LANGUAGE SPOKEN AROUND THE WORLD:

LESSONS FROM LE CORBUSIER

A Thesis
Presented to
The Academic Faculty

by

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In Partial Fulfillment
of the Requirements for the Degree
Master's of Architecture in the
College of Architecture

Georgia Institute of Technology
May 2010

LANGUAGE SPOKEN AROUND THE WORLD:

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ACKNOWLEDGEMENTS

I first and foremost like to thank my Advisor, Athanassios Economou. I cannot express enough the appreciation I have for the confidence he had in me when starting this project, and especially his patience throughout this process. I have always considered it an honor to work with you. I would also like to extend my gratitude to Professors Sonit Bafna and Frances Hsu for their guidance and support. They have not only made a mark on this project of mine, but also a mark on my understanding of Architecture, something that I will never 'un-see'. I would be remiss not to thank Professor Benjamin Flowers, I cannot imagine my architectural education being complete without his profound way of looking at things; I have never been in classes so unpredictable. I would like to thank Professor John Peponis for his push that has made me think and then re-think.

Additionally, I would like to thank Professor Stuart Rom and Professor Judy Gordon, your calm yet insightful ways have been a source of encouragement for me always. I would also like to thank Professors David Sledge and Charles Rudolph who were the first to open the doors to the world of Architecture for me. And last but not least, I'd like to take a moment to thank all the Professors who have been a part of the foundation of my architectural education in the past few years.

I am forever indebted to all of you, for you have made my experience at Georgia Tech enlightening. My teachers, thank you.

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SUMMARY

Le Corbusier's method of creating Architecture in all regions of the world is endlessly rich in techniques. While it is impossible to exactly know his thoughts as he created his modern compositions that skillfully addressed contextual cues, I attempt to present a new thesis of how Corbusier approached different sites and masterfully created residences that were places "where happiness is born". I will use Shape Grammars and formulate my own languages that will recreate Corbusier's two Monol houses: Maison Jaoul in Paris and Sarabhai Villa in Ahmedabad. Furthermore, I will expand on these houses by creating other iterations, and transforming the grammars to understand critical major and minor moves. In the end I hope to derive architectural lessons that come from formal exercises that can be used in future design processes. I explore this practical effort by creating designs for a site in Midtown, Atlanta. I compare the process of using Shape Grammars with that of the typical studio approach. In conclusion, I find that Shape Grammars allows one to produce iterations that connect to the lessons of the original houses in an intuitive manner.

CHAPTER 1

INTRODUCTION

Le Corbusier's work is regarded as the cornerstone of Modern Architecture. His career spans the early half of the twentieth century from projects in five continents. His creative process involved a perpetual oscillation between reason and intuition, observation and abstraction (Curtis, 1986). His thoughtful and innovative approach to designing for a lifestyle continues to intrigue architects and historians. As William Curtis describes, generations of architects have found new implications that stemmed from Le Corbusier's strong prototypes. His vaulted housing type known as Monol, 'rich in possible rapproachments between vernacular and industrial, the modern and the traditional', was transformed by Balkrishna Doshi and Rogelio Salmona into addressing respective local identity. I, too, join this discourse and revisit this housing type in search for answers to sociological and historical questions through spatial techniques. Maison Jaoul near Paris, France and Sarabhai Villa in Ahmedabad, India are two houses completed late in his career and express mature ideas and masterly techniques. They also represent the Monol housing type which has been less investigated than the Domino type, and combine issues that Le Corbusier was interested in throughout his career; such as light, diversity of elements and movement through space.

The Monol type uses Catalonian vaults, segmented load bearing walls (rather than columns) and cellular plan as initial shapes in varied combinations to create drastically different buildings that thrive socially and aesthetically in their respective locations. Le Corbusier adapted a similar building type in two different locales. James Stirling writes

off Le Corbusier's implementation of a primitive, provincial type. However some scholars such as Peter Serenyi and Caroline Maniaque argue that these houses represent his larger struggle with polarities. Juxtaposition of diverse and often seemingly contradictory architectural elements are not merely a formal exercise but rather a manifestation of a new kind of synthesis that brought together images of diverse cultural, historical, environmental and social forces while permitting each to maintain its identity (Serenyi, 1985).

Modern methods of dividing and integrating space are used in both houses. I would like to take these two houses through the filter of the formal exercise of shape grammars, in order to better understand rules that guided Le Corbusier's major compositional techniques. Performing this exercise will not only give me insight into formal characteristics of the houses but lead to a better understanding of a prototype and how it is and can be used. It will serve as a means to catalogue occurrences of architectural expressions such as openings, repetitions, patterns, entrances, and colors which fit into solving the larger puzzle of how architectural intentions of moods and feelings are created. I will focus on contextual rules and see what limitations on rules mean and how they reveal intentions about design.

CHAPTER 2

THE HOUSES

Sarabhai Villa

Figure 1. Sarabhai Villa. Aerial view of site.

Le Corbusier was taken to India to work on the new capital city of the Punjab province, Chandigarh. While there, he received commissions in Ahmedabad, a textile city further south (as shown in Figure 1). The architecture of the early sultanates and the Mughals introduced the vocabulary of shaded arcades and porticoes throughout the palaces and mosques in the city. However Le Corbusier's architecture in Ahmedabad was not formally based on traditional or local precedents; but seemed to unconsciously incorporate the essence of those traditions through a language that he created and weaved through the city and his entire work in general. It directly addressed natural, social and

phenomenological issues relevant to India, its lifestyle, climate and people (Ubbelohde, 2003).

The Villa Sarabhai is set among a dozen buildings in a 20 acre park owned by the family, it was completed in 1955. The owner of the house was a widower with two young sons. She conceived of the house as one without doors, symbolizing limitless hospitality; one that was also a refuge from the hot Ahmedabad climate, and could change over time, adapting and adjusting to the needs of her guests and growing sons.

The villa is constructed of red brick and rough-cast concrete. It consists of a repeated vaulted structure is faced with clay-tiles and is generously open on either side to allow the movement of air between them. Exterior views are shown in Figure 2. The ground floor is composed of ten parallel vaults, with four additional vaults on the next level. There are large pivoting doors on the southwest end of the vaults that are in concert with large windows on the northeast end. Both these elements are used to control light and breeze in the house. Furthermore, each vault extends ten to fifteen feet beyond the house's cement façade to form a brise-soleil on the southwest side. By placing the house in accordance with local breezes, the interior allows the temperature to remain cooler relative to the scorching outdoors. The indigenous black Madras stone also contributes to the cooling affect and covers the floor and continues outside to the area immediately surrounding the house. A garden extends on the entire roof, providing protection from the sun's heat during the hot summer days, and offering a verdant retreat on cool fall evenings.

Inside, Le Corbusier incorporated the owner's desire for flexibility by separating the vaults with white cedar sliding doors. This allows spaces to expand laterally across

multiple vaults or contract to create intimate, single-vault rooms. Stationary plaster walls, painted in red, yellow, and blue, punctuate diagonal views across the vaulted interior, bringing rhythm to the continuity of the black stone, bare cement, and exposed brick. With a seemingly endless variety of perspectives across solids and through voids along with the constant movement of sunlight, Villa Sarabhai is always in flux (Starbird, 2003).

The ground floor is divided into two sections, demarcated by the open veranda and the car park in the center. Behind the deep verandas lie cave like spaces that become a welcome refuge during the summer days, as shown through a series of interior views in Figure 3. Living room, library, and studio space flow into one another and have adequate space for daily rituals and entertaining guests. The plan keeps the activity central in the house. The kitchen and servant spaces are separated completely from the main house and set somewhat in the same style to the east.

The first floor is mainly given to the outdoor roof garden, along with a covered loggia. The bedrooms on this level are located in the center, with living and circulation space surrounding them. This way, even the private spaces are surrounded by more public areas, and thus echo the lifestyle of the region, where self identity is seamlessly in flux with the larger identity of the family. The individual is always seen in relation to the collective group. Le Corbusier was able to translate these cultural nuances he picked up while in India into the villa. One can note that the only exception to the collective rhythm of the house is extremely private interior space. Three bathrooms are juxtaposed, breaking the powerful order of the parallel brick walls to emphasize the privacy of these rooms.

Figure 2. Sarabhai Villa Exterior Views. a) Front view with toboggan slide; b) Front view with pond; c) View of entrance and stairs leading to roof; d) side view of second story with spout detail; e) View of Verandah space at front of house with doors open; f) Glimpse of house from verandah area looking through sliding door; g) View of verandah space in front of house; h) Two views approaching house from back drive-though.

Figure 3. Sarabhai Villa Interior Views. a) Verandah space drawn into retreat by covering with screen. b) Vaulted ceilings with mechanical fans. c) – h) Views through the interior spaces highlighting openness with definition.

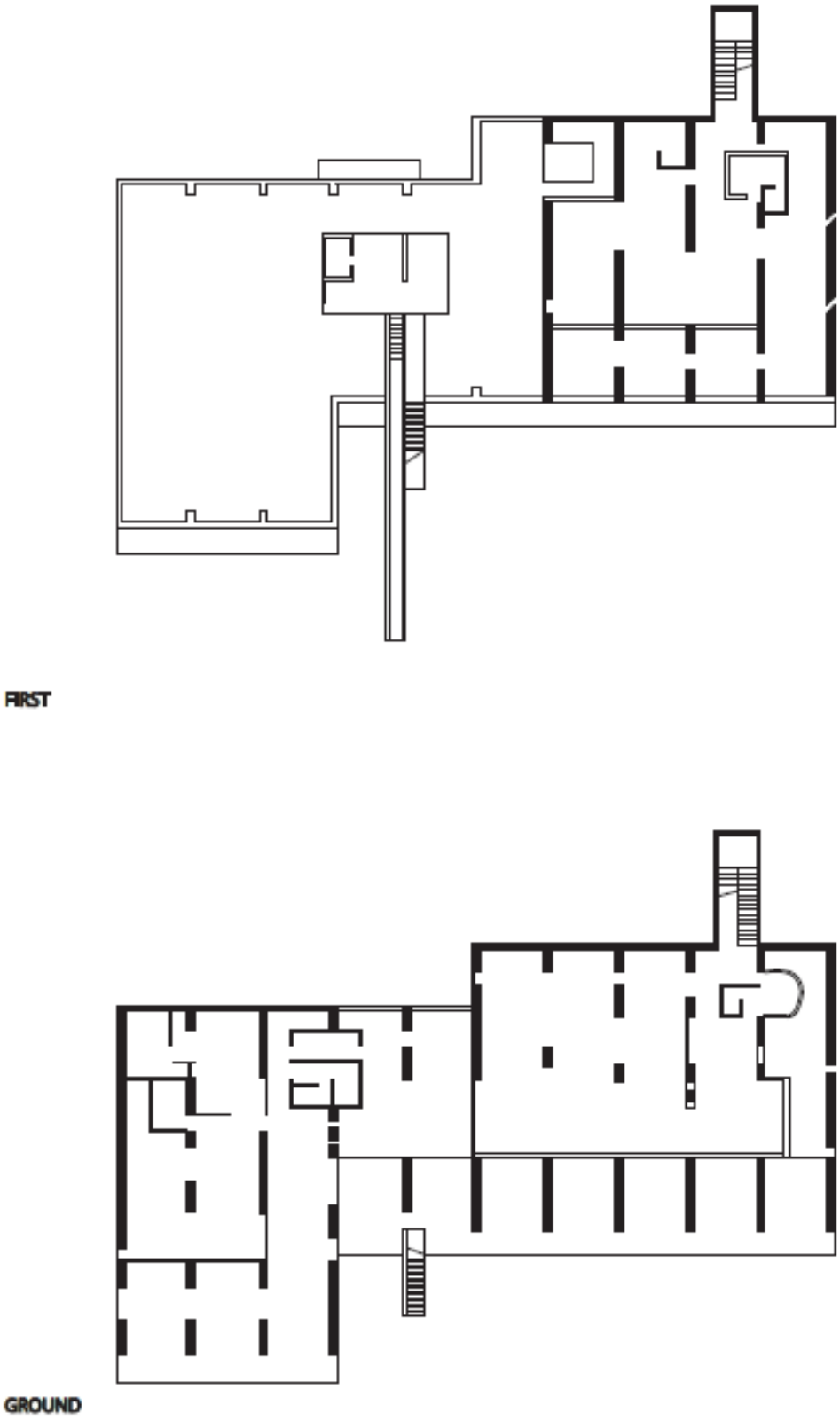


Figure 5. Plans, Sarabhai Villa.

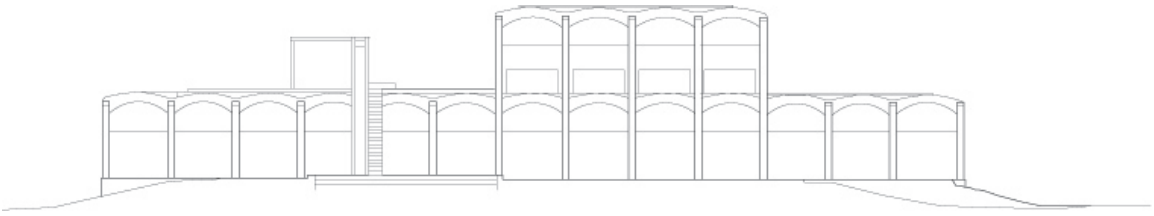


Figure 6. Southwest Elevation, ‘Front Elevation’

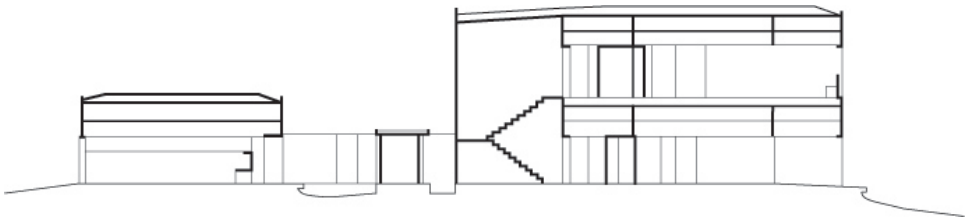


Figure 7. Section showing the main double story portion of the house through the stairs and the servant quarters in back.

Maison Jaoul

Figure 8. Maison Jaoul. Aerial View.

Le Corbusier in his late career more than ever addressed the balance between responding to the modern era with the industrial aesthetic versus creating an intimate space which addressed the dweller's desire for comfort (Maniaque, 2008). He experimented with extremes in his vocabulary, using forms and textures that may seem to others as 'unrational', 'personal', and 'anti-mechanistic' (Stirling, 1955). In fact it involved a practice of a 'master' employing his grand skills in his liberated maturity, not having to confine his work within the limits of a typical modernistic grammar (Futugawa, 1956).

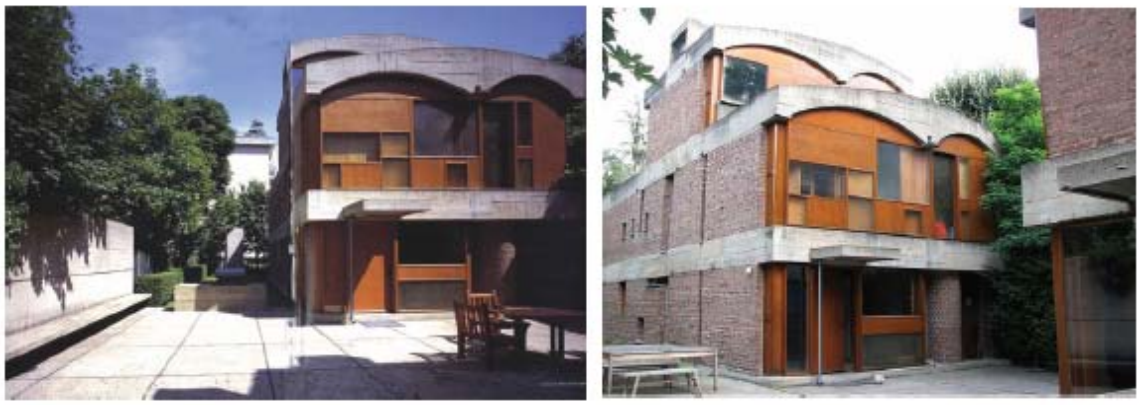
In 1951 he agreed to design two houses: one for his friend the industrialist Andre Jaoul and his wife, Suzanne (House A), and one for their eldest son, Michel and his wife, Nadine (House B). The Maisons Jaoul was built in a leafy suburb of Neuilly-sur-Seine

just outside Paris, on a rectangular site that is adjacent to the street on one side. Completed in 1955, the two houses are set at right angles to one another. The two volumes made of concrete and brick with rugged wall surfaces was carefully placed in the plot according to the nature of the site, the attempt to create private outdoor space as well as sophisticated indoor spaces that were connected thematically yet separate showed a concerted effort to create livable spaces where the needs and aspirations of these two families could find satisfactory expression. A series of exterior and interior views are shown in Figure 9 and 10.

Le Corbusier was accused of being an internationalist, but in fact as James Stirling points out, he was one of the most regional of architects. The structure of Maisons Jaoul is load bearing, with brick cross-walls, which implies cellular planning. However, the primary visual reading from the houses is that of the massive concrete, Catalan vaults that occur at each floor level. The vaults, as originally intended, were covered with soil and grass to resist thermal expansion, and patterned with timber shutter boards set to leave impressions in the concrete. Internally one inch solid steel tiles were positioned at approximately fifteen foot centers to resist diagonal thrust into the brick walls (Stirling, 1955). Overall the site shows a narrow walkway that slopes up from the street to a shared patio. The buildings are consciously placed with strategic setbacks from all property lines, except to the south where House A abuts the wall of the adjacent building. The resulting is a sequence of increasingly outdoor private spaces (Maniaque, 2002). Circulation is on two levels and of two kinds. Cars drive straight off the road into the garage, a large underground cavern from which separate stairs rise through to each house. Walking circulation is above the garage on what appears to be natural ground level which

in actuality is a raised terrace on which the houses stand. Rising from the underground garage through to the top of each house are cast in situ dog-leg stairs that confine vertical circulation towards one portion of the house, away from the main open living space (Stirling, 1955). The private spaces are removed by a floor change, and thus, unlike Sarabhai Villa, creates a clear separation between individual space and time versus collective space and time.

House A contains a double height living room on the ground floor. The first floor features two bedrooms and bath along with office and chapel, and the third floor has two additional rooms. House B on the other hand has no double height space, due to the requirement of having four bedrooms on the first floor, each with bathroom. The second floor is devoted to an artist's studio and a small bedroom (Seulliet, 2002). There is an overall static quality to the house, due to the lack of rhythm and repetition. The perception of the limits of the house is a difficult one to comprehend. Fragmented walls coated with primary colors emphasize the geometry and built in furniture pieces like sculpture interrupt lines of sight and draw the eye to the "mark of the inhabitants" (Maniaque, 1988).



a. b.

c. d.

e. f.

Figure 9. a)-b) View towards House A entrance. c) View of House B, adjacent to its main entrance. d) View of House B from top of House A. e) View of House B, capturing entrance and adjacent side. f) View of House A from House B.

Figure 10. a) View of House B interior from double height space. b) Bedroom in House A. c) View of House A towards double height space. d) Looking towards stairs from double height space in House B. e) House A main living. f) House B view towards stairs from entrance.

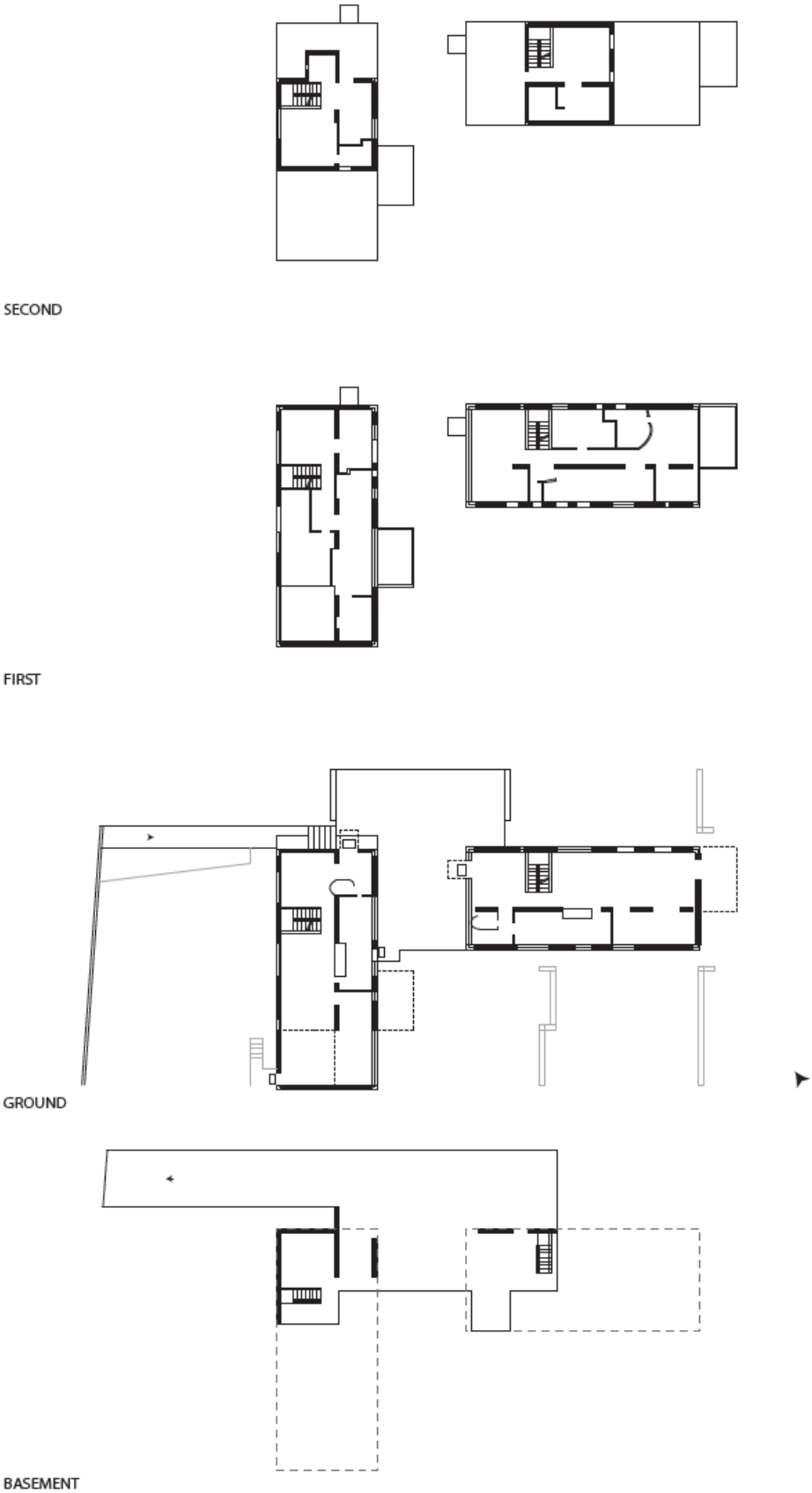


Figure 11. Plans., Maison Jaoul.

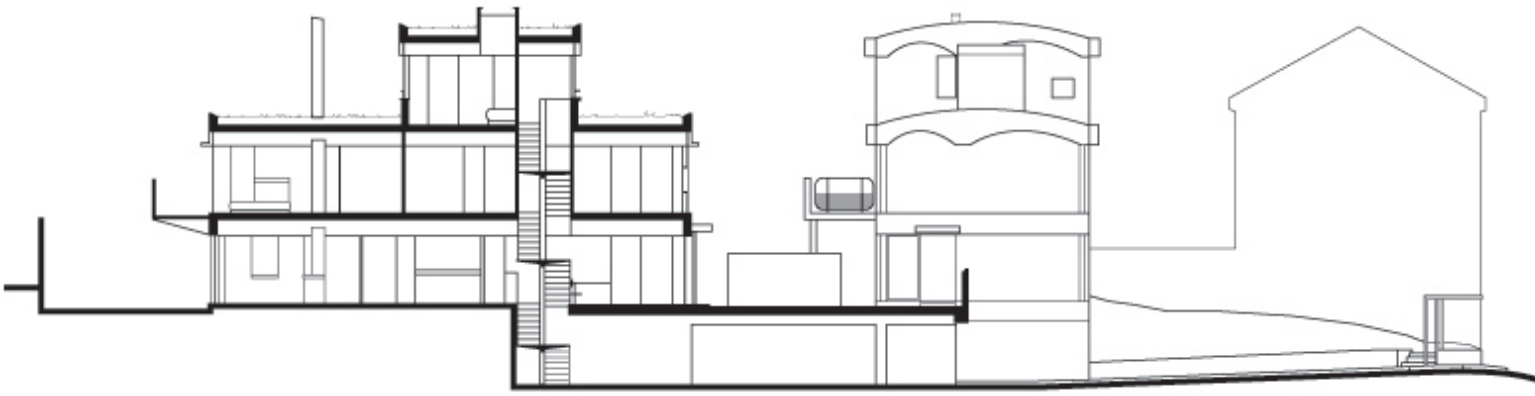


Figure 12. Section through House A looking south.

CHAPTER 3

PROPOSAL

It is impossible to get into an architect's head and know for sure how Le Corbusier designed the houses, what came first and so on. However I propose a way of thinking though shape grammars that catalogues a sequence of changes and captures architecturally intuitive means of building the houses. The rules will recreate the houses and also others that are in the same language. Once the grammars are produced for the two houses, I will transform them and analyze them using space syntax techniques. Changes made in one point in the grammar will produce controlled derivations. Looking at different iterations through the transformed grammars will help identify critical and essential moves in the houses.

The design portion of the thesis includes exploring and identifying interior conditions that define modern arrangement of space. Experiments done with shape grammars will allow me to find out which changes produce the most drastic changes and have the largest syntactical implications (would change social interactions). Thus, I can create iterations that would be suitable in different contexts, climates and perhaps even for different clients and in 'different outer shells'.

What is Shape Grammar?

Shape grammar is a way to understand spatial arrangement of shapes. It performs computation with shapes by making rules that are repeated or combined to create new products from shapes. These rules involve two steps, recognizing of a shape and replacing it with another. The result is a series of rules that produce a language of shapes. The rules are generative, and allow the formation of complex spatial arrangements, but

the rules are also descriptive, intuitively connecting how space is made through juxtaposition of shapes. The goal of the rules is to describe spatial forms; this approach can be used as a tool to design by generate shapes and spatial relationships and also can be used as a powerful tool to analyze and understand existing spatial conditions.

As suggested by Stiny, Shape Grammar is useful as a generative tool. This approach has three stages. First a finite vocabulary of primitive shapes is given which fixes the spatial elements that are to be used to make other shapes. Second, using the shapes in the vocabulary distinct spatial arrangements that are allowed or rules of how one shape occurs with another are enumerated. Third, the vocabulary and spatial relationships are used to define shape grammars. These rules generate shapes made up of shapes in the vocabulary in accordance with the spatial relations.

Shape Grammars, is also a powerful tool to analyze existing compositions. This formal exercise consists of beginning with a given arrangement or arrangements of certain spatial elements and constructing or identifying additional arrangements of these elements that are in the same style (Stiny 1976).

Shape Grammar is a visual methodology that formally analyzes existing relationships and serves to catalogue spatial characteristics. I intend to look at architecturally expressive qualities in Le Corbusier's work, such as having rhythm, being open, sheltered, and to associate rules with them. The process of formalizing expressive qualities will begin to create a catalogue of techniques that can be used to identify architectural intentions in other projects or convey similar intentions in one's own future designing endeavors. Additionally by analyzing the houses, I hope to reveal Corbusier's

forms and methods utilized in the Monol building type as a sophisticated gesture that took modernistic techniques into a higher stakes arena of the vernacular.

Why Shape Grammar?

Shape Grammar is a useful method to employ with Le Corbusier's collection because the intention is to unpack a prototype that was put forth through his architectural works. Since the Monol housing type is considered a prototype there is inherently a language of design that is present. There are certain characteristics and methods associated with that prototype that shape grammars will help reveal because it can deal with spatial characteristics at various scales.

In order to fully understand a design or strategy it is essential to understand it and also reproduce it. One must be able to produce rules that generate new instances in the same style. Shape grammar is advantageous because rules do not have to stand alone. Similar to grammars developed for the Frank Llyod Prairie houses and Casa Frigerio the grammars have a growth that depend on contextual cues and guidelines. This approach is useful in understanding composition which is incomplete without being keenly aware of juxtapositions and patterns. The process of understanding comes into fruition when rules are modified from being open ended, to having restrictions. It is these restrictions upon the grammar rules that make it unique and hold the key to understanding design logic.

Once a grammar is in place, it helps guide experimentation with spatial features. The iterations are controlled derivations in the sense that a methodology and sequence of producing the house is in place, thus changing one rule has either cascading affects down to other rules only affects that one rule. The grammar will provide the user with a stable

platform on which to experiment and introduce change while staying true to the original inquiry.

How to Use Shape Grammar?

The process of creating a grammar will unpack relationships and key moves Le Corbusier made. An awareness of them will emerge as rules are created tried and adjusted. The formal exercise will then serve as a framework or backdrop to change spatial relationships to create results that were or were not anticipated.

The first step to create my own shape grammar involves revisiting the drawings of the house and drawing them according to the detail desired. These drawings can be seen in Figure 5 and 11.

The type of grammar I will be creating will be a loose parametric grammar, meaning rigorous parameterization will not apply. In order to create a generative grammar, to help bring rules of composition into better understanding there are some key shape grammars published in the past that contribute meaningful insights.

The Language of the Prairie: Frank Lloyd Wright's prairie house by Koning and Eizenberg begins to think in an architecturally intuitive manner when constructing the grammar as it associates its initial shape with the fireplace or hearth of the house. Zones that define programmatic elements are added from there in subsequent rules attempting to follow Wright's own prescription for creating prairie style houses. Once the core unit has an established axis of growth, shape rules provide ways of combining to generate basic compositions. Figure 13 shows basic compositions that can be derived using the first set of thirteen rules. Once the basic form has been established, it can be elaborated with further sets of rules to produce more complete designs (Koning, 1981).

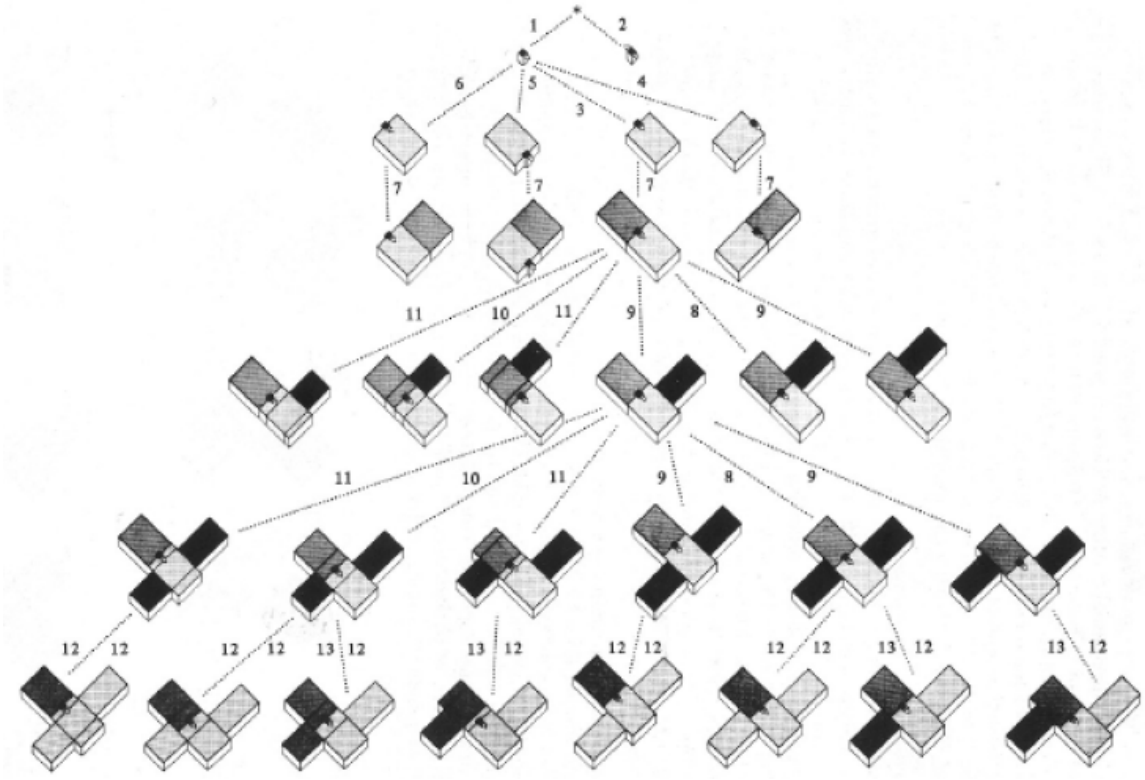


Figure 13. Different combination of forms can result from an initial shape that first establishes the fireplace as the point of growth.

Knight defines the general language of Japanese tearooms called in his grammar called Forty One Steps. He captures centuries old way of space making into a parametric shape grammar. He beings by forming the ‘ken grid’ as a basis for tearoom plans. Once that is established it then incorporates architectural features like walls, alcoves and further details. I will use the concept found in this and other grammars of first establishing a parti or grid on which then I begin to enrich with architectural features like walls, windows, etc. One thing to also take note of is the layers of labels created in the grammar that allows one to have a point of reference to articulate stage changes, and define relationships of upcoming elements such as entrances, corners, alcoves, etc. The

following figure shows an example of a derived grid plan for a tearoom going into the next stage of placing a wall which is allowed by a rule that uses certain labels present.

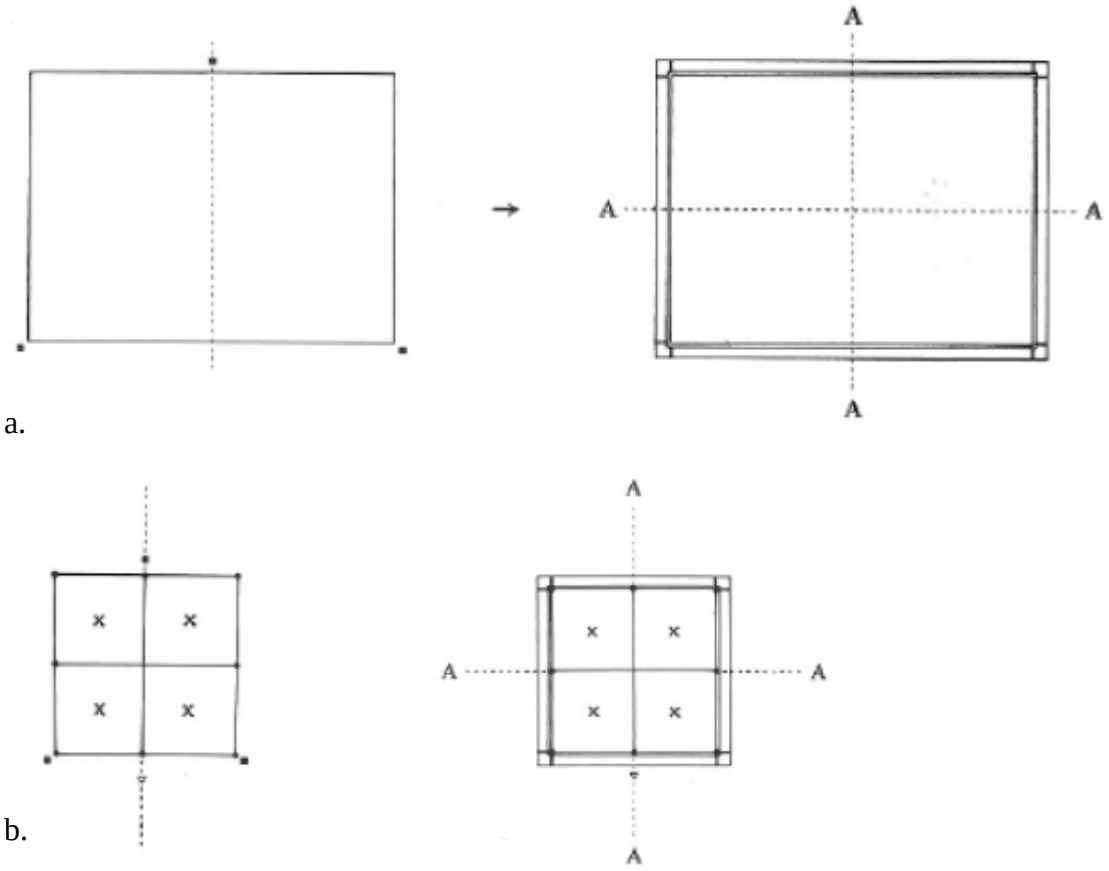


Figure 14. a) Rule that allows wall placement on a grid. b) Shows that rule being applied to a grid.

This sequence is also seen in the grammar unpacking Casa Giuliani Frigerio by Flemming. The rules are arranged in different stages that take the composition from one level of detail to the next. The initial shapes sets up a series of rows and columns which can be added to using one rule, as shown in the following figure.

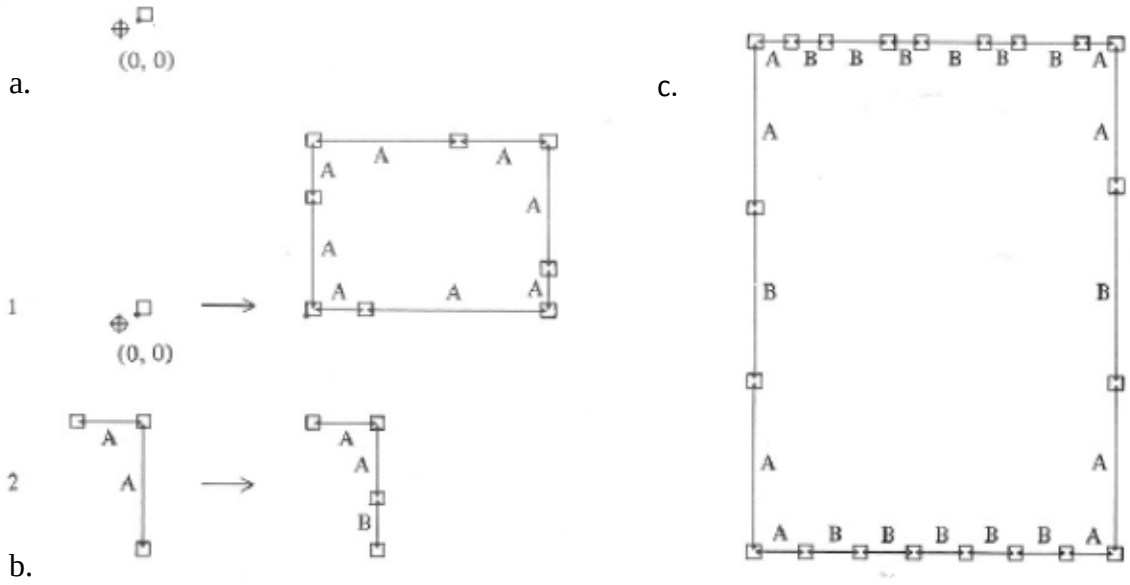


Figure 15. a) Initial shape. b) Rule 1 and 2. c) Resulting shape after several applications of Rule 2.

Wall development in this grammar is also of particular interest, and like the previous grammar explained, it established a layer of labels that allows different possibilities to be articulated.

CHAPTER 4

VILLAS UNPACKED

To begin forming the grammars, I look towards the plans for clues about important features and characteristics.

Sarabhai Villa has several important features that I wish to capture with my grammar. The two main units of the house are joined by an ‘anchor piece’ which is where entrance by foot or car takes place. There is secondary access to the outside through the verandah space which has doors that can open or close. The most private spaces (bathrooms) read as data marks on a sheet and break the anomaly of the parallel vaults by being inserted in the middle of the space. The bedroom on the second floor is situated in the middle of the plan allowing potential circulation paths around it.

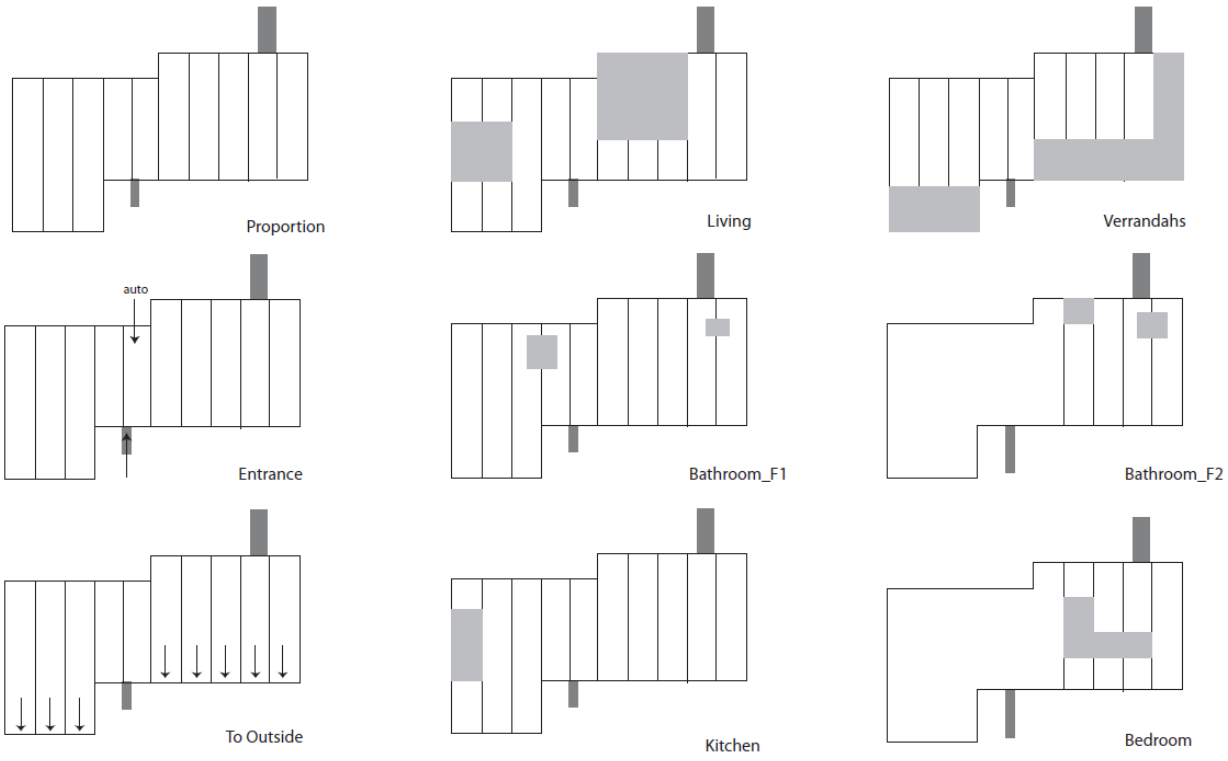


Figure 16. Sarabhai Villa Diagrams

Figure 17. Maison Jaoul Diagrams

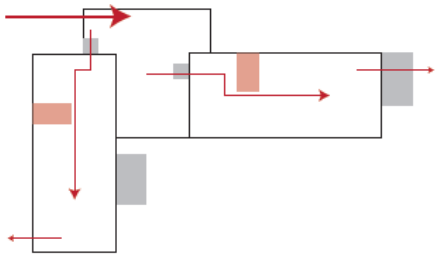


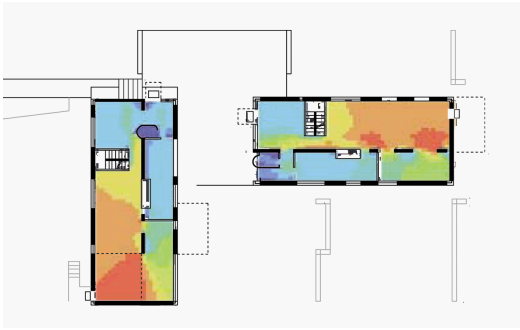
Figure 18. Maison Jaoul Circulation Diagram

The circulation diagram (Fig 18) of Maison Jaoul shows that the entrance and organization of the house emphasize the long proportion of the rectangle. Service spaces are also placed along side living space, which is not a traditional way to divide a house (with a front and a back).

Depth Map is used to generate a space syntax analysis of the houses. Two features are shown in Figures 19 and 20; connectivity and visual integration. Connectivity essentially refers to the most connected space shown in warmer hues and least connected spaces with cooler colors. Similarly red indicates high visual integration, meaning high degree of visibility to other parts of the house from one point.

By comparing the two houses we see that one enters into the most visually connected and visually integrated areas in Sarabhai Villa where as a sense of privacy is retained by entering into a space that has low connectivity and visual integration. In Sarabhai villa the sight lines are diagonal and produce sweeping perspectives across the parallel series, this is lacking in Maison Jaoul and rather there is strong segregation of service and living spaces.

a.



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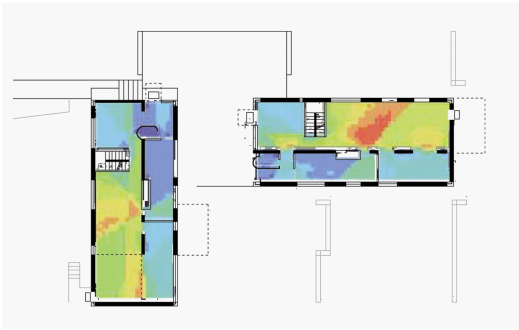
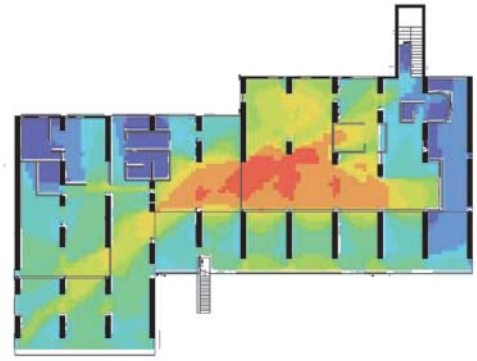
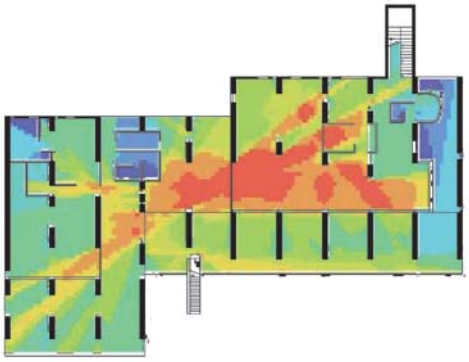


Figure 19. Maison Jaoul Space Syntax Analysis. a) Connectivity Diagram b) Visual Integration



a.



b.

Figure 20. Sarabhai Villa a) Connectivity b) Visual Integration

CHAPTER 5

THE GRAMMARS

The following grammars were produced after studying the aforementioned shape grammars as well as numerous iterations. The intent of each grammar is to capture distinct architectural qualities from the houses through major moves, and to be able to reproduce the original floor plan and numerous other floor plans that are in the same 'language'. Both grammars have four stages that allow development of the designs. The process begins as more diagrammatic and transitions into concrete ideas and conditions. Starting with 'Site Layout', the initial move tries to capture its orientation relative to an important feature on the site. In the case of Sarabhai Villa, wind and solar direction are integral part to the overall workings of the house. The vastness of the site at Sarabhai is contrasted at Maison Jaoul, which has very strict boundaries. Le Corbusier strategy here was to maximize boundaries of designed and usable space through juxtaposition of open and closed space; thus the beginning of this composition is at the property line and creates adjacencies from it.

The following stage of the grammar include Unit Layout, which takes into consideration how the form is divided and organized; rules here address location of stair and double height spaces as well as define the *parti* diagram. The 'Program' portion of this stage begins to locate functional differences. The grammar now recognizes lines not just as shapes but as space. The final two stages, Exterior Wall and Interior Wall definition, are where the shapes transform to have true architectural meaning and quality. Conditions like adjacencies, views, and function give depth to what before where simply

lines and shapes; one begins to see the consequences of what the exercise in shape making produced.

Sarabhai Villa Grammar

One can use the set of rules illustrated in Figure 21 to create numerous architectural plans that exemplify the language used in Sarabhai. Rules one through eight begin with a rectangle and create a composition on the site mainly through repetition with some shifting, and also adds a marking for what will become the entrance. Note the markings or symbols such as a,b,* , “, etc. They are important when determining which shape can qualify for having a rule applied to it.

Rules nine through eleven create a *parti* like diagram. This starts to differentiate zones in the rectangle unit, and also defines boundary conditions that contrast with ‘interior’ lines. Within each rectangular unit, a portion of it is given to what will eventually become the verandah. This shows that early in the process the interior-exterior relationship is defined and is an integral part of the overall composition. The intention is to create rules that capture the essence of the composition that will then allow one to confidently use the grammar to create other compositions that will speak the same language as the original.

Rules twelve through fourteen mark exterior spaces, and add the stair component. The program is added by rules fifteen through twenty-one. The living portion of the house takes up two rectangular units, where as other programmatic elements such as the study or bedrooms are limited to one unit. The kitchen on the other hand is associated with lines that are on the perimeter of the overall shape. Also note the locale of the program in the unit, which varies. Rules try to incorporate ‘memory’, in other words all

rules cannot be applied ubiquitously. The rules remove or change symbols that affect what rules the resulting shape or portion of the plan can qualify for. For example in rule 17, adding a ‘S’ (study) removes the symbols ‘x’, therefore that portion can no longer go through rule 15 or rule 21. Thus the living area cannot coincide with the study or library but it may be adjacent to it.

Stage three addresses exterior wall conditions, some of which use programmatic elements as cues. Thus the happenings on the inside affect boundary conditions. Interior walls in the final stage take into account sight lines. Through analyzing the houses earlier, I determined that this was an important feature in the house that allowed for increased visual integration. The intense rhythm created in the Sarabhai villa in not brought alive through perpendicular views; rather it is the cuts that cross the parallel lines that create intense perspectives. In order to create and recreate this phenomenon through rules, zones were determined in relation to program and physical markers. Rules 35 and 36 create zones, and rules 37 and 38 call for the sight lines that pass through these zones. The final rules further detail interior walls according to program.

The main concepts communicated through the Sarabhai grammar are composition through repetition, integration of interior and exterior space into each unit and internal perspectives that create sight lines and influence movement within the house.

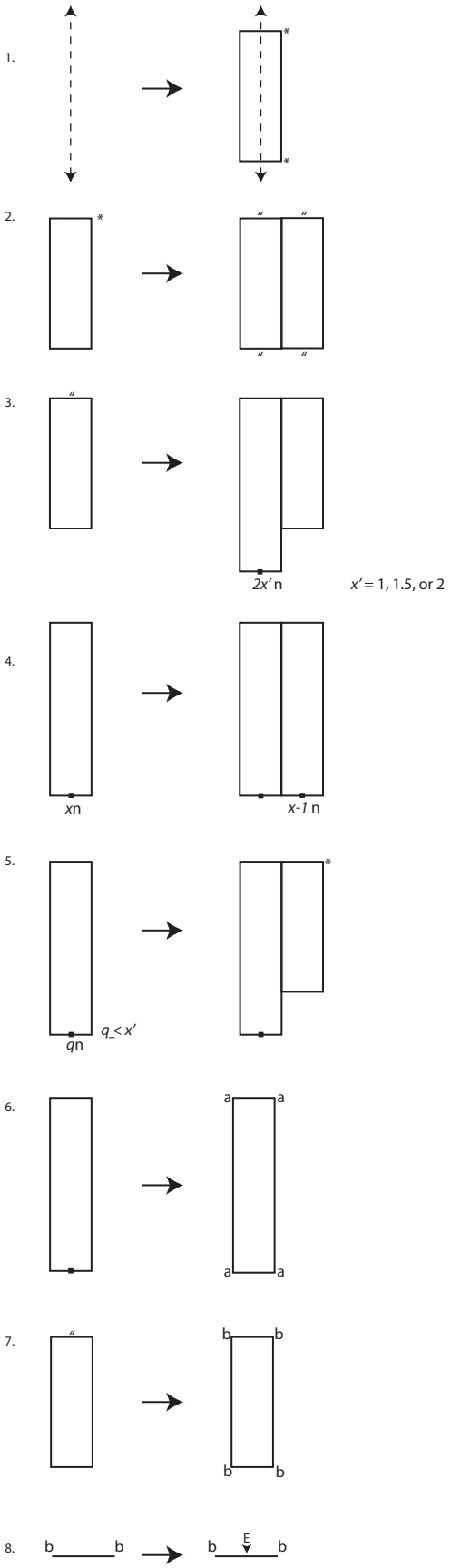
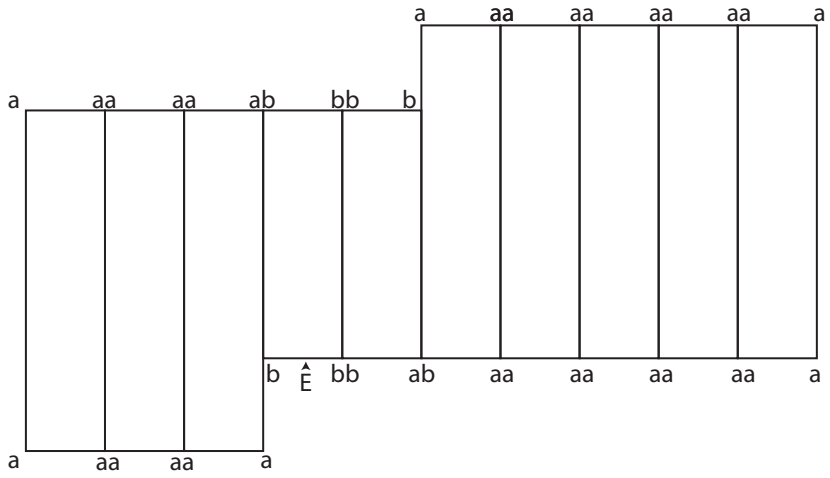


Figure 21. I. Site Layout
Sarabhai Villa Grammar rules 1 through 8.



Example
1,2,3,3,4,4,4,4,4,4,6,7,8

Figure 22. Example of the result of using rules 1 – 8 in a specific order.

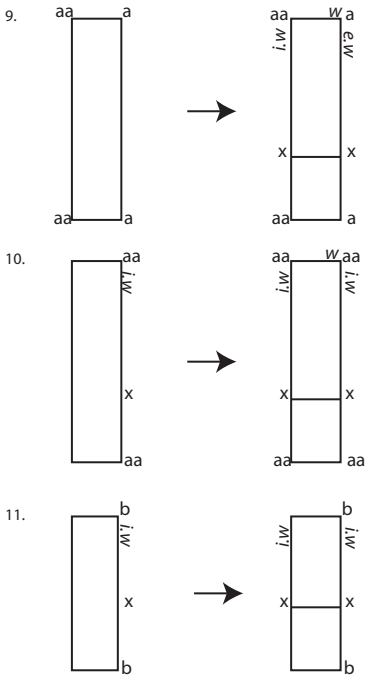


Figure 23. II. Unit Layout.
Sarabhai Grammar rules 9 through 11 creates the parti .

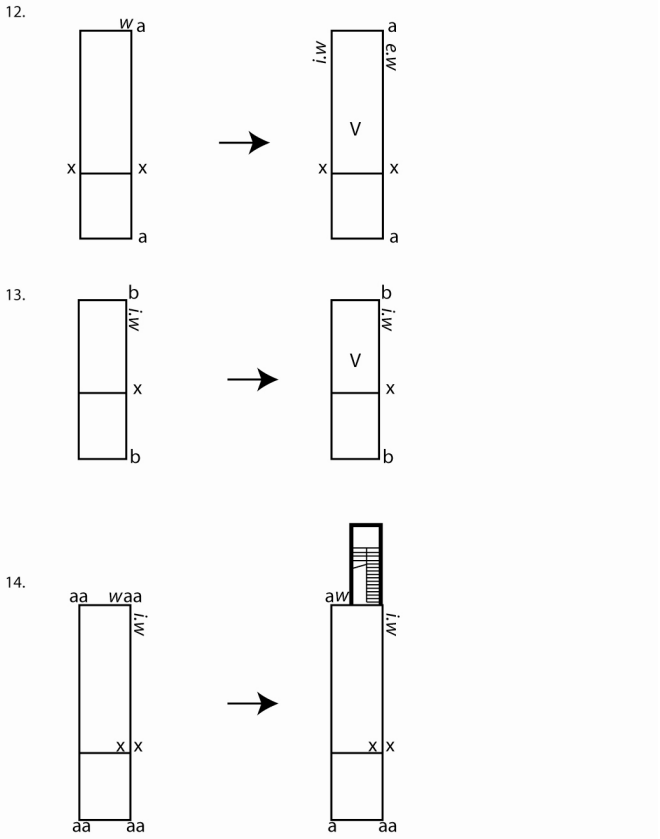


Figure 24. Rules 12 though 14 determine conditions such as verandahs and circulation.

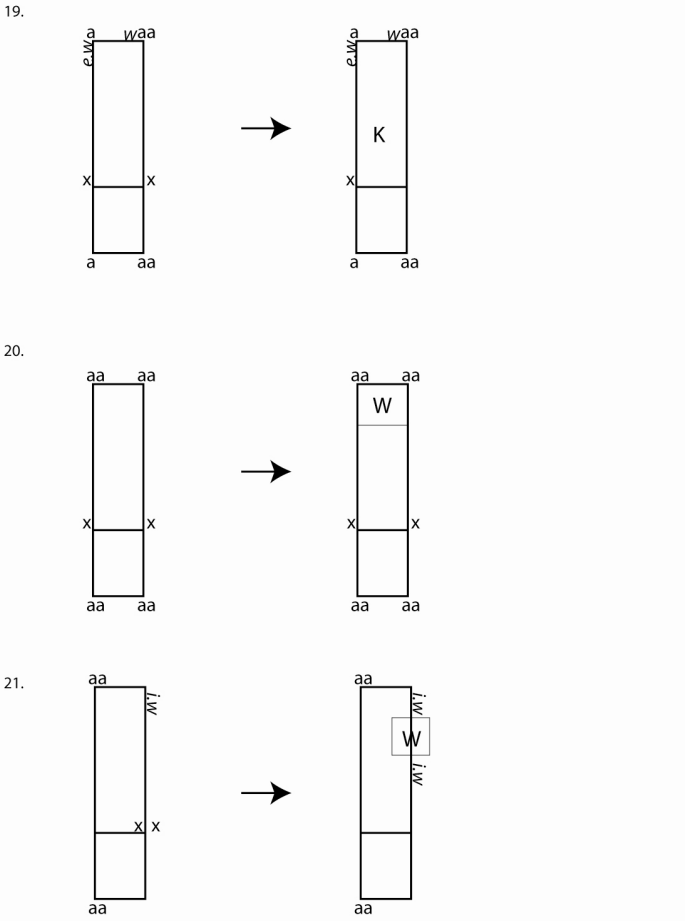
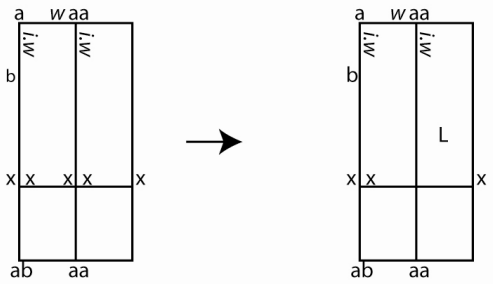
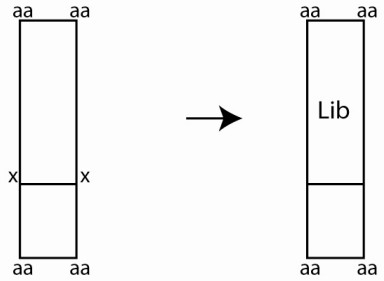


Figure 25. Rules 15 through 21 are responsible for program.

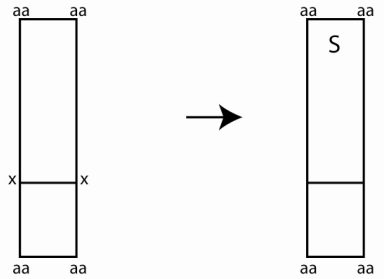
15.



16.



17.



18.

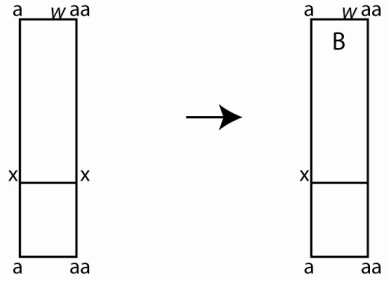


Figure 25. Continued.

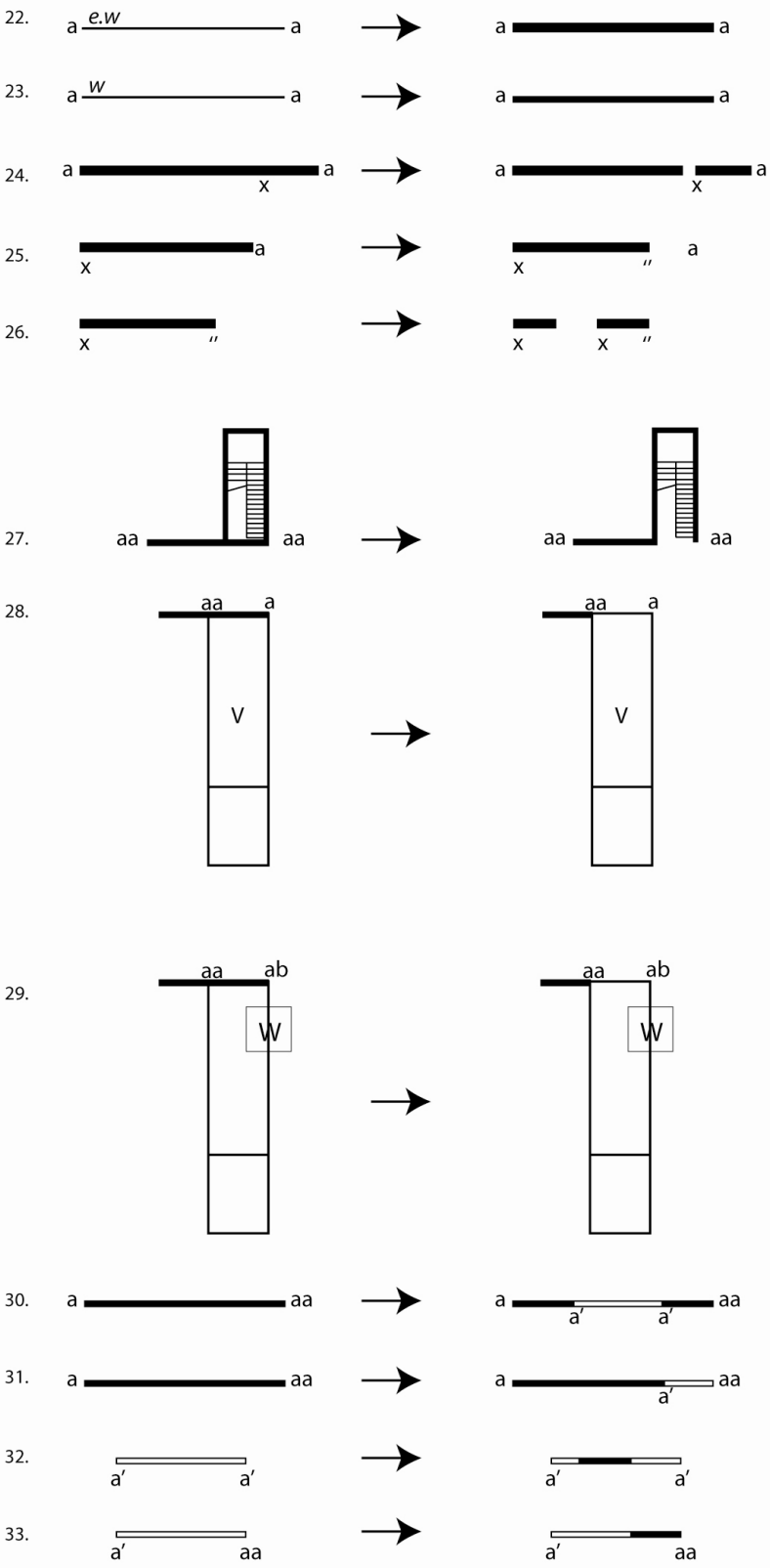


Figure 26. III. Exterior Walls. Rules 22 through 33.

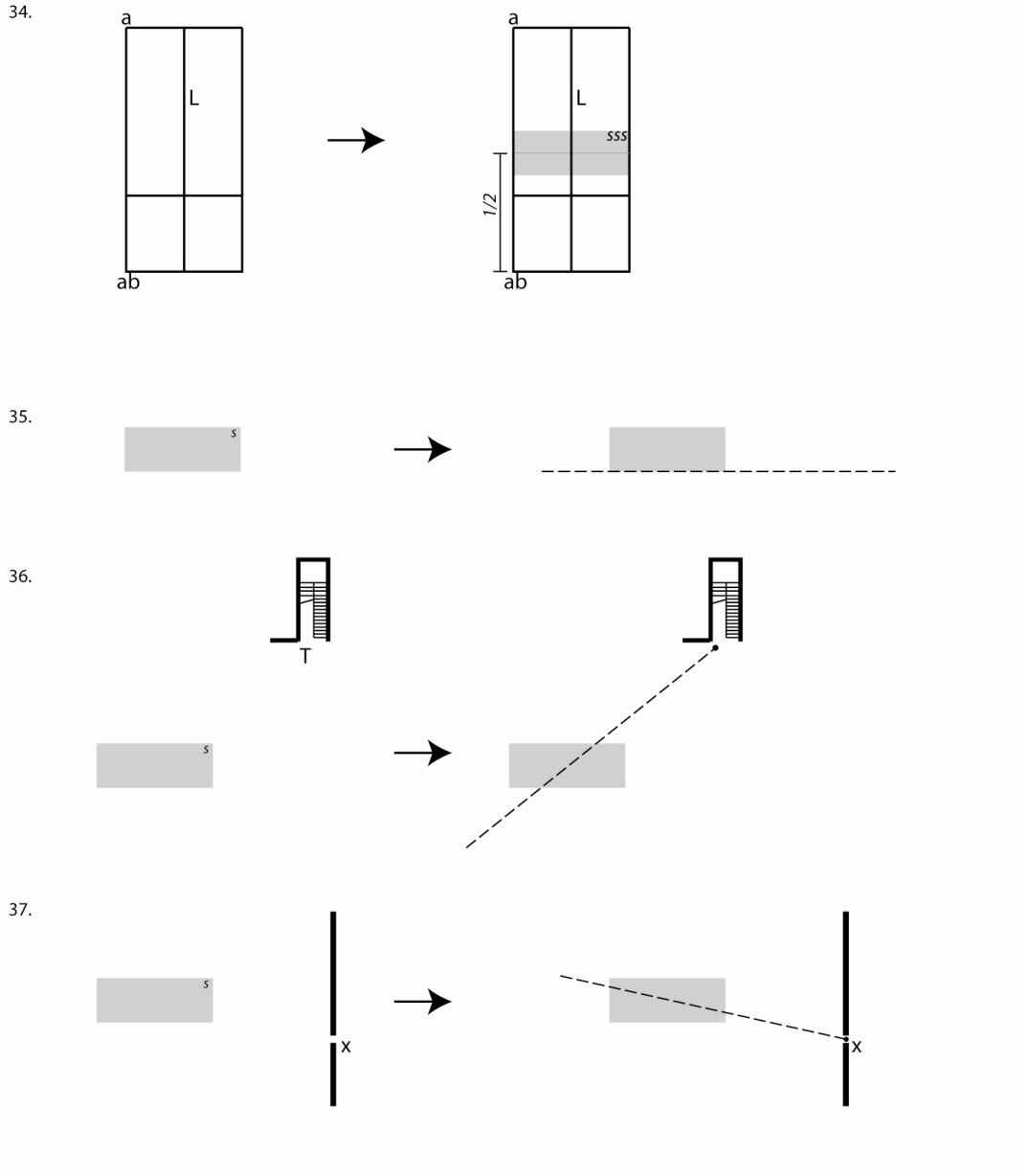


Figure 27. IV. Interior Walls. Rules 34 though 37 create site lines which can be defined later.

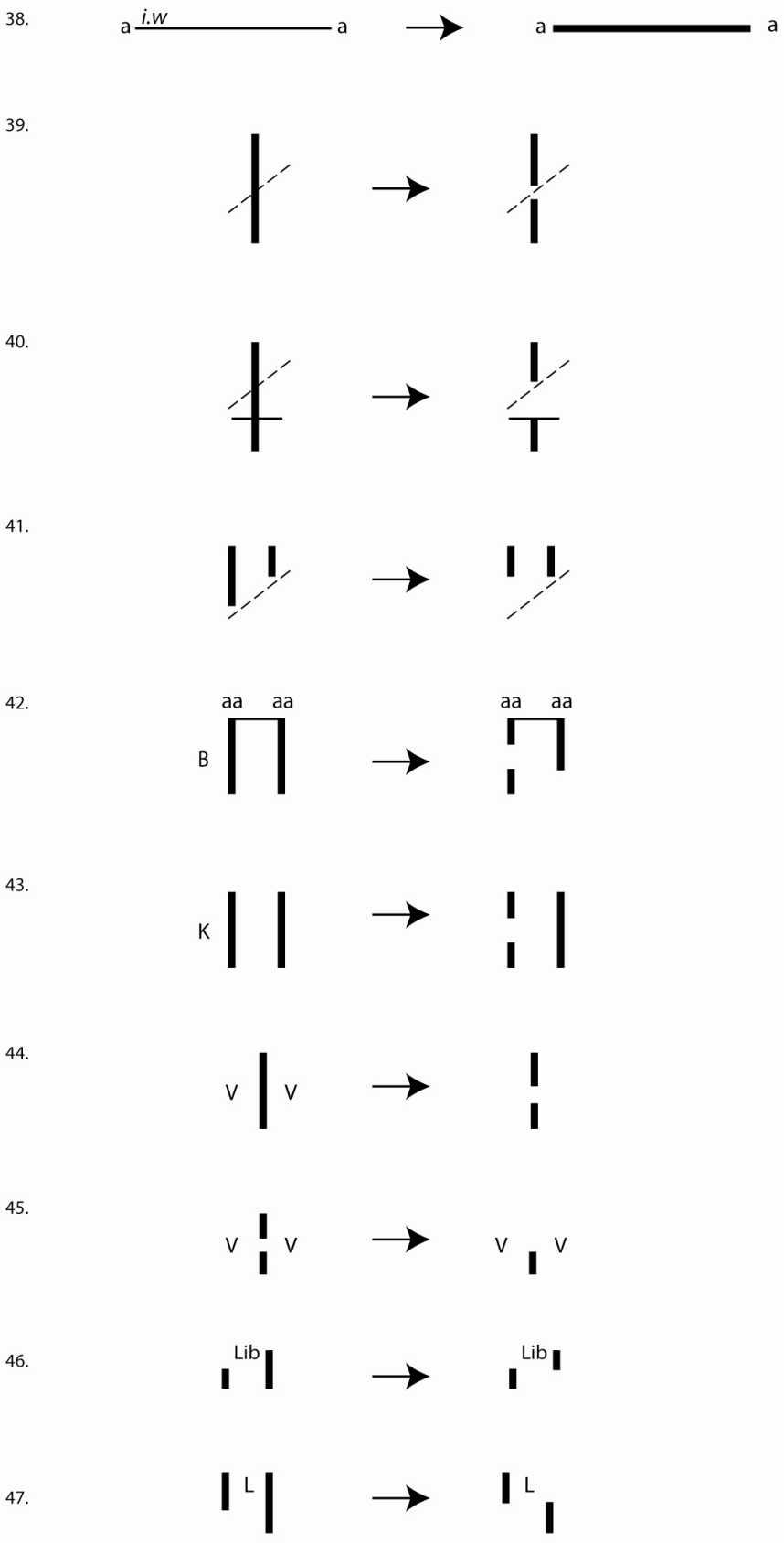


Figure 28 Interior wall definition. Rules 38 – 52. After using these rules, all symbols such as dotted lines, letters and * can be removed.

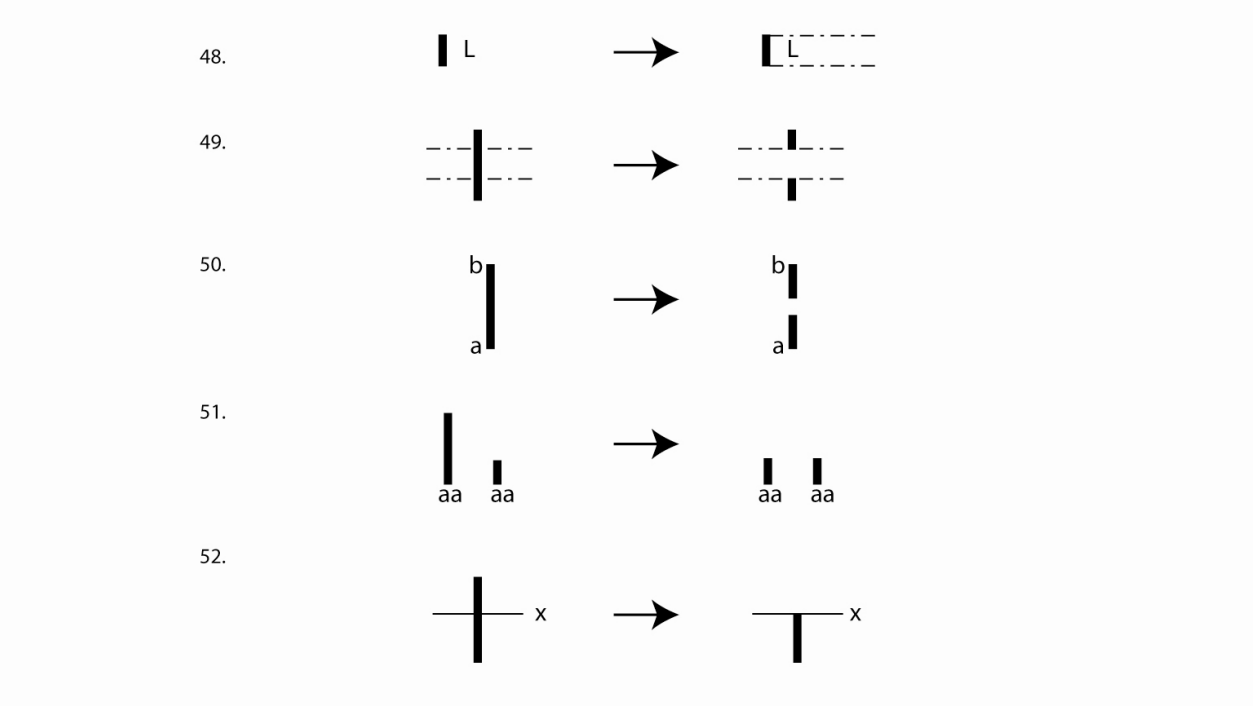
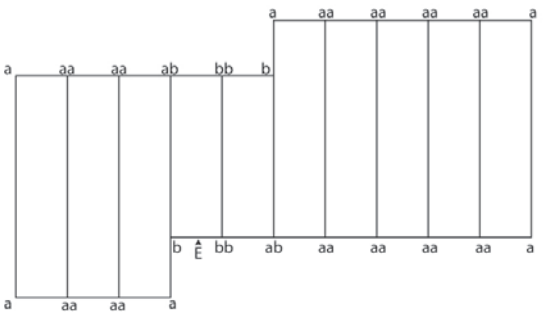
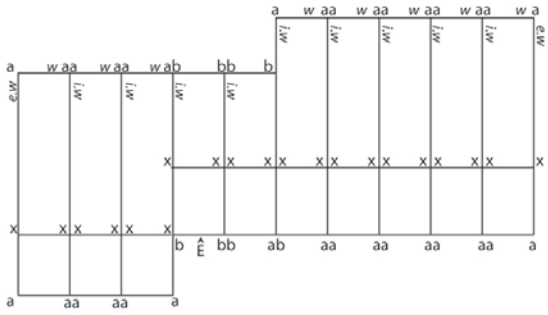


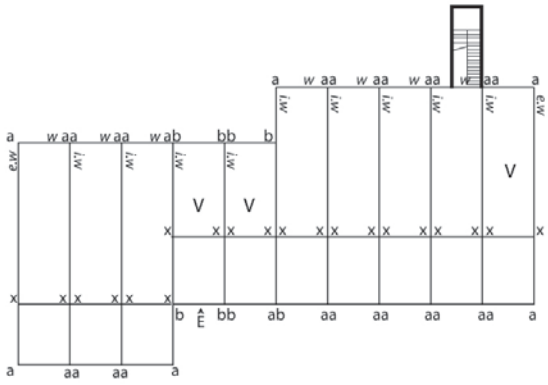
Figure 28. Continued.



Rules applied:
1,2,3,3,4,4,4,4,4,4,6,7,8

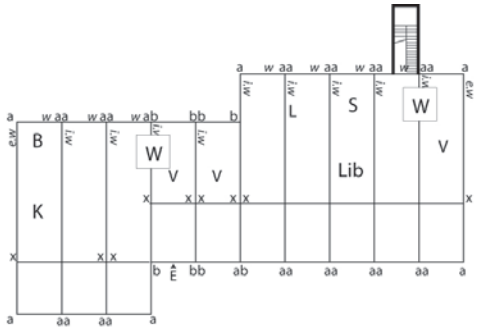


Rules applied:
9,9,10,10,10,10,10,10,11,11

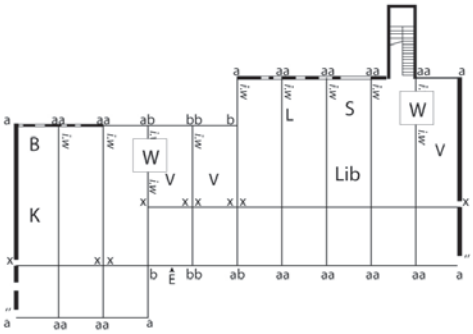


Rules applied:
12,13,13,14

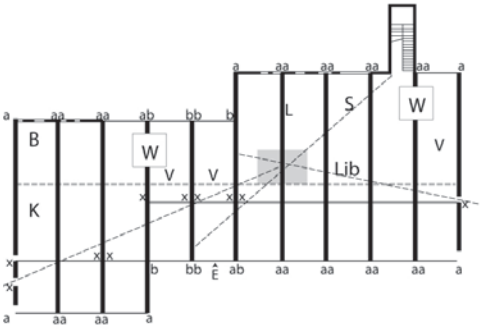
Figure 29. Using the rules to re-create Sarabhai Villa.



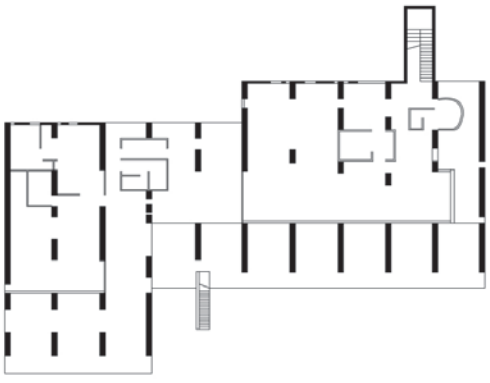
Rules applied:
15, 16, 17, 18, 19, 21, 22



Rules applied:
23, 23, 24, 24, 24,24,24,24,24,24,
26, 26, 27, 27 28, 29, 30, 31, 32, 32,
32, 32, 33, 33, 34, 34



Rules applied
35, 36, 37, 38, 38



FINAL

Figure 29. Continued.

Maison Jaoul Grammar

After looking at the Sarabhai Villa closely, one can instantly recognize a similarity in Maison Jaoul. However, Le Corbusier treats the rectangular units that create this composition a very different way, as I found out going through the process of creating a set of rules for Maison Jaoul. Basic shapes begin this grammar as well, and are arranged with thoughtful consideration to area, juxtaposition, and structure. Figure 22 takes one through the Maison Jaoul Grammar.

The initial stage takes into consideration the site. The symbol '^{o}' is placed along the edge of the buildable area. It can be anywhere along the length of the edge except for the middle 1/5th. The square is a common patio space that no more than two units will share. Rules two onward begin to place units. In the instance that the width of the site is within reasonable range, the unit can span the site and its short side placed on the edge of buildable area. Rules apply the label 'n' which add a temporal quality to the rules and resulting shapes when treated in an algebraic manner. 'x' refers to any integer, 'k' is any odd integer equal or less than 3, 'p' is any even integer. Rules two and three subtract 1 from any integer in front of 'n'. Thus 2n will become the label n (with integer 1), n will become 0 n therefore it will remove the label, and stop the application of rules.

In rule four, an identical shape is added perpendicular to the initial shape, however note that the label shifts from the initial shape to the one that was added. Once k reaches 3, it will not be possible to apply rule four at that location. The application of rule four will not be possible in tandem at the same location; in order to continue a patio space must be added, as shown by rule five. Rule six is a termination rule for the stage. Once

rectangular shapes have rule six applied on them, they are ready for the ‘Unit Layout’ stage.

Dividing the interior space in a proportional manner create the *parti* for this composition. Rules ten through fifteen address the *parti*, where as rules sixteen through twenty-two are concerned with overhead conditions that will create threshold spaces at access points. Stairs in this composition are in contrast to those in the Sarabhai villa, here they sit perpendicular to the length of the rectangular unit. However in both cases, one can infer a structural intent, whether it is resting on internal structural supports making up the house or the perimeter like in Sarabhai villa.

Rules twenty-three to twenty-nine introduce limited program. The rest of the space function is left open in the grammar. As a ground floor level the original house has living, dining areas as well as the kitchen as prominent programmatic features, where as the upper floors consist of bedrooms and bathrooms. The unnamed space becomes either depending on which floor the diagram is fated to become. The last two stages like in the Sarabhai Villa, transform the diagram to actual architectural plan by adding exterior and interior walls.

A note when creating a multi-level composition: the *parti* of each floor is created in a similar fashion. The second level above retains memory of what is found on the ground floor; and the first floor is affected by threshold conditions which become concrete space on this floor, and the interior partitions also in part reflect the shifts in *parti* that might be seen floor to floor.

The main concepts that the grammar intends to capture are juxtaposition and efficiently using space. The relationship two units have to each other is explored further

in iterations where the composition is taken beyond just two houses, but infers what would happen if there were more house units added.

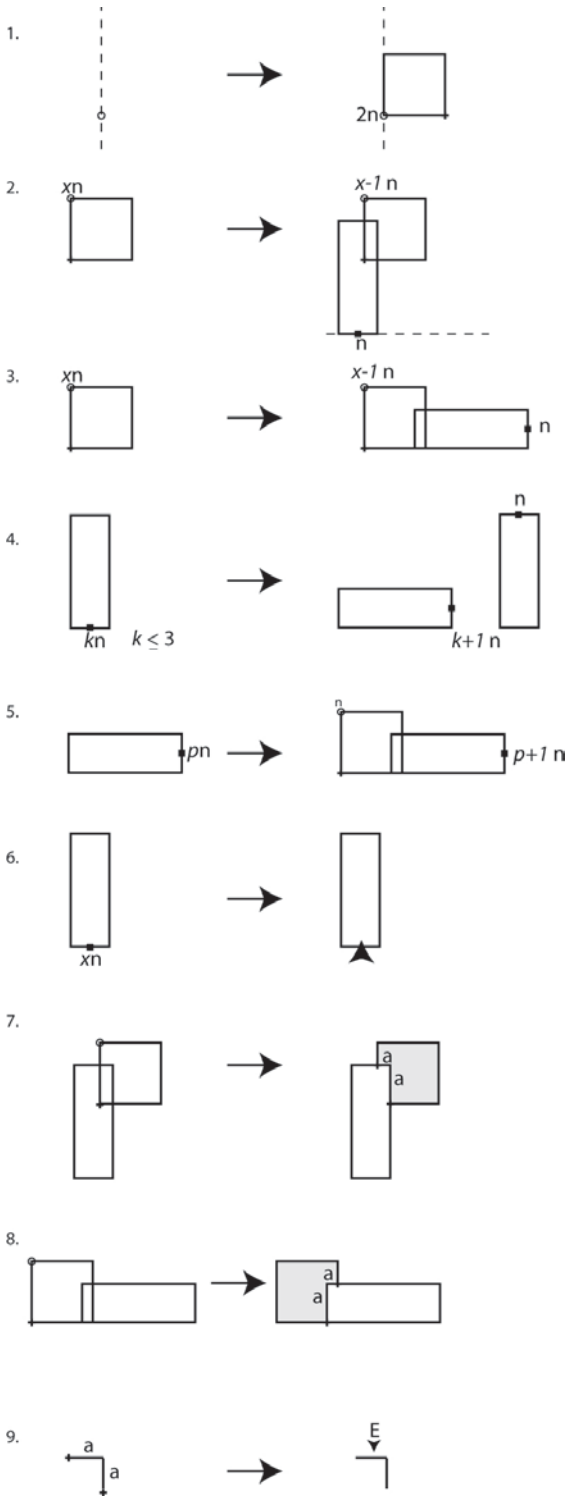


Figure 30. Grammar for Maison Jaoul. a) First stage: Site Layout

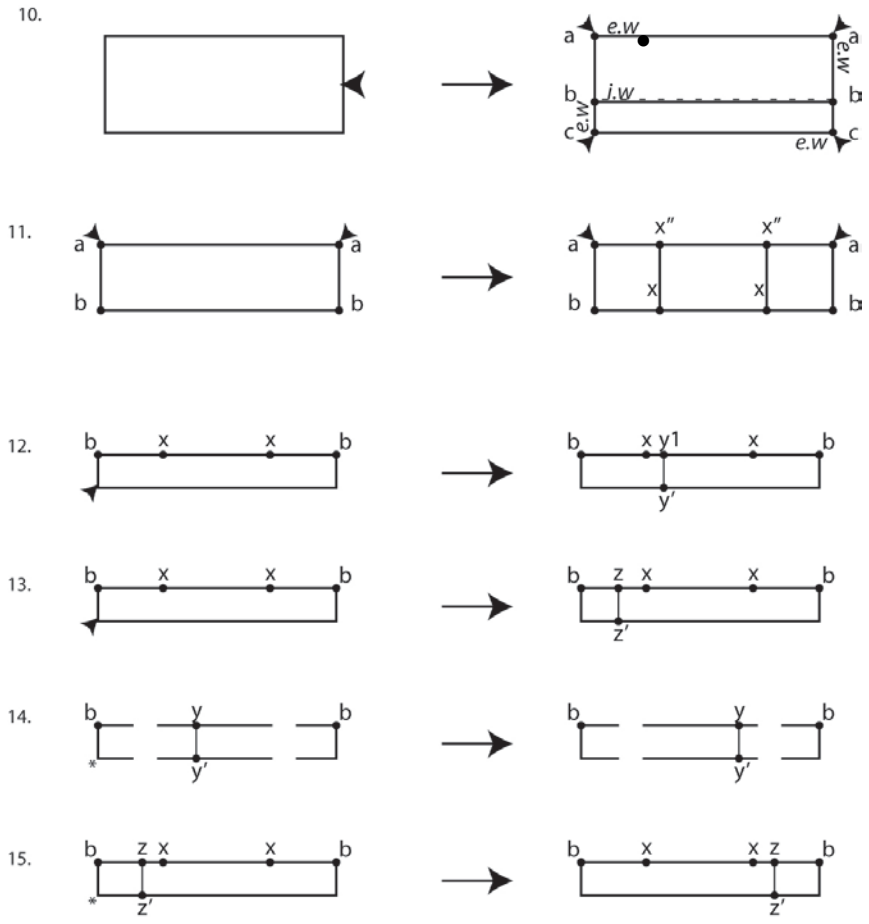


Figure 30 continued.b) Second stage: Unit Layout. Rules 10 through 15 help determine the parti.

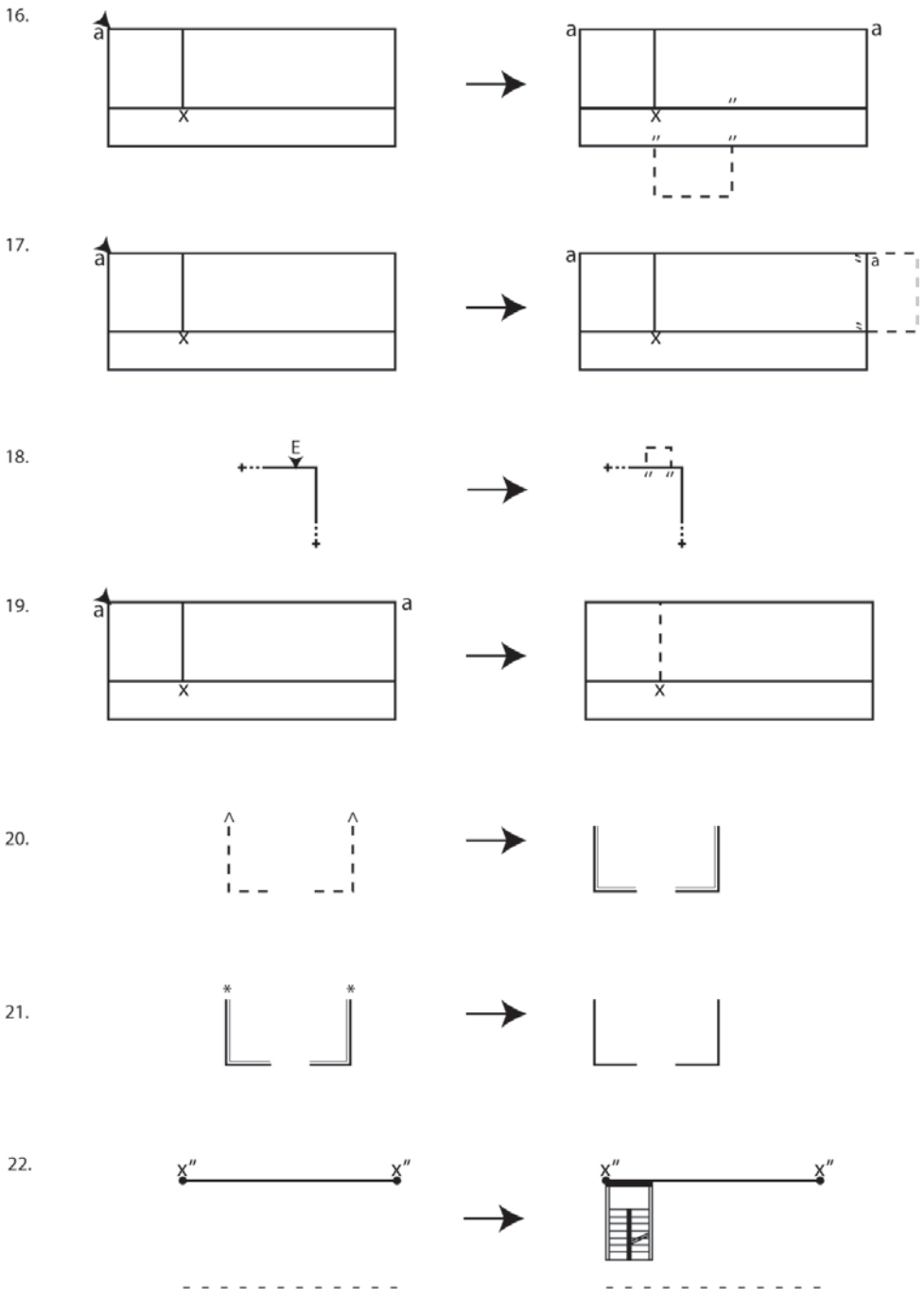


Figure 30 continued. c) Rules 16 through 22 introduce circulation and overhead conditions

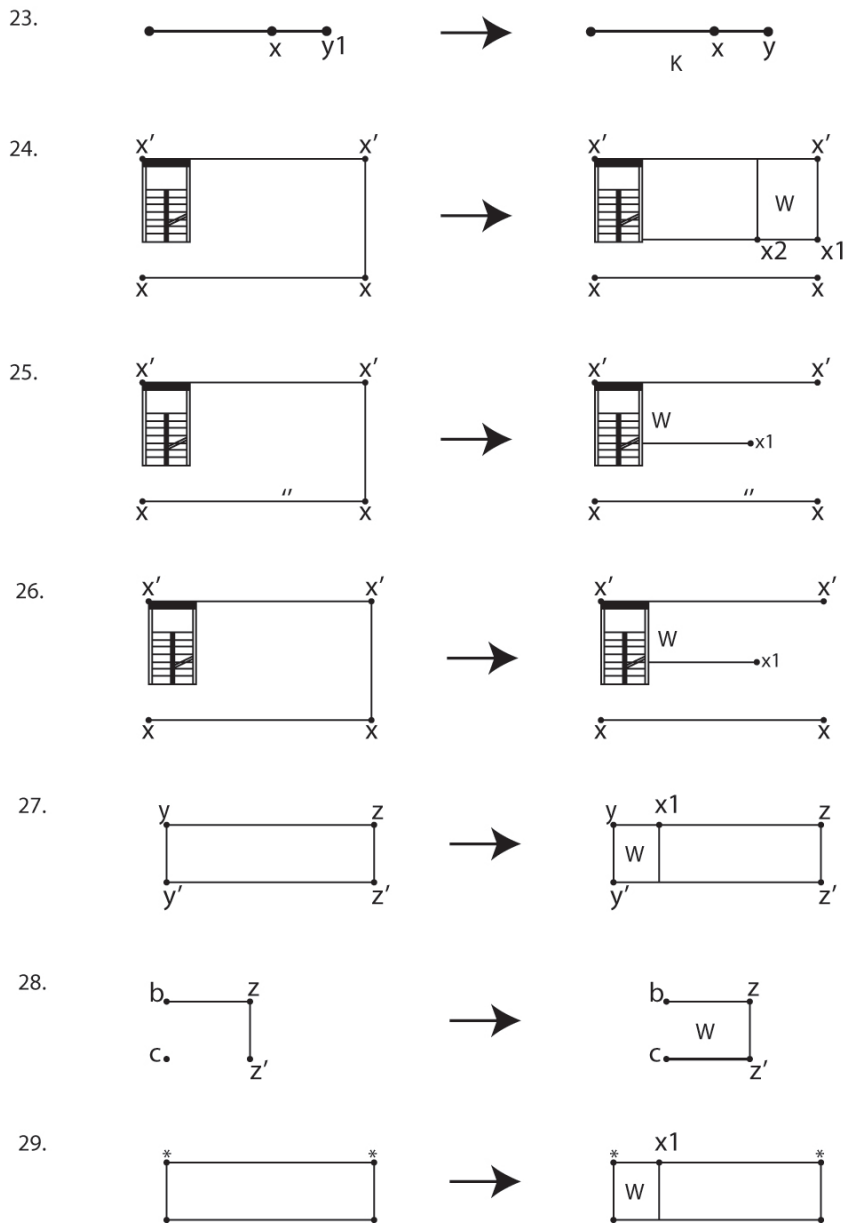


Figure 30 continued. d) Rules 23 through 29 allow Program allow for programmatic designations, such as *K* for kitchen and *W* for bathroom.

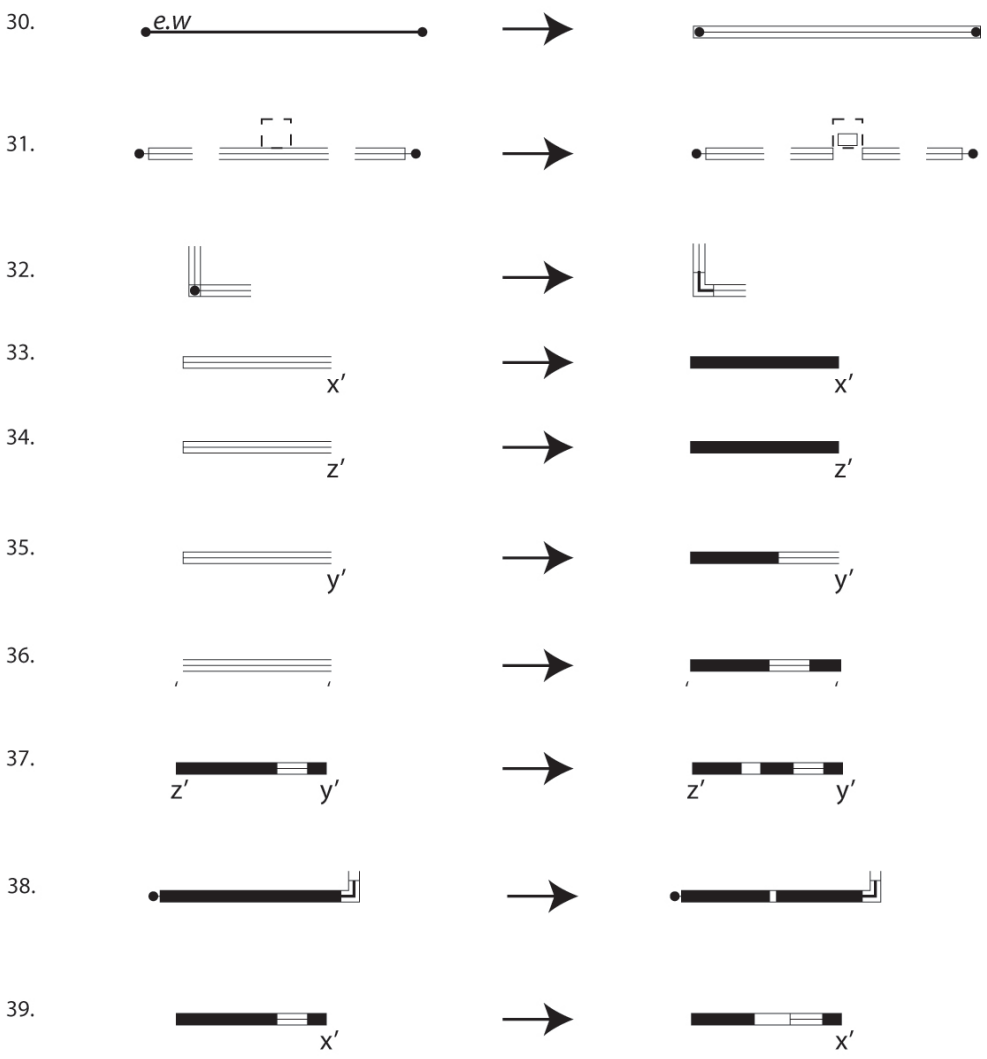


Figure 30 continued. e) Stage three, Exterior Walls.

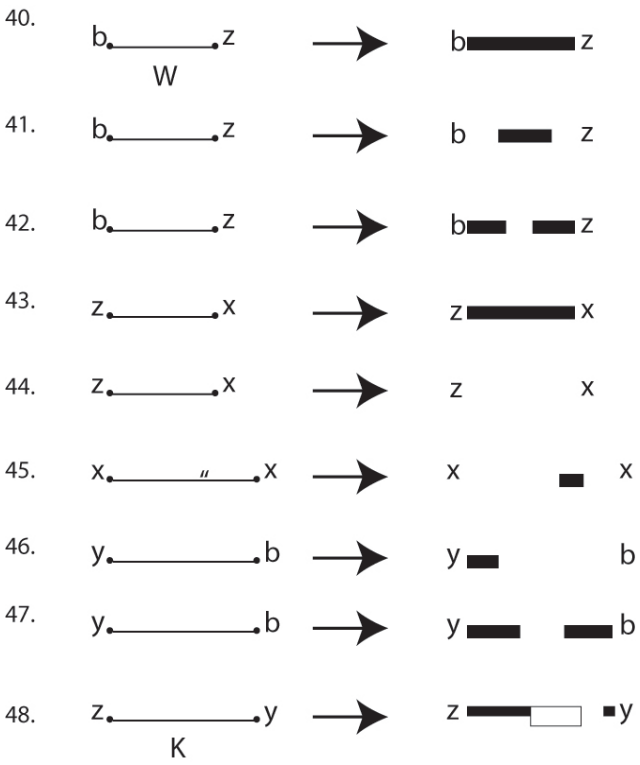


Figure 30 continued. f) Stage four, Interior Walls.

Using the Grammars

As stated before, the grammars just presented are not only meant to produce the original houses, but to infer what other compositions can be formed using the same set of rules. Figure 31 and 32 show variations of each house. The process begins with the site layout, and produces two iterations, which are two out of numerous other options. After the first stage, the diagram-like floor plans go through a series of transformations that begin to add detail. The final is a comparison of the floor plans with the original. According to the grammars presented, these two variations of each of the houses are in the same language as the original.

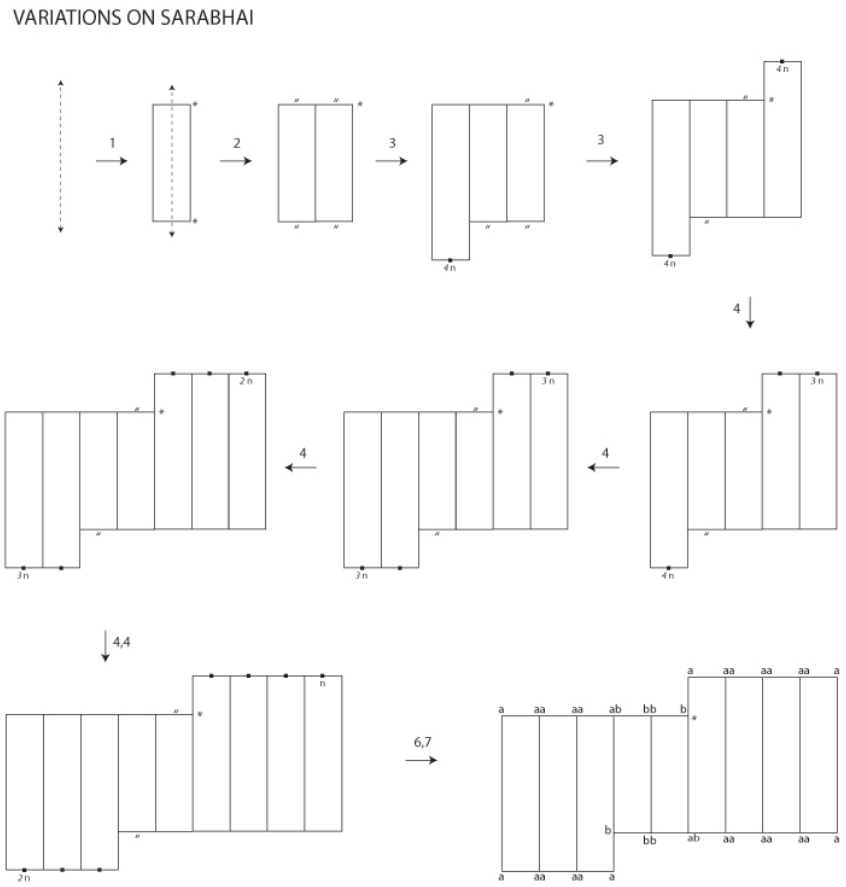


Figure 31. Variations on Sarabhai Grammar

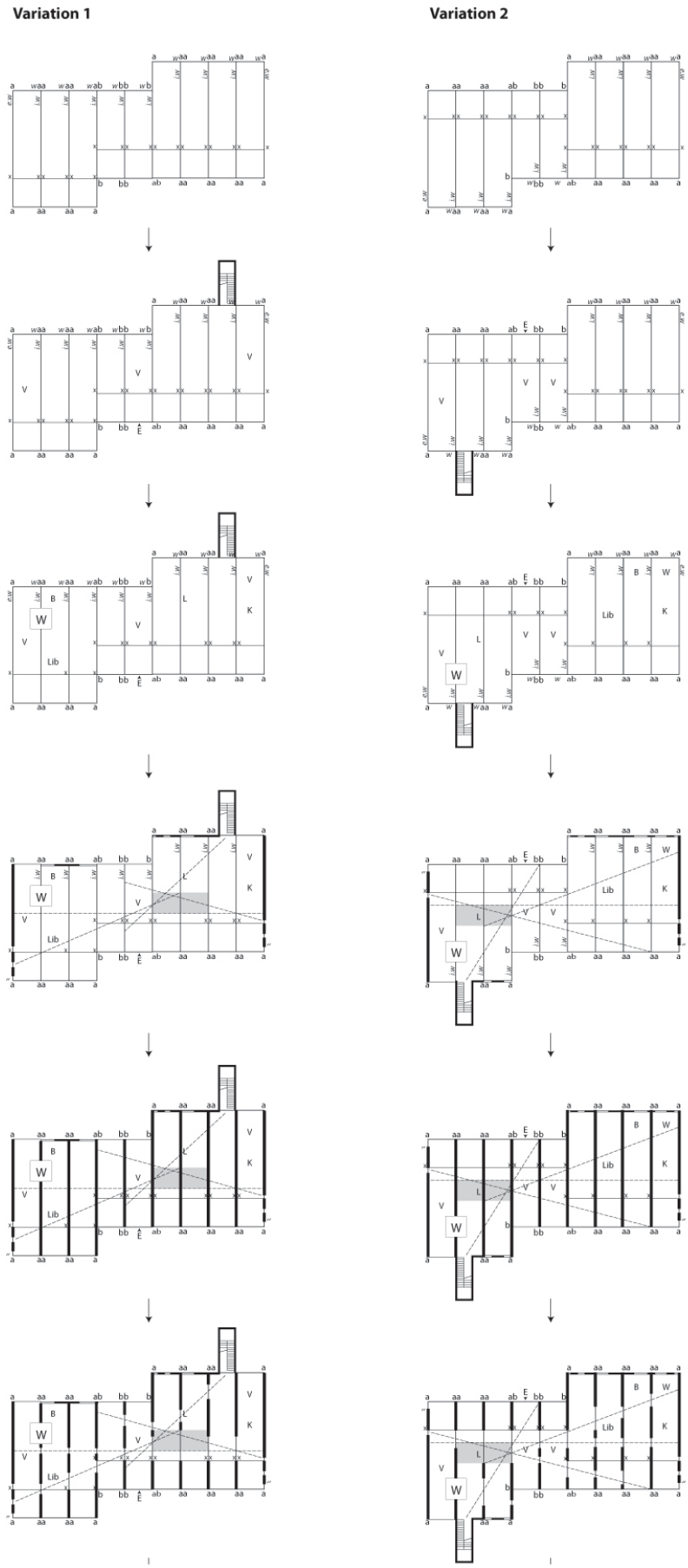
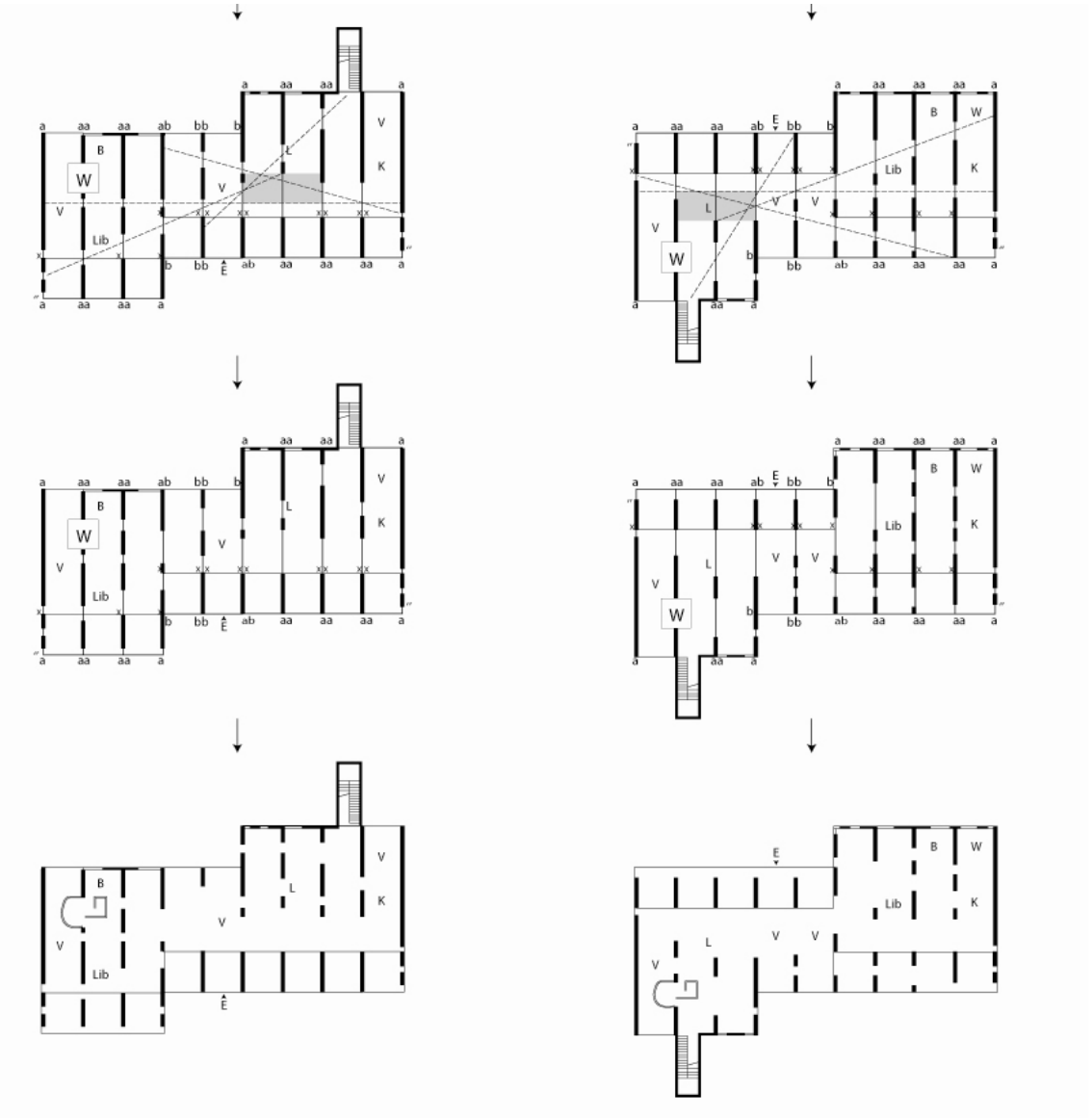


Figure 31continued. Variations on Sarabhai Grammar



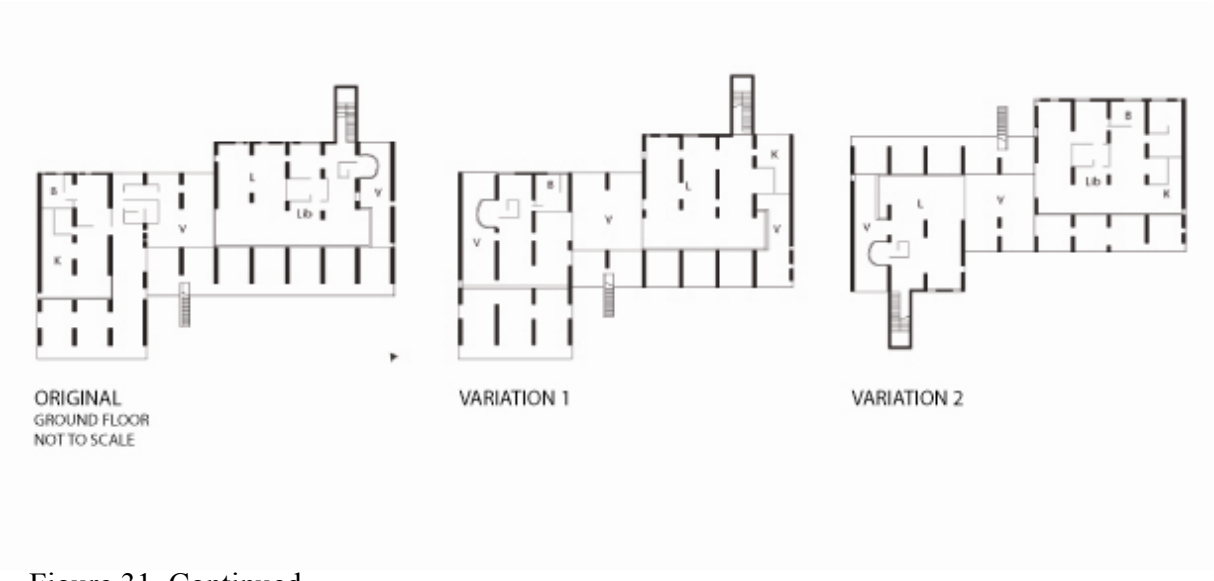


Figure 31. Continued.

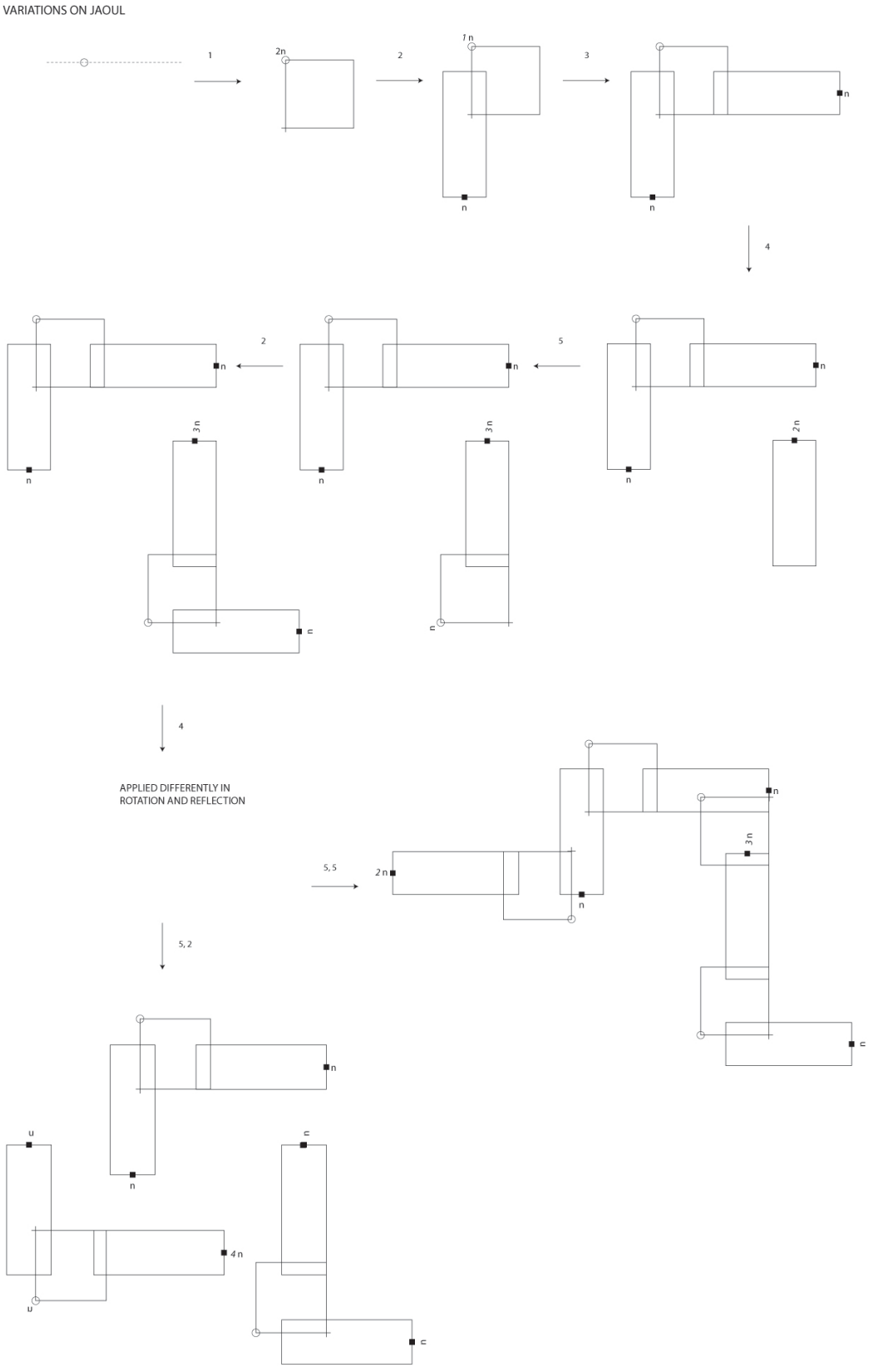


Figure 32. Variations on Jaoul Grammar

Maison Jaoul Variation 1

Maison Jaoul Variation 2

Maison Jaoul Variation 1 **Maison Jaoul Variation 2**

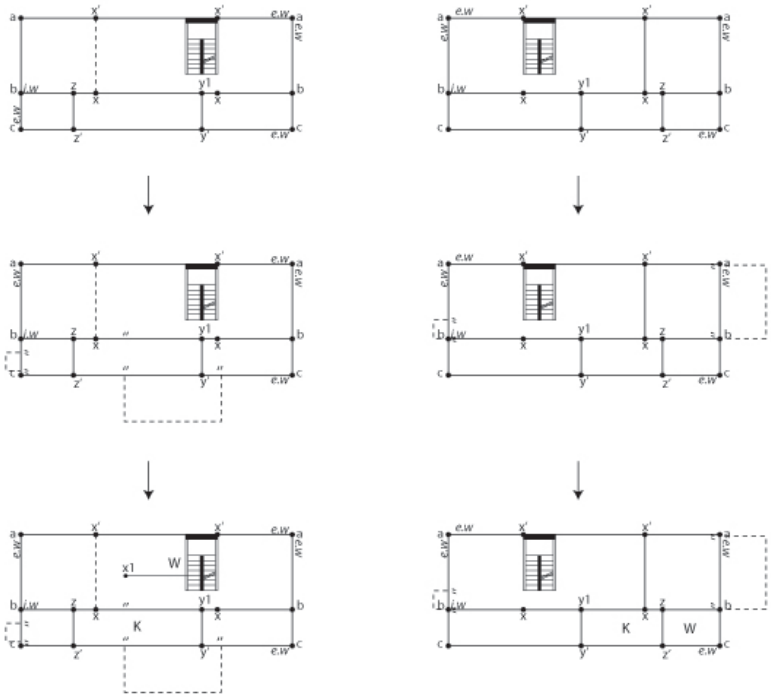


Figure 32 continued. Variations on Jaoul Grammar

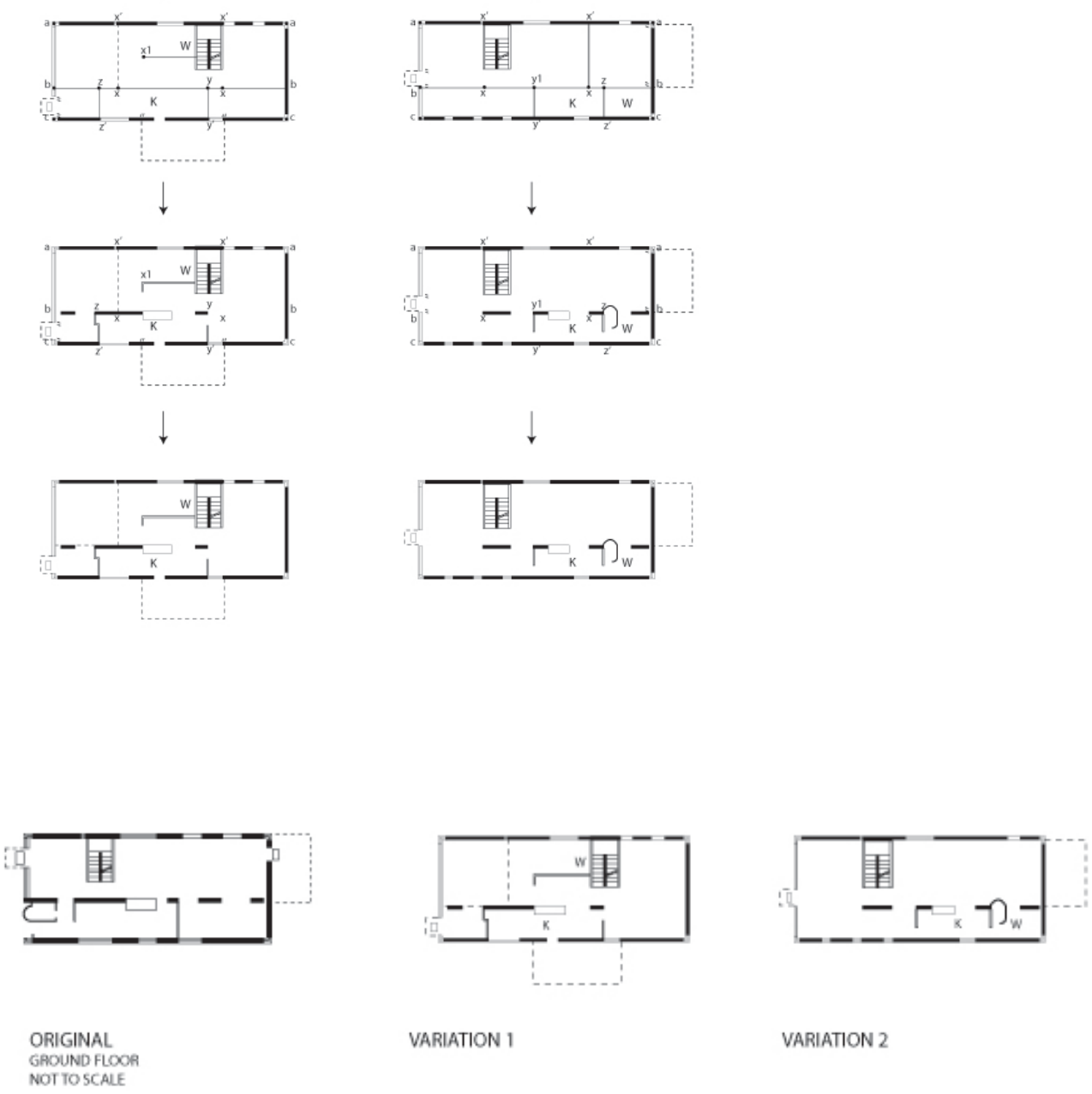


Figure 32 continued. Variations on Jaoul Grammar

Limitations of the Proposed Grammars

The grammars created have several limitations. The scope of this exercise does not include other conventions of architectural representation. Once I studied the houses and the initial process of creating a grammar began I used the plans as a guideline, and shapes to represent plans as my 'alphabet' for the language. Exploring sections and/or three dimensional approaches would also serve a useful purpose in understanding the language of the houses. However in this project I go down one avenue, and have found that the depth of intent and the sophistication of the design can still be captured. This exercise also limits exploring to the ground floor of Sarabhai Villa and Maison Jaoul. Relationships in the above floors are taken into considerations as instances of what happens on the ground floor, mainly in terms of partition walls, circulation and simple programmatic relationships. Thus instances found on the above floors can be produced by the grammar that produces the original ground floor plan. However the grammar does not contain rules to carry the user from ground to first floor in simple shapes. After completing the composition of one floor, one may move on to the second floor by redoing the grammar with key constants that should be factored in, such as location of stairs and double height conditions.

This particular grammar does not do enough justice to the structural aspect of these houses. The Catalonian vaults that are unique to these two homes are set aside for this particular discussion. Introducing them into the grammar would require perhaps a strategy throughout the grammar in order to allow all aspects to come together coherently.

Regarding technicalities of the shape grammar, termination rules can be further streamlined in order to clearly signal the end of a stage and beginning of a new one. Additionally, the following rules do not incorporate limits and rely on the user to judge when to stop certain repetition sequences or patterns.

CHAPTER 6

CAPTURTING ARCHITECTURAL QUALITIES

I would like to propose shape grammar as a practical tool for exploring and understanding architectural works. I see potential in its production method. Once there are a set of rules in place, it is interesting to see how modifying one or two rules can begin to impact the overall designs. One can imagine following one single change throughout the process and monitoring its affects.

Questions about shape, angles, and even structure arise. The original grammars use rectilinear shapes; is the essence maintained if the orthogonal nature of the shapes changes? How can one introduce personal notes to the overall design through the grammar? Changing just one factor begins to impact the overall production in profound ways. As the intention is to put this method to practical use, I carry out an experiment by using a studio project. I approach the design assignment of a single family home for two parents and two children in Midtown, Atlanta before beginning my exercise in shape grammars and then approach the site again for a second time, after analyzing the two houses using shape grammar, and creating actual grammars. After sharing what stands in for ‘regular’ studio process and its result, I present how the process is rethought using the above analyses. Finally I compare the two methods of approaching design.

Figure 33. Site in Midtown, with existing structure.

Home in Midtown

My intention for this site, even before beginning my journey into shape grammars, was to use Corbusier's Sarabhai Villa and Maison Jaoul as influences for the assignment. I initially focused on the houses rhythm and organization. I also noted the feature of 'un-programmed' space in both houses. I inferred the presence of a grid on the site, which drew subtle cues from the context, such as topography. This created a field condition in which I made formal moves to the overall organization of the house. I used the urban nature of the site to rationalize more compact elements, and pushed and pulled volumes according to site cues and programmatic needs.

The result was a cube, with volumes pushed and slid out and in; a compact, three-story structure. The interior was not successful in communicating to the exterior space. The element of juxtaposition as is so vital in Maison Jaoul was missing, as was a flow or logic of movement through the space.

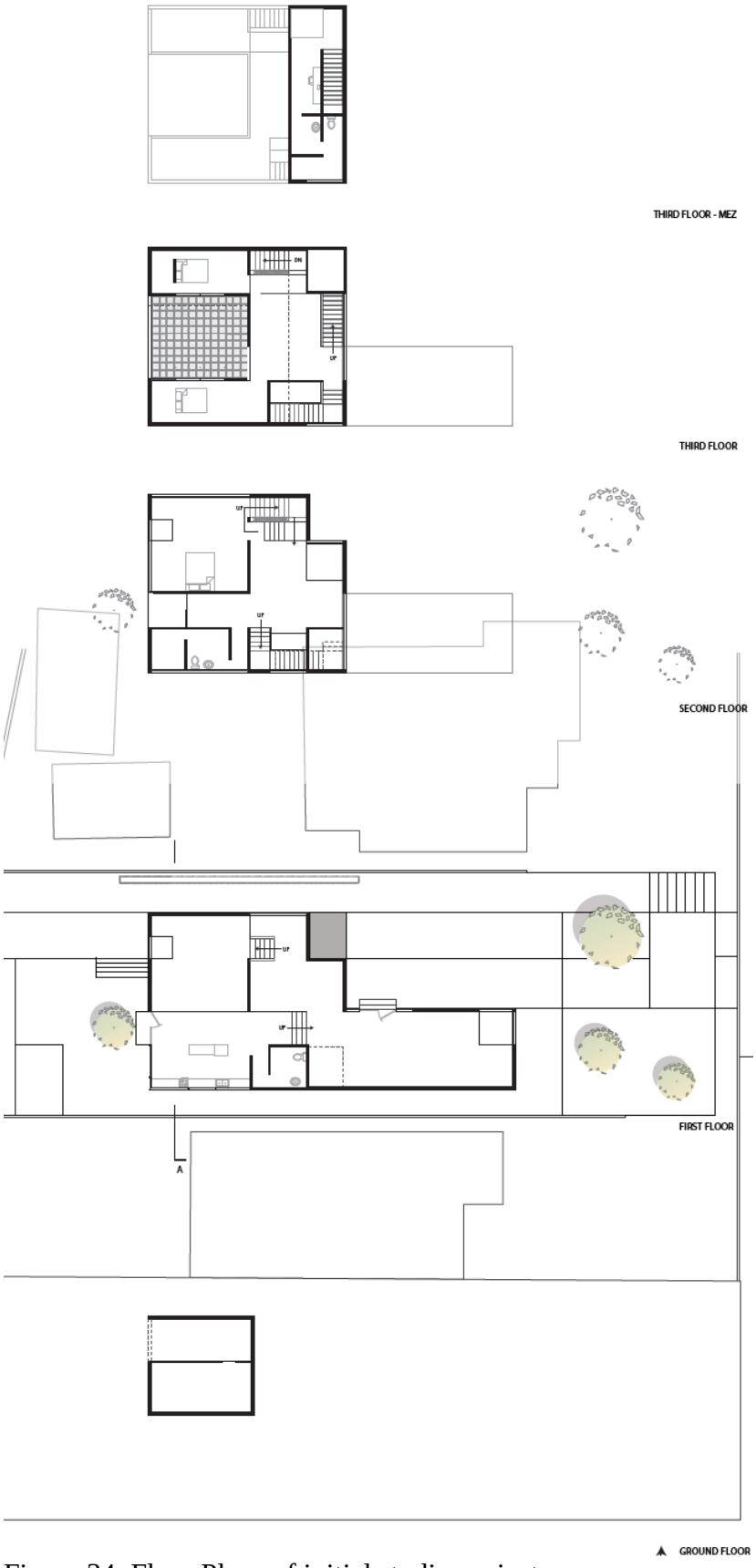


Figure 34. Floor Plans of initial studio project

Figure 35. Section of initial studio project

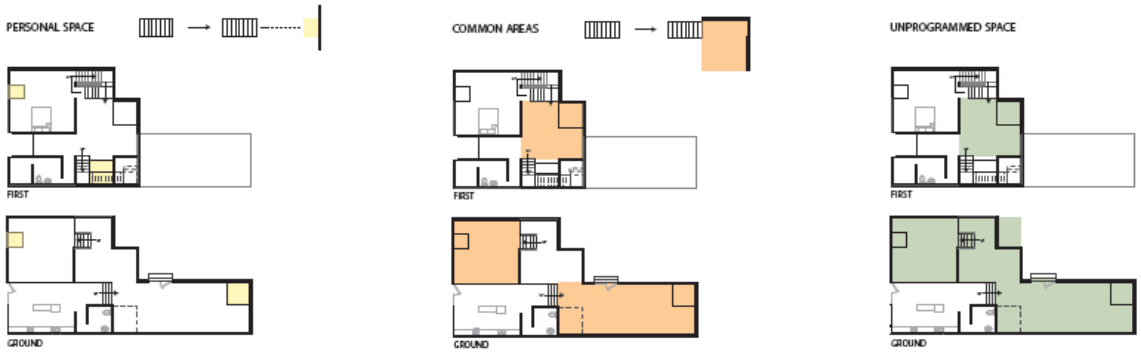


Figure 36. diagrams

Using Shape Grammar as a Design Tool

When approaching an actual studio project, I was able to assess the true value of shape grammars as a design tool. This final step reveals the strengths and weaknesses of using such a method practically. The first part consists of analyzing the houses through shape grammars; the exercise is presented in Chapter 5. This allowed me to get a better understanding of the key moves Corbusier exhibited in those particular projects. To make the designs adjust to the site and context as well as introduce aspects that were not in Corbusier's language but my own, I experiment with shifting and changing the building block from strictly proportioned rectangles to shapes that retain four sides, yet are not rectilinear.

I first introduced the grammars into the site, as were, without any modifications. However, as shown in Figure 37 the proportions are not adequate for the size of the Midtown site. The narrow rectilinear shapes that will eventually become the units are too small to create any substantial space. Therefore I modify my grammar by exploring the boundaries of parametric shapes. By allowing flexibility in the grammar, it creates possibilities at a whole new level, introducing instances that were not previously found in the original houses. However, I argue that the essence or backbone of the houses created is still very much aligned with the language used by Corbusier. The aspects that make the latter productions on the Midtown site a valid continuation of Corbusier's language is found in the organization of the space and key moments. These conditions that were produced and then reproduced in the grammar allow the same relationships to exist regardless of how the 'shell' appears.

I also allow shifts in the new grammar. The shifts of the shapes create overlap conditions that can be explored further as interesting opportunities to re-imagine that space. Perhaps as double height space, or changes in elevation or even space to add additional program. Figure 29, shows different iterations of the Sarabhai Grammar on the Midtown site. The sequence of diagrams in Figure 37 show how rectilinear shapes can be transformed to other quadrangles. Once the shapes are established and shifted, the grammar continues from Stage 2 as it would apply to rectangles. The flexibility allows one to quickly create many potential layouts.

Similarly, the Maison Jaoul grammar is modified to suit its context. Shapes can be shifted according to adjacent masses. Here the start and end point of the initial stage of site layout is modified to create units that are not necessarily identical. Corbusier's original houses in Paris and in Ahmedabad both serve as two units, for two families that are related. In the case of Midtown, the program can be inferred to have a distinct public and private space. The 'public' portion of the house can become a home office or study with a library. The relationship of adjacencies that existed in Maison Jaoul between the two units (of two different families) is echoed in Midtown by the relationship between the office portion of the house and the more private version. The shifts in the final diagrams of Figure 39 are extended to such a point where the 'patio' square found in the original grammar becomes an element that melds the two private portions of the house together. Movement between two 'units' in the original was through exterior space; in the new grammar both conditions are expressed. The private portion has movement between two units without actually going outside. The private and public portions of the houses

(which can also be taken as two units) exhibit the original condition of an exterior space separating the two.

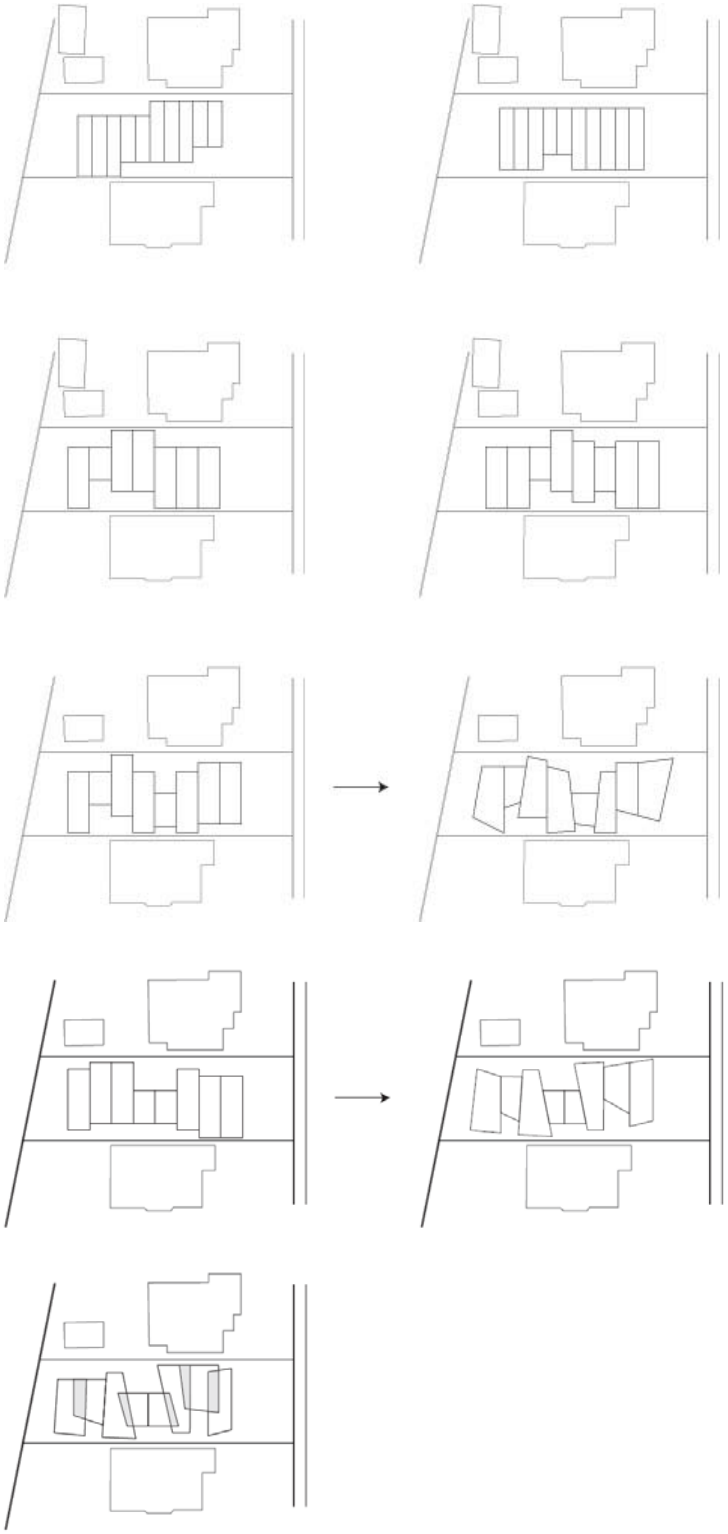


Figure 37. Variations of Sarabhai Grammar on the midtown site

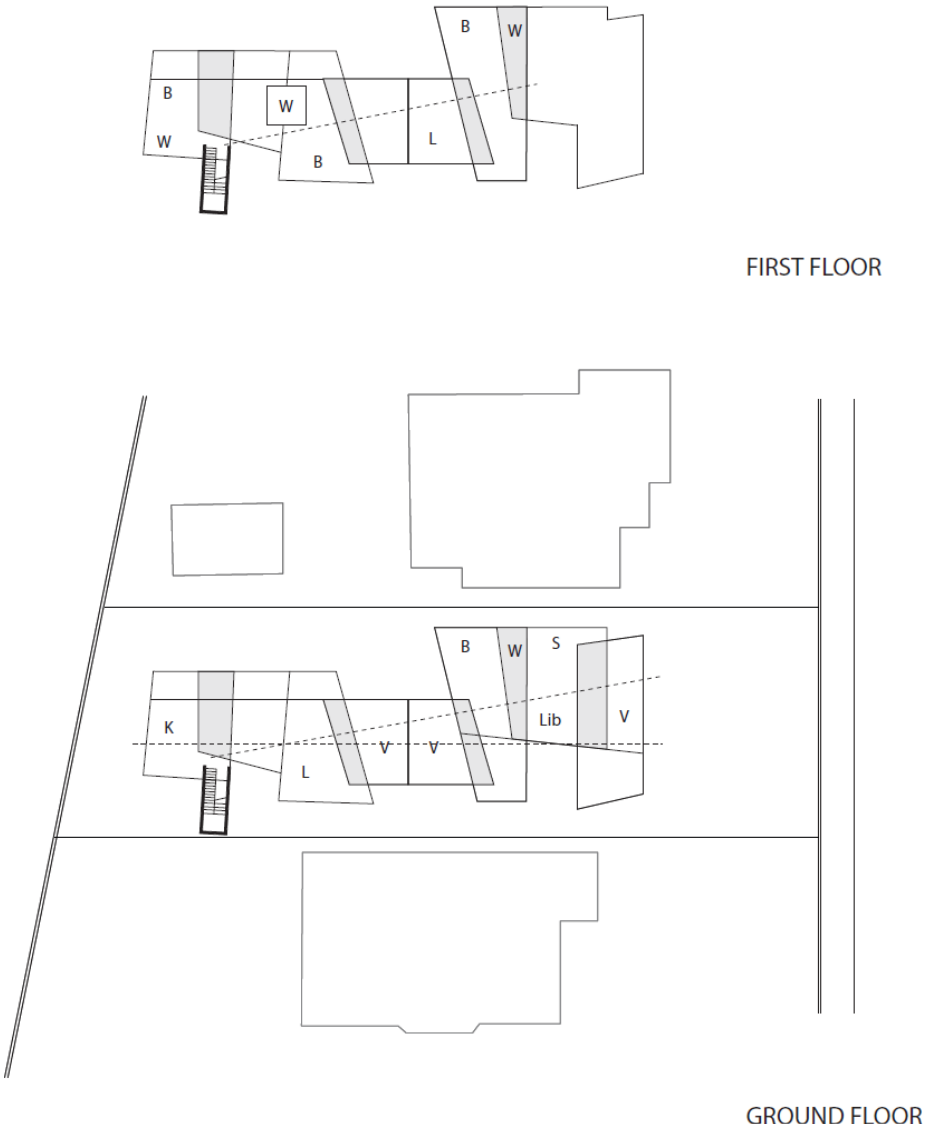


Figure 38. Potential new layout using the new Sarabhai Grammar

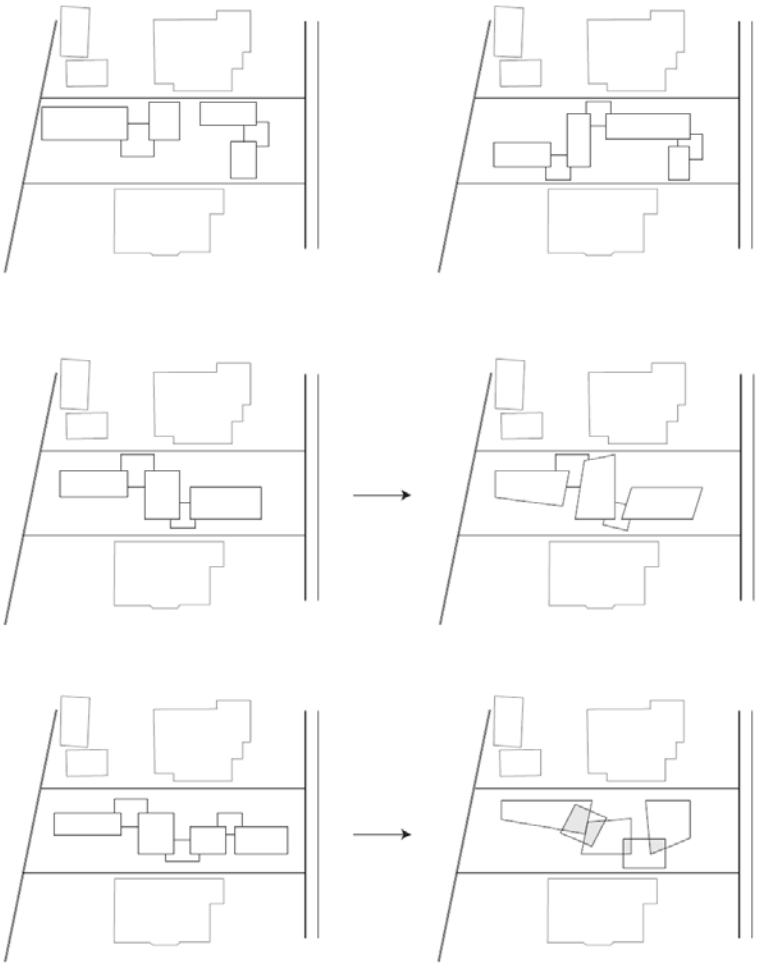


Figure 39. Variations of Maison Jaoul Grammar

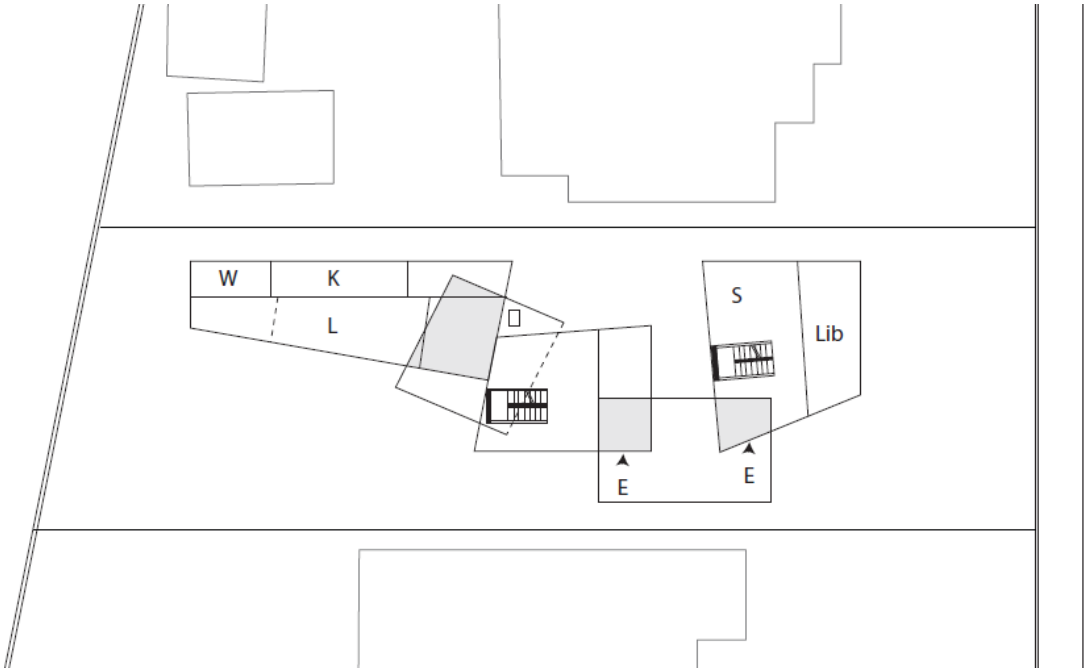
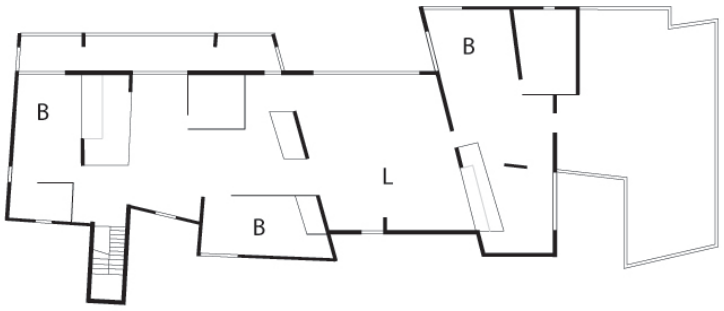
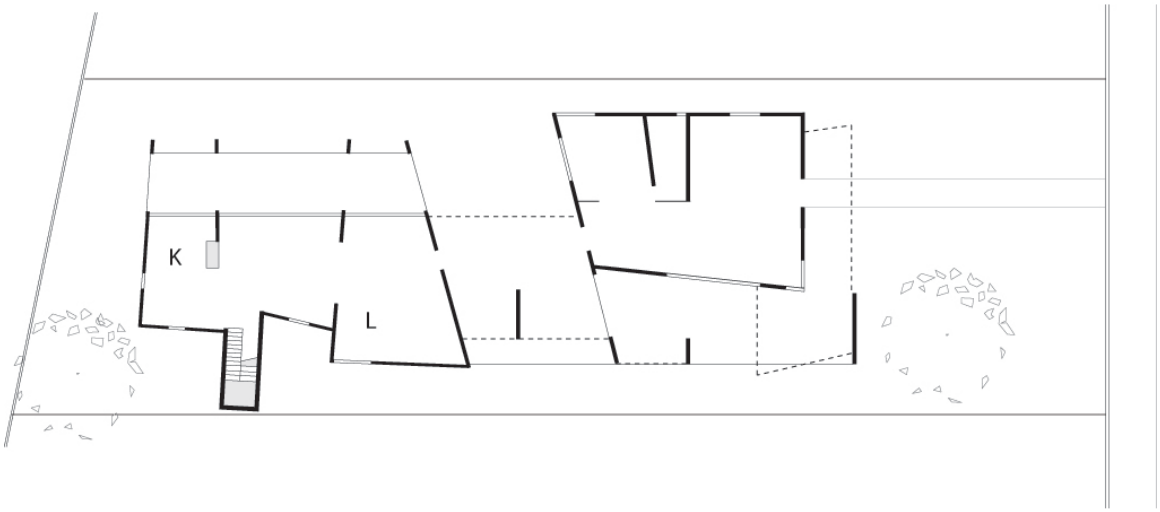


Figure 40. Potential new layout using new Maison Jaoul Grammar



FIRST FLOOR



GROUND FLOOR

Figure 41. Plans conceived for a house in Midtown after shape grammar exercise.

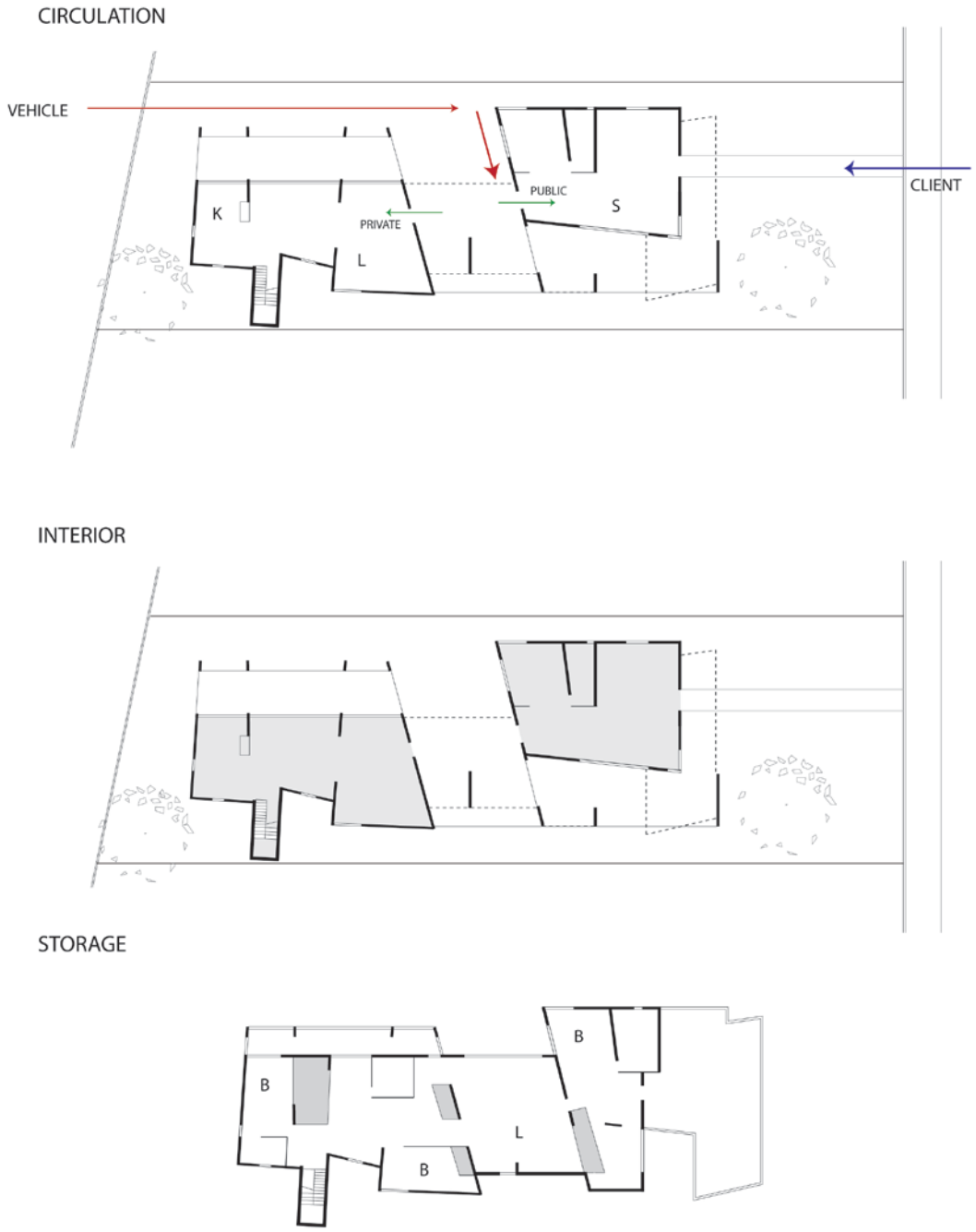


Figure 42. Diagrams

I take the layouts influenced from the Sarabhai villa and develop them into floor plans for a new house to be situated on the Midtown site. I believe that this new house, compared to my initial attempt, engages more of the site and divides it into private and public. The home is humble in size, yet has more openness. It has more interesting features such as storage, long site lines and opportunity for the dining space near the kitchen to expand into the exterior ‘verandah’. The living spaces are located in areas of the layout that are highly visually integrated and therefore will feel much more connected to the rest of the spaces.

Conclusion

In both the studio and shape grammar versions of the projects, the ideas were conceived after studying and analyzing Corbusier's two houses. When the Midtown project was first done, the process involved inferring connections from ideas and then translating them into form. Thus form and concept are separated by interpretation. The space between studying Corbusier's concept and then creating a response contained analysis that has intellectual basis and can be rationalized through intellectual discussion.

In the assignment where shape grammar was applied, first an analysis was done and then iterations produced through a formula. In contrast to the previous method, shape grammar allows the form and concept to act as a combined tool. The grammar associates architectural concepts with the shapes. The intention is that other shapes/outcomes from this production method will innately contain concepts that were recognized in Corbusier's houses.

This results in a process that is very liberating, in the sense that iterations are produced in greater numbers and are limited by one's vigor. The iterations then can be filtered through using judgments about context. When performing the exercise one can relax and unleash their imagination and 'play' with the shapes. Where as before, each move has to be analyzed and seen through a critical eye as to whether it is staying true to the original intent of following the lessons learned from earlier study of the houses. However in the shape grammar exercise, one can decide later the architectural details associated with the shapes knowing that the architectural consequences will overall be the same.

One might argue that the process of filtering and then associating further meaning can introduce the same ‘space’ between studying and production referred to earlier. However in this case, each iteration theoretically contains the essence and lessons from the original houses. Thus the latter exercise is a step that takes it to the next level incorporating lessons from Le Corbusier into practical projects.

The characteristic feature that drew me towards investigating shape grammar as a method of practical design has matured into a philosophy through the process of creating this paper. The alluring quality of a process being systematic but at the same time unpredictable is unique to the approach that I present. Creating architecture involves an exceedingly technical process that is almost paradoxically extremely artistic as well. I find that the technical and the abstract are reflected in this process and transition into coexisting as they do in true final Architectural products. The agenda is to use both technical and artistic methods simultaneously because that is the essence of Architecture.

By combining artistry with technique in this process, consequences are unexpected and these accidental features have richness. The results are not elements for the sake of fulfilling a function or gratifying a spatial solution in the immediate context; rather they are pieces in a larger composition with multiple meanings and uses. The technique of using a shape grammar in the design process allows one to capture the science and art and to coalesce it into a composition that is Architecture.

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