

## ■ Grammar

### • General Assumptions

- bilateral symmetry is considered to be a basic feature even though there are extant traditional dwellings which do not possess this property.
- the analysis is restricted to plans of rural farmhouses. Urban sites are typically limiting, with narrow widths and long depths; however, urban dwellings followed much the same traditional rules of design and construction as rural enclosure courtyard houses. Thus, although the urban dwellings are not targeted as such, it is possible to generate urban plans by the grammar.
- only roofs of the *yìng-shān* (“firm mountain”) type are considered.
- plans are generated from the rear-most main building. This is in accordance with known practice, in which buildings were developed from and around the location of the *key brick*.
- the grammar is an abstraction of Taiwanese traditional vernacular house designs.

### • Concepts and Approach

- from an understanding of the practices in traditional design and construction to develop the rules  
[(construction / design) process or procedure]
- not concerned with specific artisans or specific buildings; rather, with general considerations of design  
[corpora or architectural morphology]
- from anthropological and historic approaches to shape grammars
- each rule is meaningful to its style and historic background

### • Mechanism

- parametric (labelled) shape grammars
- weights
- constraint descriptions

- Rules

### **Initial shape**

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Stage 1: **Establish the fortunate numbers**

Stage 2: **Generate the central room in the principal building**

Stage 3: *Add doors and windows to the central room*

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Stage 4: **Generate the plan of a main building**

Stage 5: *Add openings to the rooms in a main building*

Stage 6: *Replace doors and windows by their icons*

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Stage 7: **Generate a courtyard in front of a main building**

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Stage 8: **Generate the plan of the secondary building**

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Stage 9: **Compute the fortunate dimensions of a main building which is in front of a courtyard**

Stage 10: **Generate a main building plan which is in front of a courtyard**

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Stage 11: **Generate a secondary building which surrounds the front main building**

Stage 12: **Generate another kind of secondary building that is connected by a passing room to the end room of a main building**

Stage 13: *Add openings to the secondary buildings*

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Stage 14: **Generate platforms**

Stage 15: **Create roofs**

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Stage 16: **Modify the lines in plan to three-dimensional walls**

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Stage 17: **Termination**

## Initial Shape

(0,0) \*



Figure 1. Geomancer checks the site. (After Knapp, 1990: 58)

## Stage 1: Establish the fortunate numbers

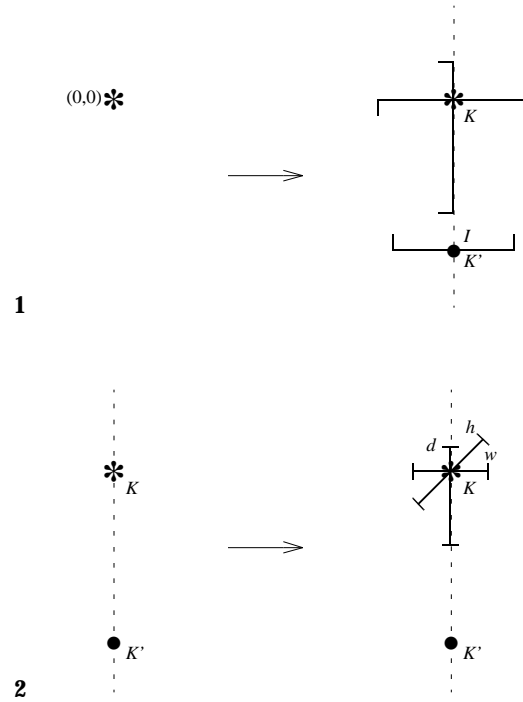


Figure 2. (Stage 1) Establishing the fortunate numbers.



### Stage 3: Add doors and windows to the central room

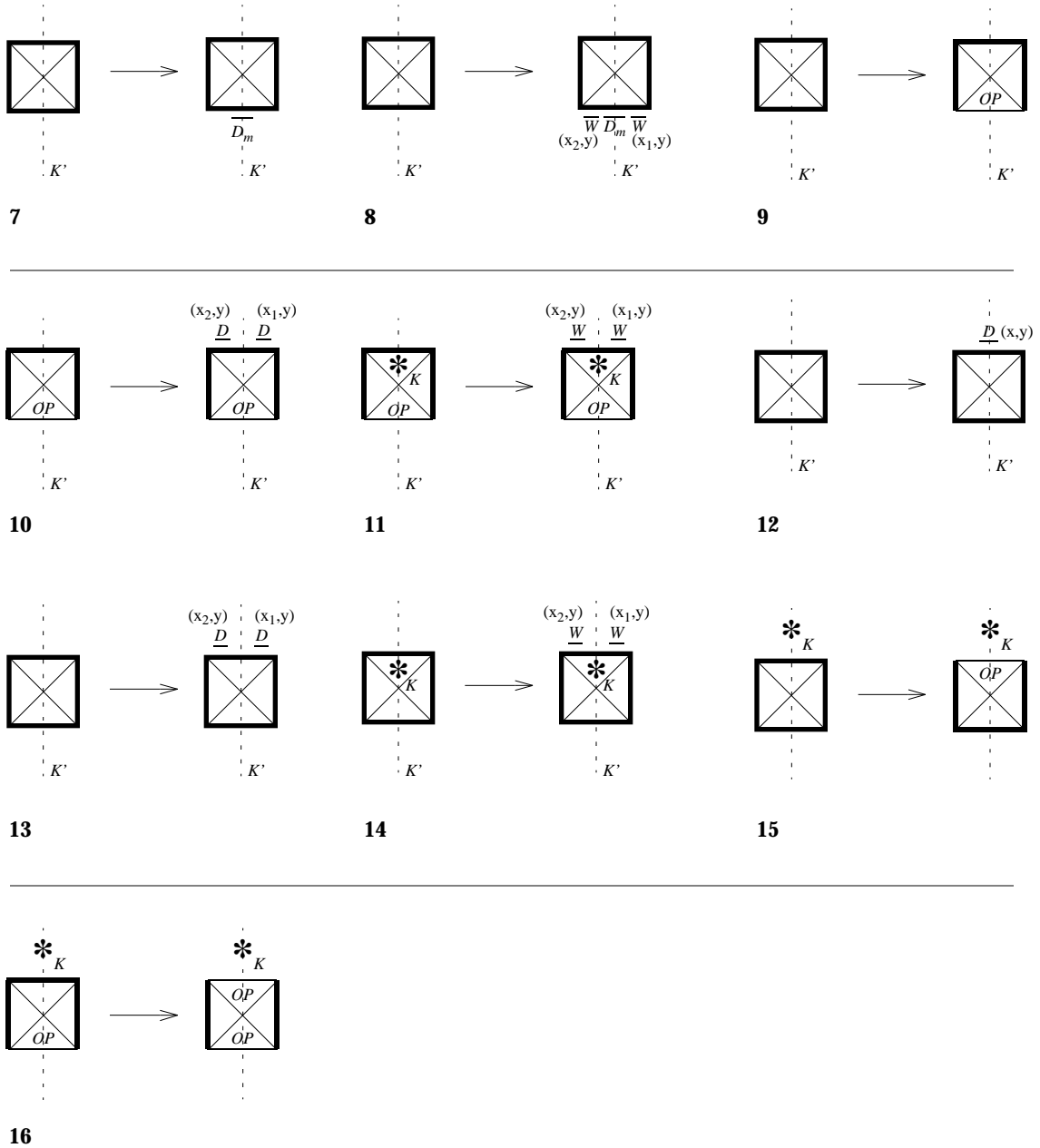


Figure 4. (Stage 3) Rules for adding openings to the central room.

### Stage 4: Generate the plan of a main building

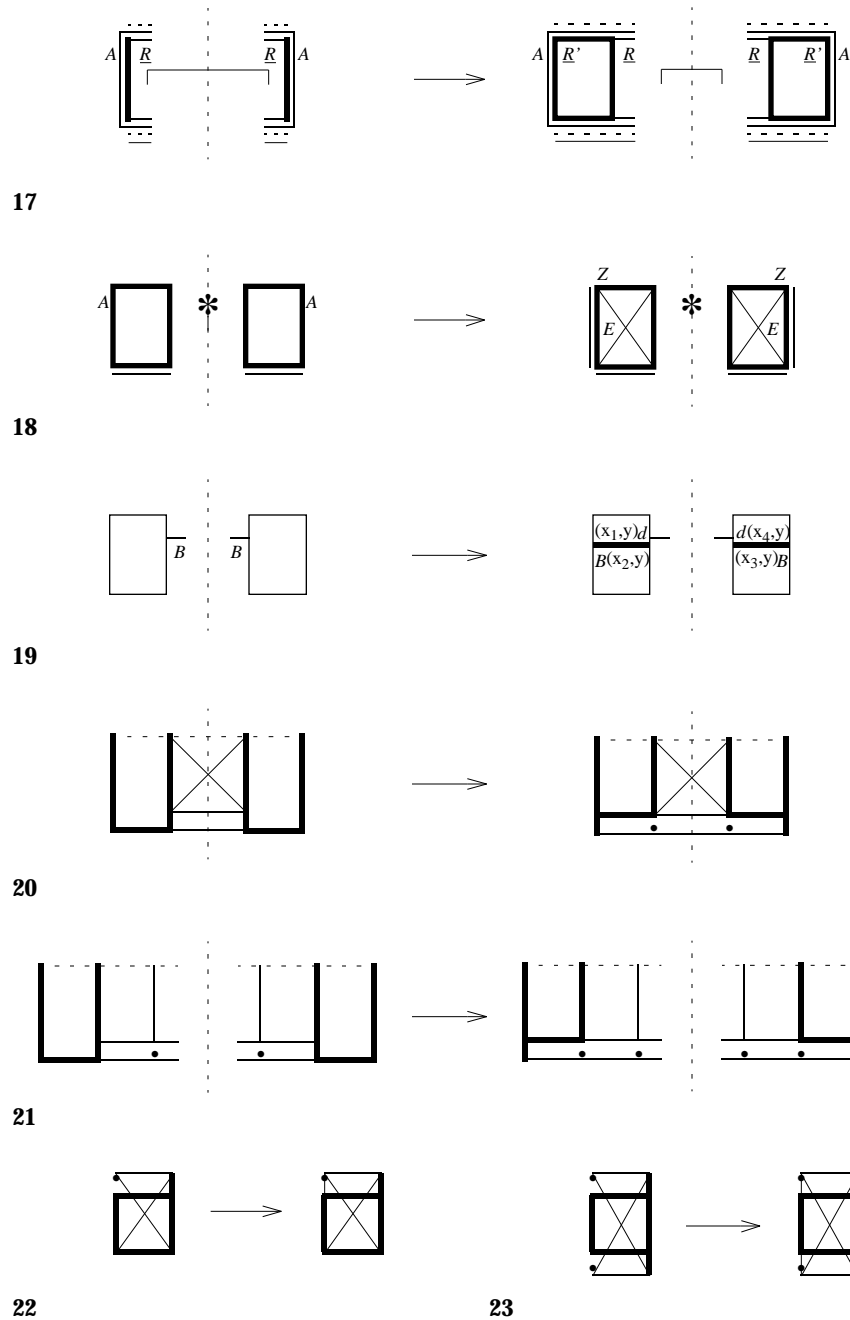


Figure 5. (Stage 4) Rules for generating rooms in a main building.

## Stage 5: Add openings to the rooms in a main building

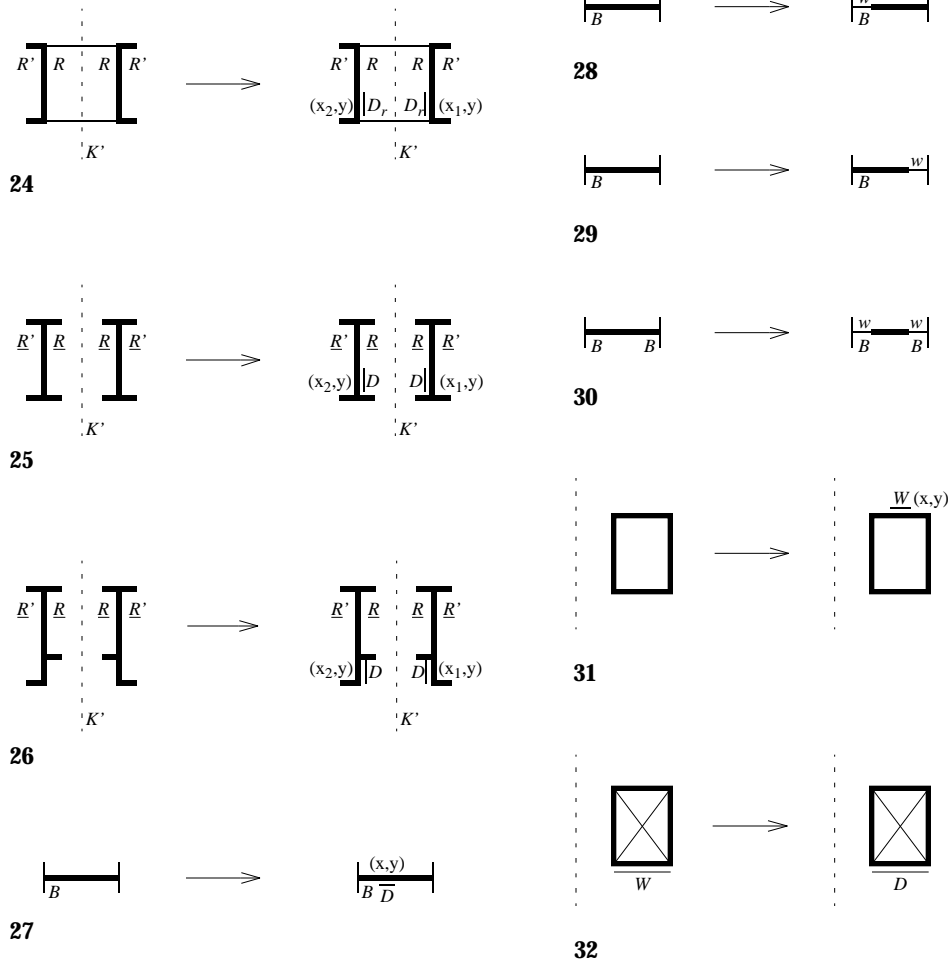
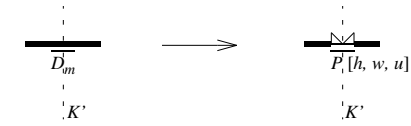


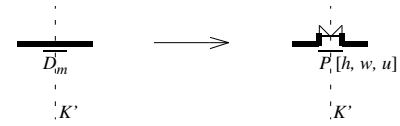
Figure 6. (Stage 5) Rules for generating windows and doors in a main building.



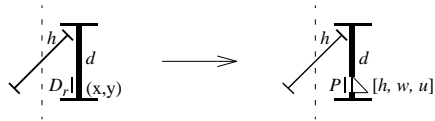
## Stage 6: Replace doors and windows by their icons



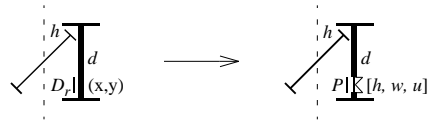
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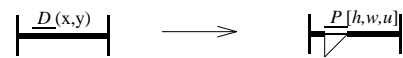
34



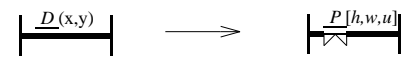
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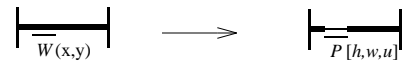
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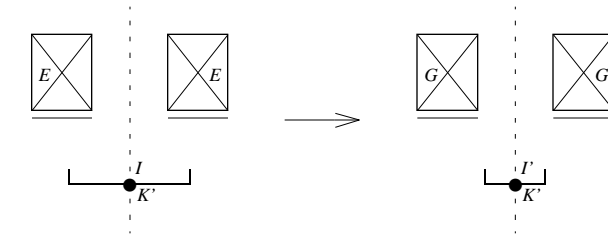
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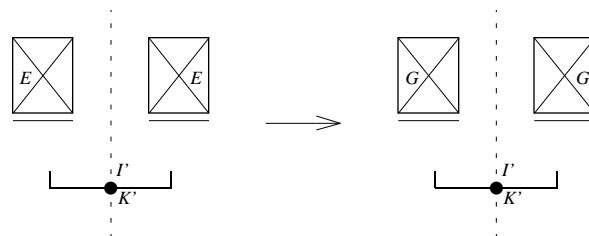
39

Figure 7. (Stage 6) Rules for replacing doors and windows by their icons.

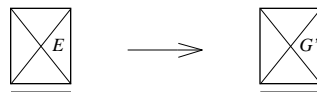
### Stage 7: Generate a courtyard in front of a main building



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Figure 8. (Stage 7) Rules that mark the generation of a courtyard and secondary buildings.

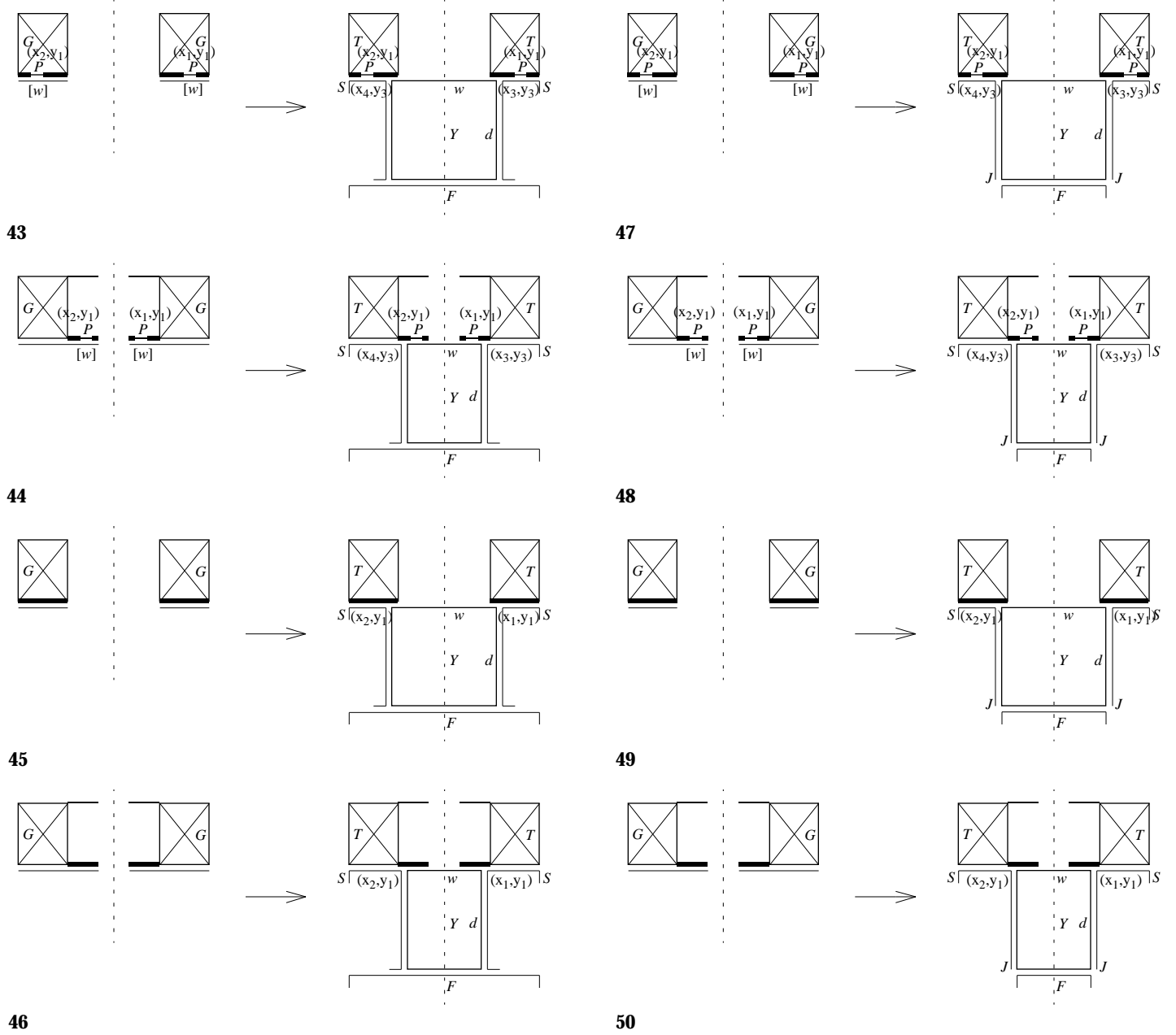
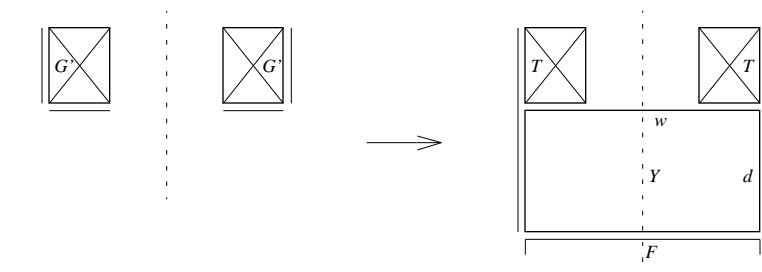
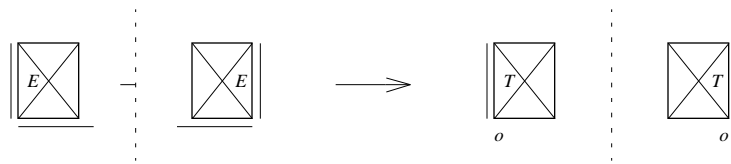


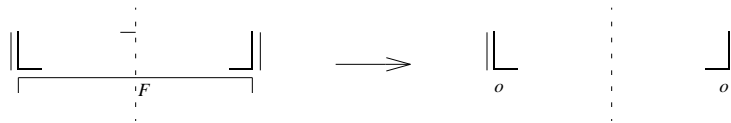
Figure 9. (Stage 7) Rules for generating courtyards enclosed by inner secondary buildings.



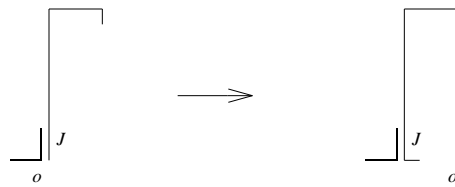
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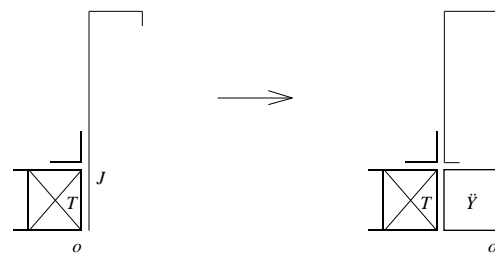
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Figure 10. (Stage 7) Courtyard and terminating rules.

## Stage 8: Generate the plan of the secondary building

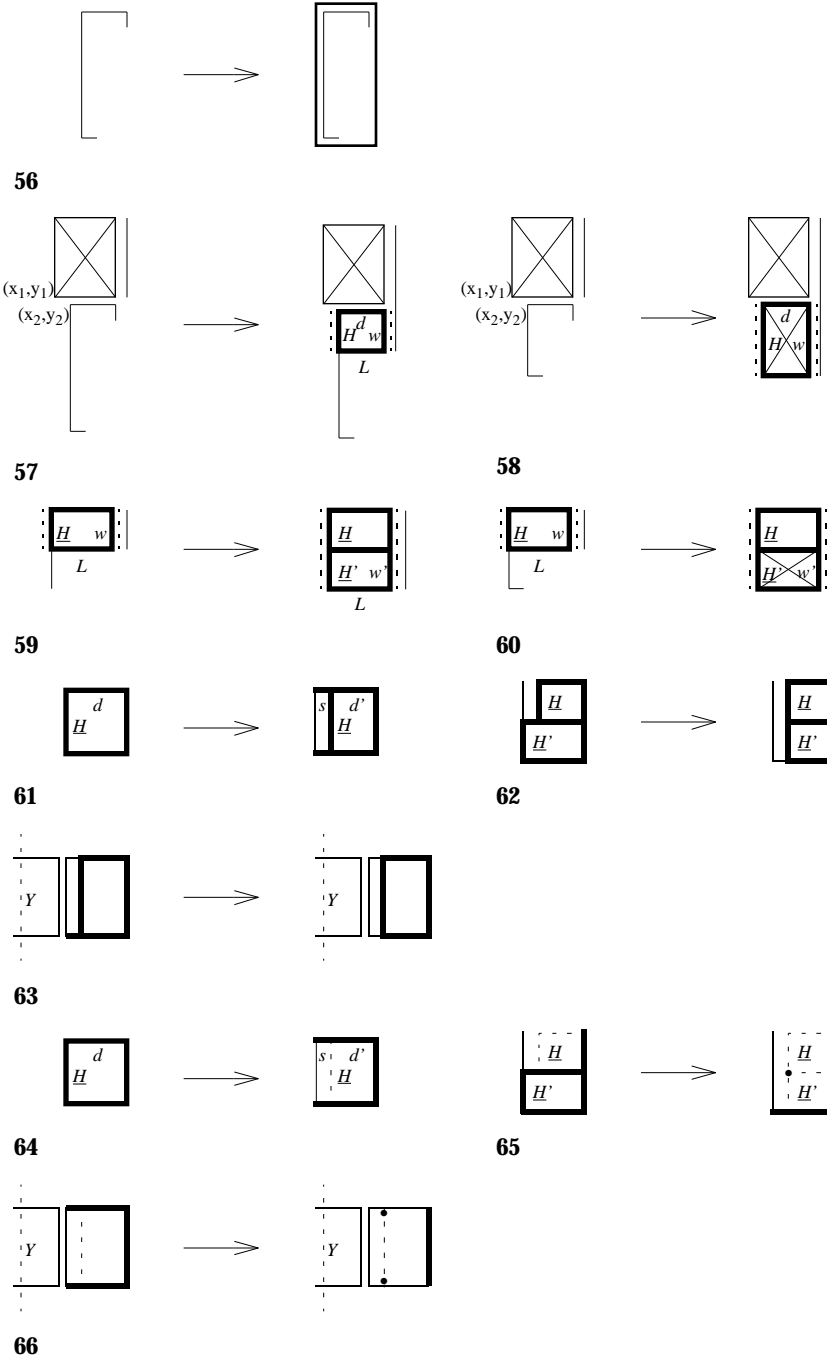
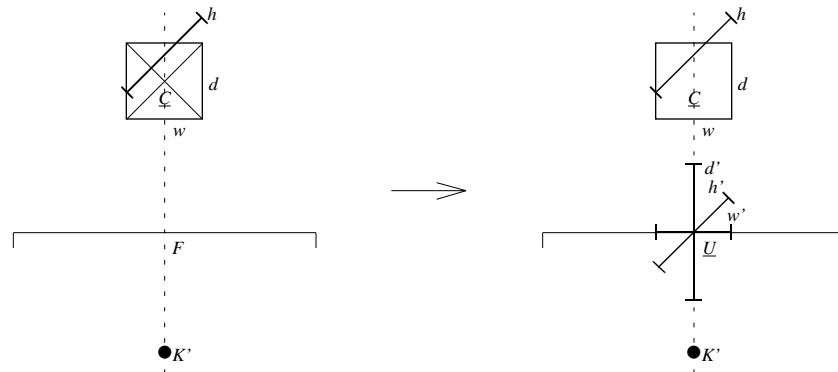


Figure 11. (Stage 8) Rules for generating rooms in a secondary building and for adding porches and refining rooms.

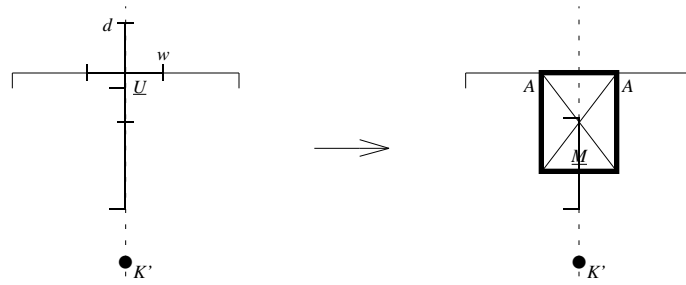
**Stage 9: Compute the fortunate dimensions of a main building which is in front of a courtyard**



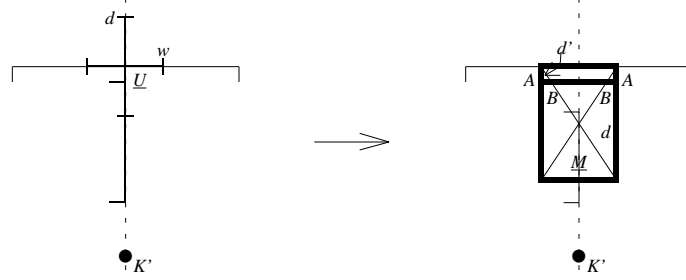
67

Figure 12. (Stage 9) Calculate the fortunate dimensions of a new main building.

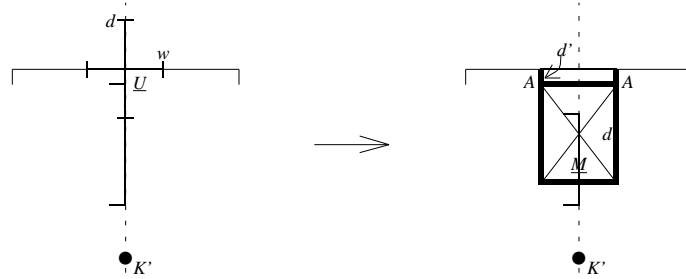
**Stage 10: Generate a main building plan which is in front of a courtyard**



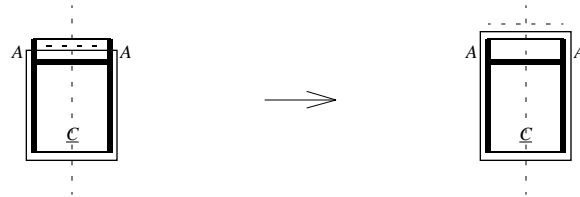
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Figure 13. (Stage 10) Shape rules for generating the central room of a main building.

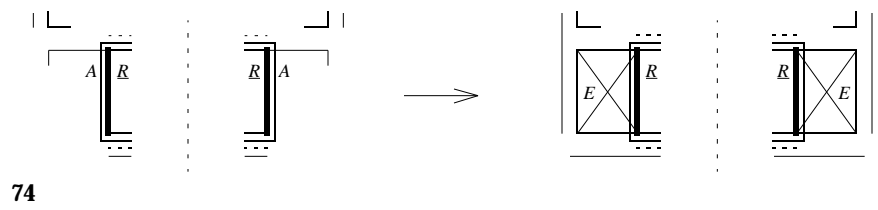
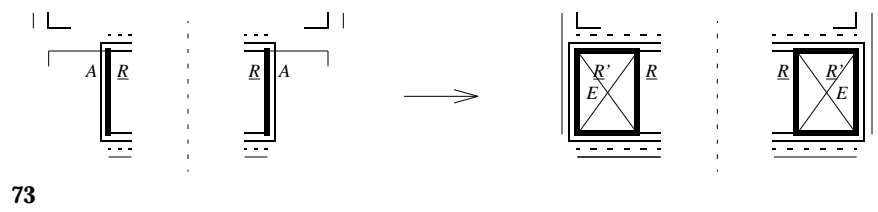
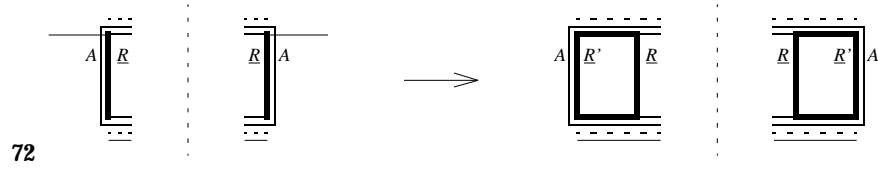


Figure 14. (Stage 10) Rules for generating rooms in a main building.



**Stage 11: Generate a secondary building which surrounds the front main building**

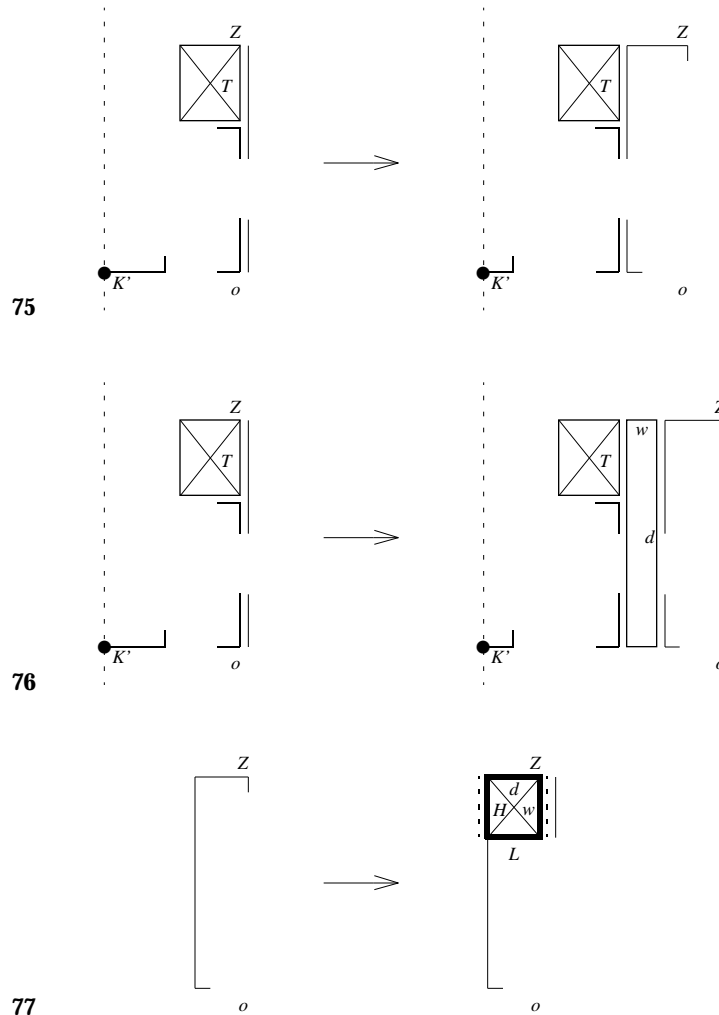


Figure 15. (Stage 11) Shape rules for generating secondary buildings that surround main buildings.

**Stage 12: Generate another kind of secondary building that is connected by a passing room to the end room of a main building**

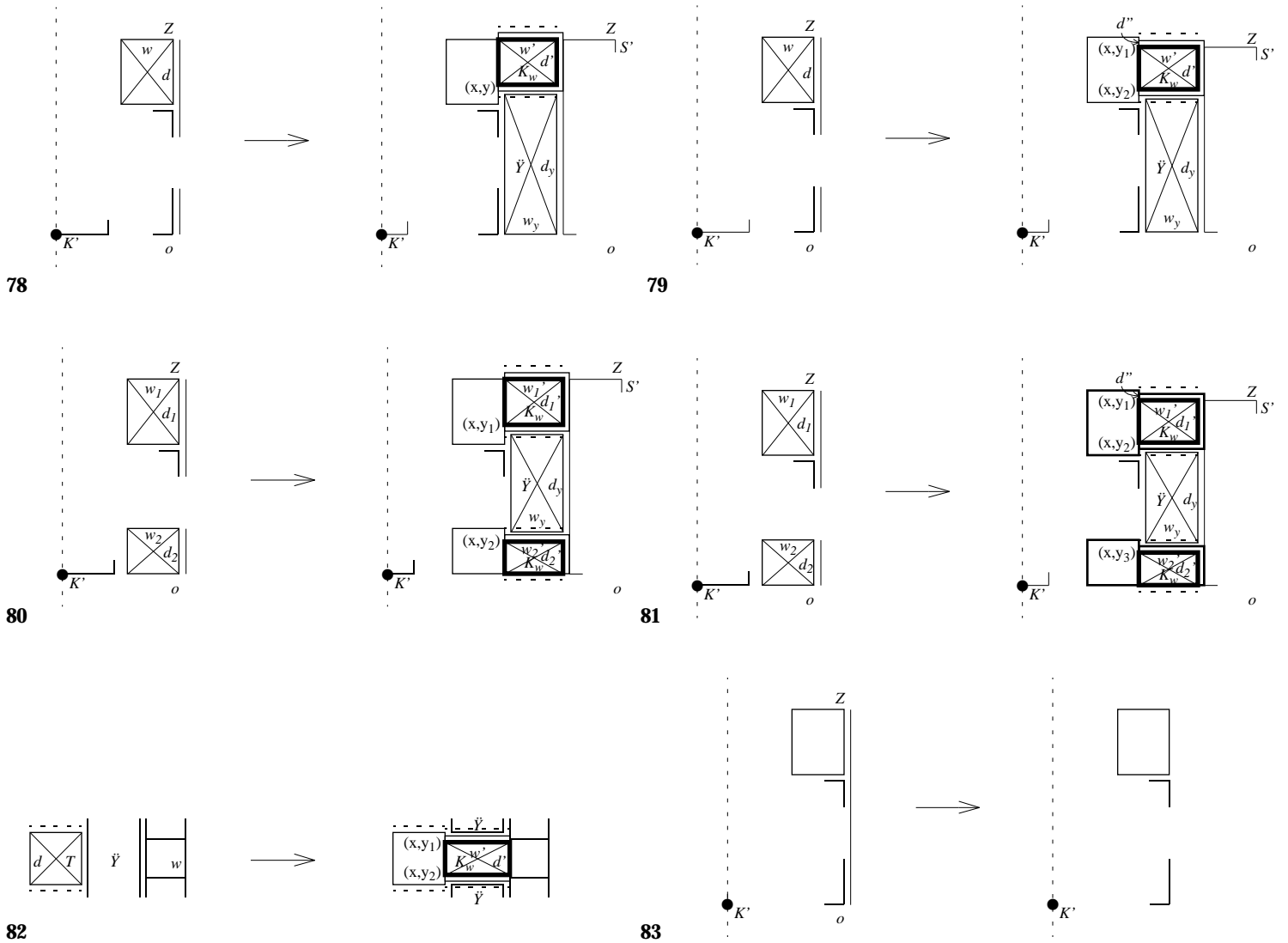


Figure 16. (Stage 12) Shape rules for generating secondary buildings that connect with the main building through a passing room.

### Stage 13: Add openings to the secondary buildings

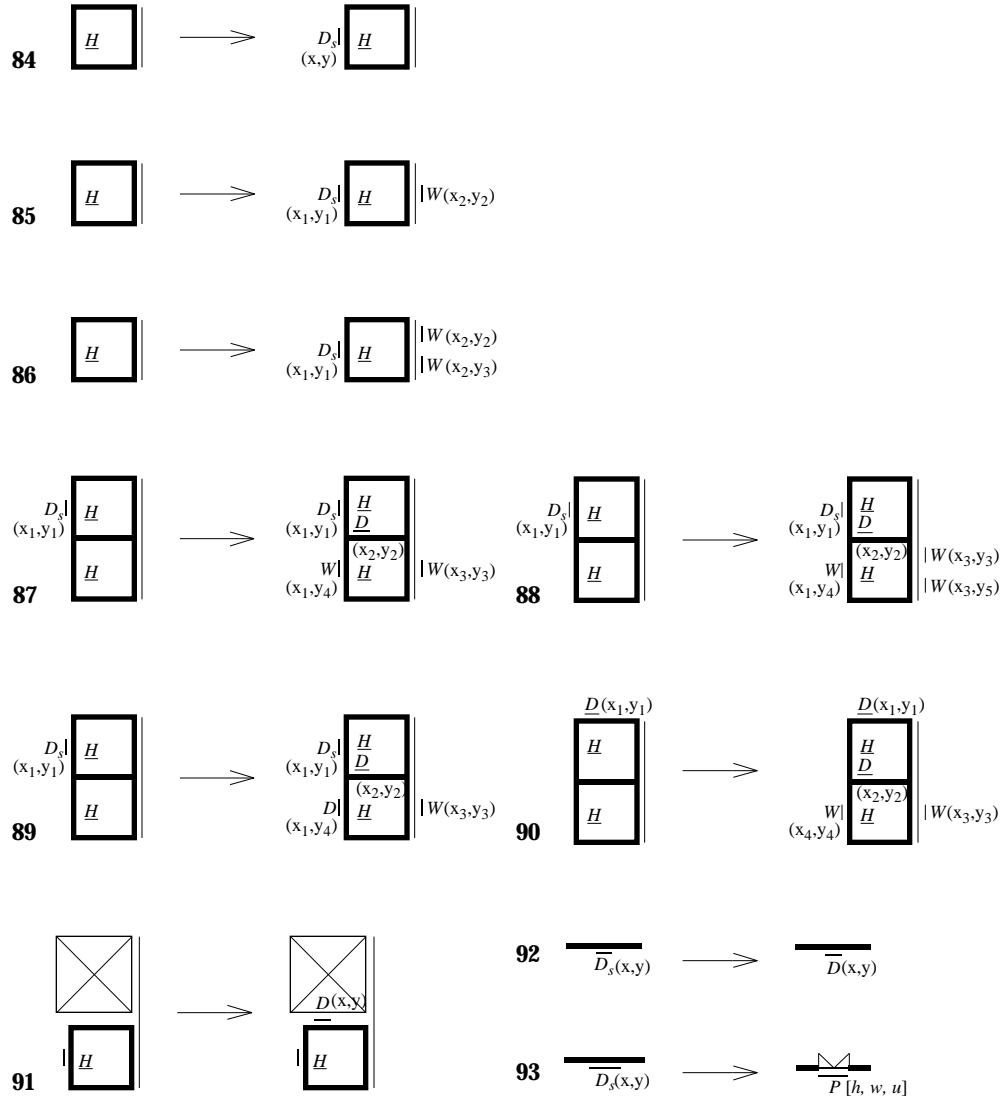


Figure 17. (Stage 13) Rules to add openings to secondary building.

## Stage 14: Generate platforms

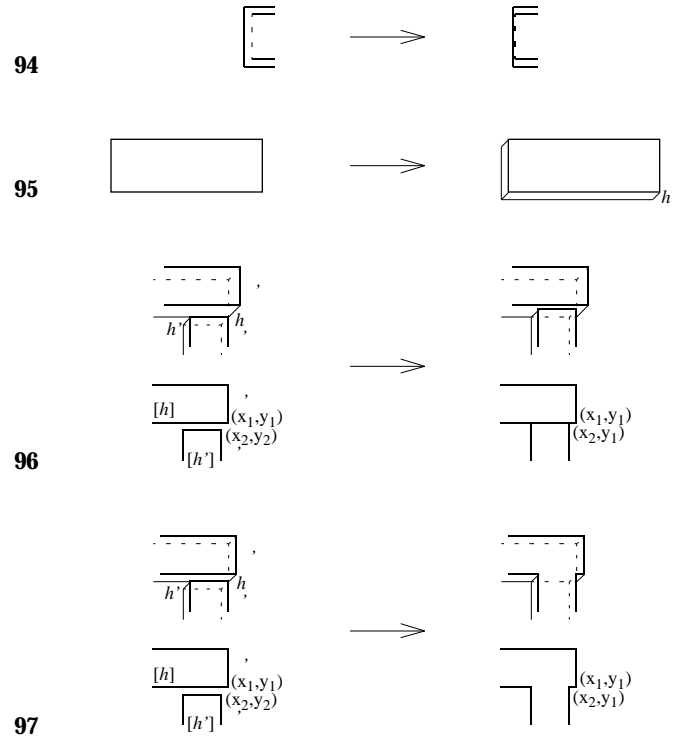


Figure 18. (Stage 14) Rules for generating platforms.

## Stage 15: Create roofs



Figure 19. Various types of roofs. (After Lin, 1990: 88)



Figure 20. Yin-yáng-biān. (After Lin, 1990: 96)

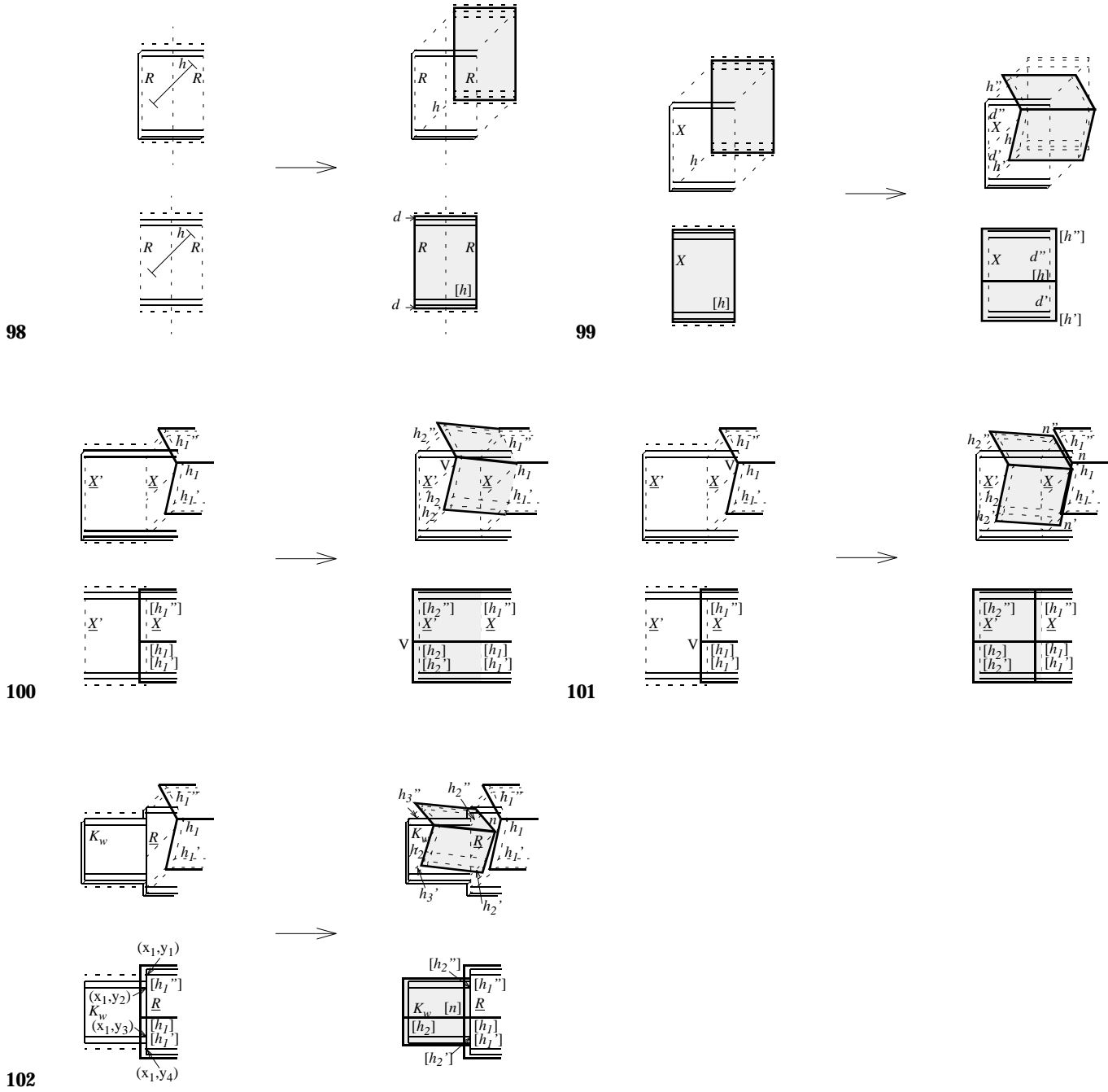


Figure 21. (Stage 15) Rules for creating roofs.

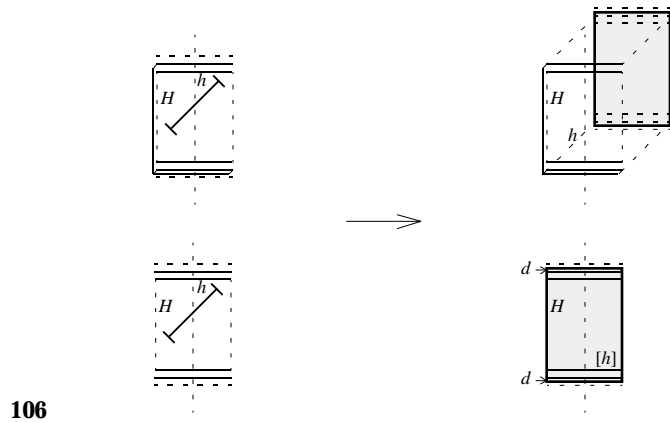
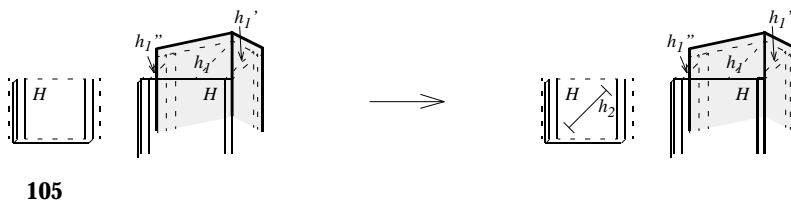
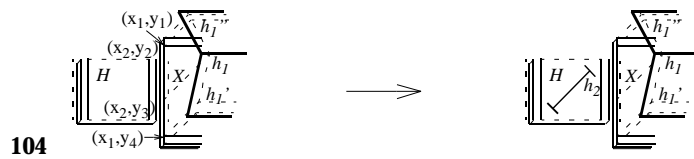
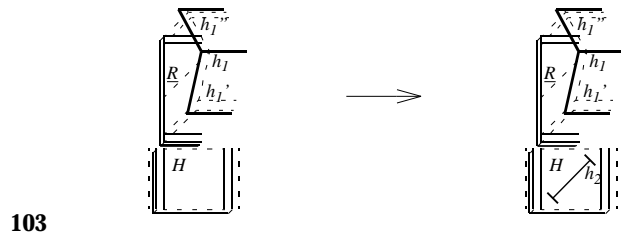


Figure 21 (continued).

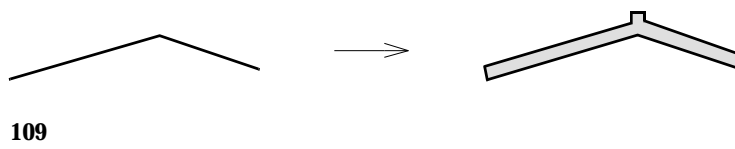
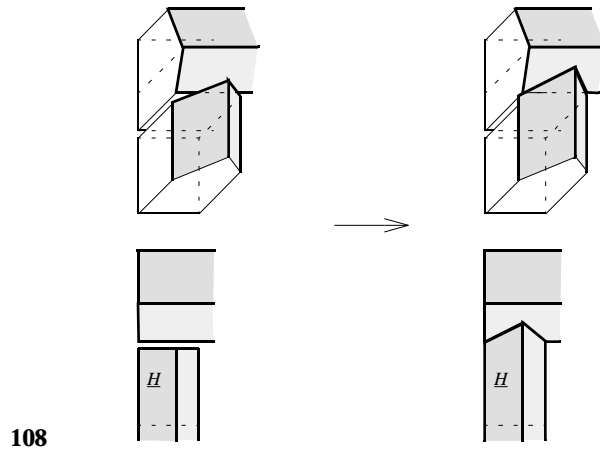
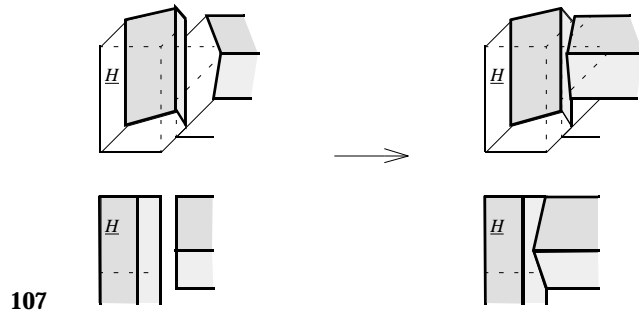


Figure 21 (continued).



**Stage 16: Modify the lines in plan to three-dimensional walls**

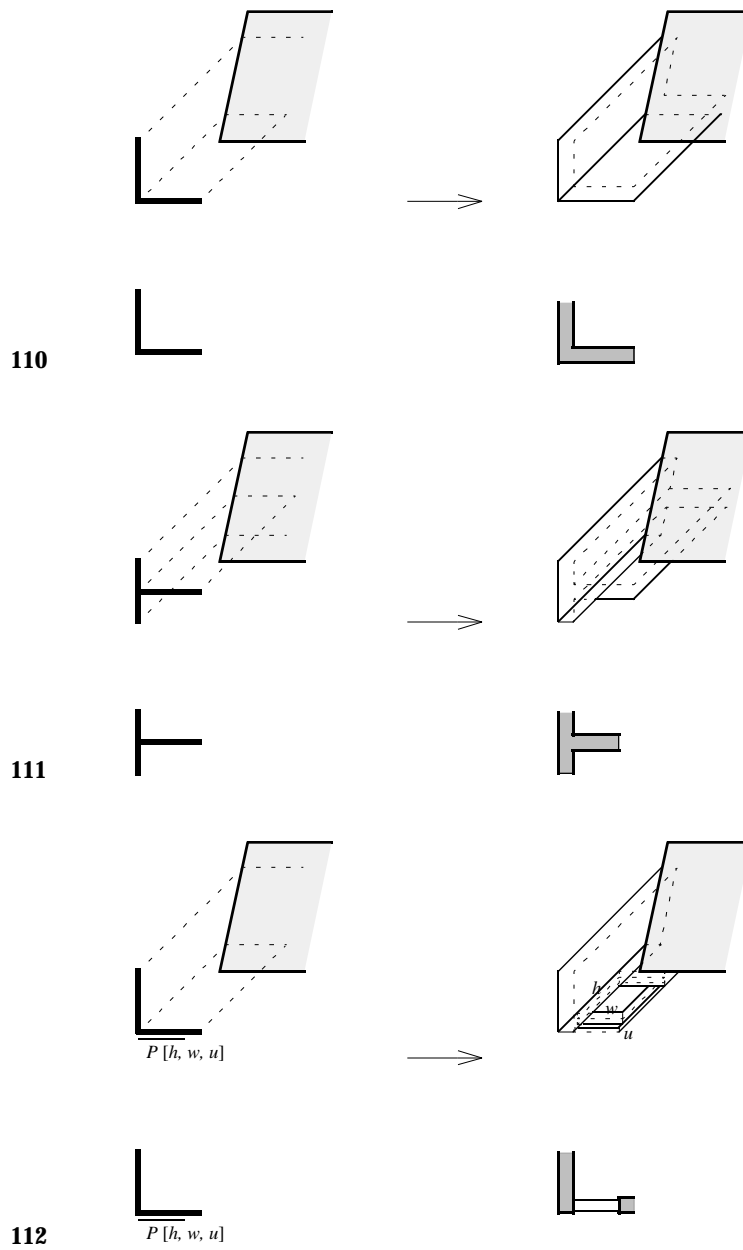


Figure 22. (Stage 16) Rules to transform lines to three-dimensional walls.

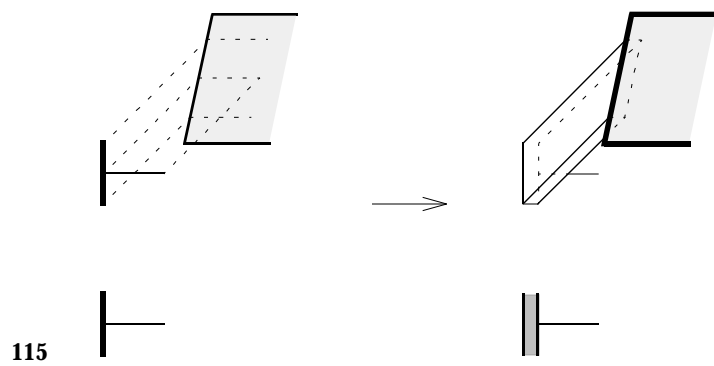
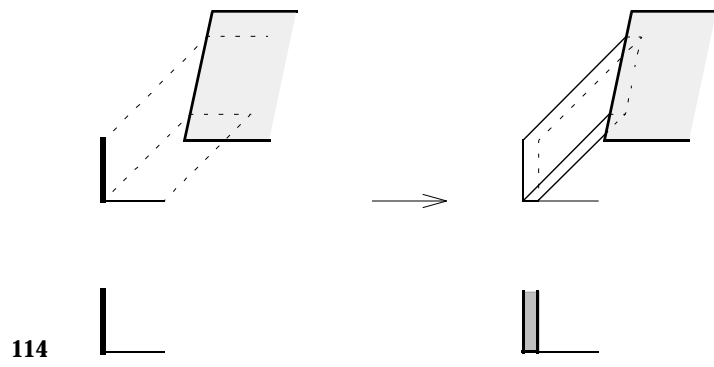
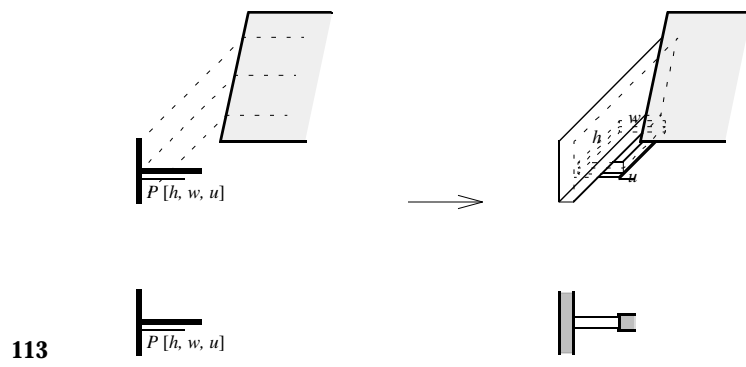


Figure 22 (continued).

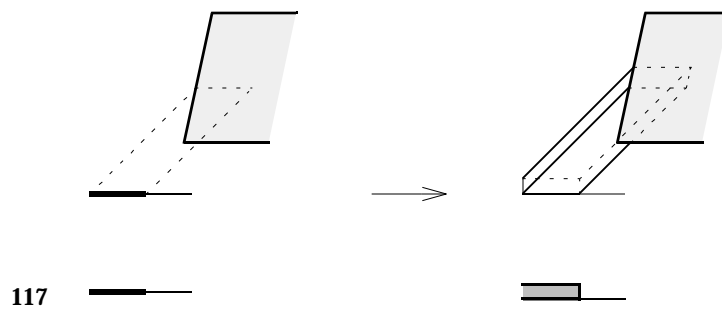
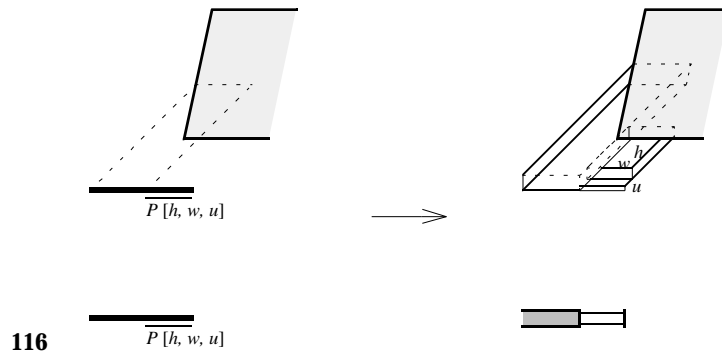


Figure 22 (continued).

## Stage 17: Termination

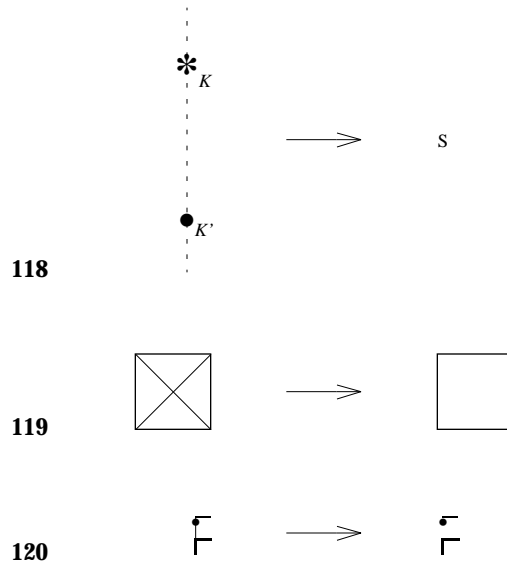


Figure 23. (Stage 17) Termination rules.

There are eighteen shape rules, numbered 121 through 138, by substituting for variable  $X$ , the labels  $A, \overset{\circ}{A}, B, \underline{C}, \underline{R}, \underline{H}, K_w, E, T, S, S', Y, \ddot{Y}, \mathbf{V}, ', I,$  and  $I'$ .

$$(0,0): X \longrightarrow s$$

## ■ Example

### ***Zhōu Family House in Taipei***

- a compact adaptation of a farmhouse
- located in the Wan-hua (*Wàn-huá*) District, Taipei

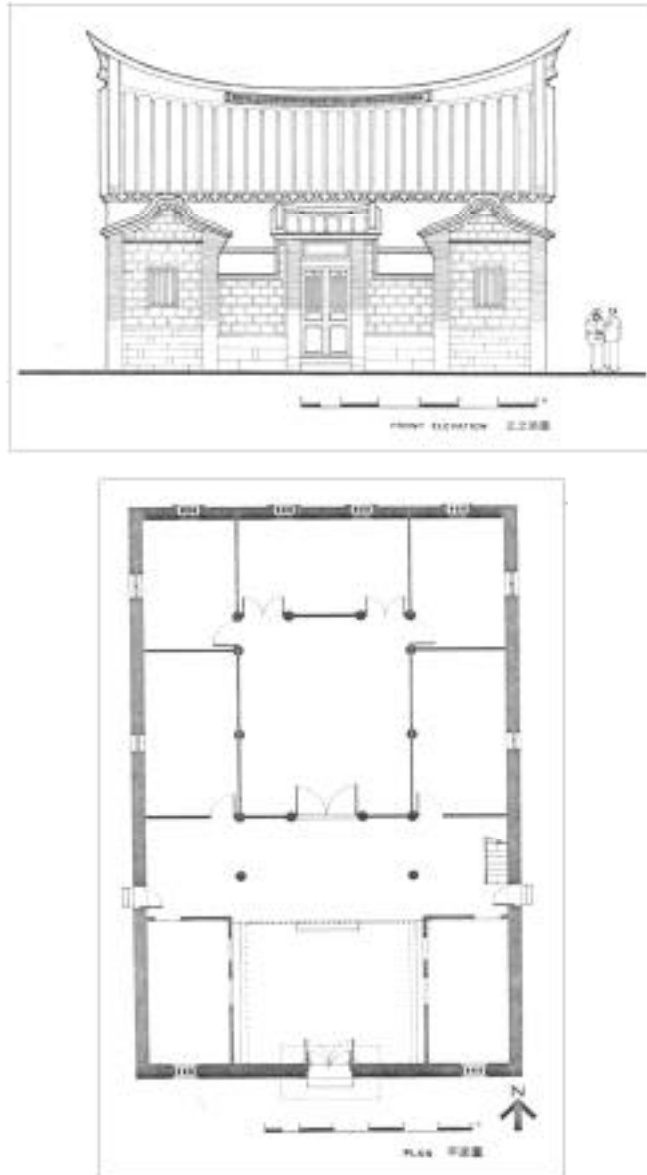


Figure 24. Front elevation and plan of the *Zhōu* family house.  
(After Dillingham and Dillingham, 1985: 12 & 15)



(0,0)✱

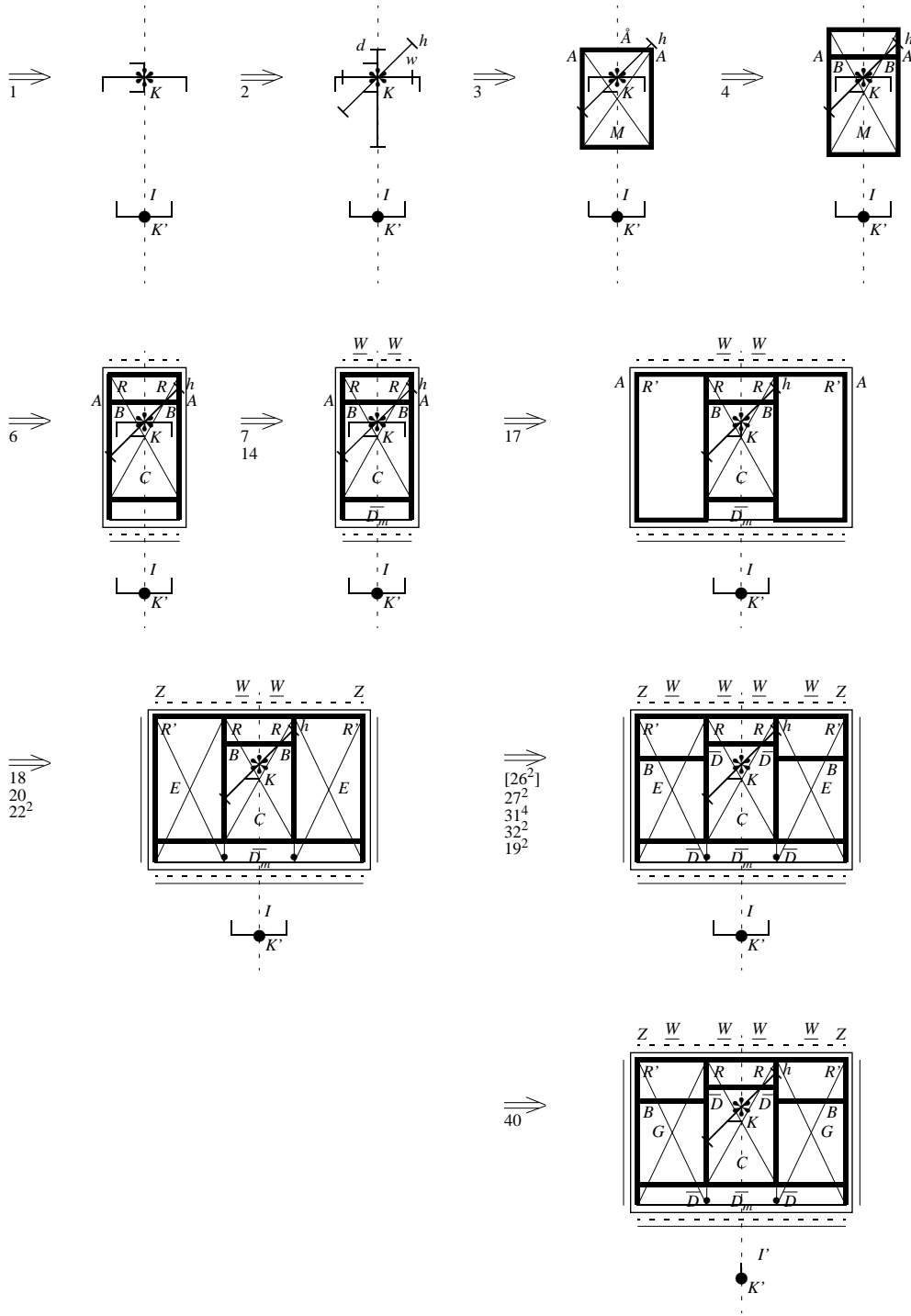


Figure 25. Derivation of the Zhōu family house.

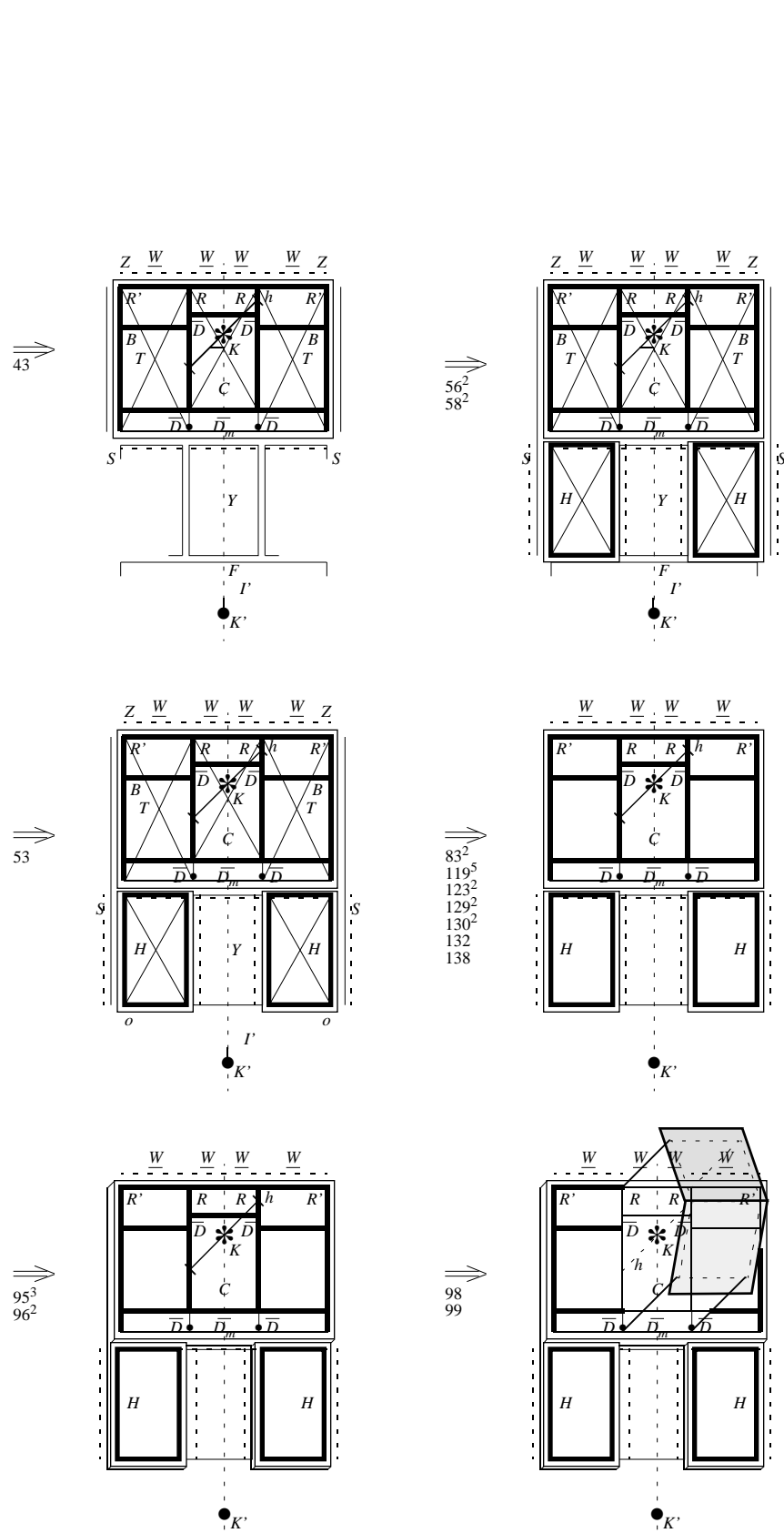
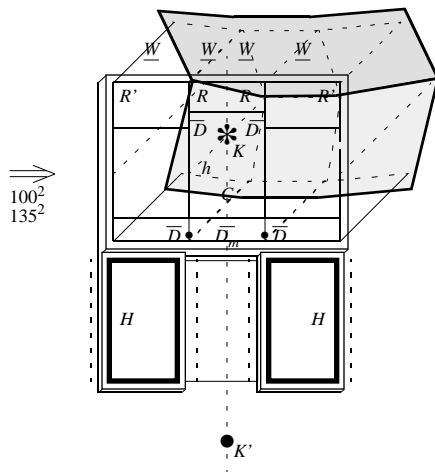
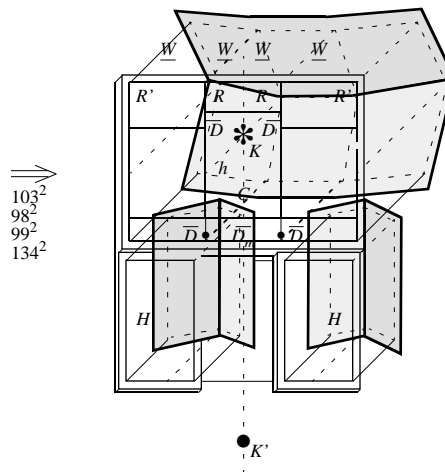


Figure 25 (continued).





$\Rightarrow$   
 $100^2$   
 $135^2$



$\Rightarrow$   
 $103^2$   
 $98^2$   
 $99^2$   
 $134^2$

Figure 25 (continued).

### ***The Lín Ān-tài Residence in Taipei***

- *Lín* family's house
- a large farm house
- located in Taipei
- built in 1822
- the outer secondary buildings were built during the period of Japanese colonization (1895-1945 A.D.)



Figure 26. The *Lín Ān-tài* residence. (After Li, 1980: 126)

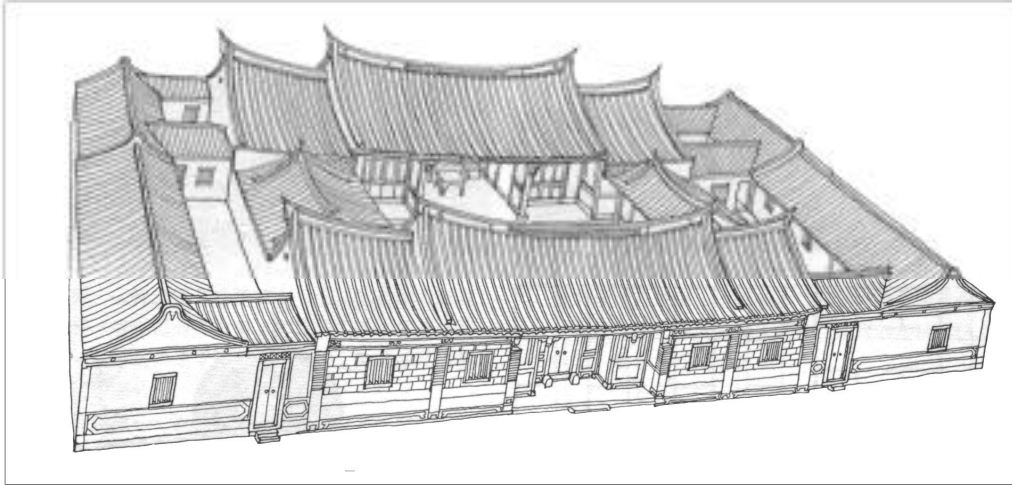


Figure 27. View of the *Lín Ān-tài* residence. (After Li, 1980: 137)

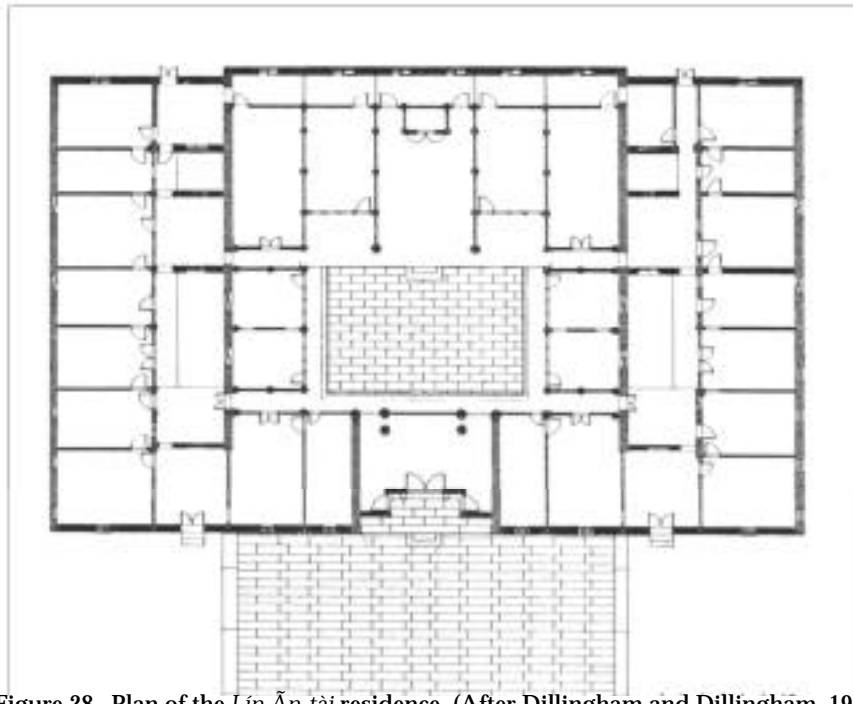


Figure 28. Plan of the *Lín Ān-tài* residence. (After Dillingham and Dillingham, 1985: 52)

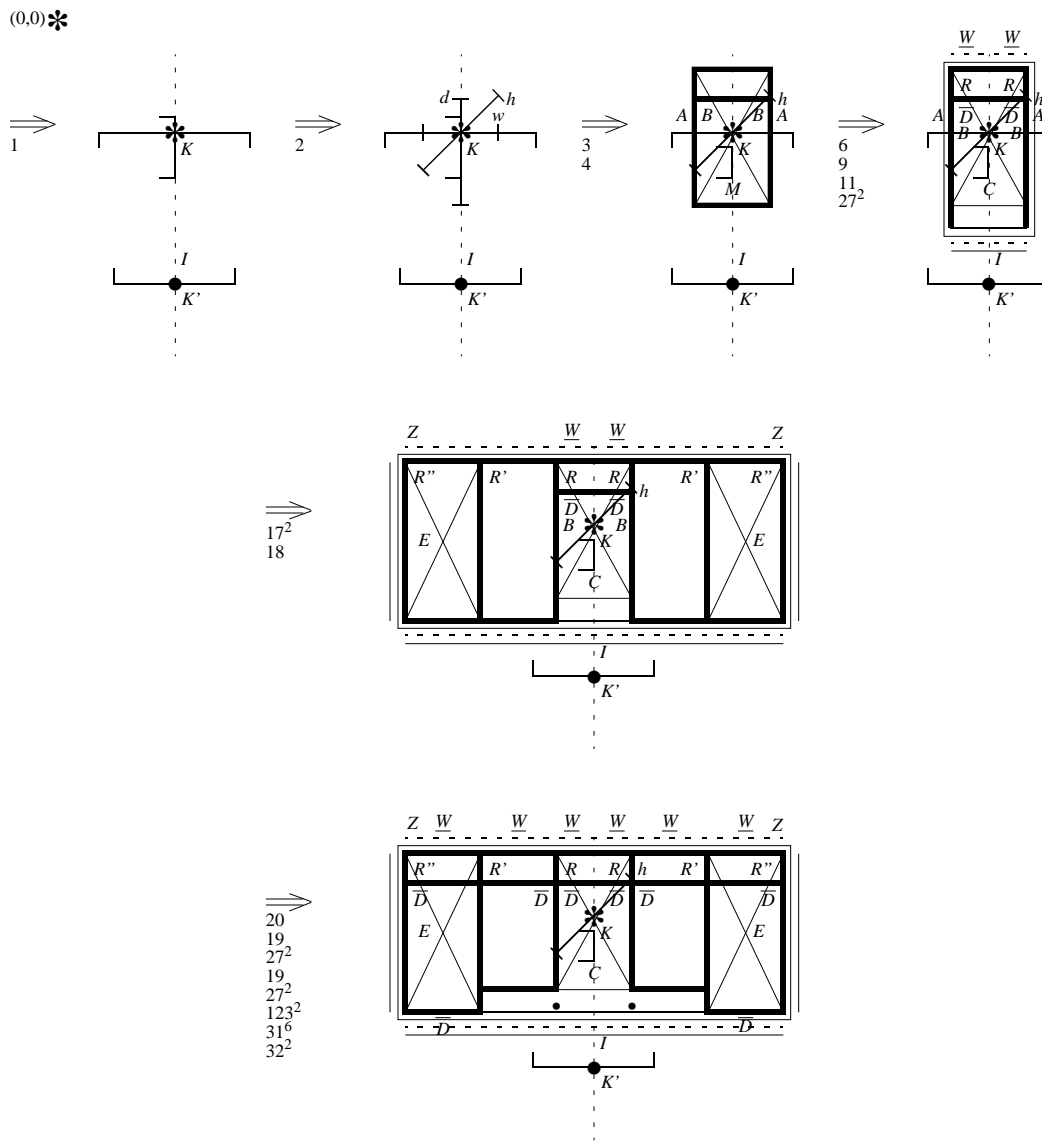


Figure 29. Generation of the *Lín Ān-tài* residence.

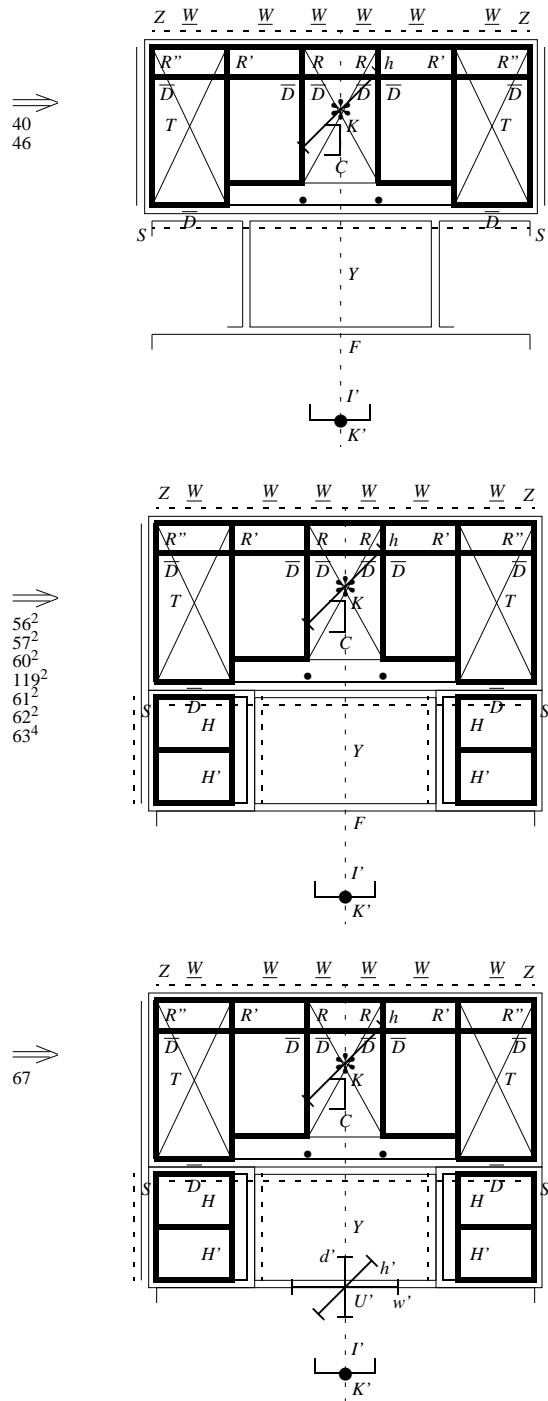


Figure 29 (continued).

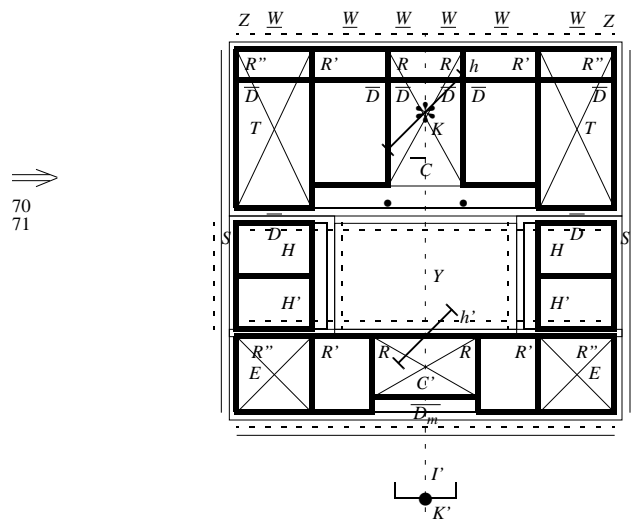
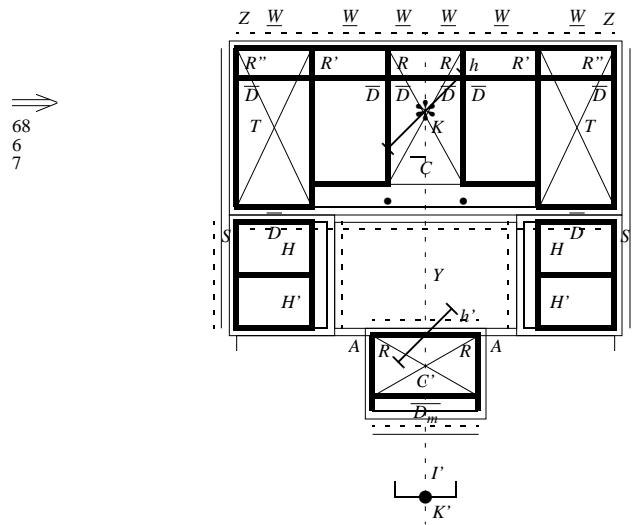


Figure 29 (continued).

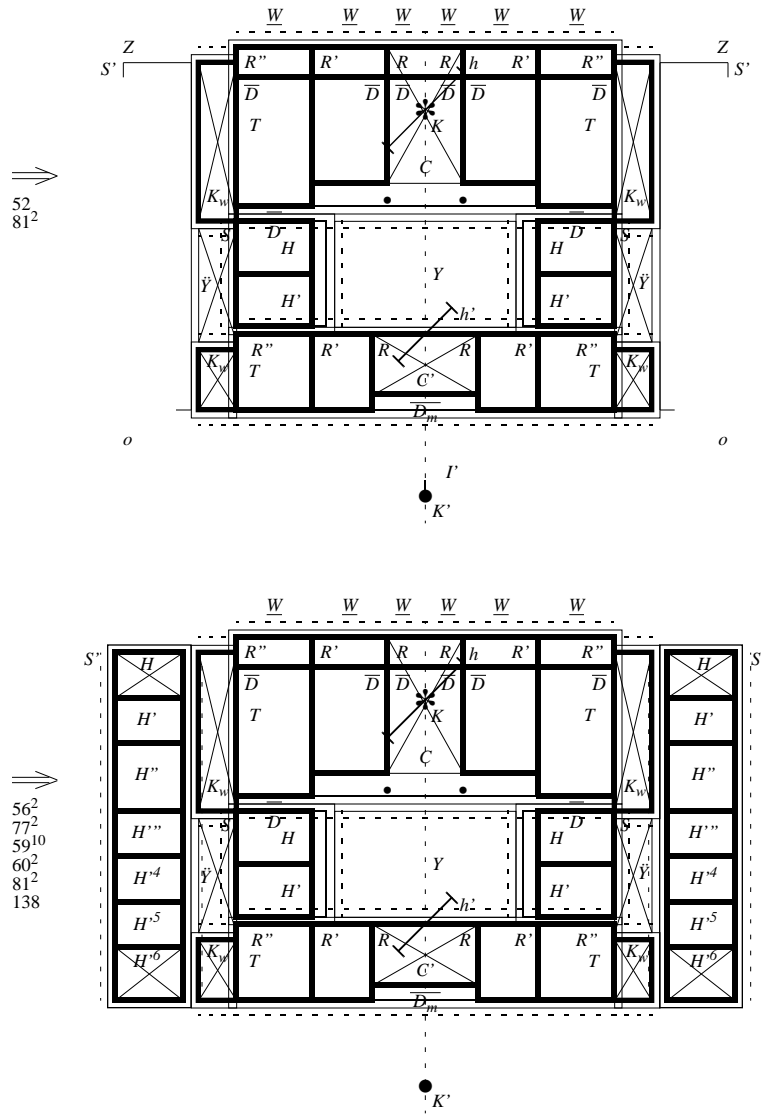


Figure 29 (continued).

## ■ Summary

- The shape rules generate plans that are not dissimilar from the original plans. It should be possible to generate exact replicas provided additional shape rules are specified in each case. Whether this would add significantly to an understanding of the basic Taiwanese traditional style of design is questionable.
- Taiwanese traditional architecture is rigid by comparison to other architectural styles. And, it is rich in variation. Yet, it is also flexible and simple. Although we have imposed some restrictions on the constraints in deriving the plans, in practice, the artisans were not afraid to relax some of these constraints (of course, within bounds dictated by the principles of geomancy, and by auspicious measurements on the appropriate ruler). This is shown in the way in which we set the constraints for the fortunate dimensions where we catered for the general situation. Of course, even in traditional practice, some constraints were hard, such as the one that required that the drop line of the front roof of the secondary buildings did not intrude into the opening in the main building.
- Taiwanese (and Chinese) traditional architectural designs were not based on specific architectural or “physical functions.” For example, in general, the usage of space in a building was flexible. The same plan of a building would have been adapted for a house, temple, or any public building. On the other hand, occupancy and usage was determined by seniority of rank of each individual family member. Each building would have followed a space hierarchy which determined, in principle and practice, the hierarchy of functions, the dimensions, decorations and so on. There was a correlation between specific space hierarchies for buildings and the space hierarchy of a building type.
- The main walls (or frames) of the central room in the principal building and its structure were the core to the design of the entire building. The walls defined the modulus of the building. The development of a grammar for the main frame is another important issue that one might have to consider.
- The building decorations were probably the most important features that distinguished the building, its type, functions, and its owner’s socio-economic situation.