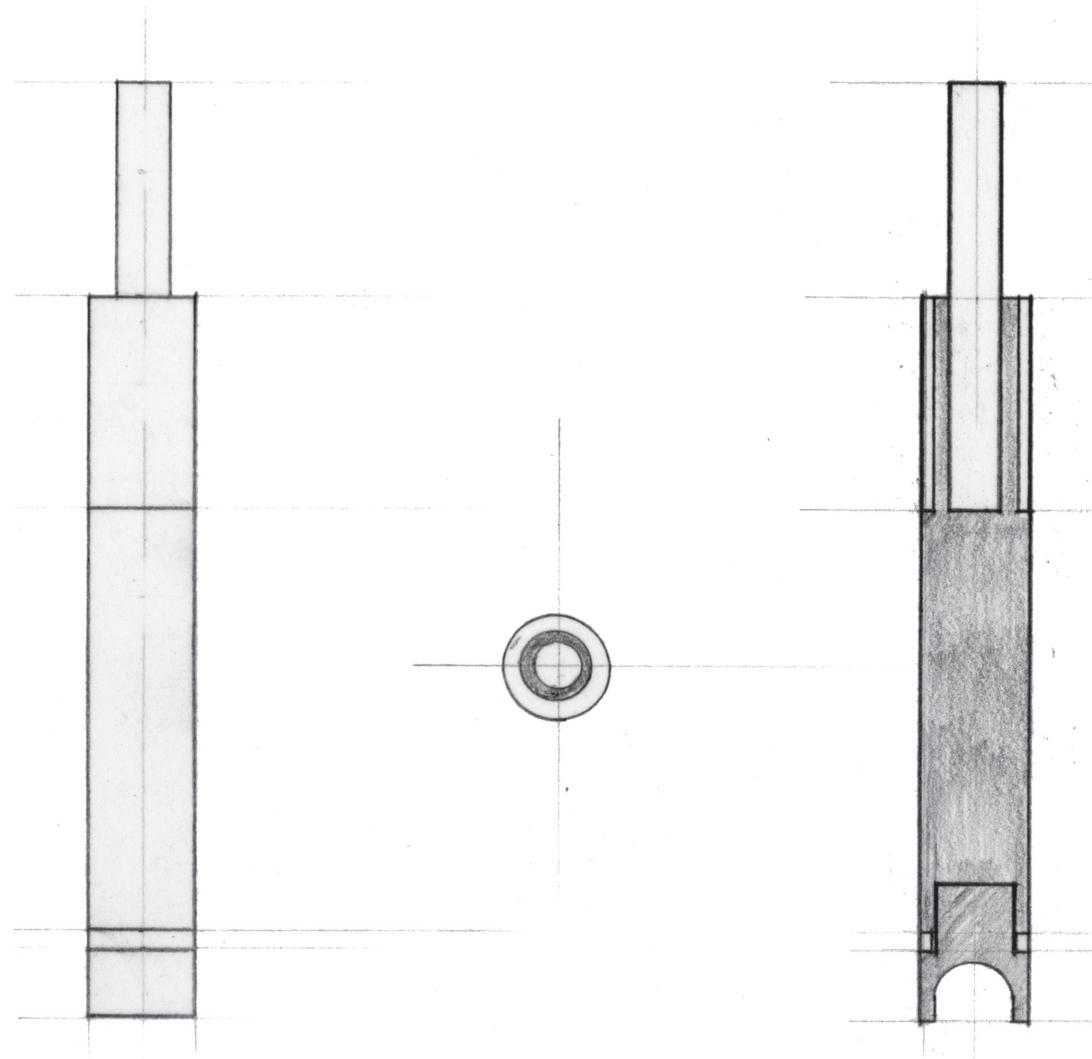
## **Drawings - Accessories**



Bean Chamber Caps

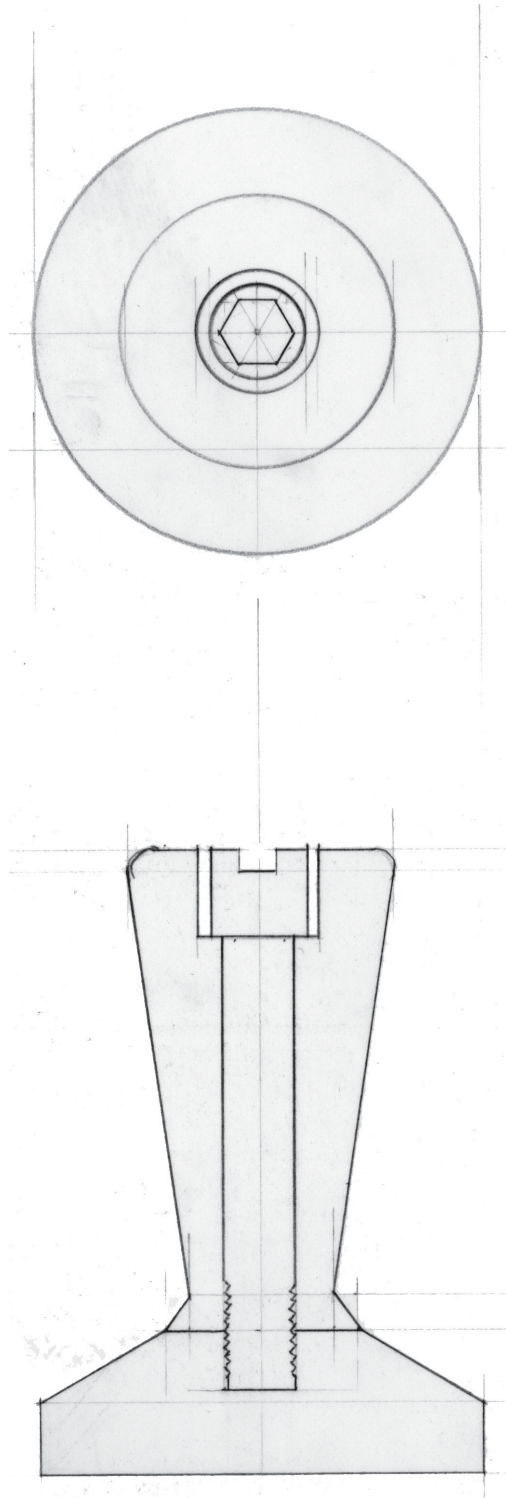


Adjustment Keys

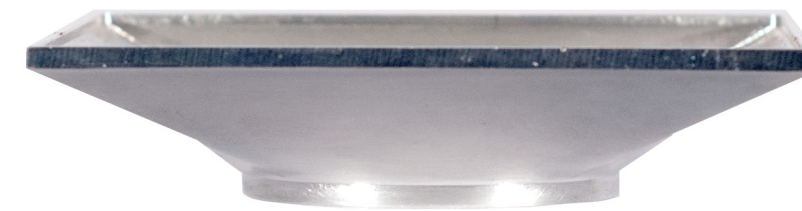
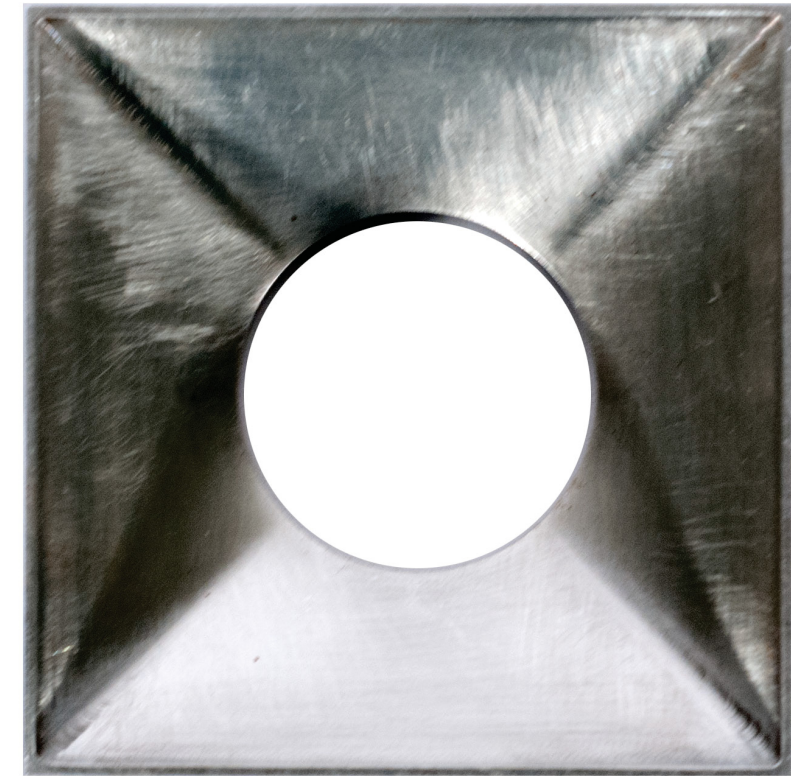
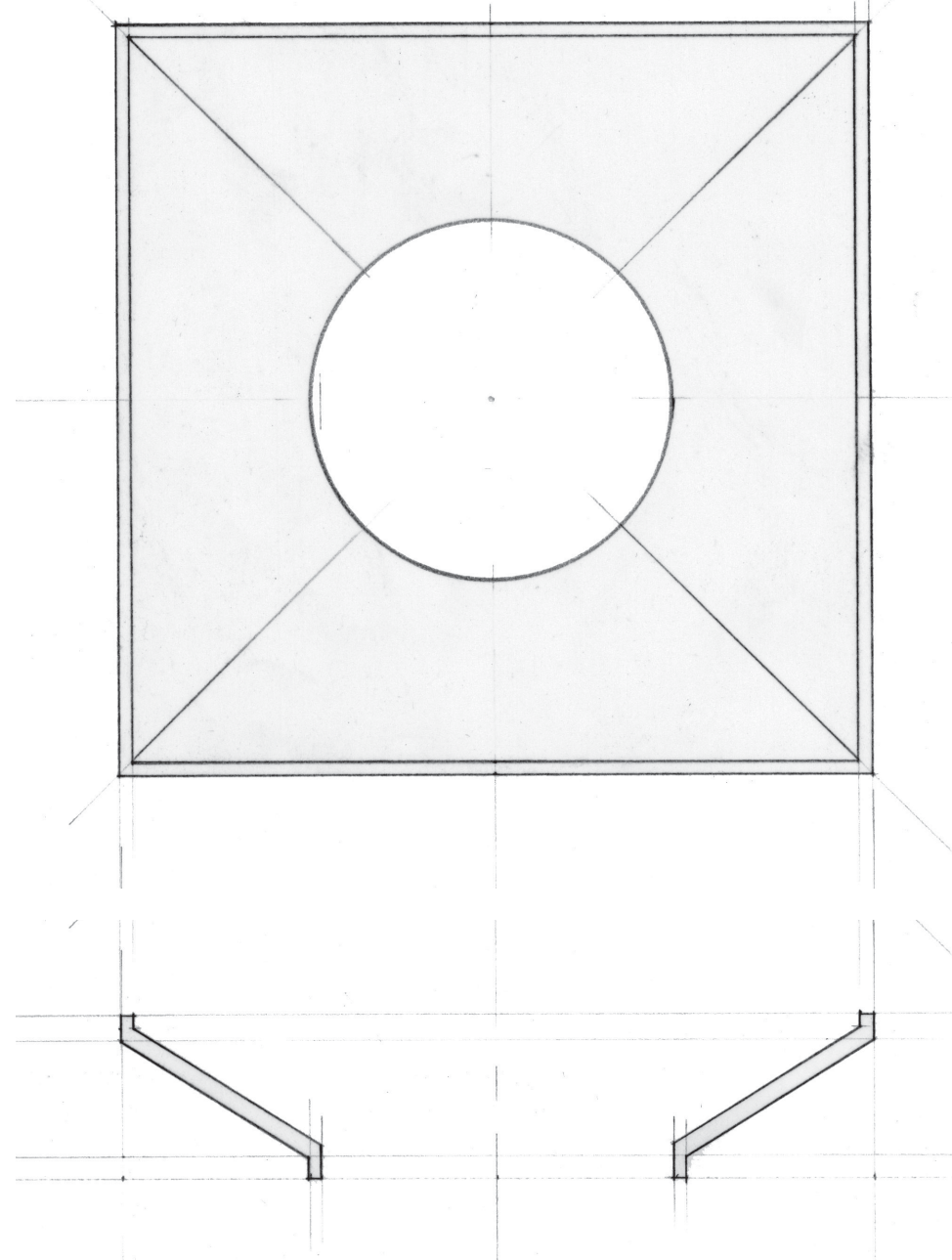




Tamper



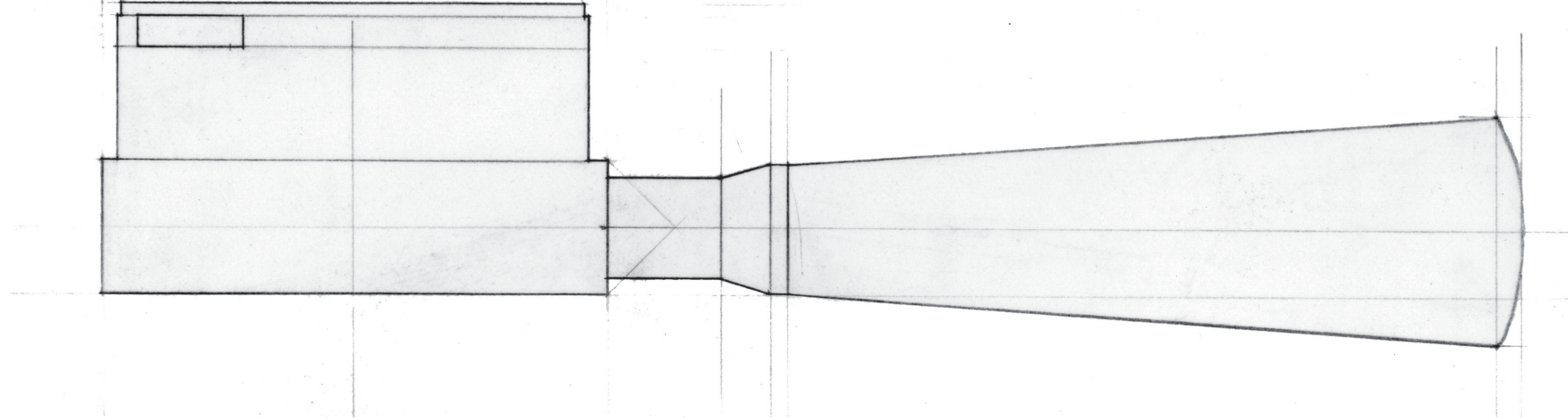
Ground Coffee Funnel





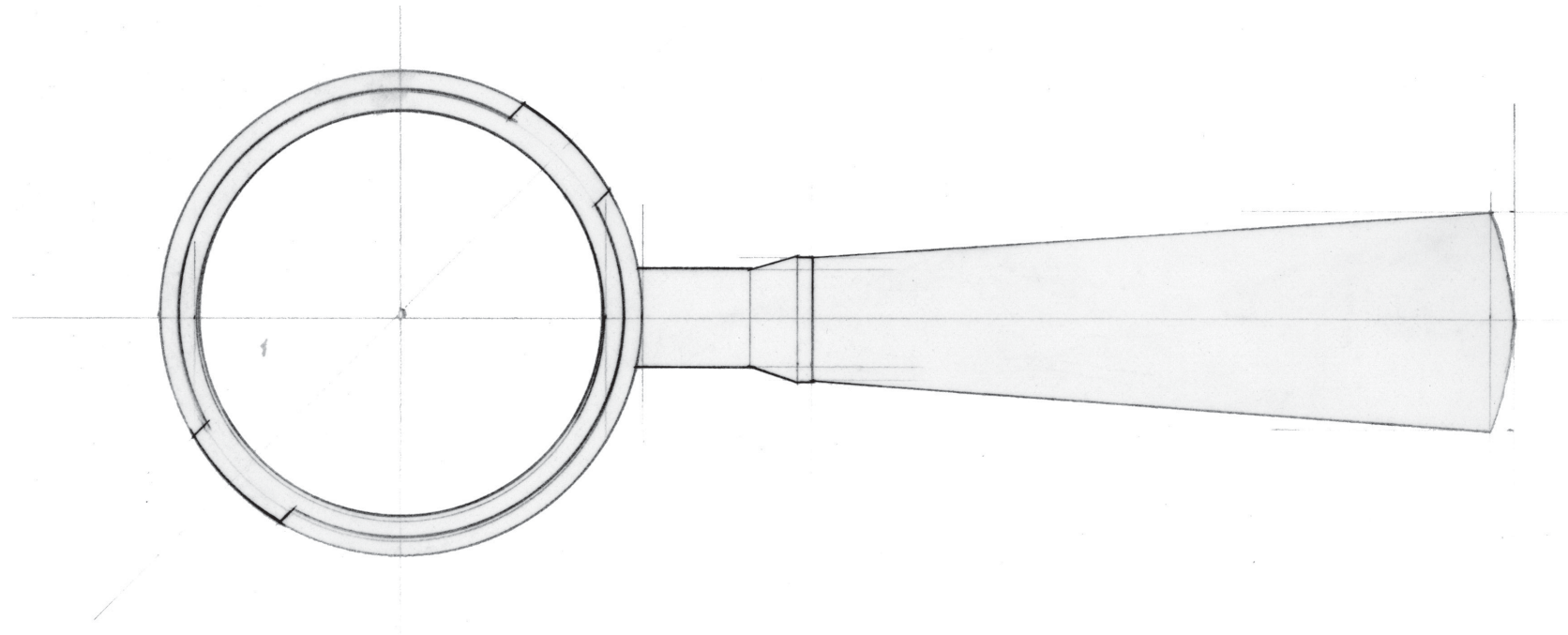
## **Drawings - Portafilter**

Portafilter - Elevation View





Portafilter - Plan View



Portafilter - Section Views



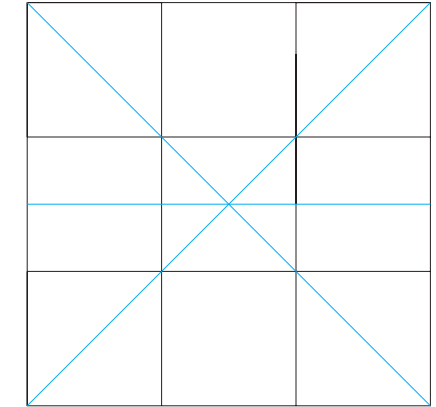
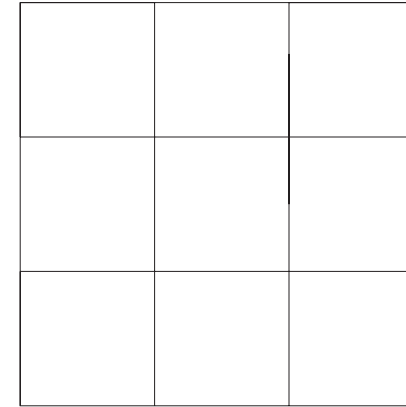


**House**

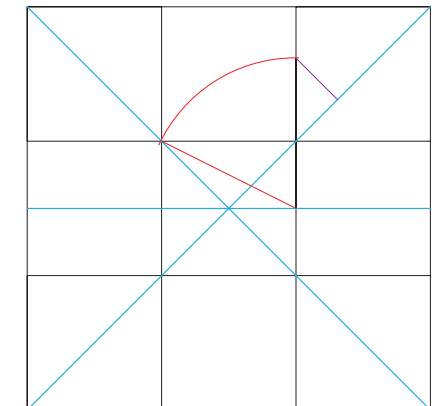
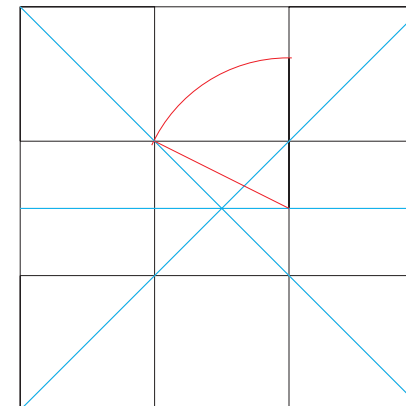
## Measure of the House

### Plan

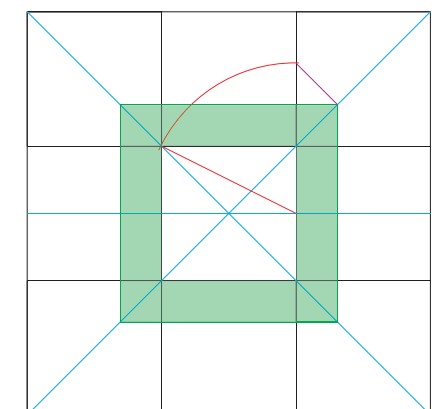
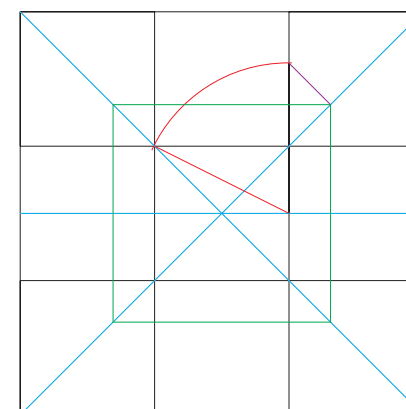
A square is divided into nine equal squares. Diagonal lines are drawn from corner to corner, and with the center found, another line is drawn straight across the center of the square.



A golden rectangle is constructed from the center square. A 45 degree line is drawn away from the corner of that golden rectangle until it intersects with the diagonal line of the original square.



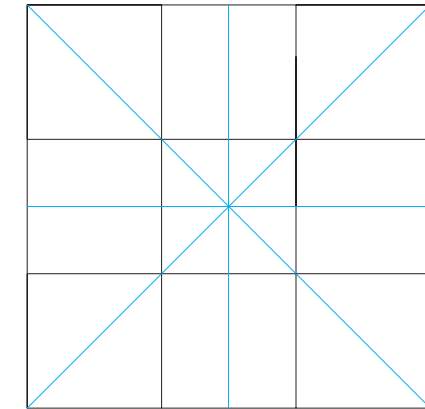
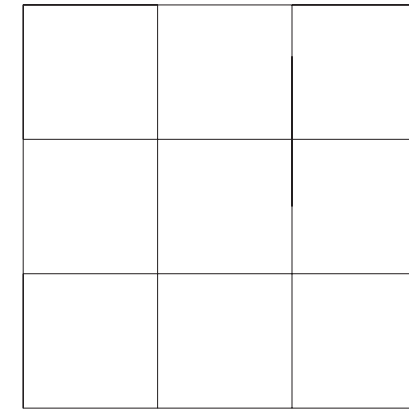
A line is drawn from that intersection to the next diagonal line of the original square until they are all connected and another square is constructed around the center square. This is the axis of rotation around the center of the original square, and the main path of movement for the house.



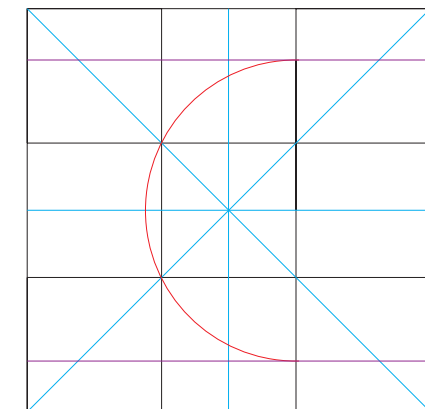
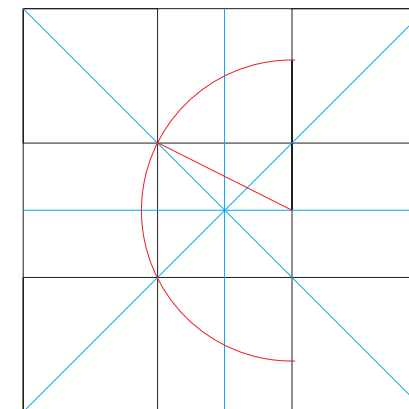


## Elevation

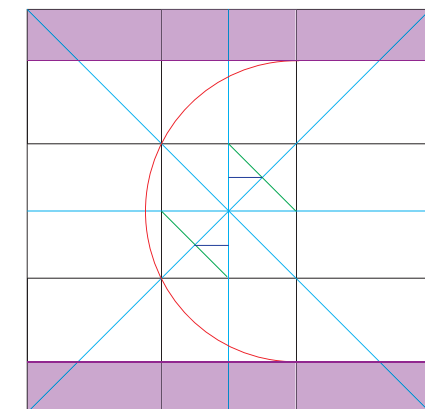
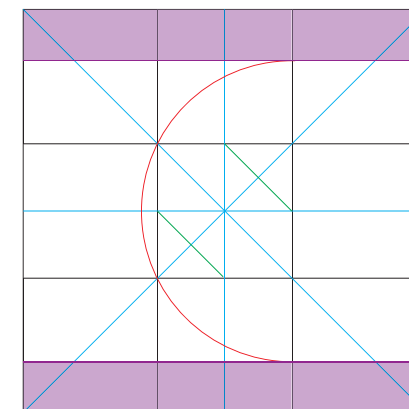
A square is divided into nine equal squares. Diagonal lines are drawn from corner to corner, and with the center found, lines are drawn horizontally and vertically across the center of the square.



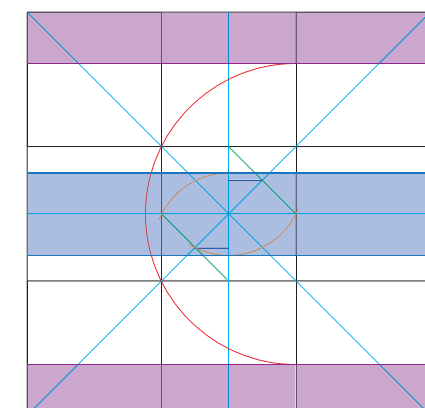
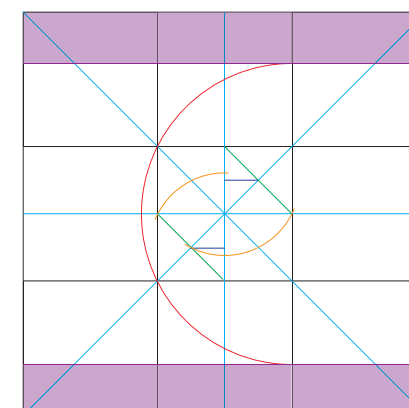
A golden rectangle is constructed from the center square. A second golden rectangle is formed in the other direction using the same measure. Lines are drawn horizontally across from where the arcs intersect the vertical origin line forming the top most and bottom most interstitial spaces in the house.



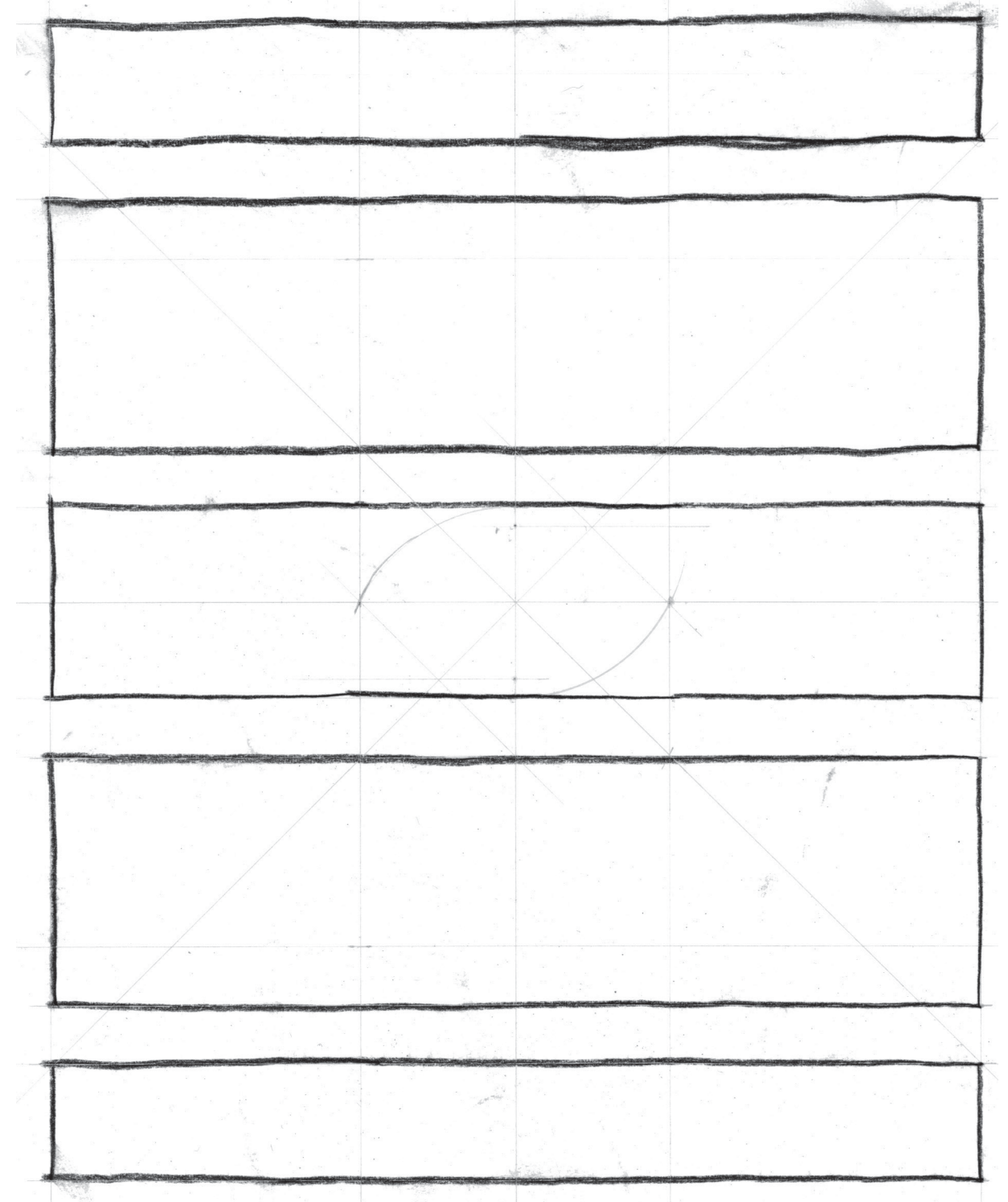
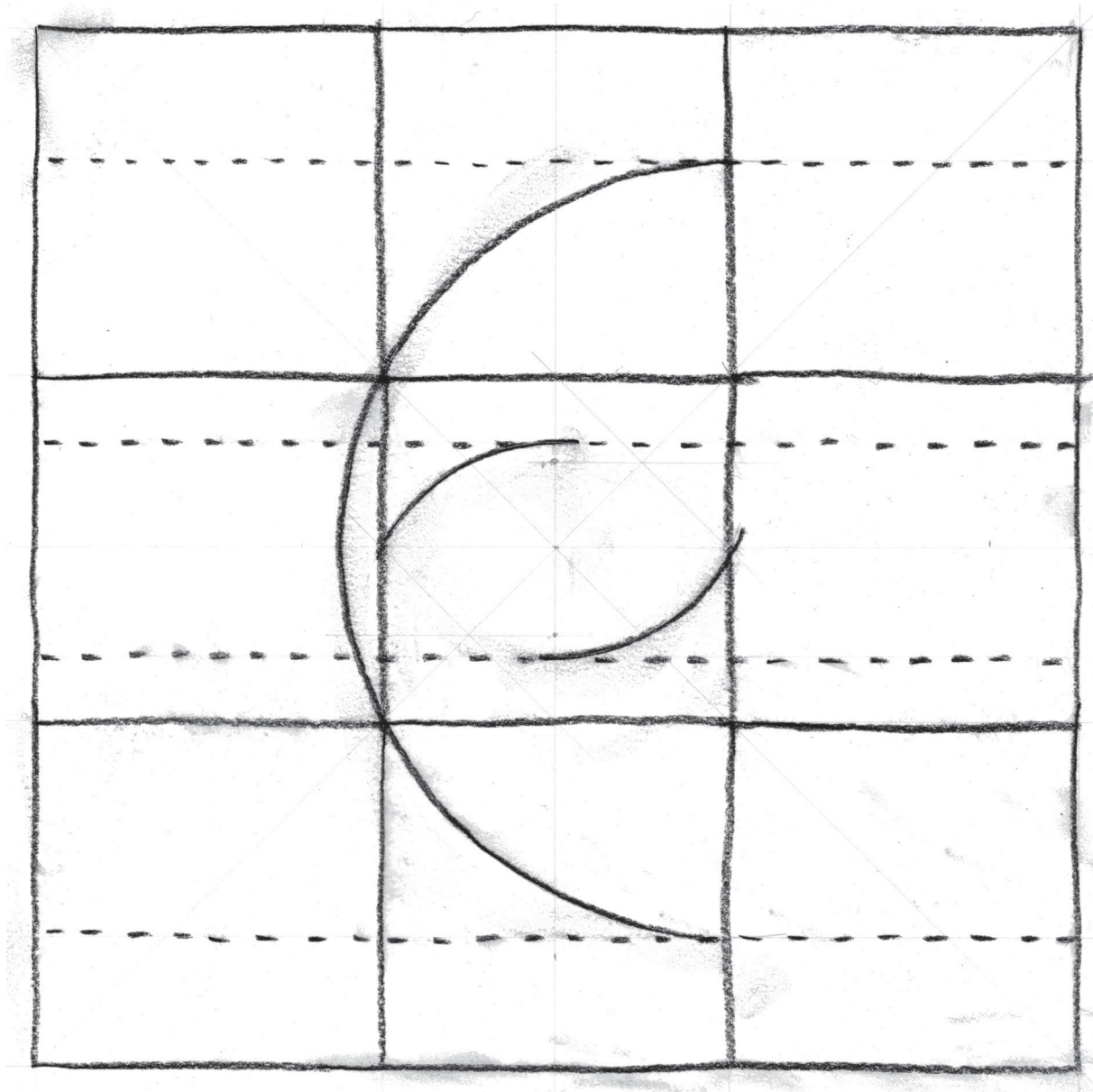
The center square is composed of four smaller squares. The centers of two diagonally opposing squares are found, and lines from the centers of these squares are drawn back to the vertical centerline of the original square.



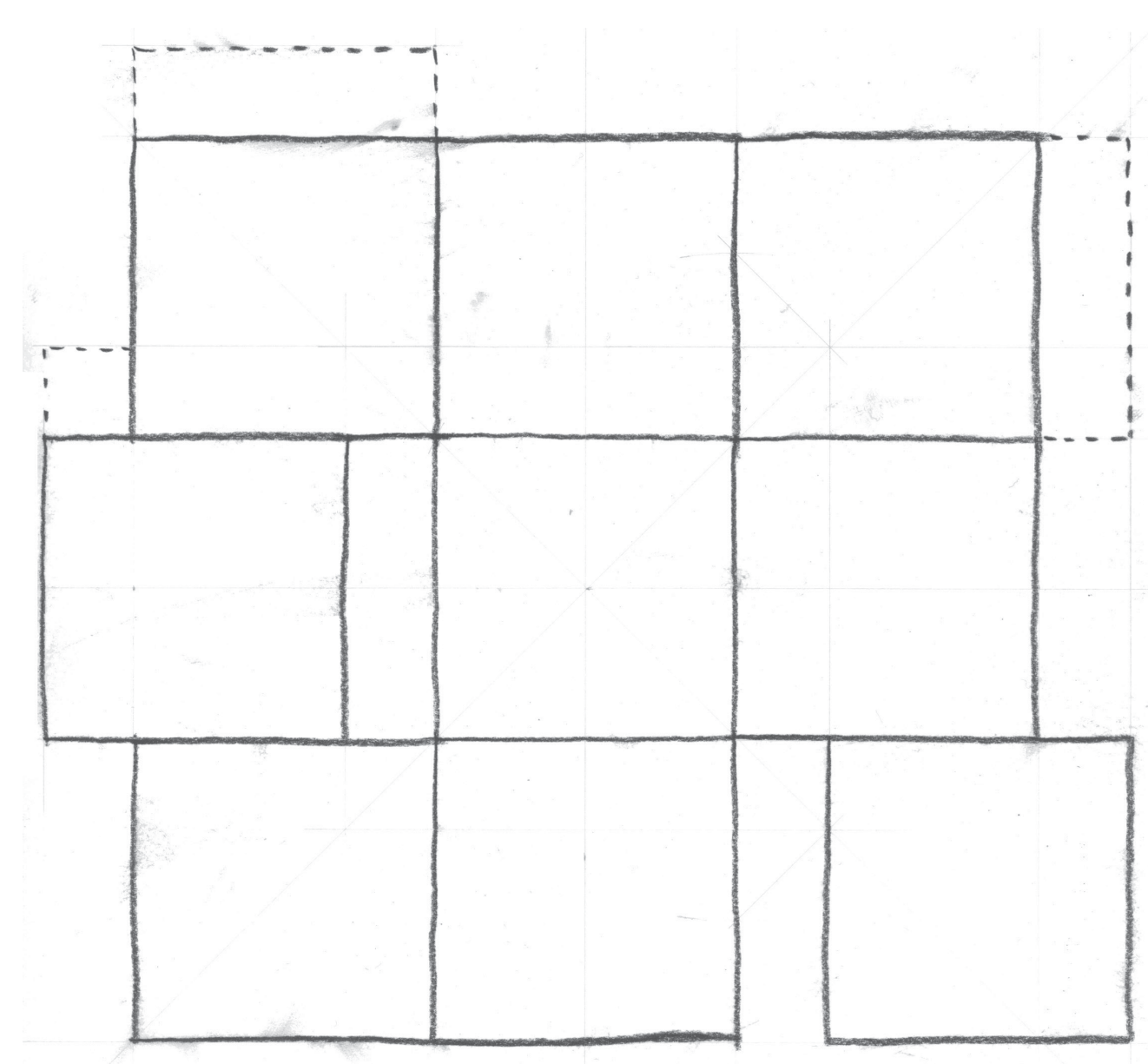
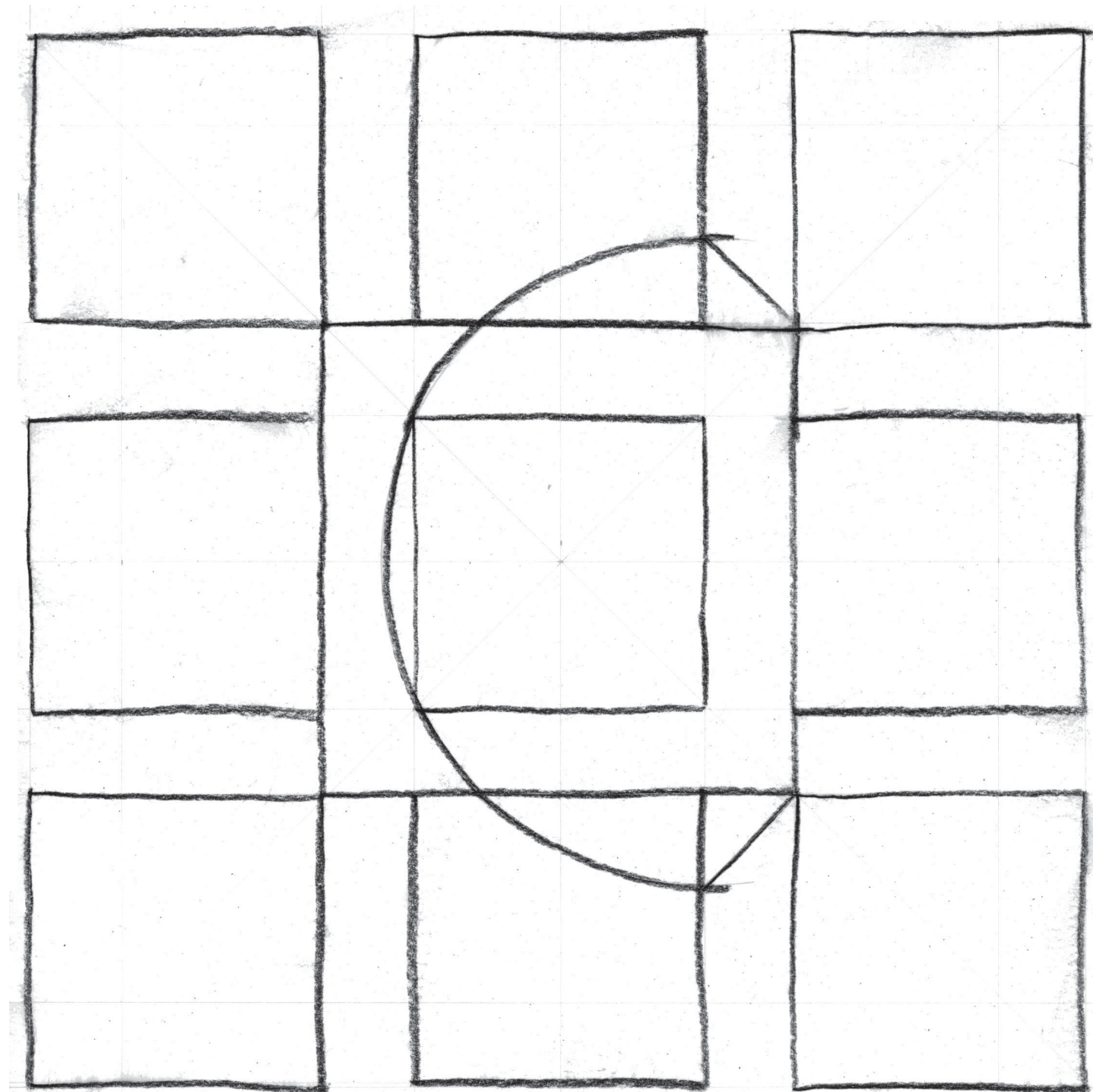
Arcs are drawn from these two points on the vertical centerline to where the horizontal centerline intersects the original center square. Where these arcs intersect the vertical centerline, lines are drawn horizontally across, defining the central interstitial space in the house.



Diagrams

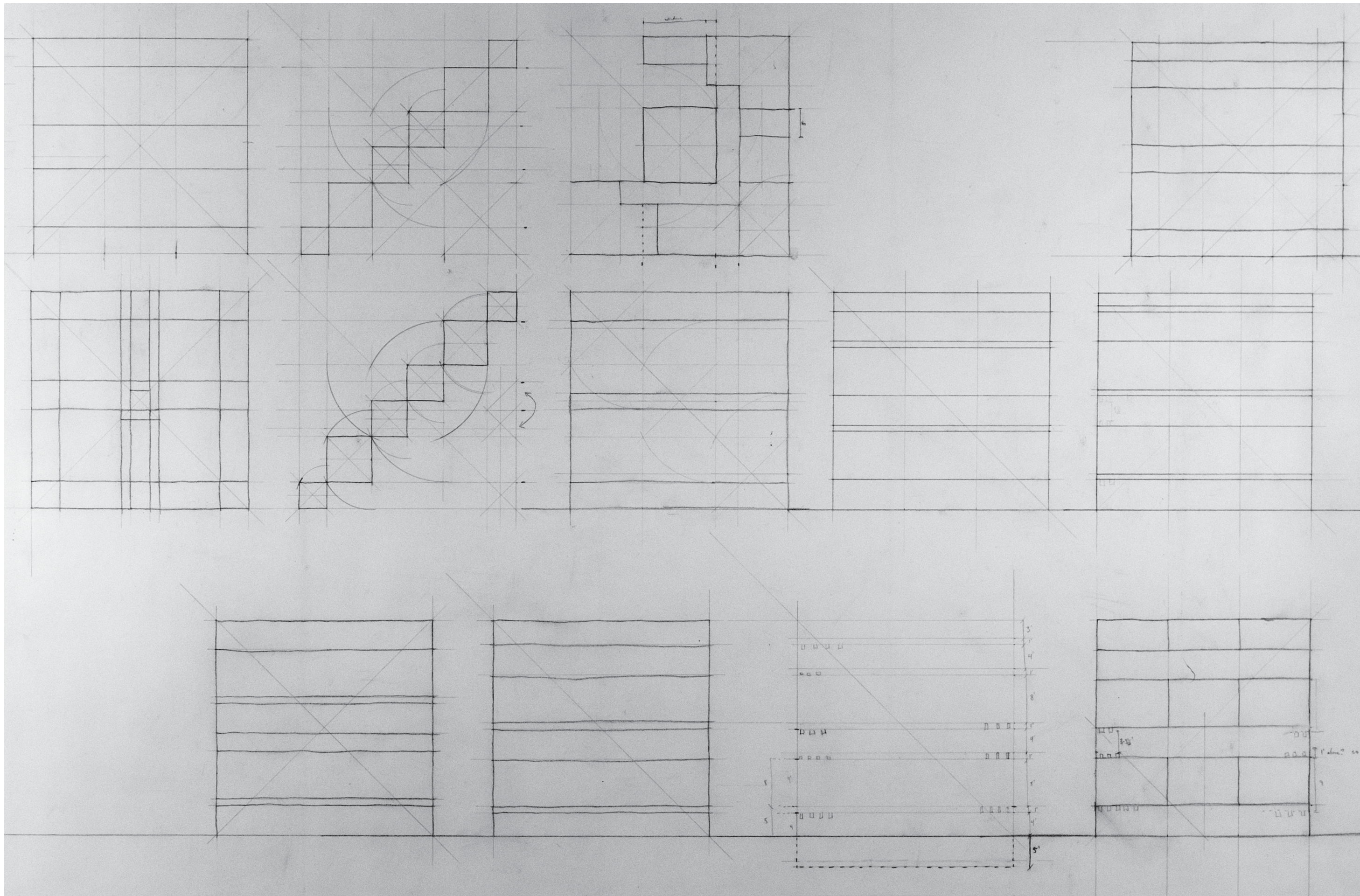






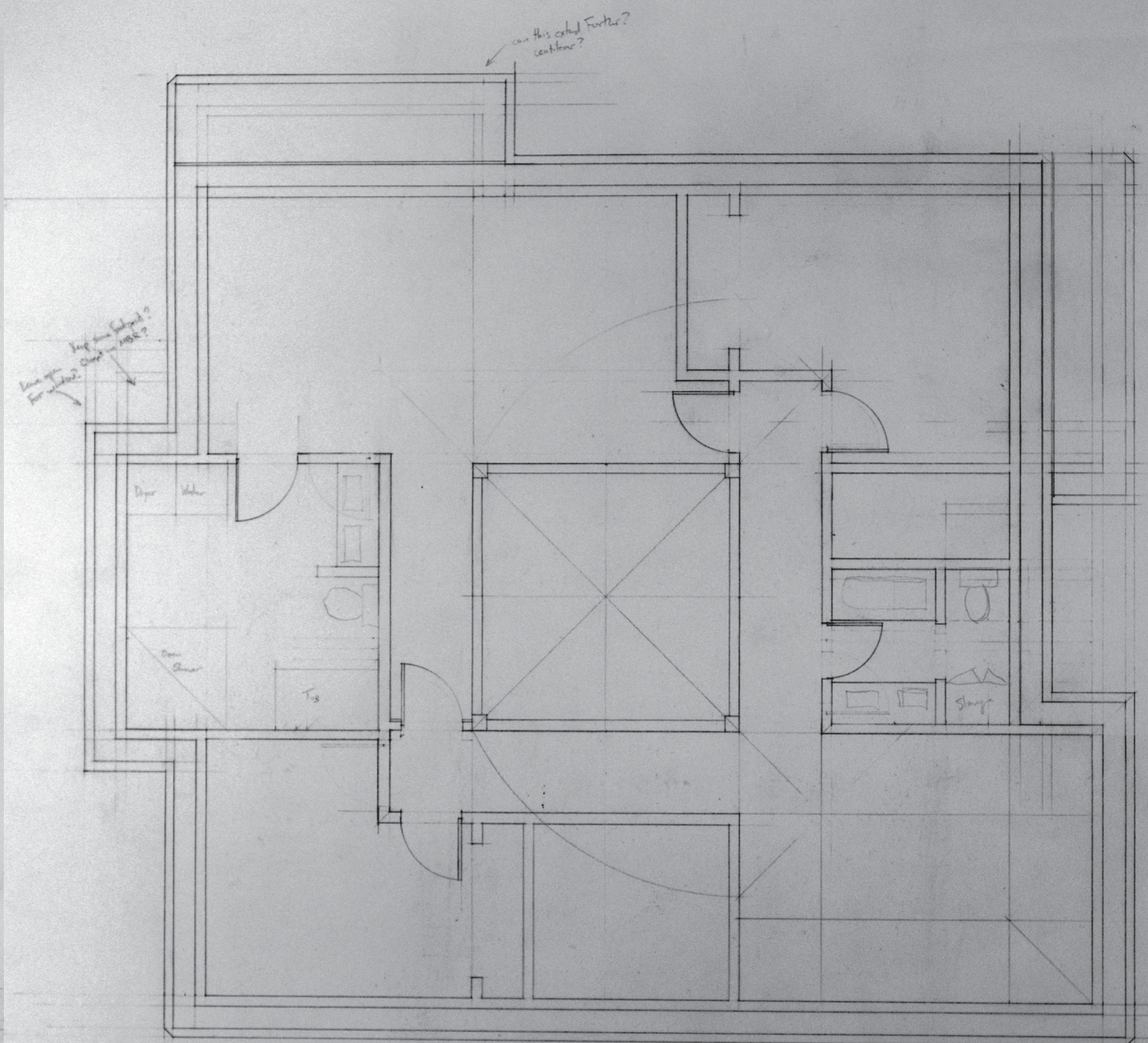
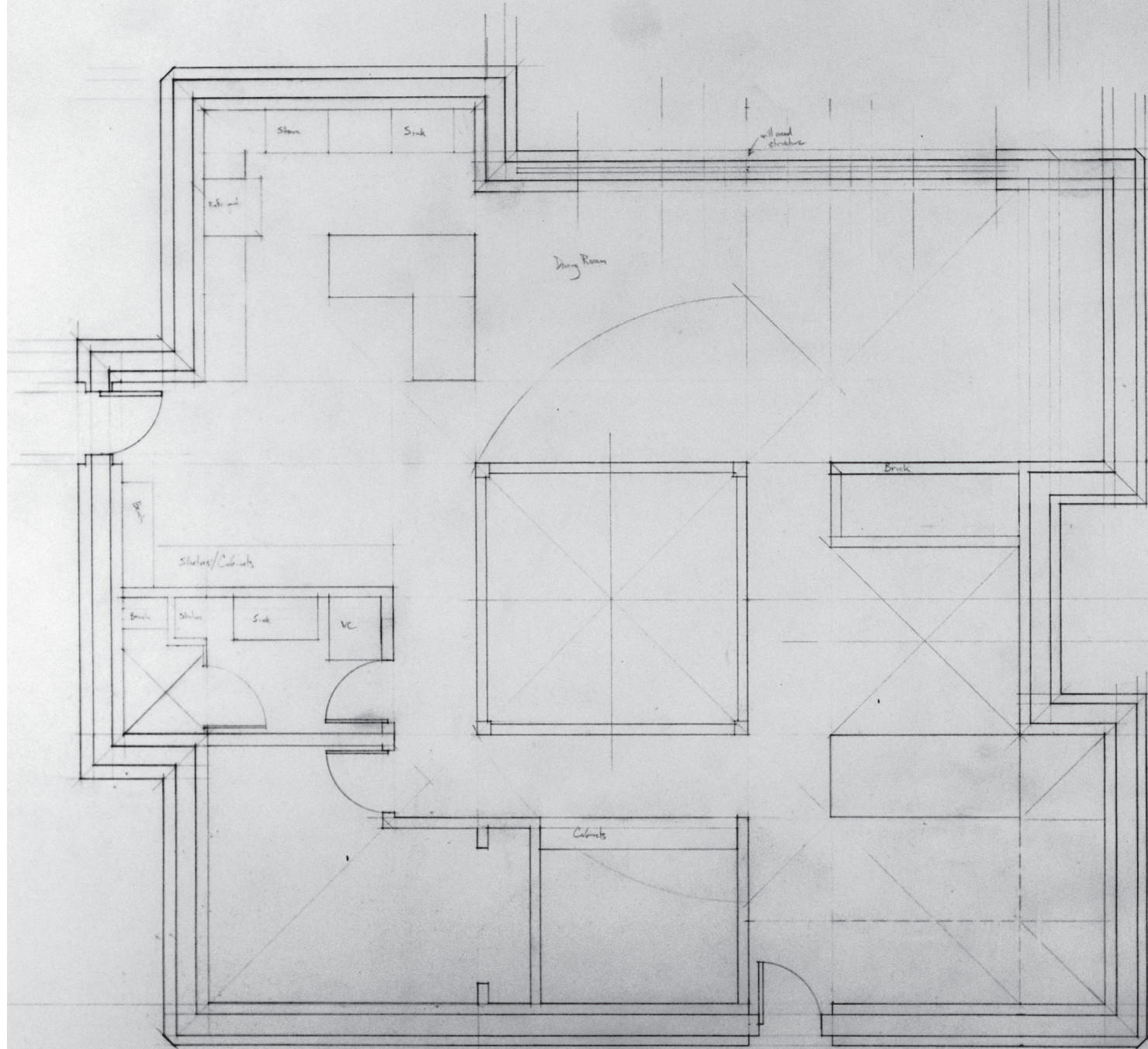
## Drawings - House





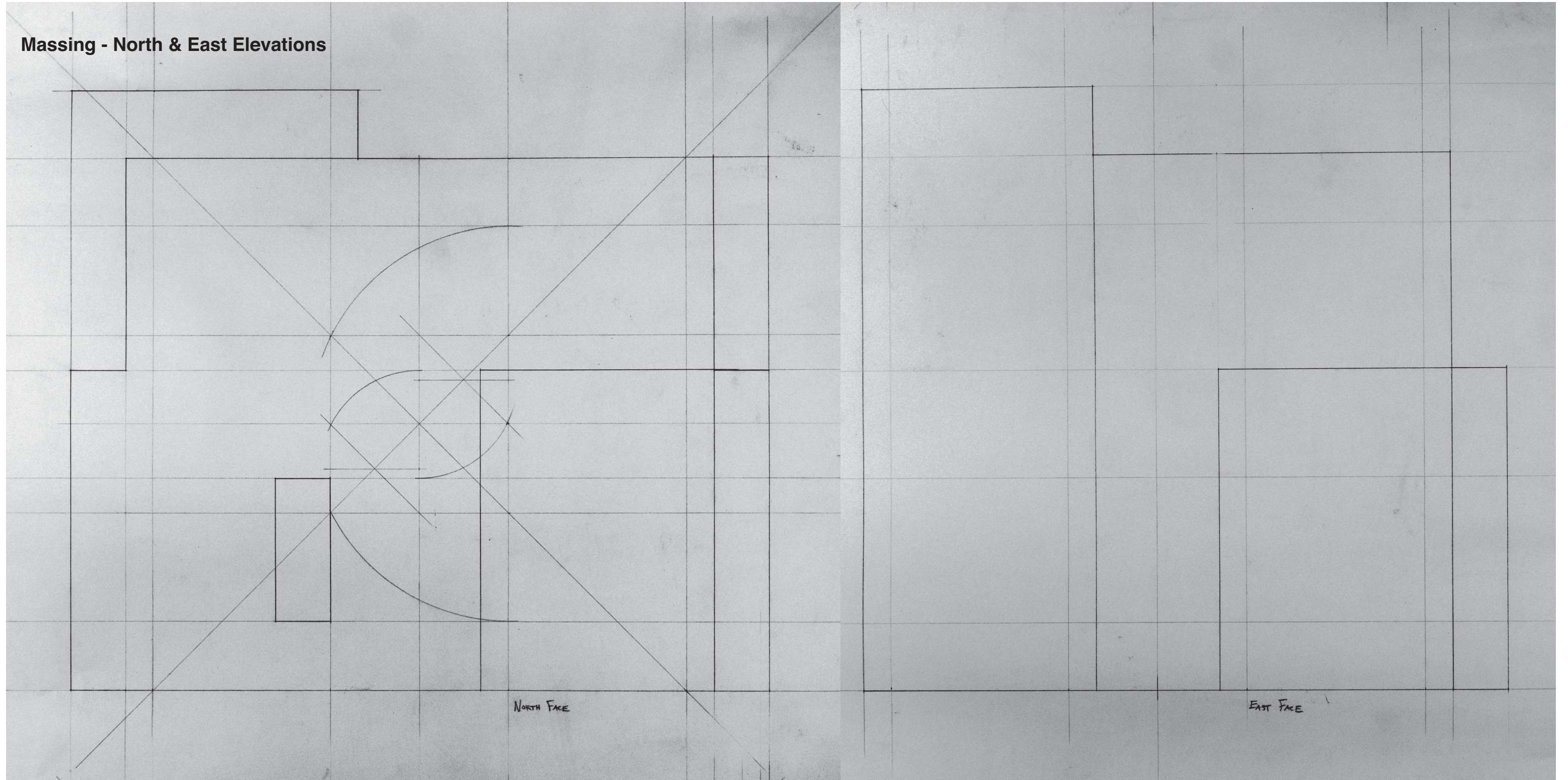


Floor Plans - 1st and 2nd Floors





Massing - North & East Elevations





Massing - South & West Elevations

HEIGHT CAN CHANGE  
W/ STAIR HEIGHT  
- STEP DOWN

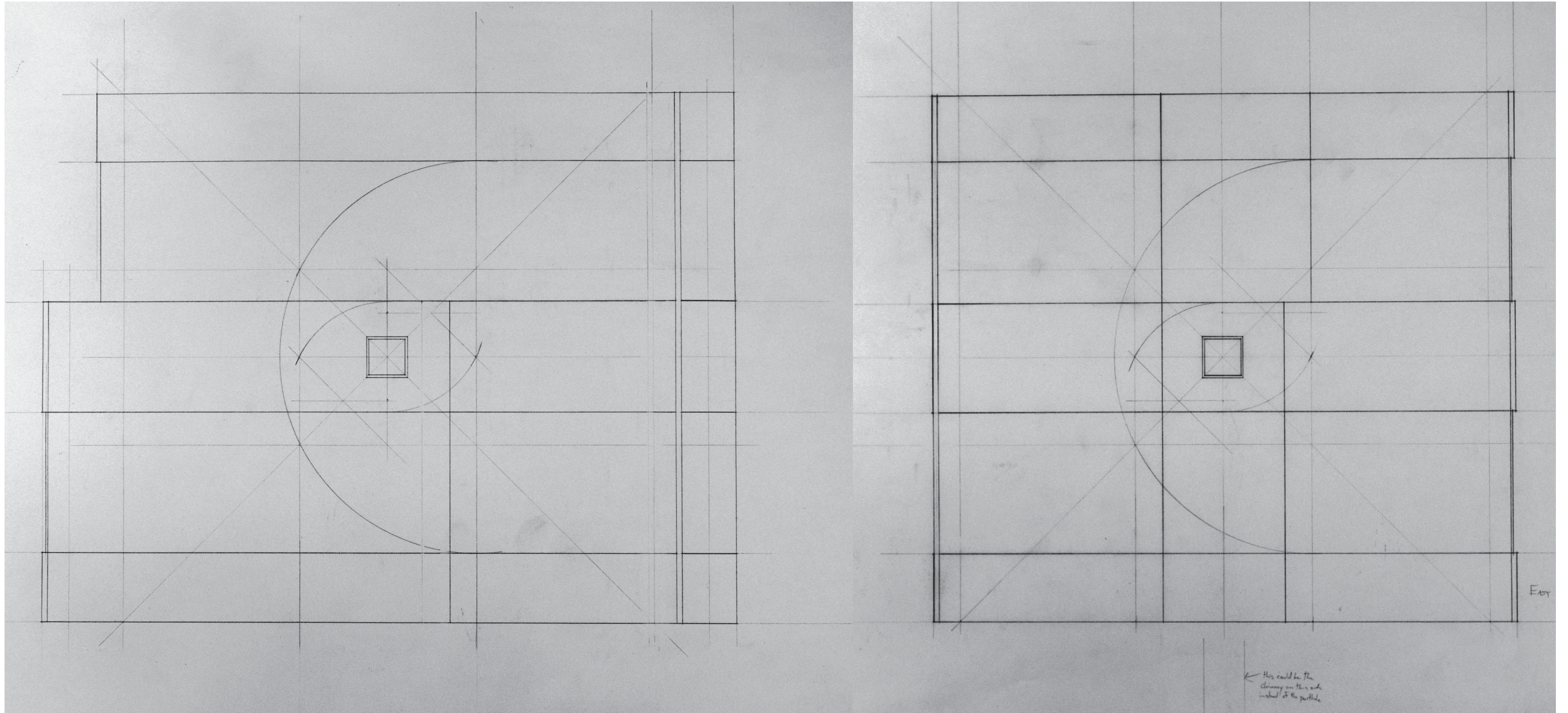


SOUTH FACE

WEST FACE

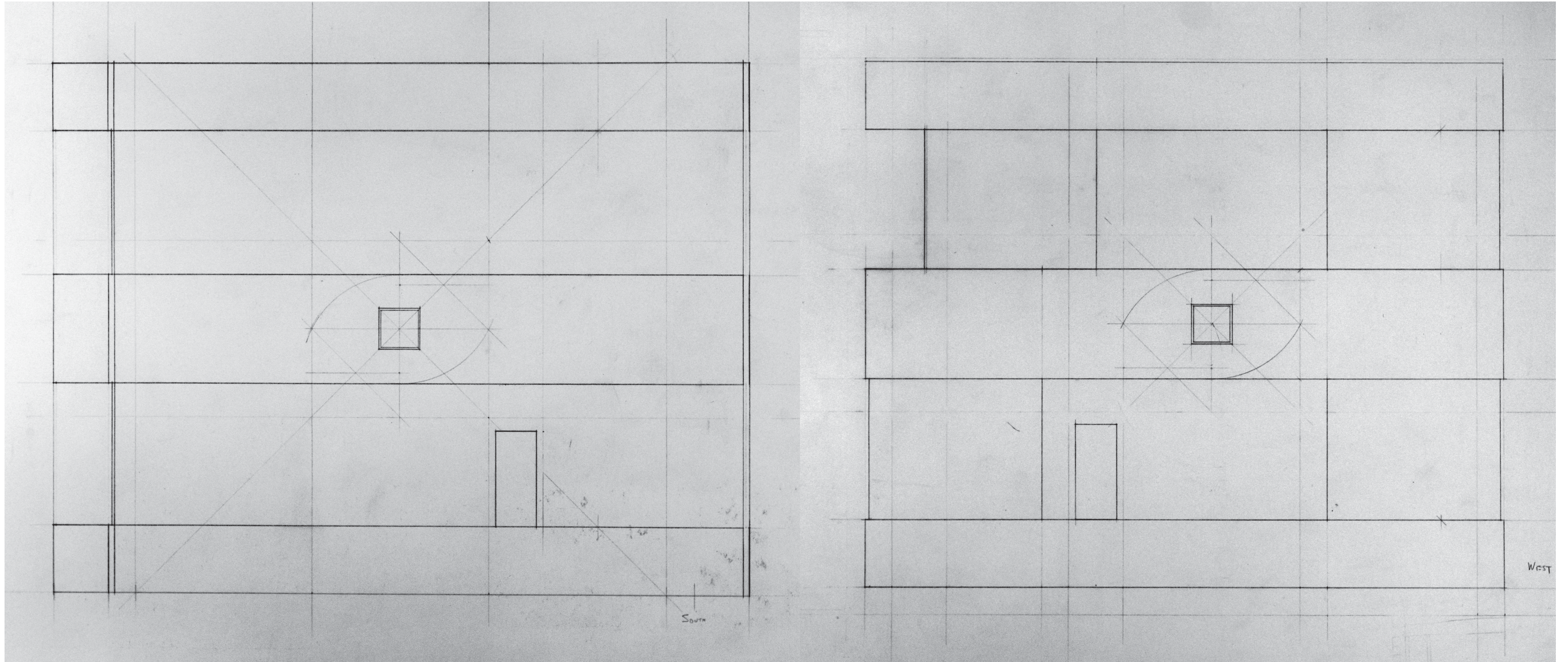


# North & East Elevations



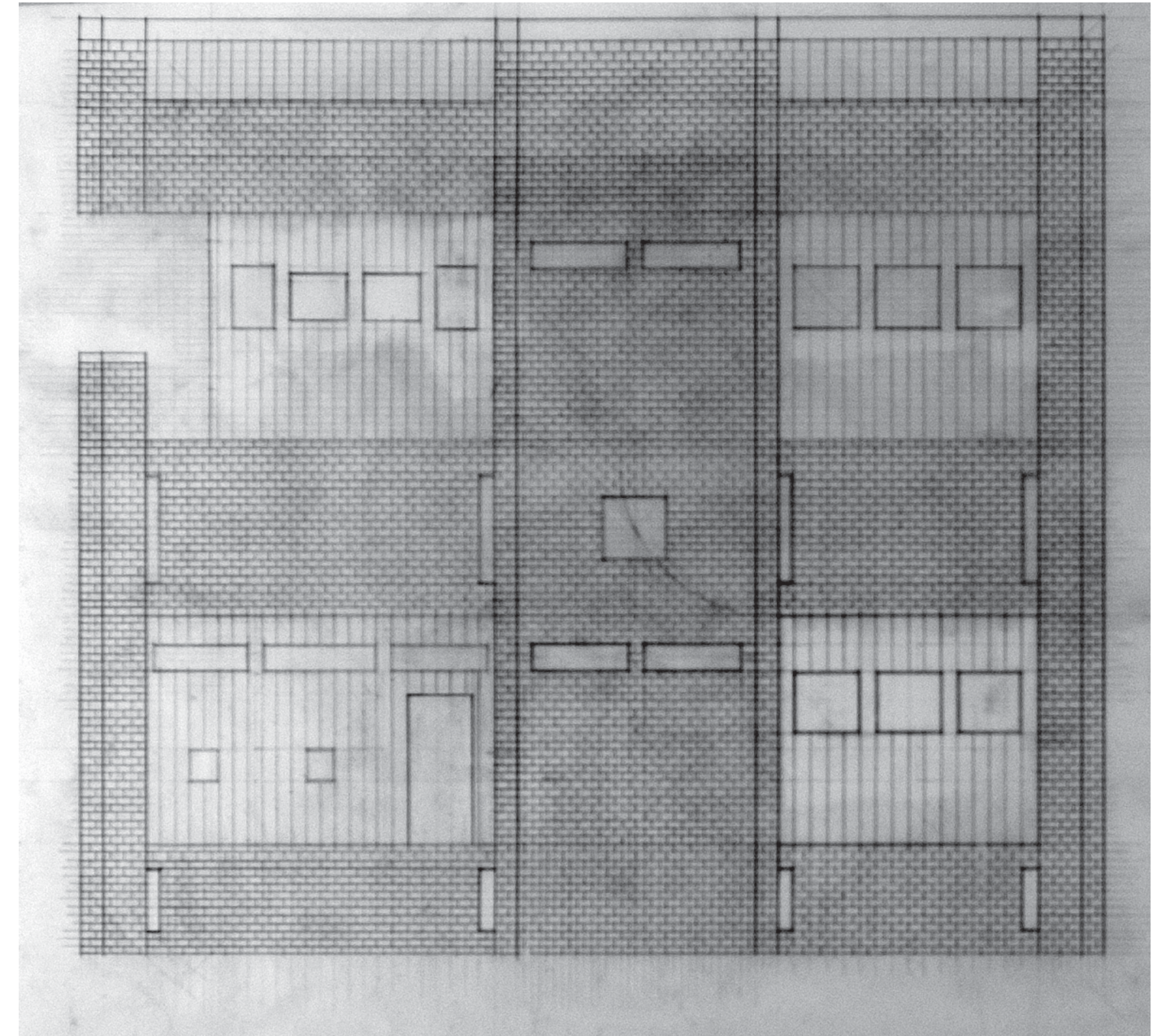
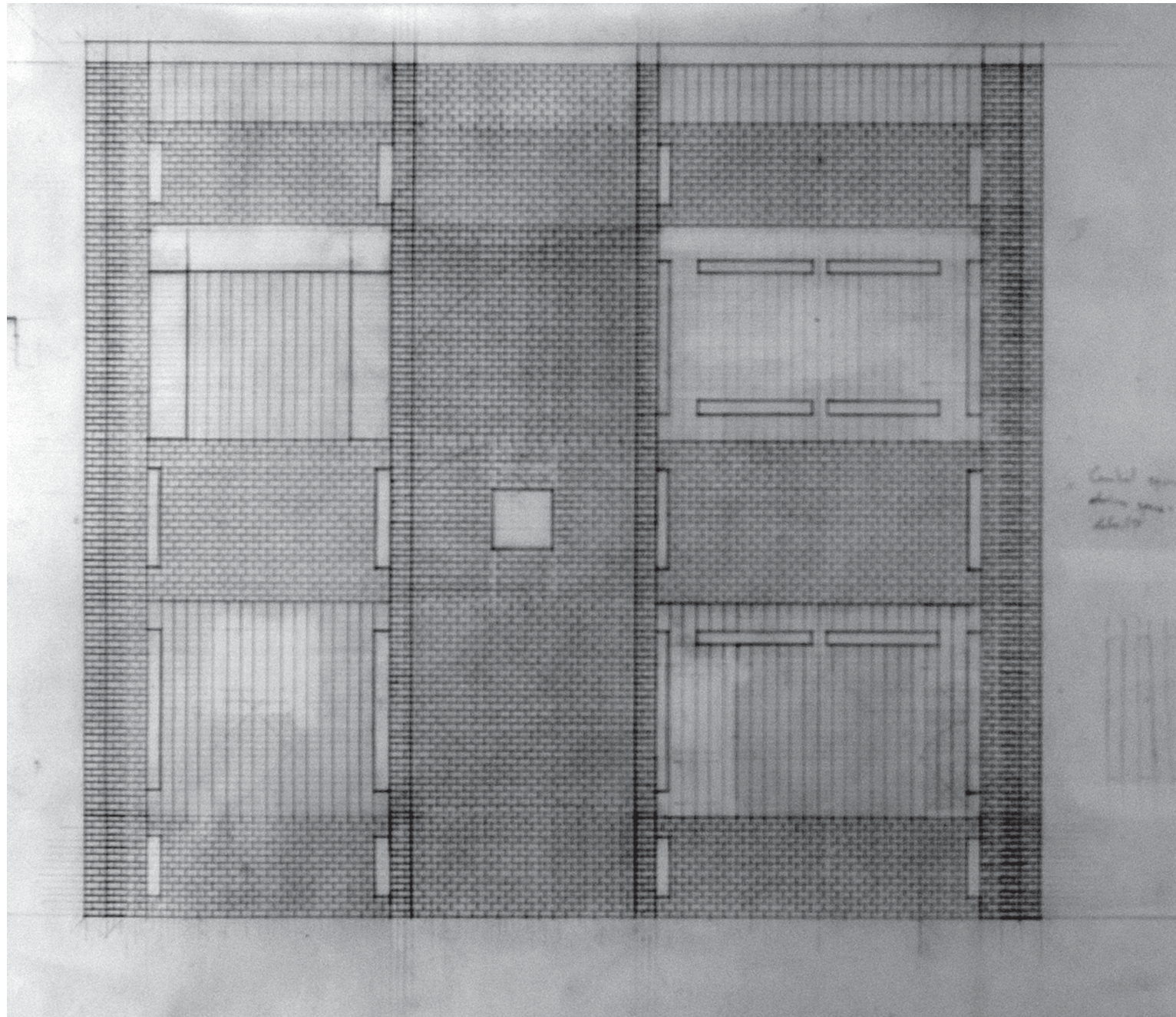


South & West Elevations



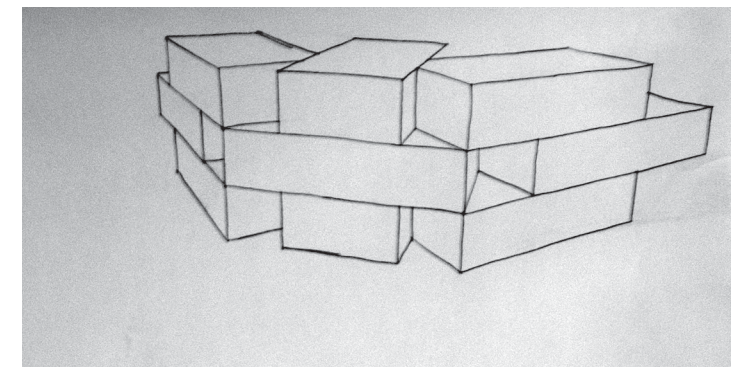
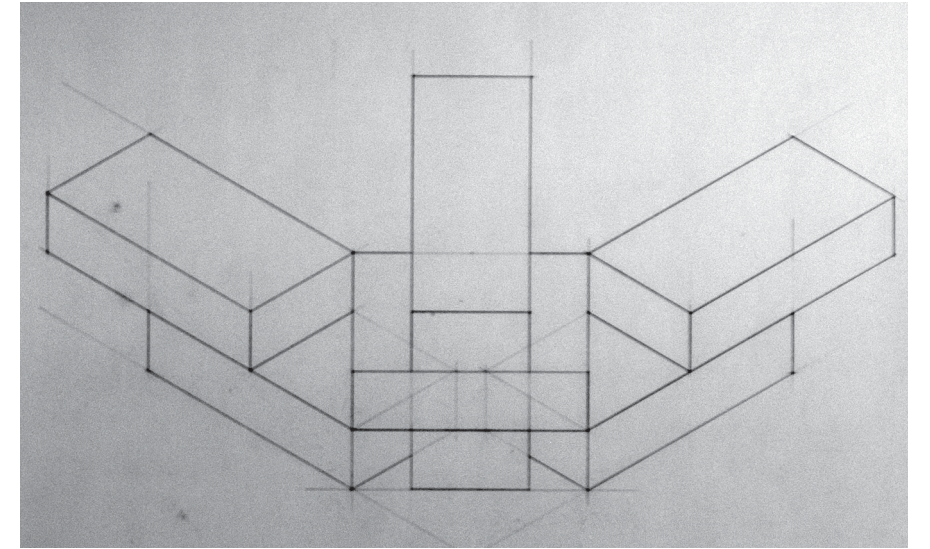
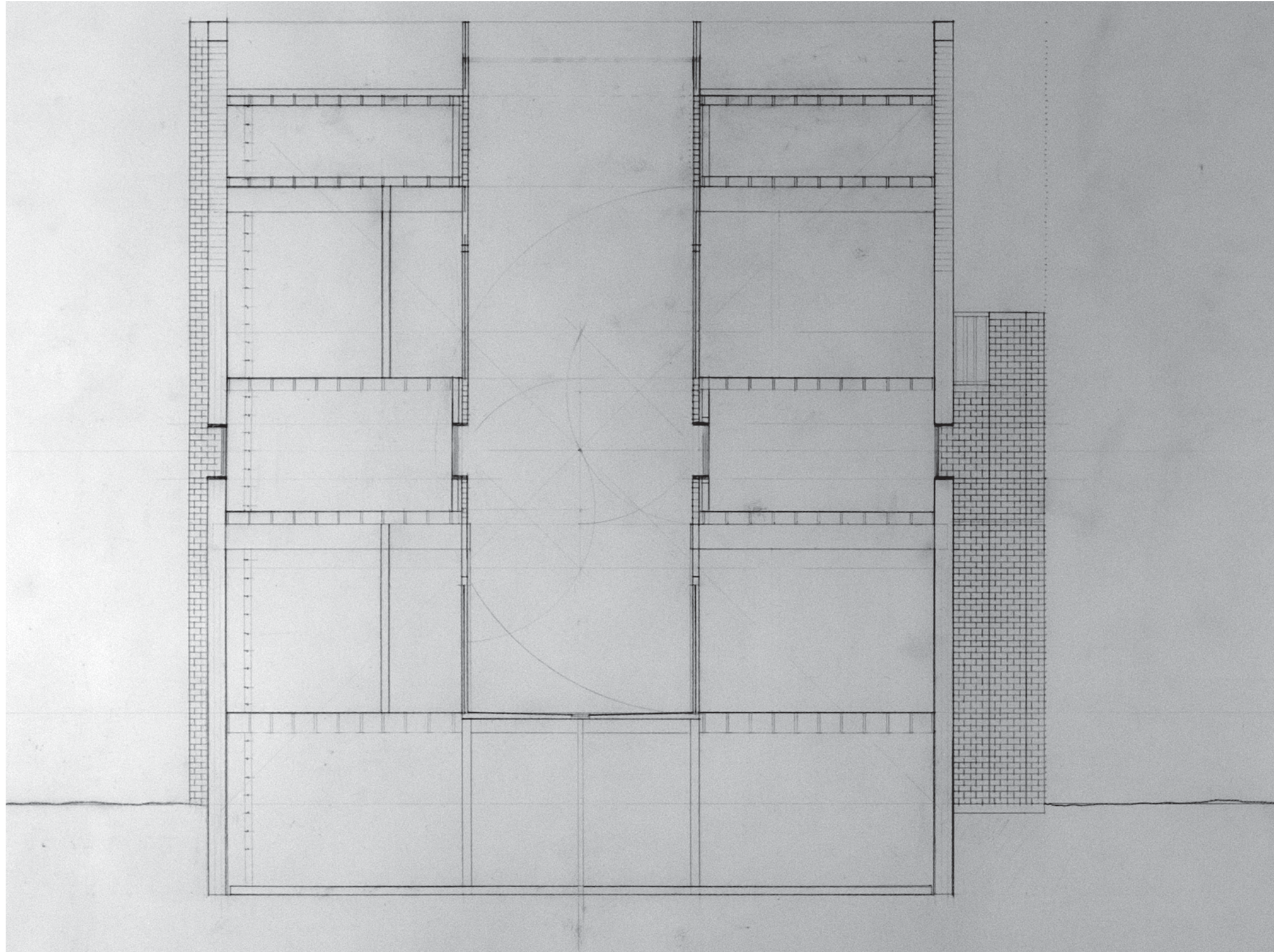


Material & Fenestration Exploration - South & West Elevations



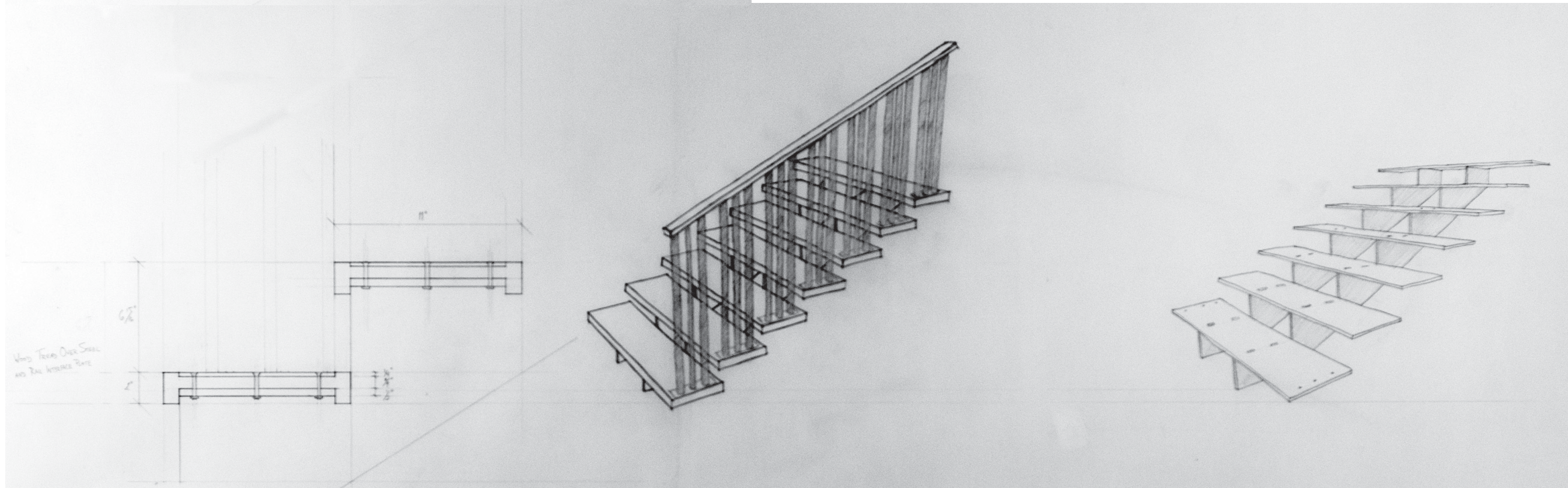
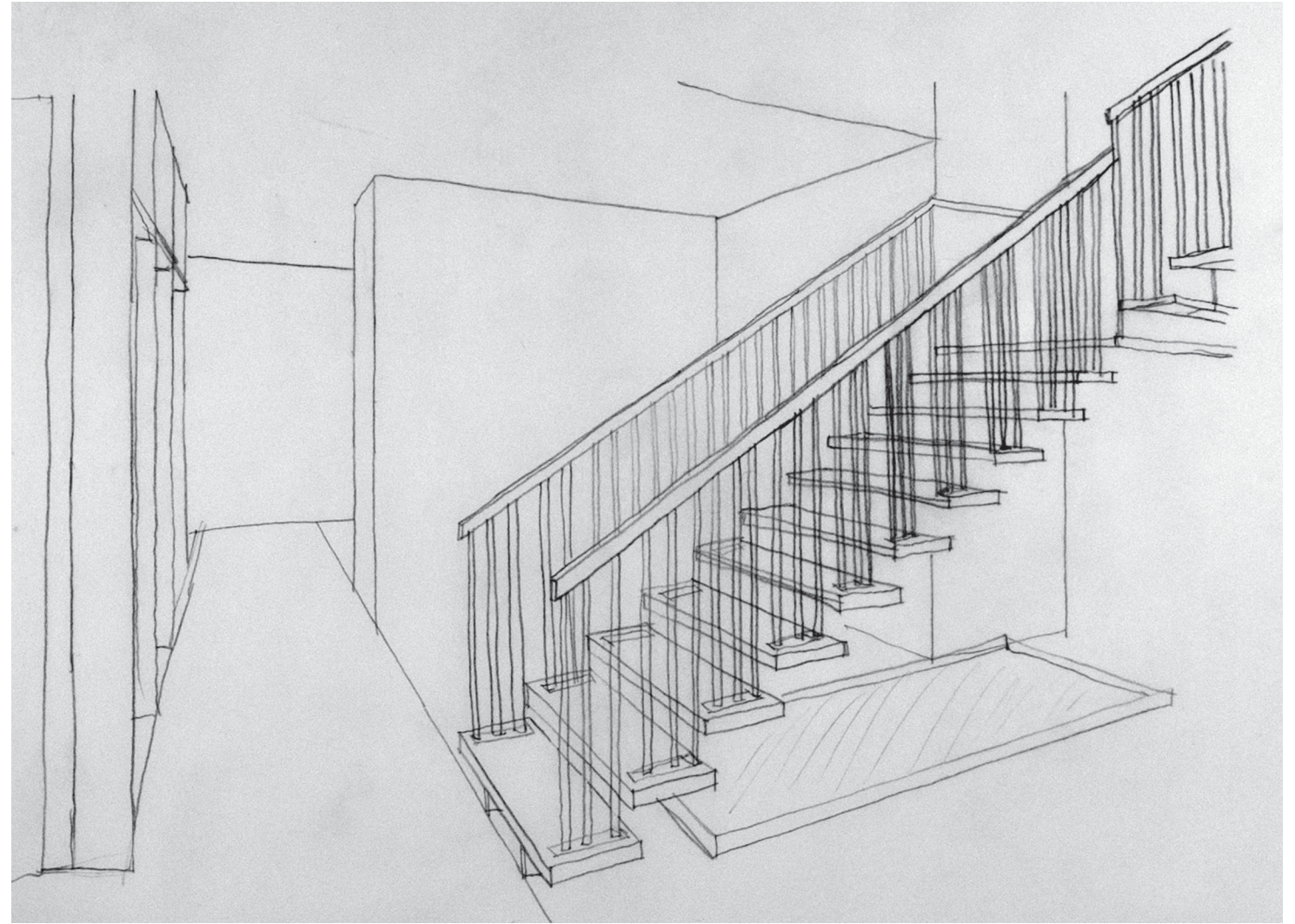
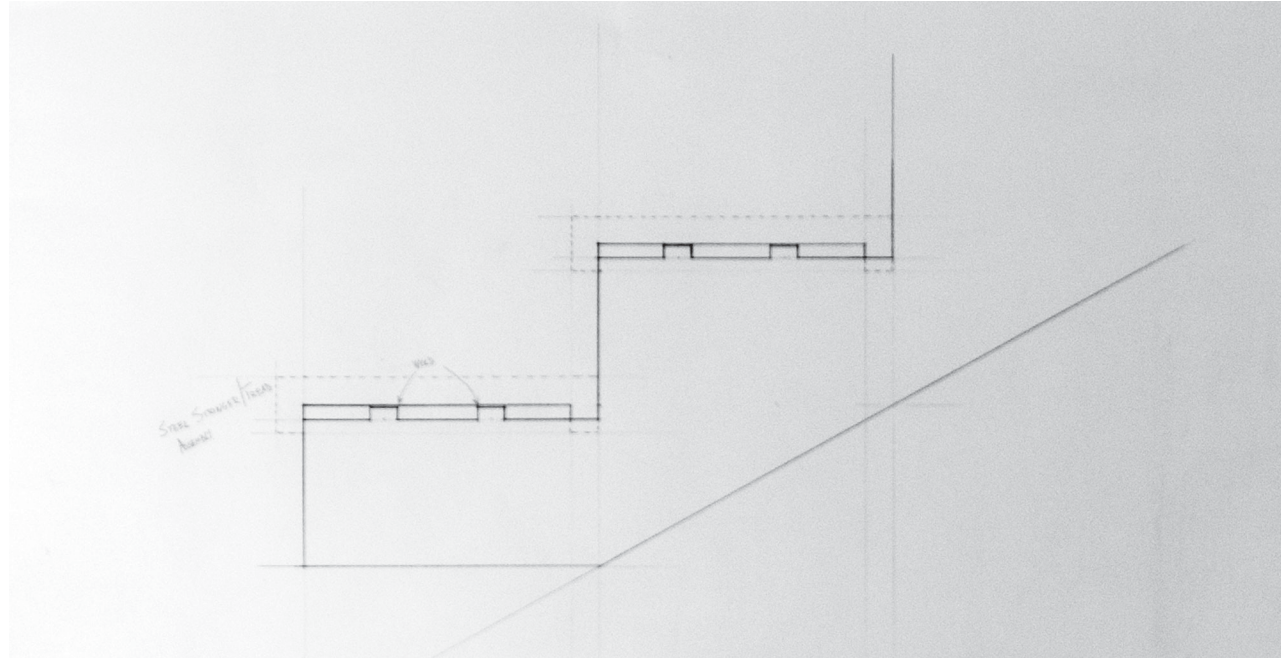


**Section Through Center & Brick Corner Details**



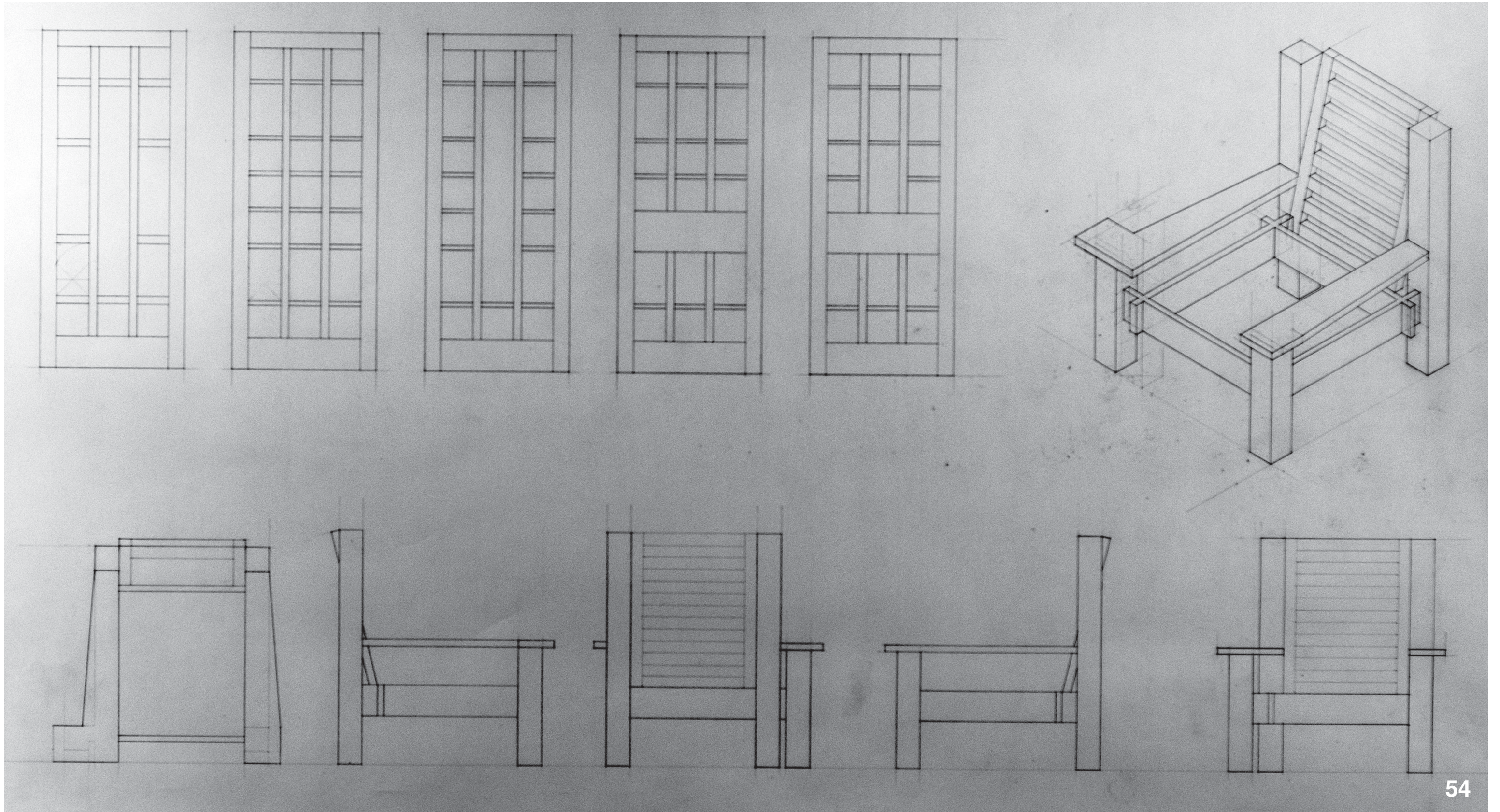


# Stair Study





Chair and Door Studies





## **Models - House**

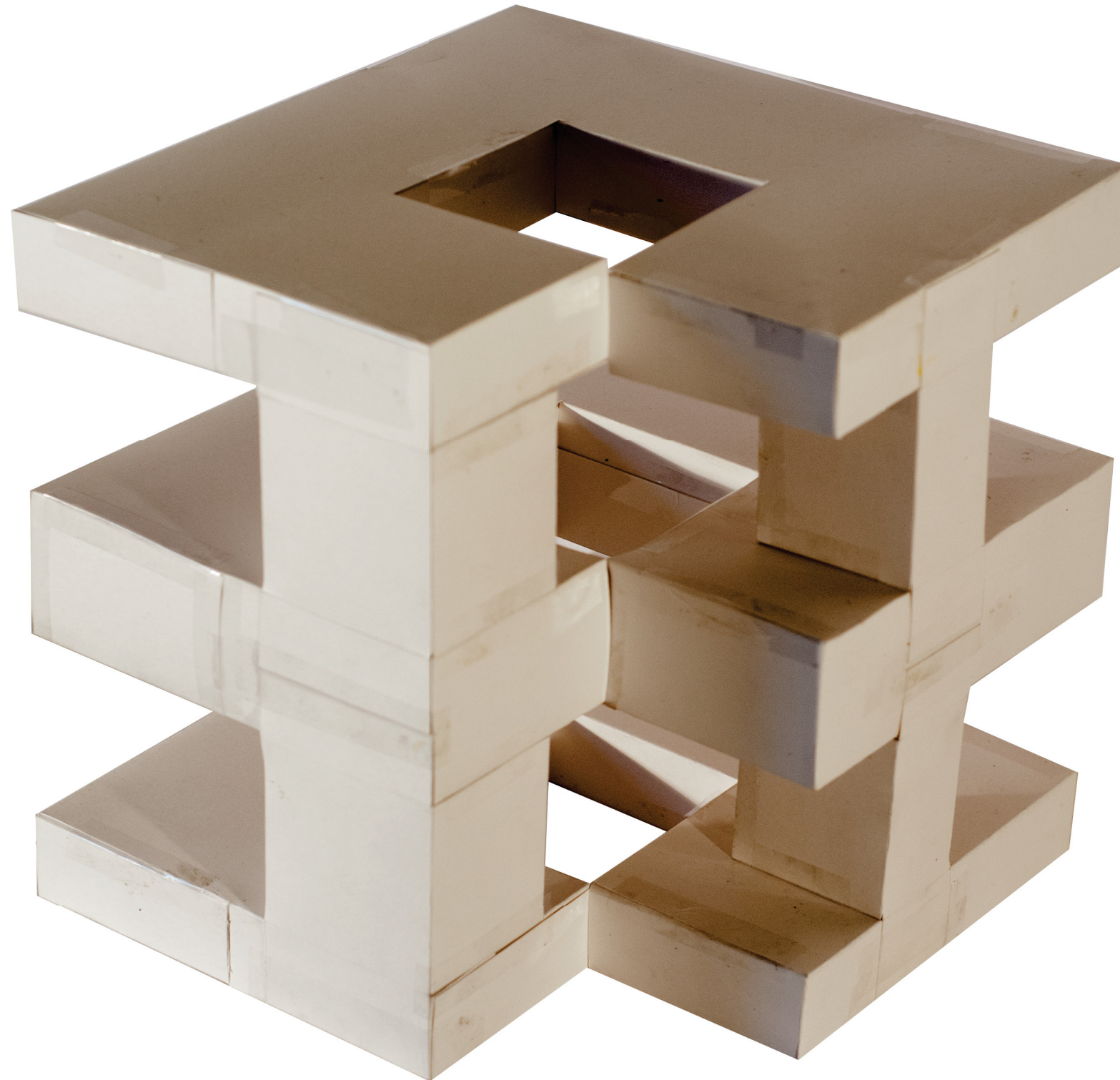


**Facade Proportion Study**





**Interstitial Space**





Massing - East Elevation





Massing - South & East Elevations





Massing - North Elevation





Massing - North & East Elevations

