48-747 Shape Grammars

QUEEN ANNE HOUSES

Follows in the picturesque traditions of the 19th century

"one of the most complex habitations ever devised for commoners. It rejected the traditional concept of the unity of design, deliberately contrasting shapes, textures, and colors – solid and void, in and out, square and round, light and dark, rough and smooth. …

… Paradoxically, this busy allover pattern created a unity of its own, very much like a patchwork quilt that makes a strong design out of many different fabrics."

(Maas, 1972, pages 140-141)

Queen Anne houses

have history

have features

have texture

have structure

have aesthetics

have style

and … are describable by **shape grammars**

among **the worlds** I study

analytic shape grammars are intended for a **particular style**

clarify ***commonality of structure*** and appearance manifest in buildings in a corpus; here,

supply ***conventions and criteria*** to determine whether any other building outwith the original corpus is an instance of the style; and

provide a ***compositional machinery*** to describe other buildings in the style.

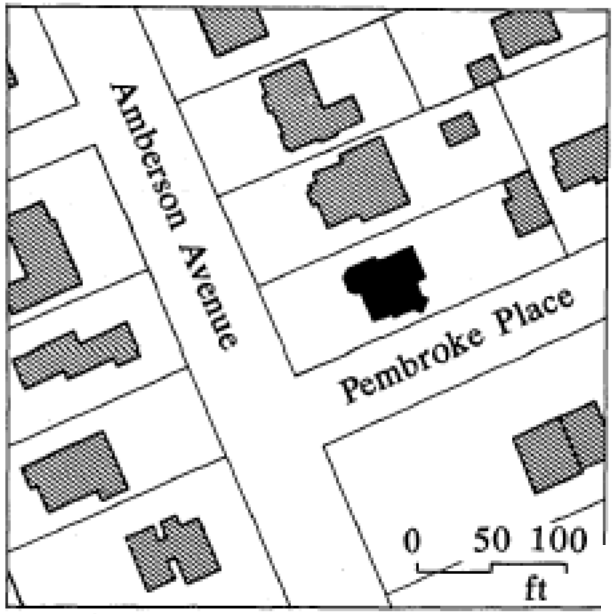
language → style ← shape grammar

(a)

(b)

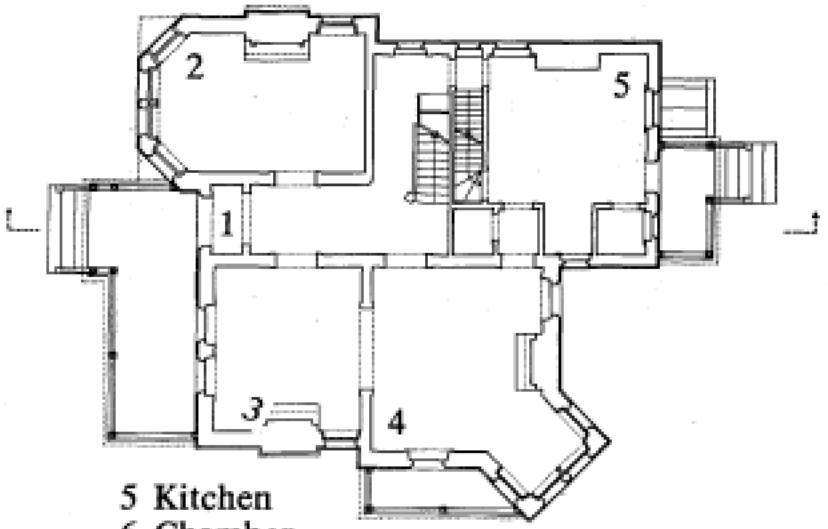
(a) Front (b) Back

719 Amberson Avenue (1985)

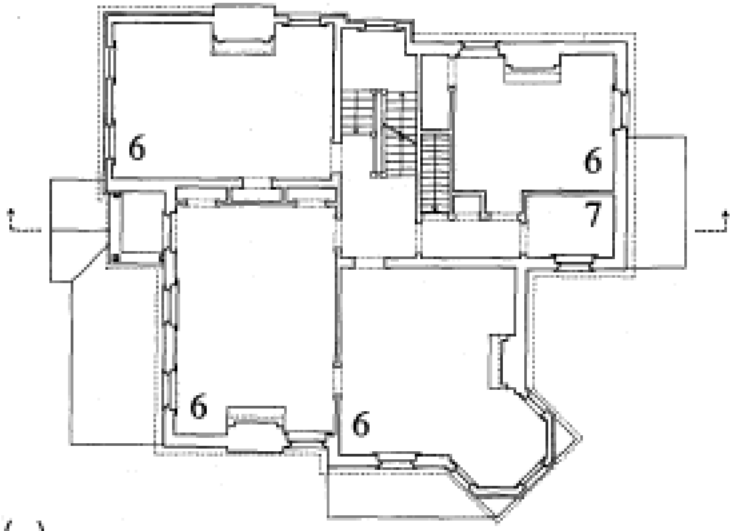


(a)

1 Entry
2 Parlor
3 Library
4 Dining room



5 Kitchen
6 Chamber
7 Bathroom



(c)

(d)

(a) context (1985) (b) first floor (c) second floor (d) section

(e)

(f)

(g)

(h)

(e) southwest (front) (f) northwest (g) northeast (h) southeast elevations

Built in 1887 by Charles Spencer

Daughter Ethel described life in the house at the turn of the century in a memoir which is very informative for anyone interested in how these houses were originally used (Spencer, 1983).

Only minor alterations have happened to the physical structure of the house since that time.

The plans shown are based on actual measurements done in the spring of 1985, but depict the original state as it can be deduced from the architect's drawings still in possession of the present owner.

about the house

A center entrance, followed by an entrance hall and main stairs located at right angles to each other.

A parlor or reception room occupies the northwest corner of the house.

A second public room, called 'library', occupies the other corner at the front across the hall from the parlor. Used for a multitude of functions: occasional naps taken by the father, board games played by the children, and informal family gatherings.

This space is followed by the dining room in the southeast corner, which is thus oriented towards the back and side.

The remaining corner contains the kitchen.

first floor

The entrance hall disappears on the second floor, and the space above it becomes part of one of the front rooms.

The second floor reflects closely the first floor in the arrangement of major rooms.

The rooms are used as bedrooms for the family and guests, with the room on top of the kitchen serving as day nursery.

A bathroom is added at the back. It is made accessible from the stair hall by a secondary corridor, which gives access also to the service stairs and a row of built-in closets.

second floor

The exterior shows features typical for the style: an irregular mass and a mix of materials and textures that become particularly dense at gables and chimneys

The gables show a great variety of stickwork patterns that contrast with the plain brick surfaces of the walls, and the chimneys are richly decorated with corbels, ribs, and inlaid patterns

exterior

Methodologically, spatial organization was treated independently of style.

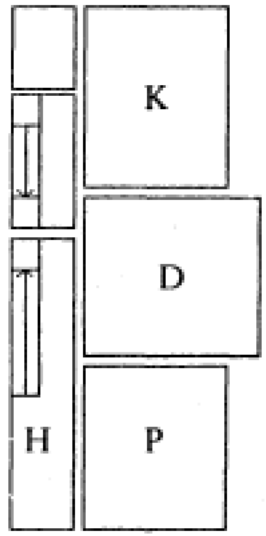
Divide the design of a house into two phases; the first phase determines its basic layout, as given by the plan of its first floor, and the second phase articulates the resulting organizational pattern in a particular style.

The two phases are expressed in distinct grammars.

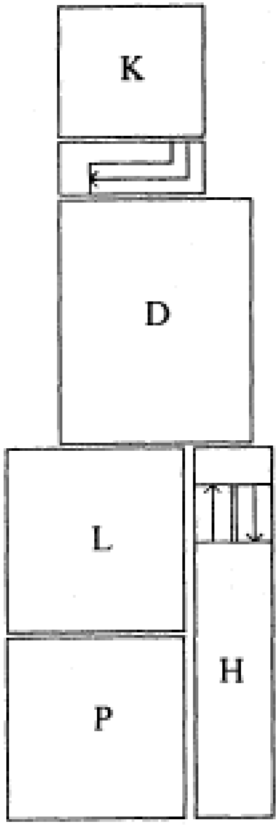
The first grammar contains the rules that can be used to generate basic layouts

…

say something about UDA and the Village of Shadyside



Plan A1



Plan A2

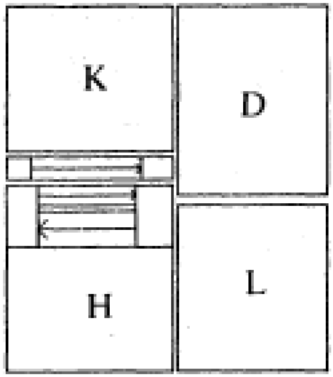
Key
B Billiard room
CE Carriage entry
D Dining room
De Den
H Hall
K Kitchen
L Library
P Parlor
Pt Pantry
S Study
SP Sun porch
SR Smoking room

0 10 30 ft

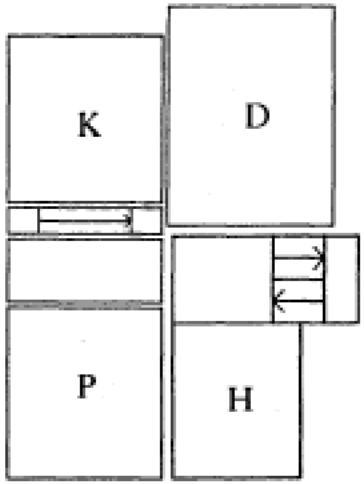
(a)

a small sample of measured drawings of Queen Anne Houses in Shadyside, Pittsburgh, PA

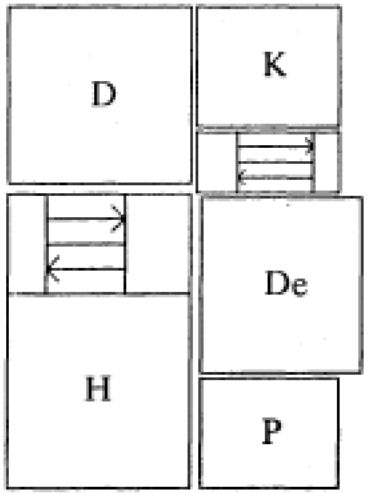
the source: side hall plans



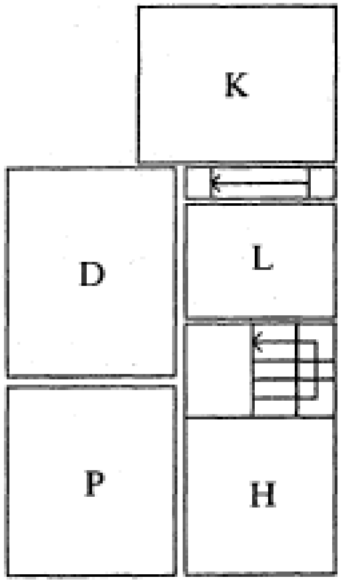
Plan B1



Plan B2

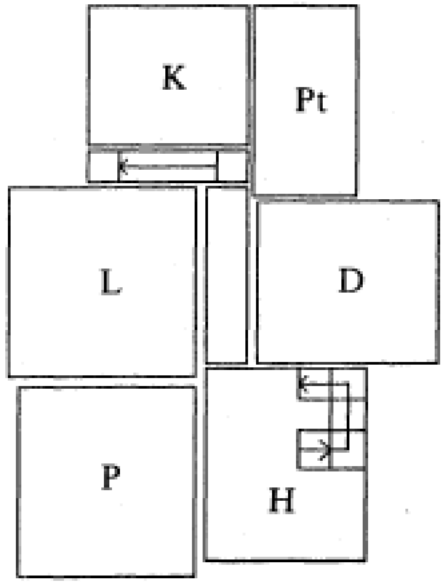


Plan B3



Plan B4

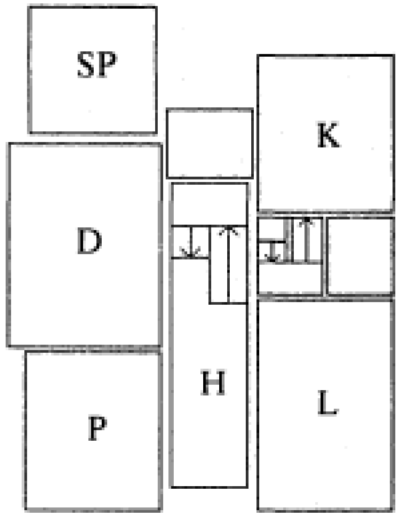
(b)



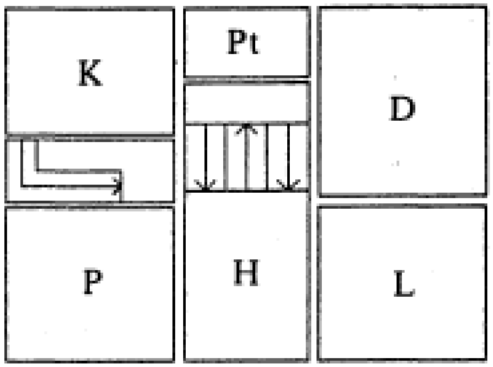
Plan B5

the source

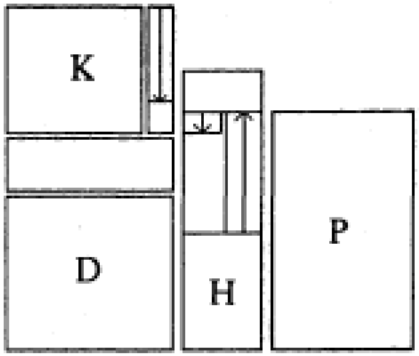
corner hall plans



Plan C1



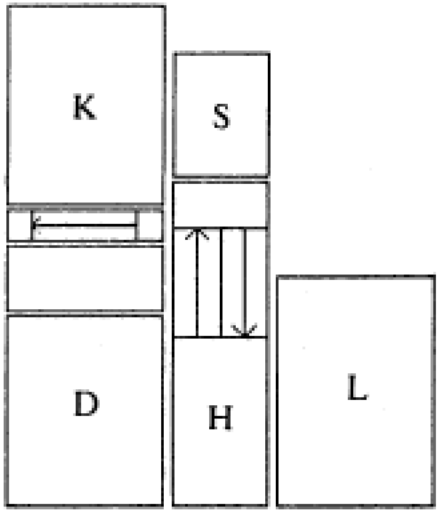
Plan C2



Plan C3

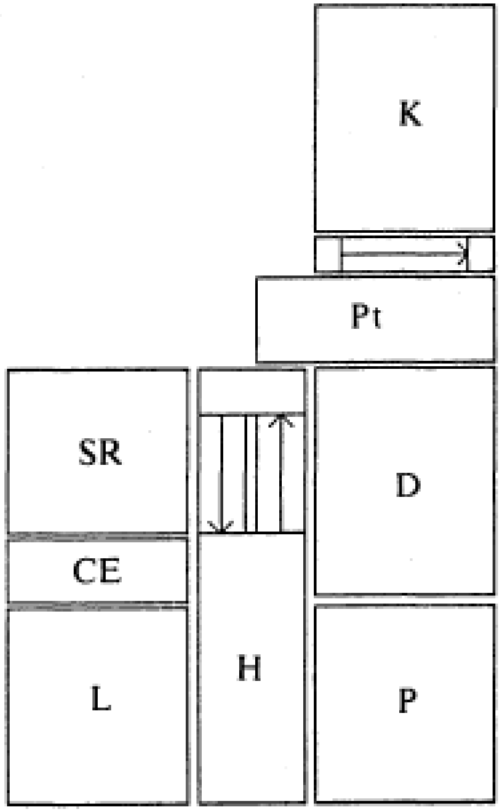
the source

center hall plans

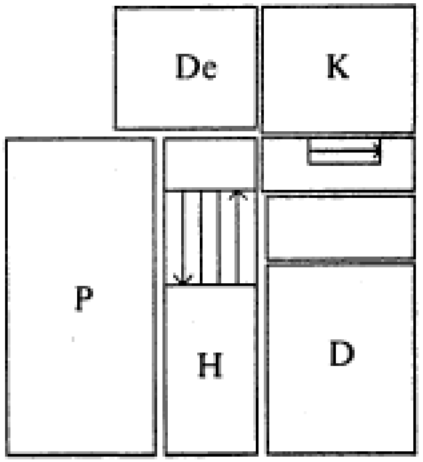


Plan C4

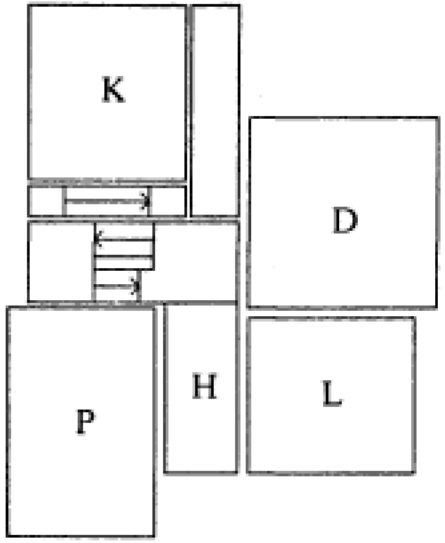
(c)



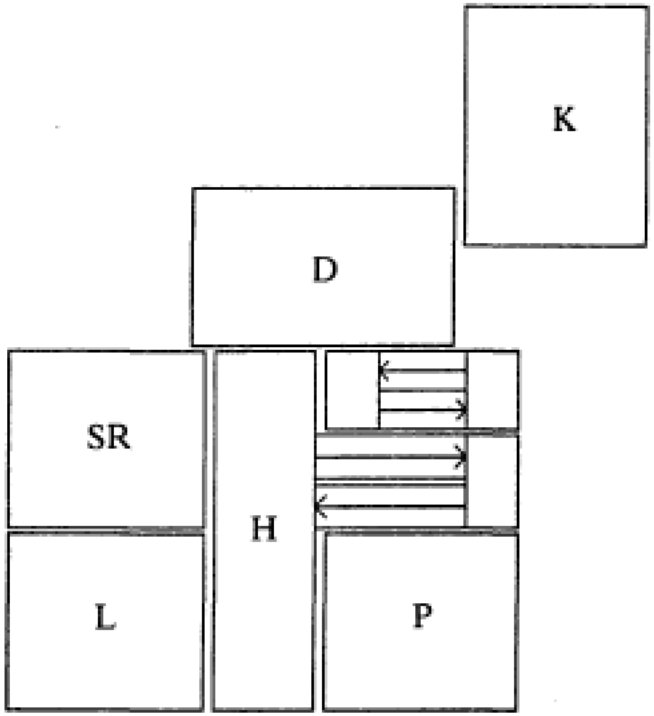
Plan C5



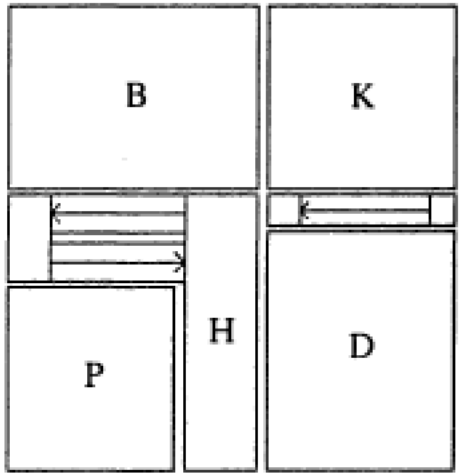
Plan C6



Plan D1



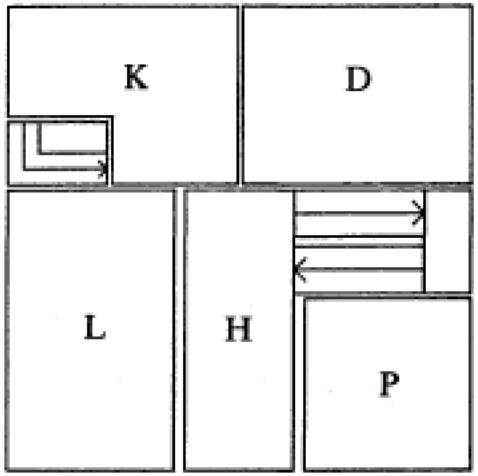
Plan D2



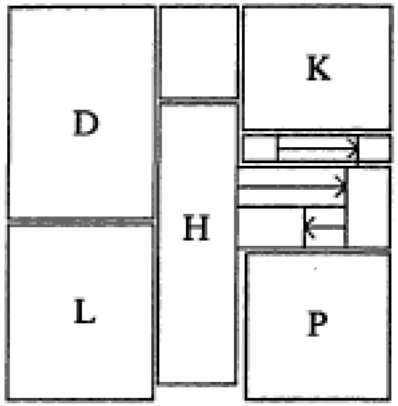
Plan D3

the source

corner room plans



Plan D4
(d)



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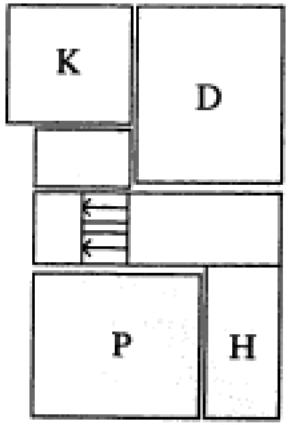


Plan D6

Spatial Organization

Allocating rooms around a hall

Allocating the kitchen

Adding a stair hall

Extruding into the third dimension

Exterior Articulation

Generating a basic house

Generate roofs

Volumetric refinements and additions

Articulation of elements

termination

stages in the shape grammar

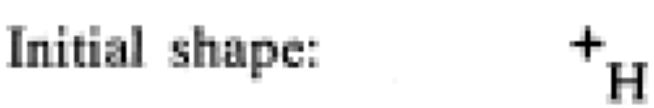
spatial organization

The main organizer on first floor is the entrance hall: it gives access to all other public spaces and thus forms the hub of the plan.

Scully calls this kind of space planning

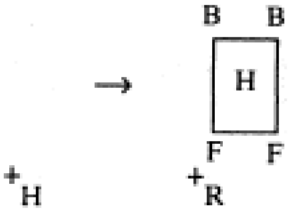
"peripherally additive, controlled by the center" (1971, page 14).

The grammar is designed to reflect this principle and to explore its implications; it starts by allocating rooms around the entrance hall

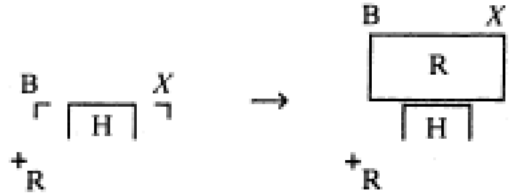


allocation of rooms around a hall

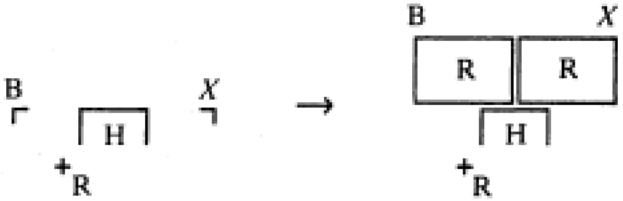
Rule 0



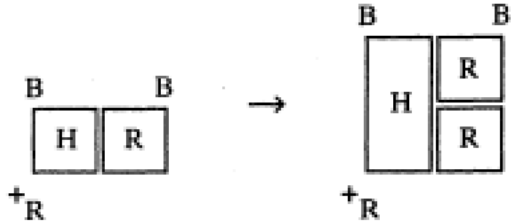
Rule 1

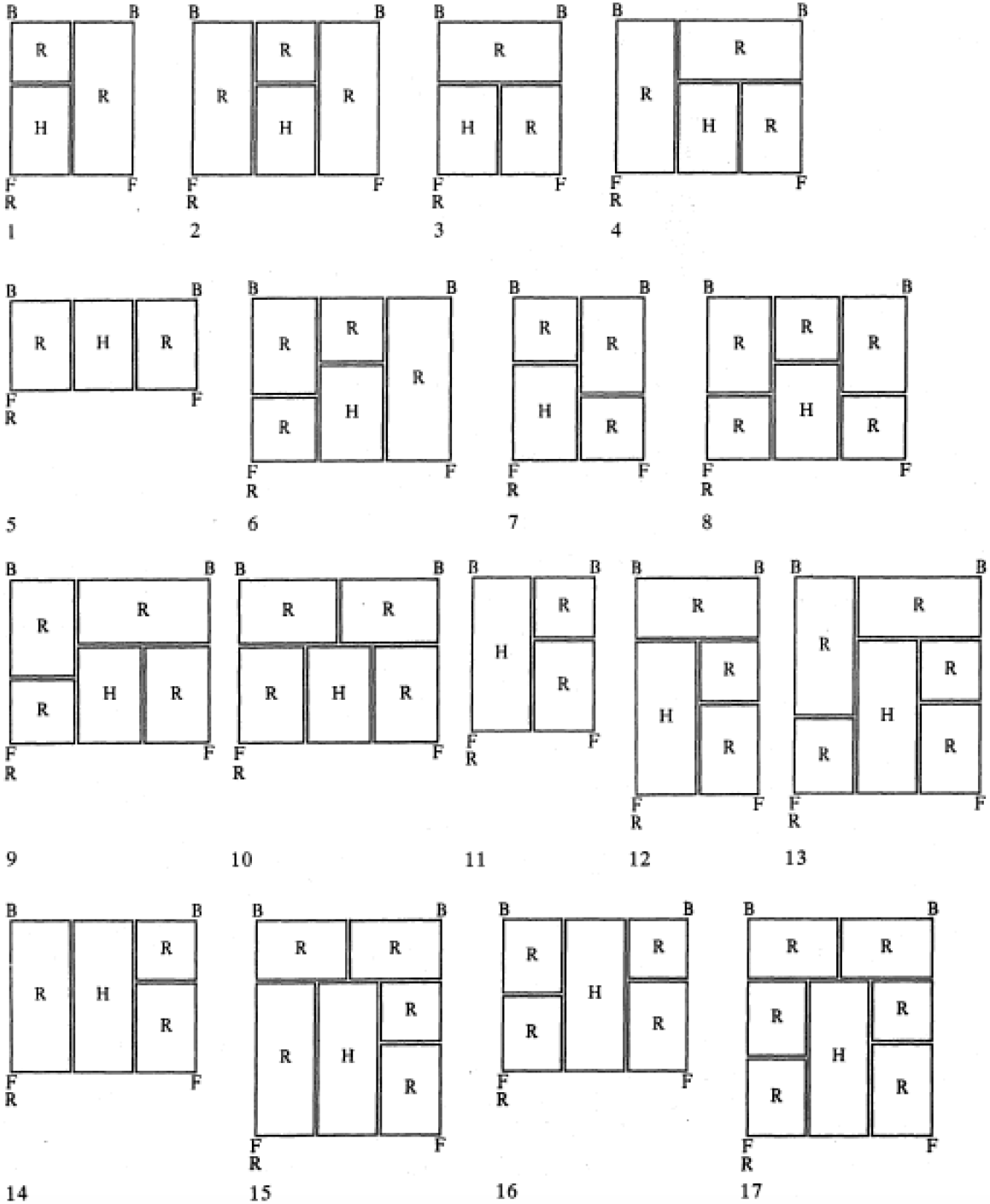


Rule 2



Rule 3





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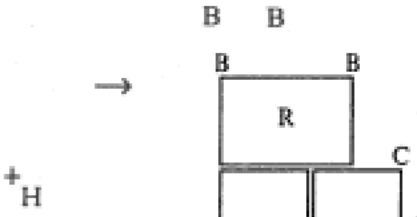
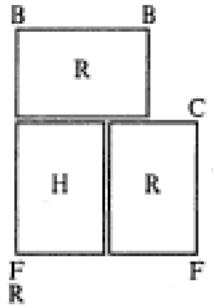
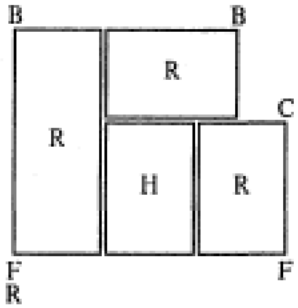
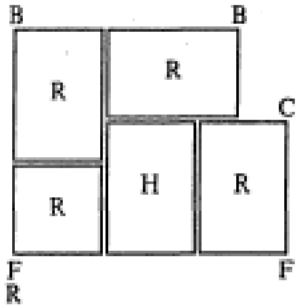
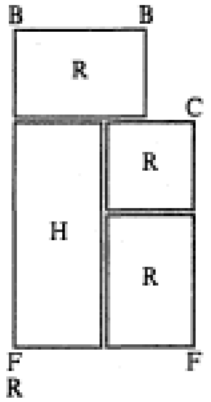


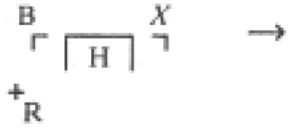








Rule 1



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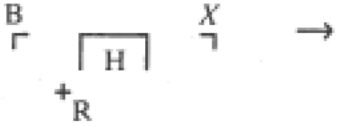

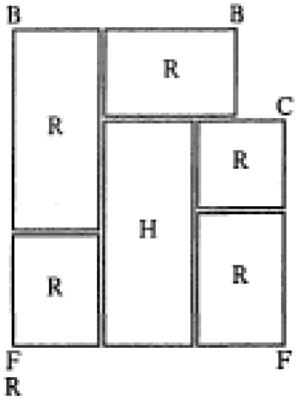

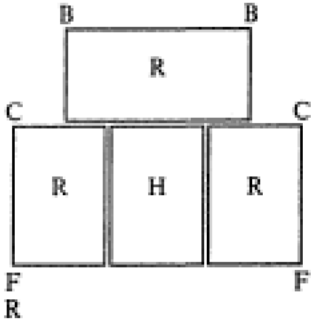

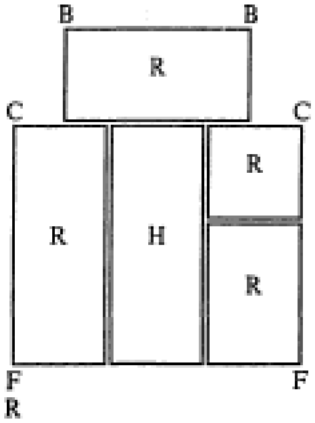

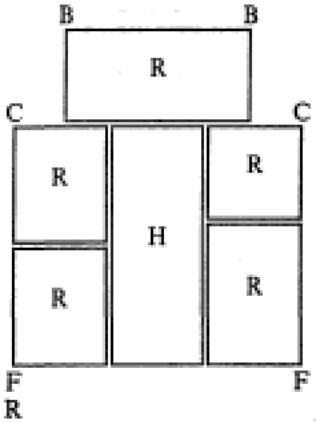

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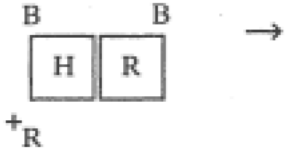

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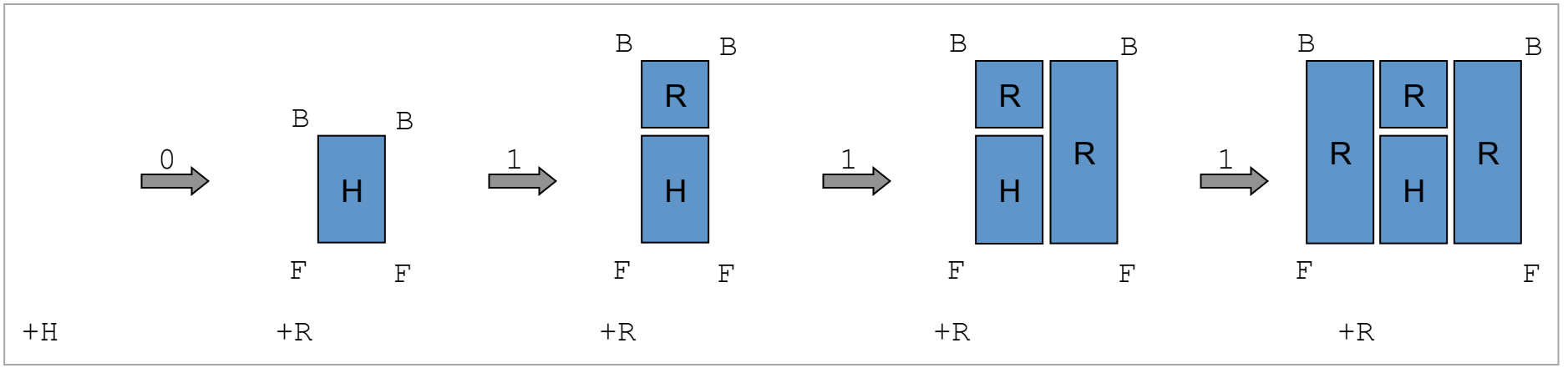
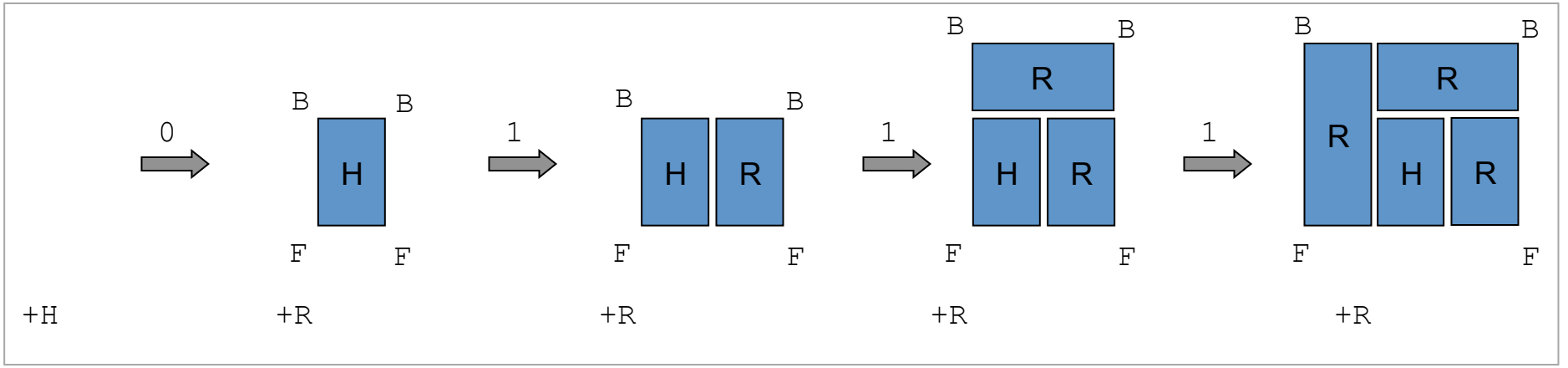
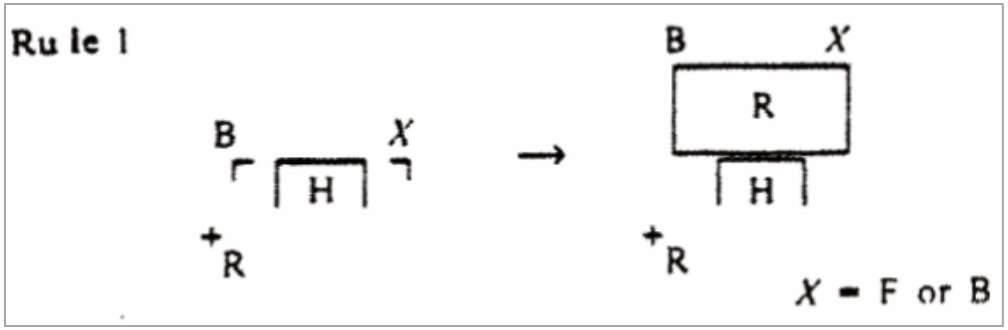
Rule 4

Rule 5





applying shape rules



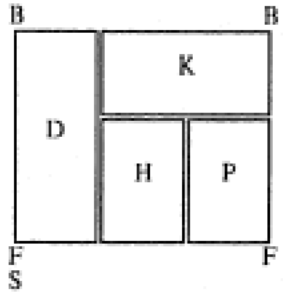
The kitchen and surrounding ancillary rooms form an area that is distinct from the public realm.

It never reaches the front and always borders the back, normally via a back porch from which deliveries are made and outside work areas can be reached.

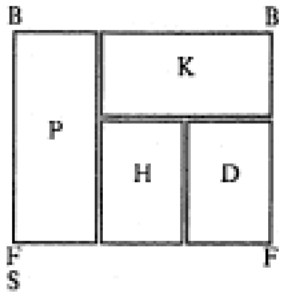
The kitchen itself can be incorporated into the plan like a public space, but if it is, it is hidden from public view.

It has a strong connection only to the dining room, and this can be realized also if the kitchen is more detached from the core of the plan.

allocating the kitchen



(i)



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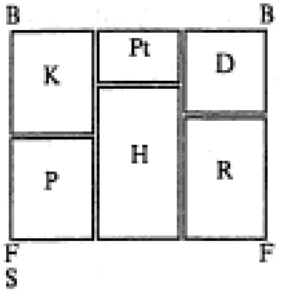

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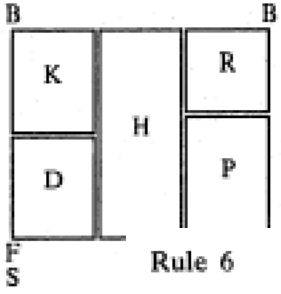

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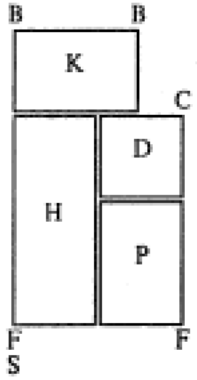

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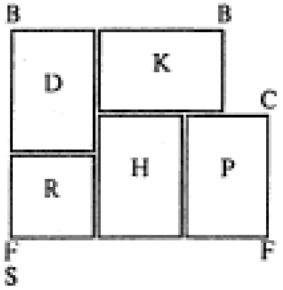

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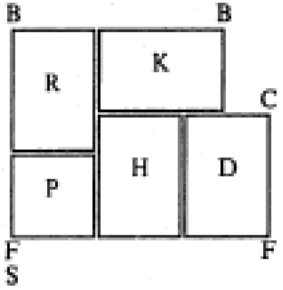

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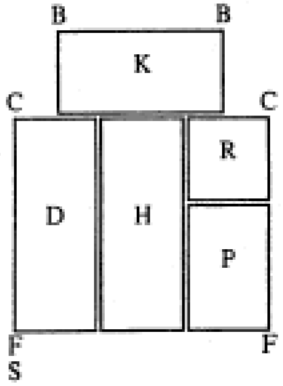
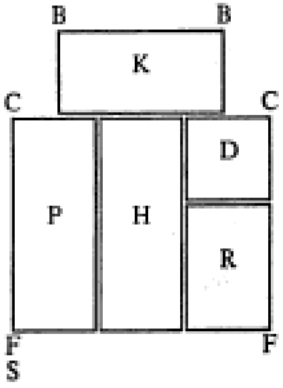


(viii)

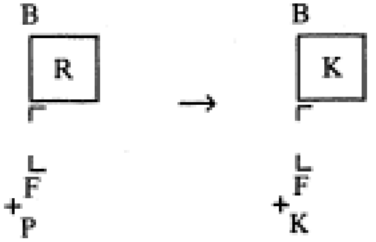


(ix)

allocating
the kitchen
rules 6-9

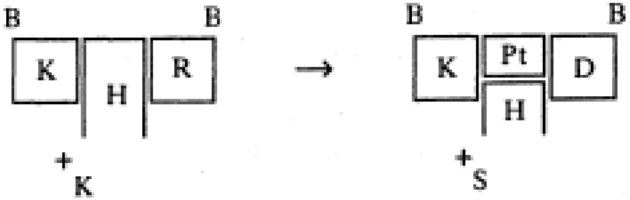
Rule 6

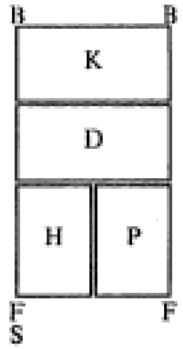
Rule 7



Rule 8

Rule 9





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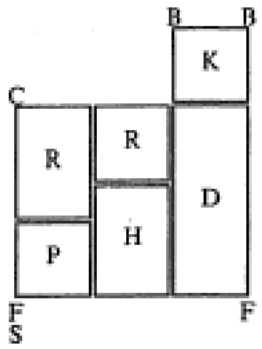

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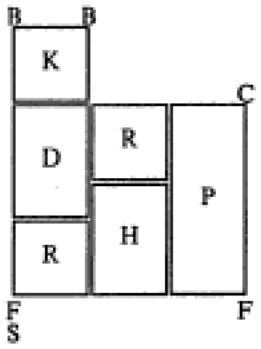
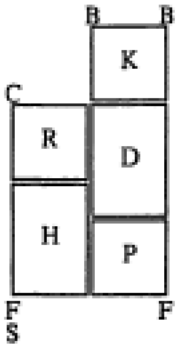
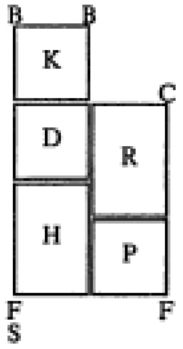


(xii)



(xiii)



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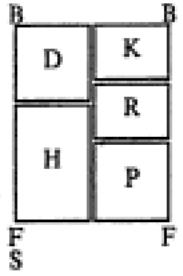

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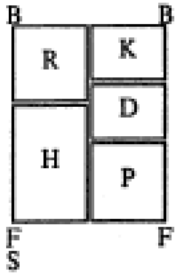
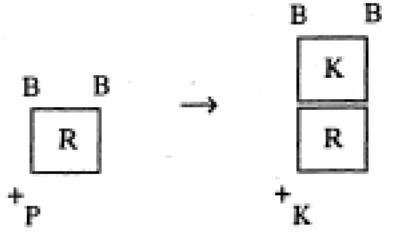
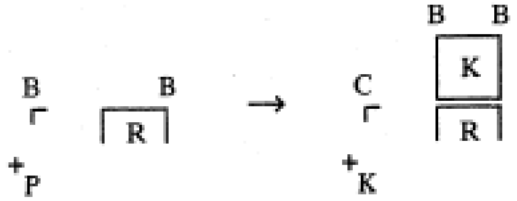


(xvi)

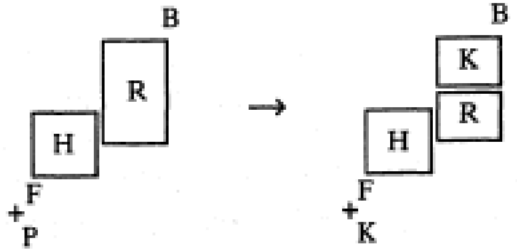
Rule 10



Rule 11

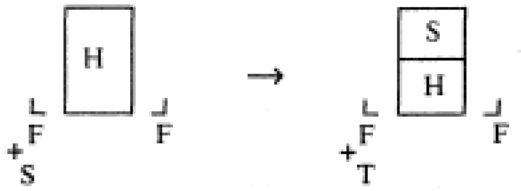


Rule 12

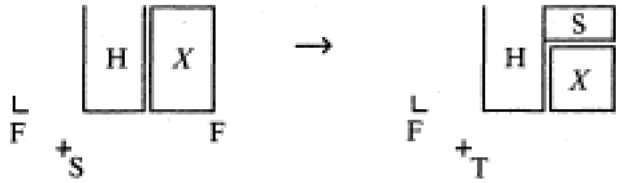


more on allocating the kitchen: rules 6, 8, 11, 12

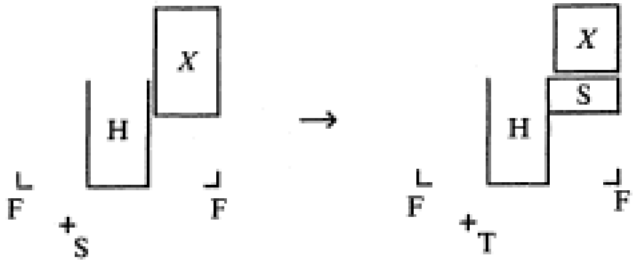
Rule 13

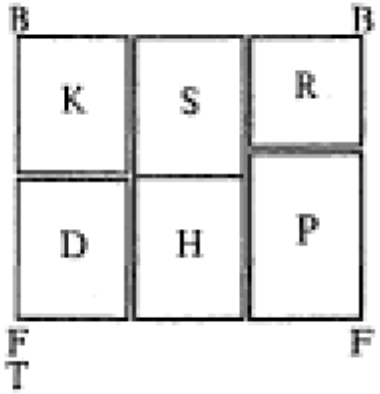


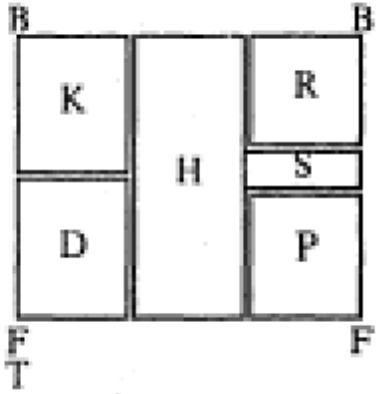
Rule 14



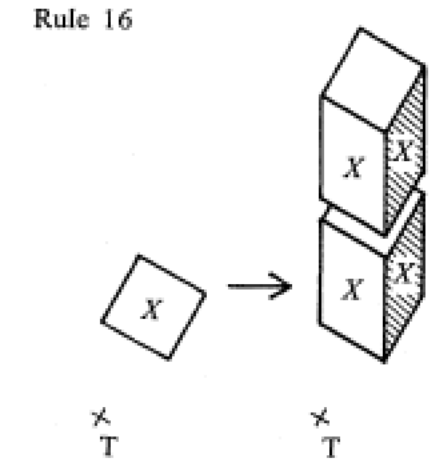
Rule 15

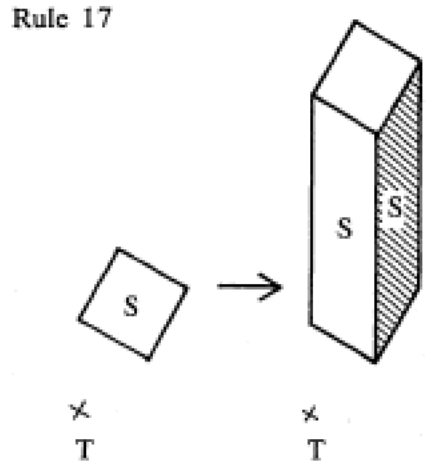


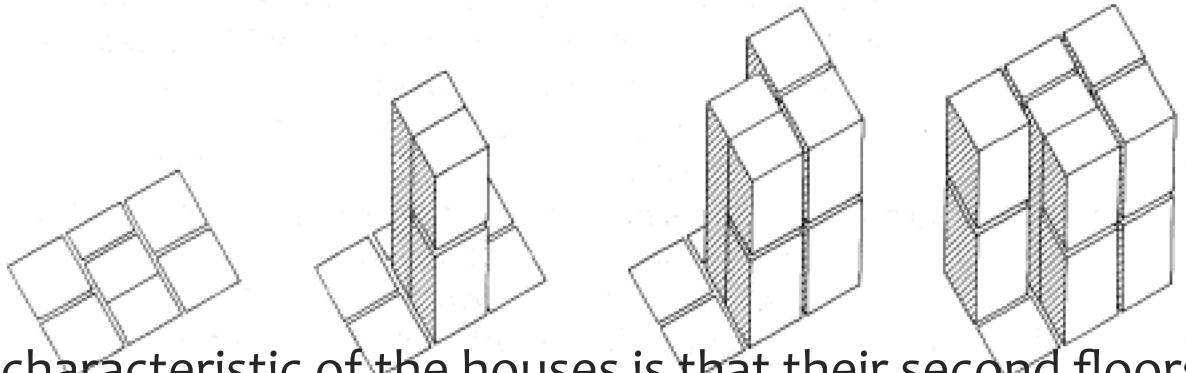




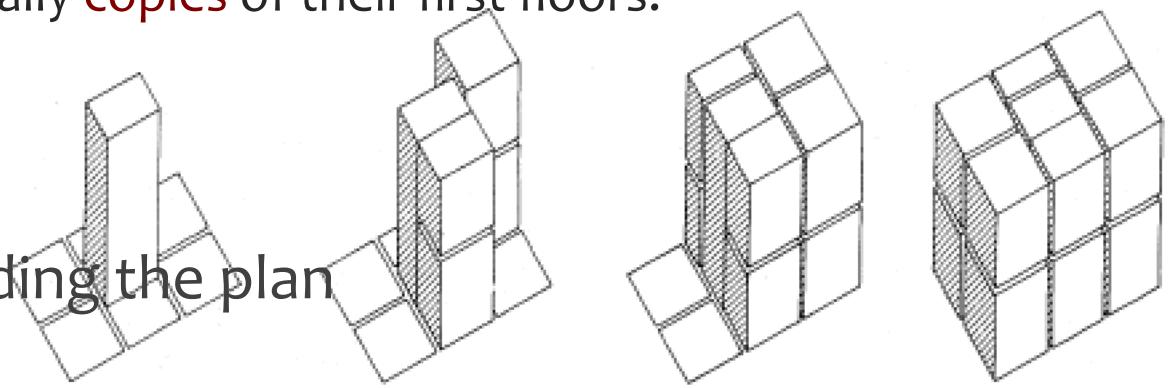
adding a stair hall







A main characteristic of the houses is that their second floors are essentially copies of their first floors.



extruding the plan

Peripherally additive planning around a hall leads to plans that are not 'open'.

Each room is clearly defined by walls or partitions and has a simple, regular geometric outline.

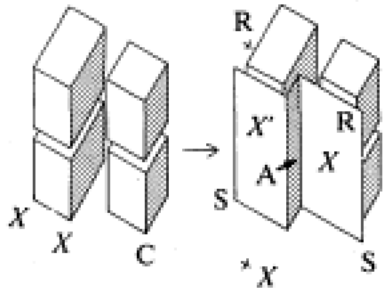
Each public room is directly connected to the overall circulation system; no room is 'trapped', that is, can only be accessed through another room.

The spaces are, as a result, well defined, but not rigidly confined;
they are separate, but can be connected and sometimes combined.

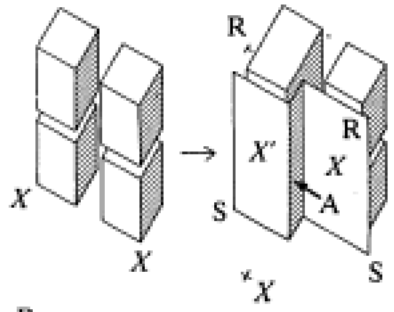
features of the plans

exterior articulation

Rule 1

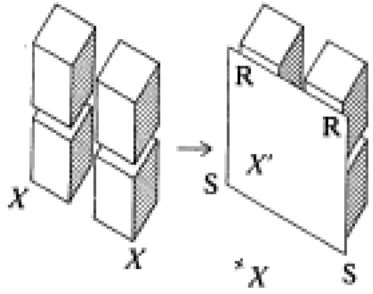


Rule 2

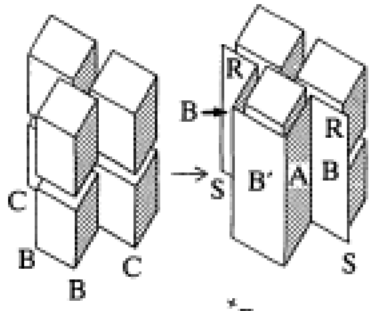


X = F or B

Rule 3

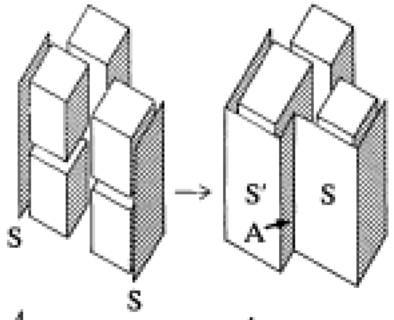


Rule 4

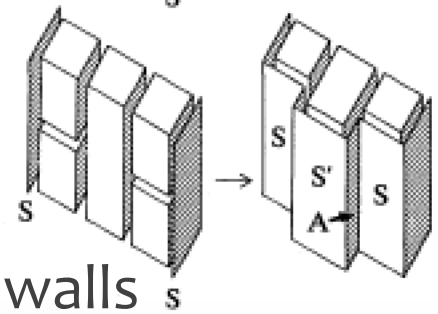


front and back walls

Rule 5

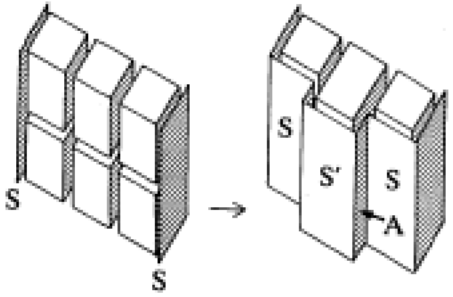


Rule 6

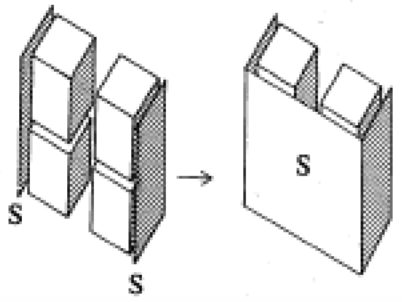


side walls

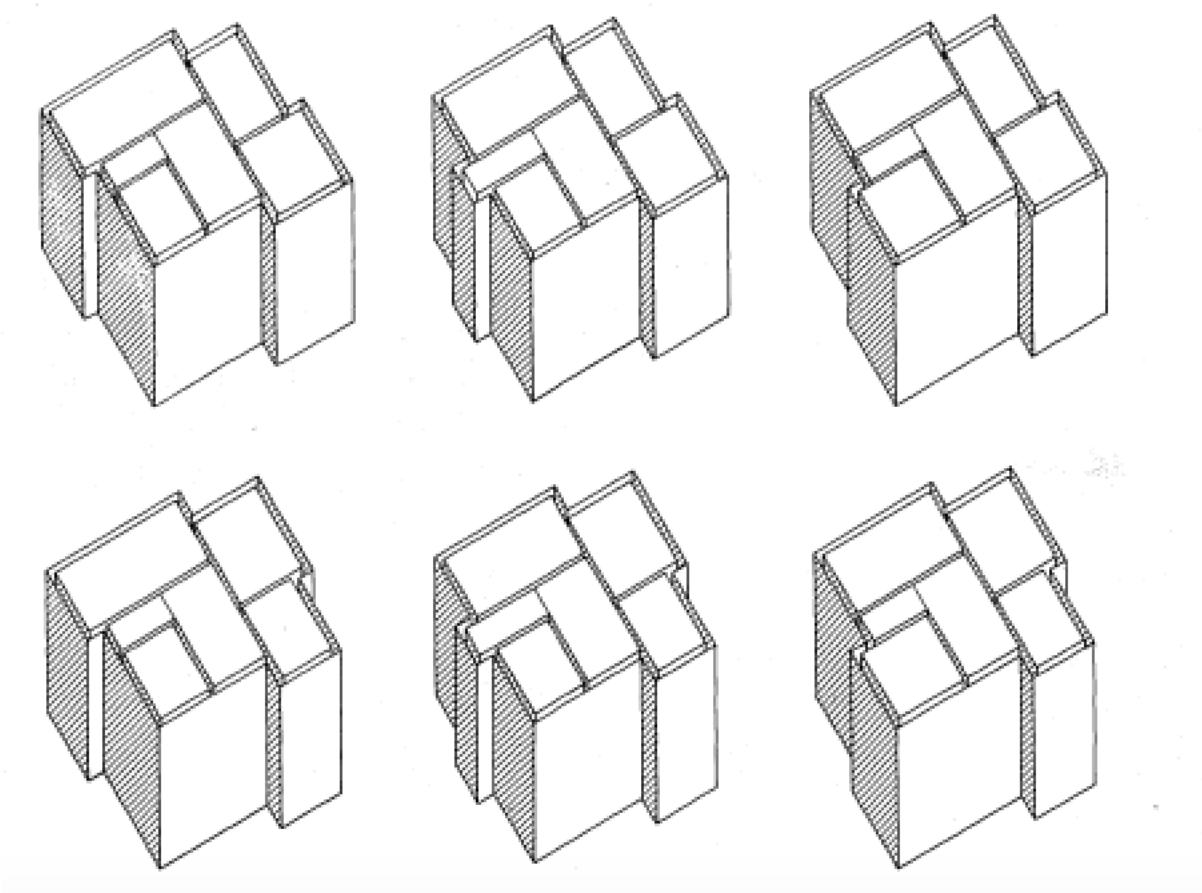
Rule 7



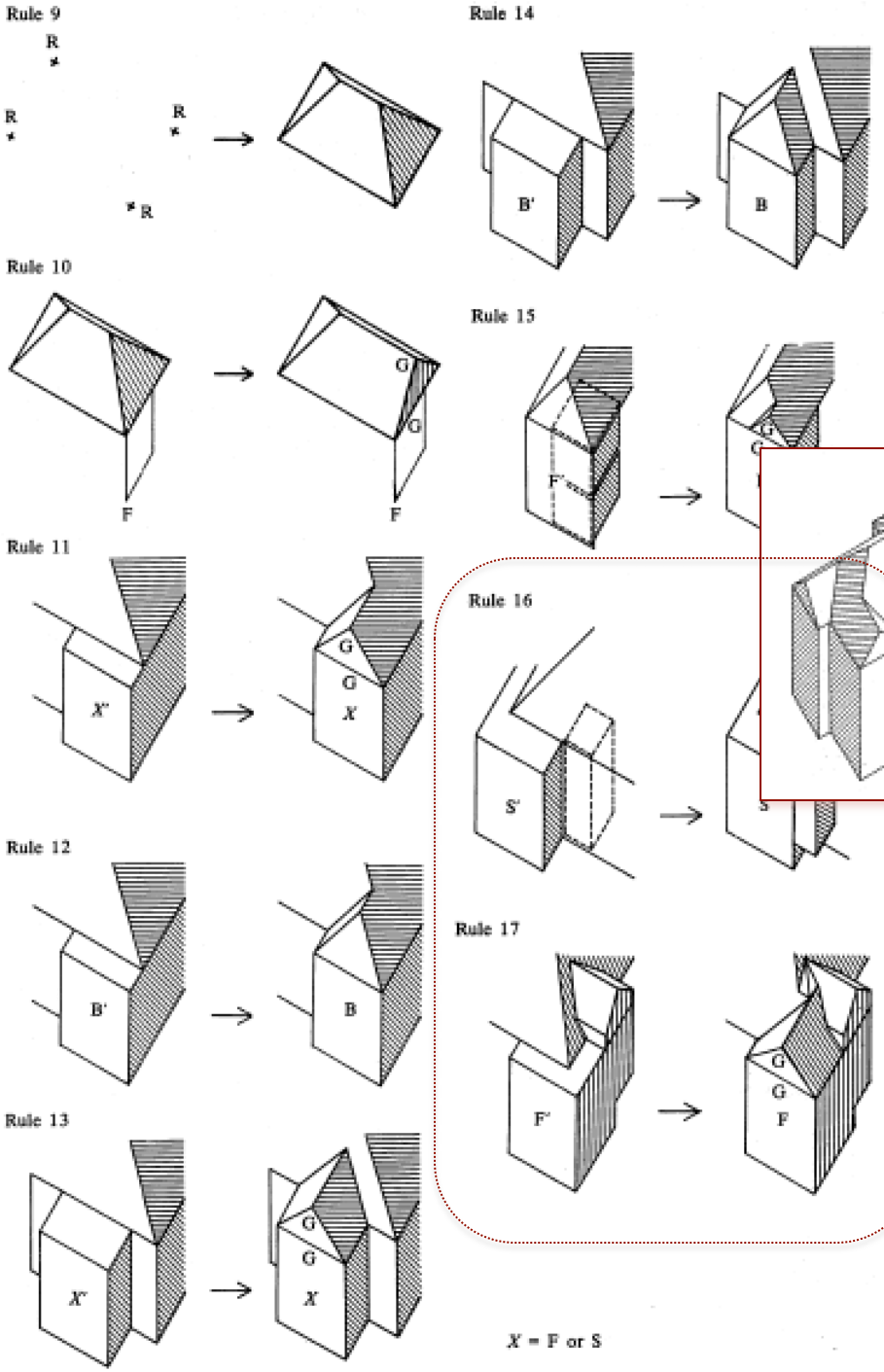
Rule 8

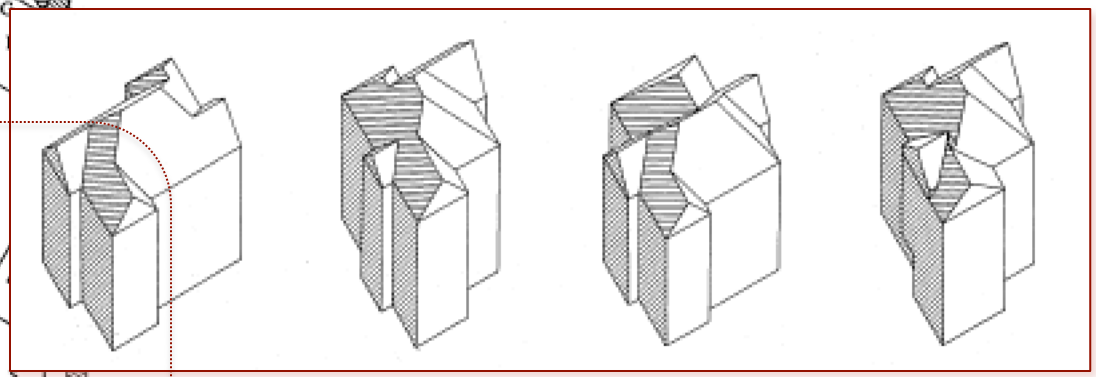


generating exterior walls



shapes generated by rules 1-8





generating roofs

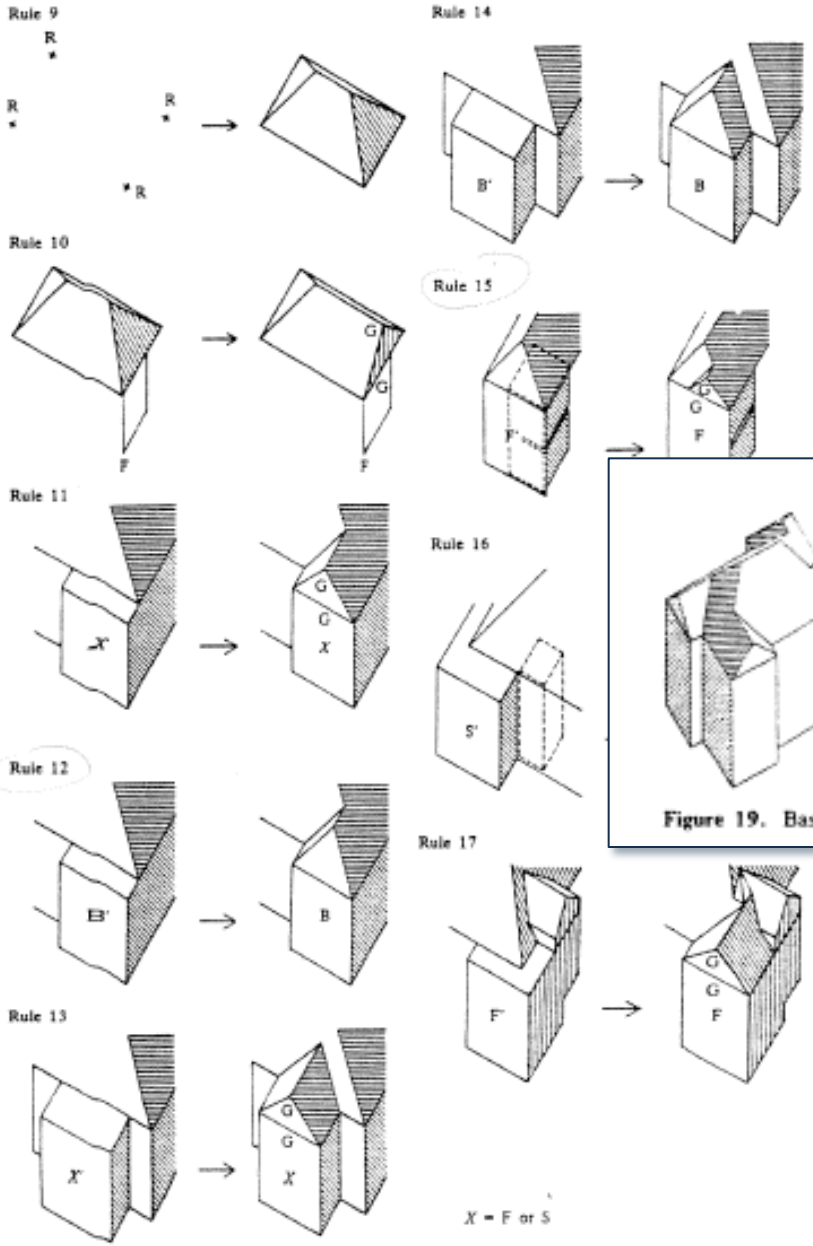


Figure 18. Rules to generate roofs.

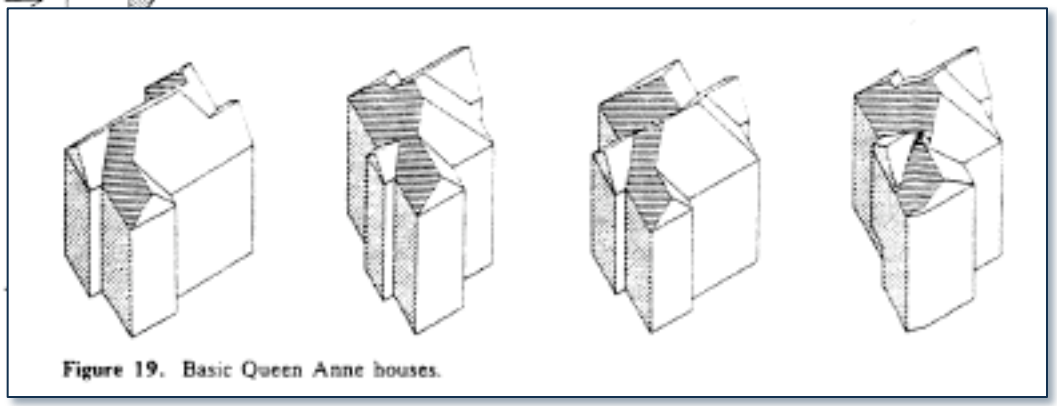
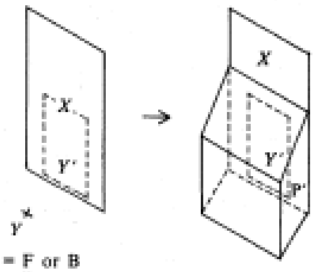


Figure 19. Basic Queen Anne houses.

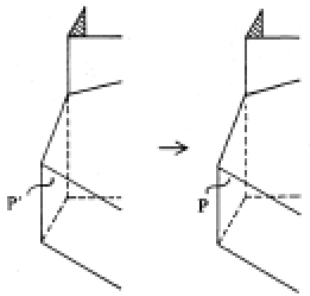
generating roofs

Rule 18

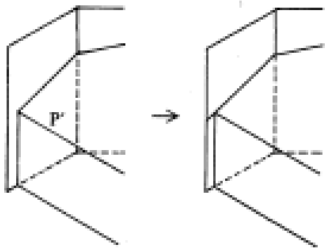


X = F or B
Y = F or B
Y' = H or K

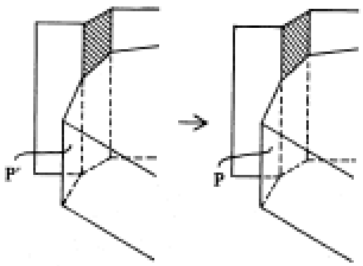
Rule 19



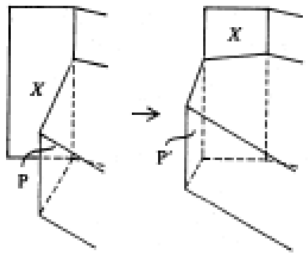
Rule 20



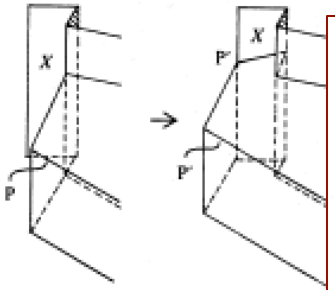
Rule 21



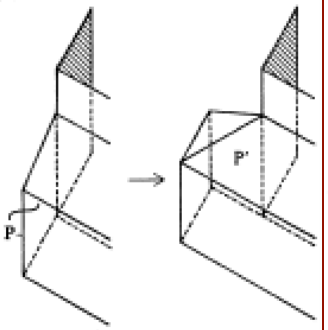
Rule 22



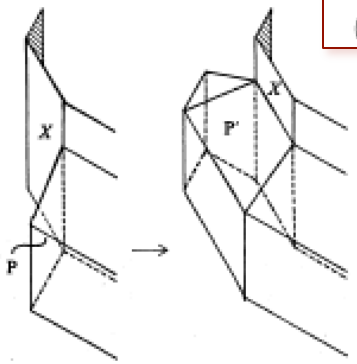
Rule 23

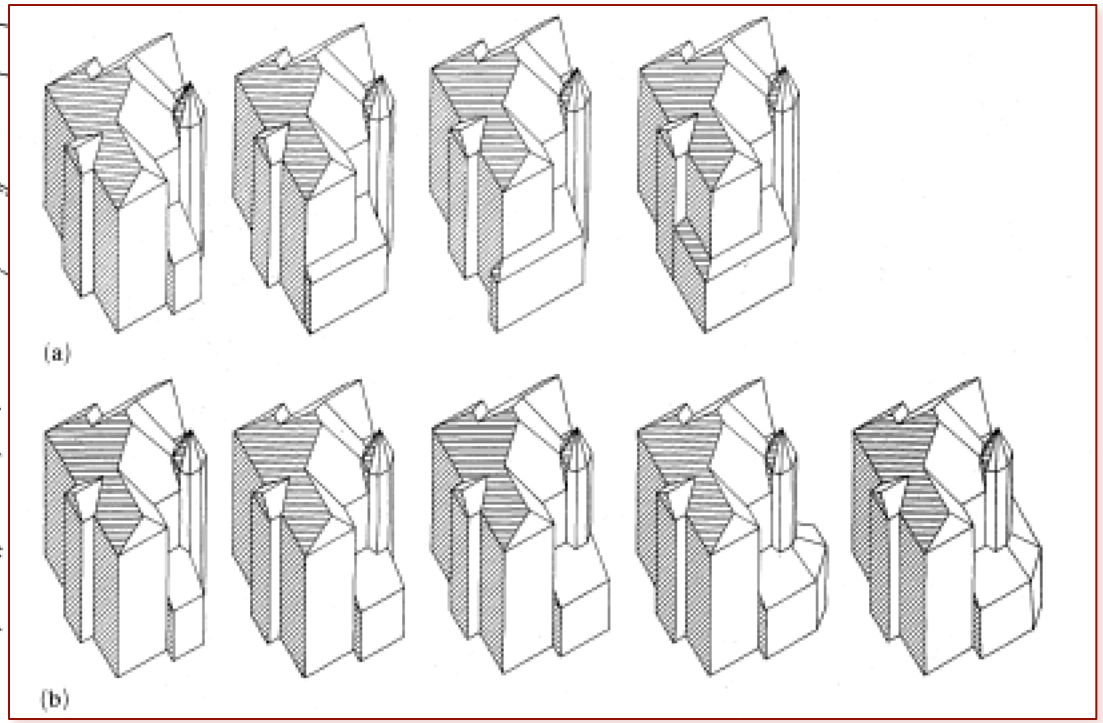


Rule 24

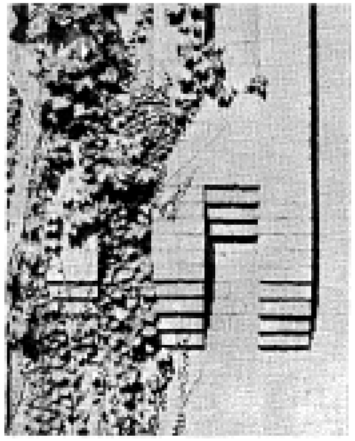


Rule 25

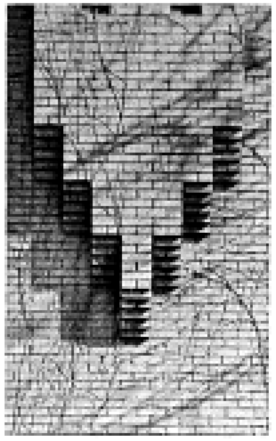




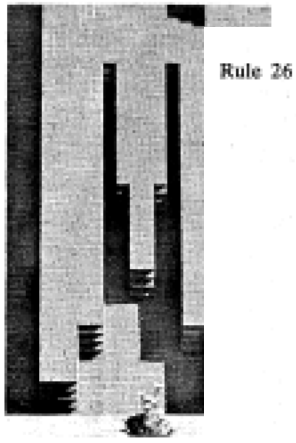
adding porches



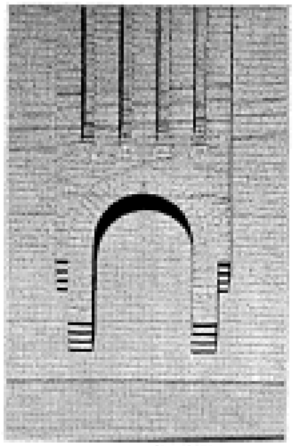
(a)



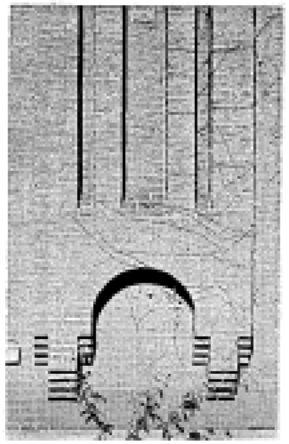
(b)



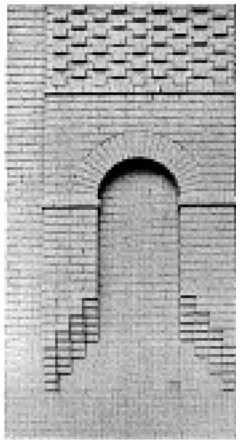
(c)



(d)



(e)



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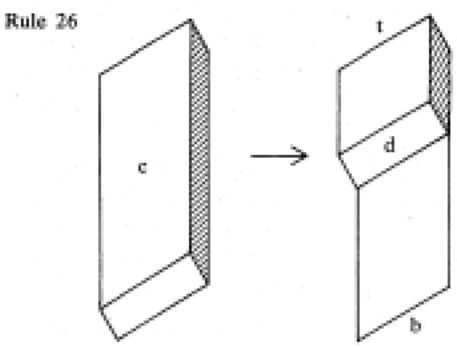
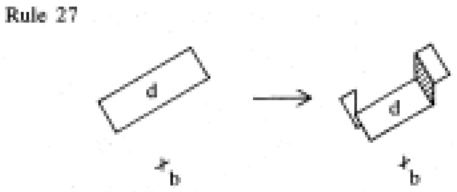
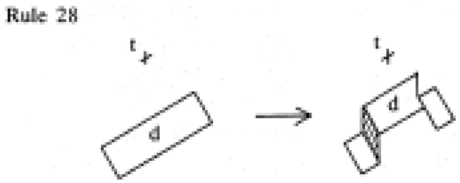
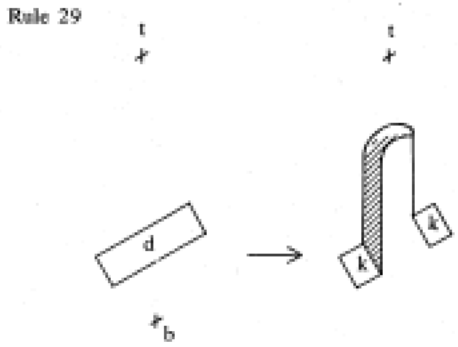
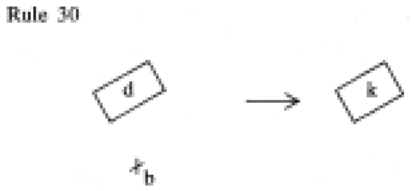
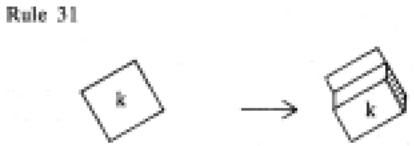


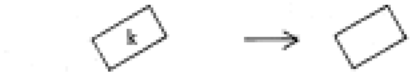












chimneys

In the process of developing the grammars we were forced to look at examples with a degree of closeness that is hardly necessary if the analysis proceeds in the traditional, intuitive way.

In particular, we were forced to deal with overall aspects of plan organization, massing, and articulation that are usually neglected in style descriptions or are described in less precise terms.

As a result, we were able to demonstrate how the various parts and features of a house relate to each other and to explain its overall geometry, given the premises of the Picturesque aesthetic.

It should be noted that once a basic house has been created, individual parts can be developed to an arbitrary level of detail.

lesson learnt

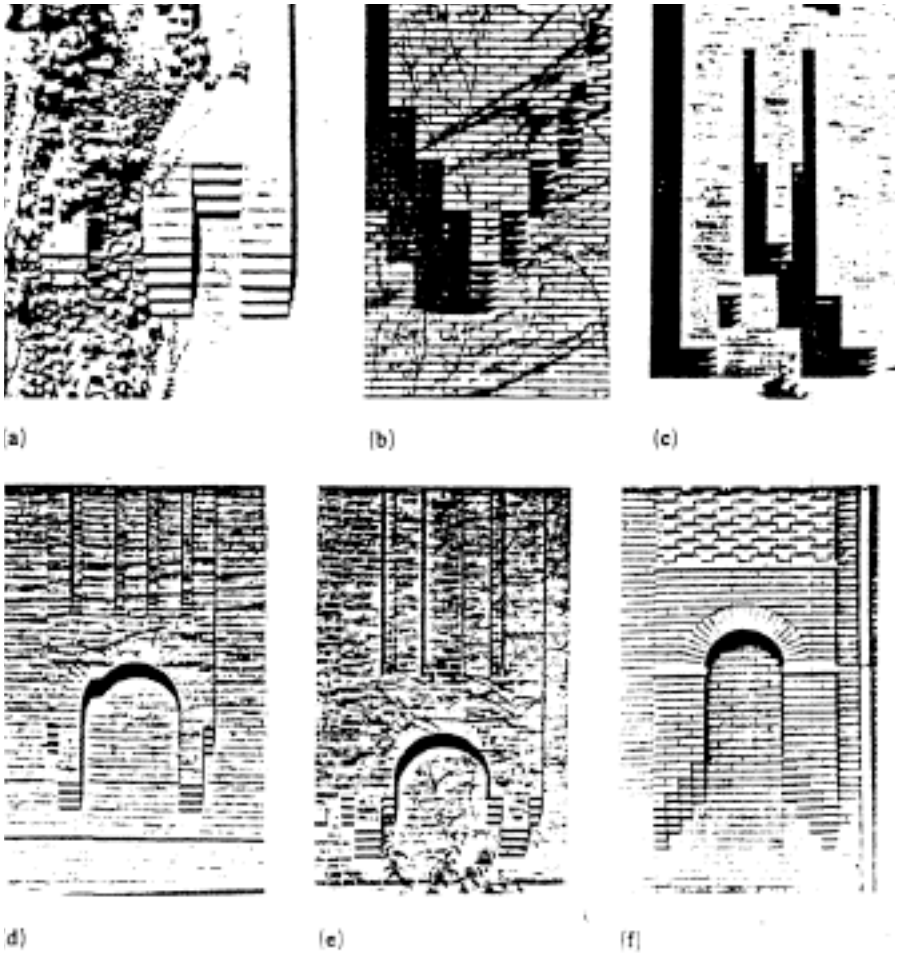


Figure 22. Bottom ends of chimney breasts.

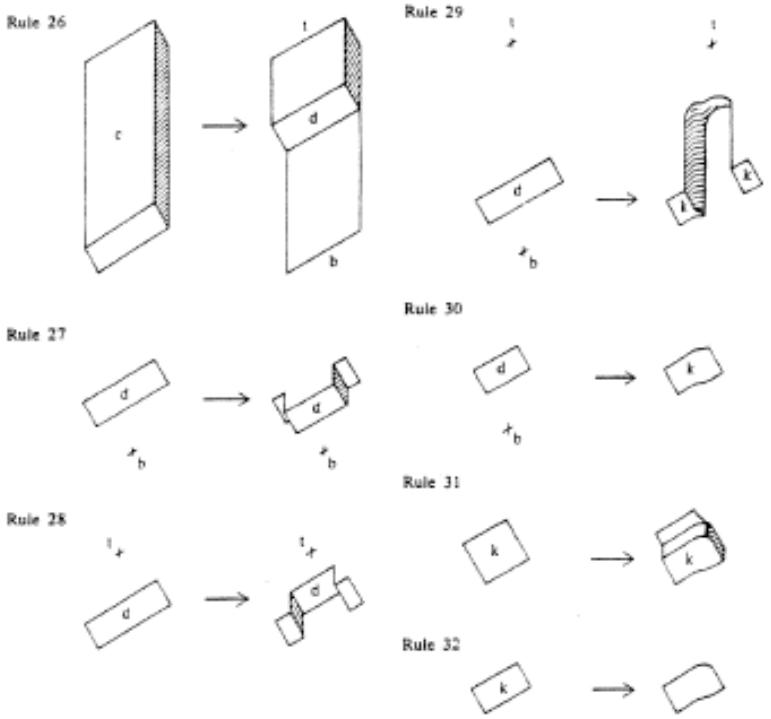


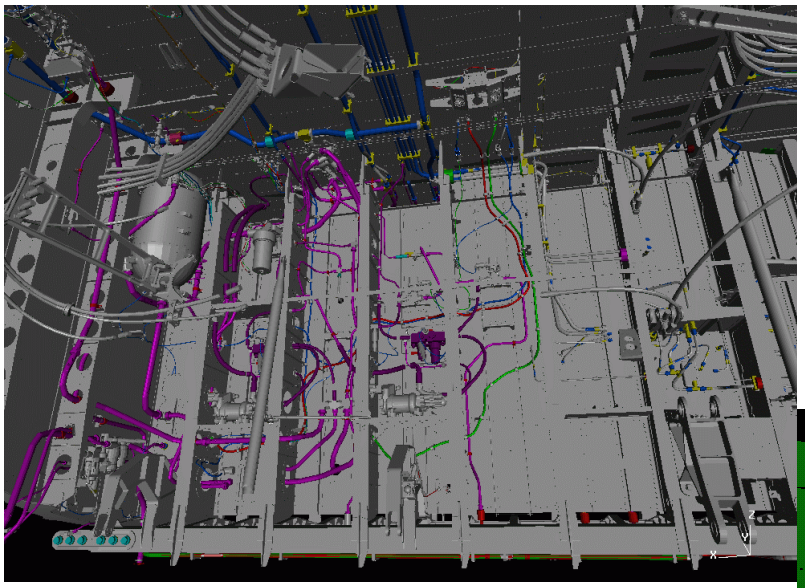
Figure 23. Rules to generate bottom ends of chimney breasts.

chimneys

follow up

generated by Jeff Heisserman

queen anne houses

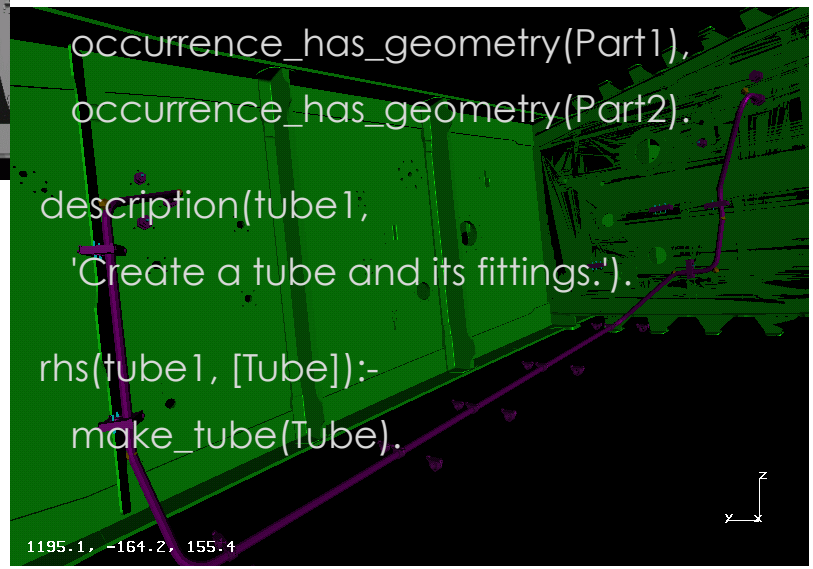


```
condition(tube1,
    'Tube has no geometry.').

lhs(tube1, [Tube], [Part1, Part2]):-
   schematic_tube_connections(Tube, Part1, Part2),
    in_context(Tube),
    not occurrence_has_geometry(Tube),
    occurrence_has_geometry(Part1),
    occurrence_has_geometry(Part2).

description(tube1,
    'Create a tube and its fittings.').

rhs(tube1, [Tube]):-
    make_tube(Tube).
```



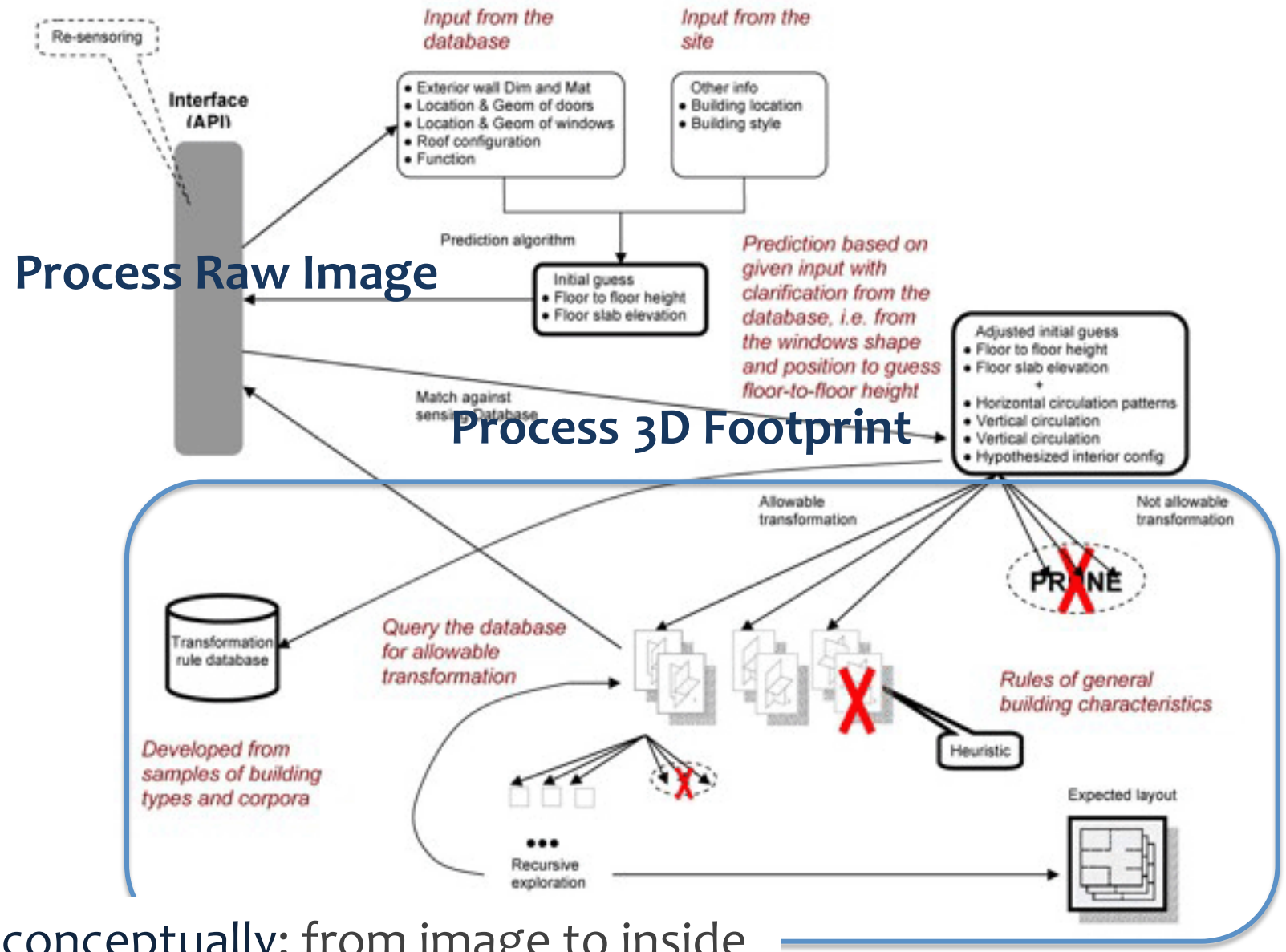
piping in the landing bay – boeing 777

an aside

humans can roughly guess the interior layout of buildings without physical entry.

can computer programs? or, rather, *what does it take for a computer program to do so*?

to the worlds I study



conceptually: from image to inside

We seek an algorithm given:

the footprint;

a reasonably complete set of exterior features, e.g. windows, chimneys and surrounding buildings;

a shape grammar describing the building style

Initial test cases:

Baltimore rowhouse

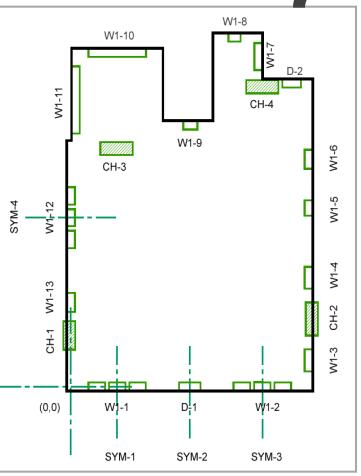
Queen Anne house

specific problem

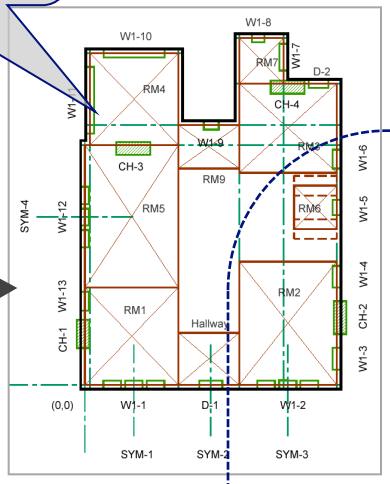
Initial layout estimation

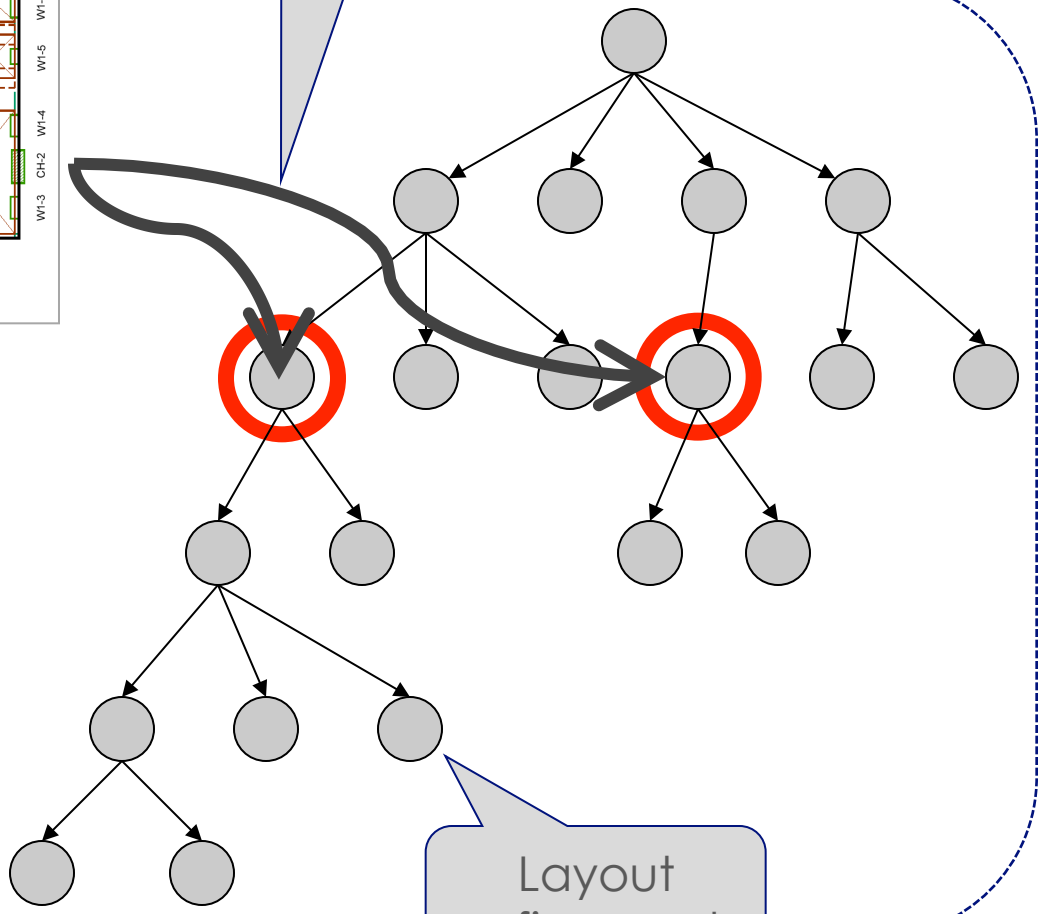
Layout tree pruning

Shape grammar



Feature input

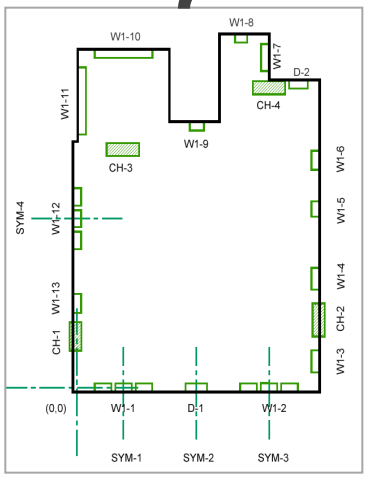




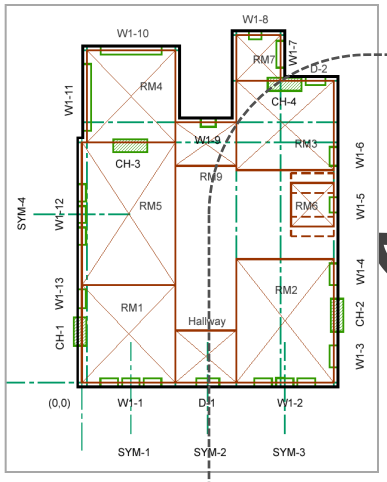
the pilot approach

Layout refinement

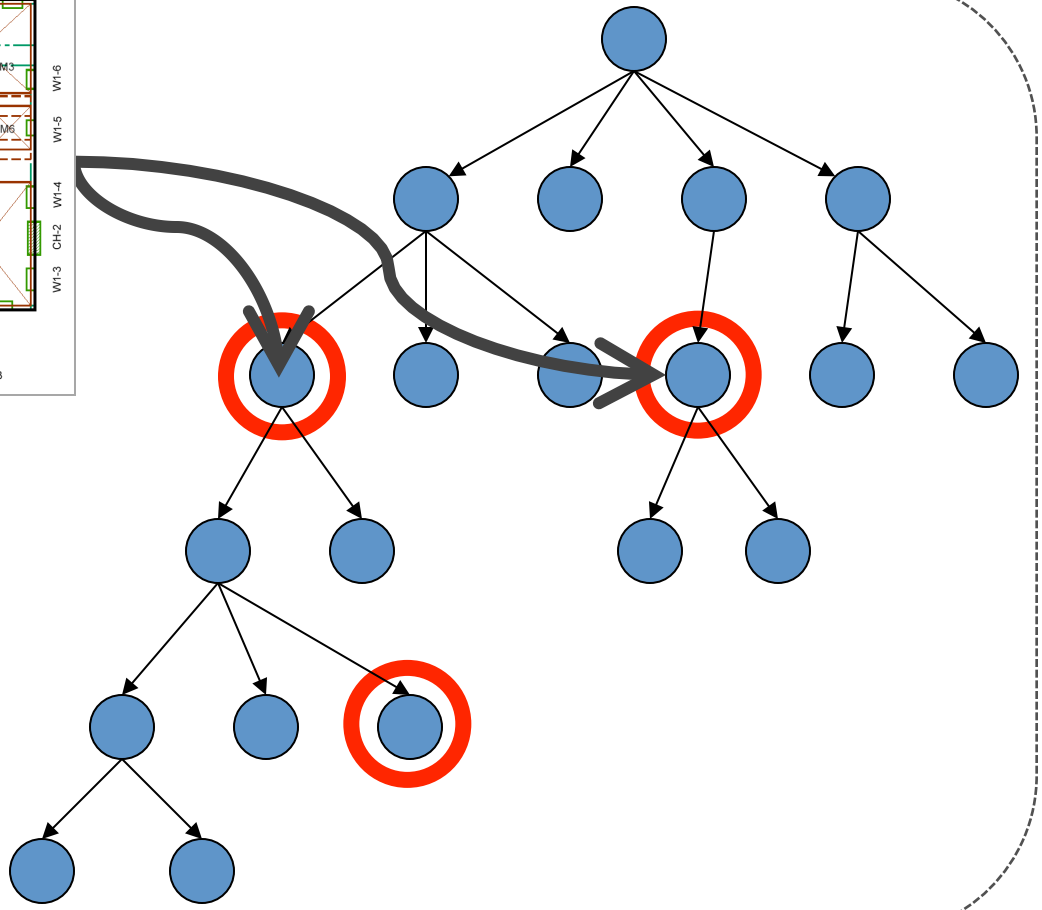
Interpreter



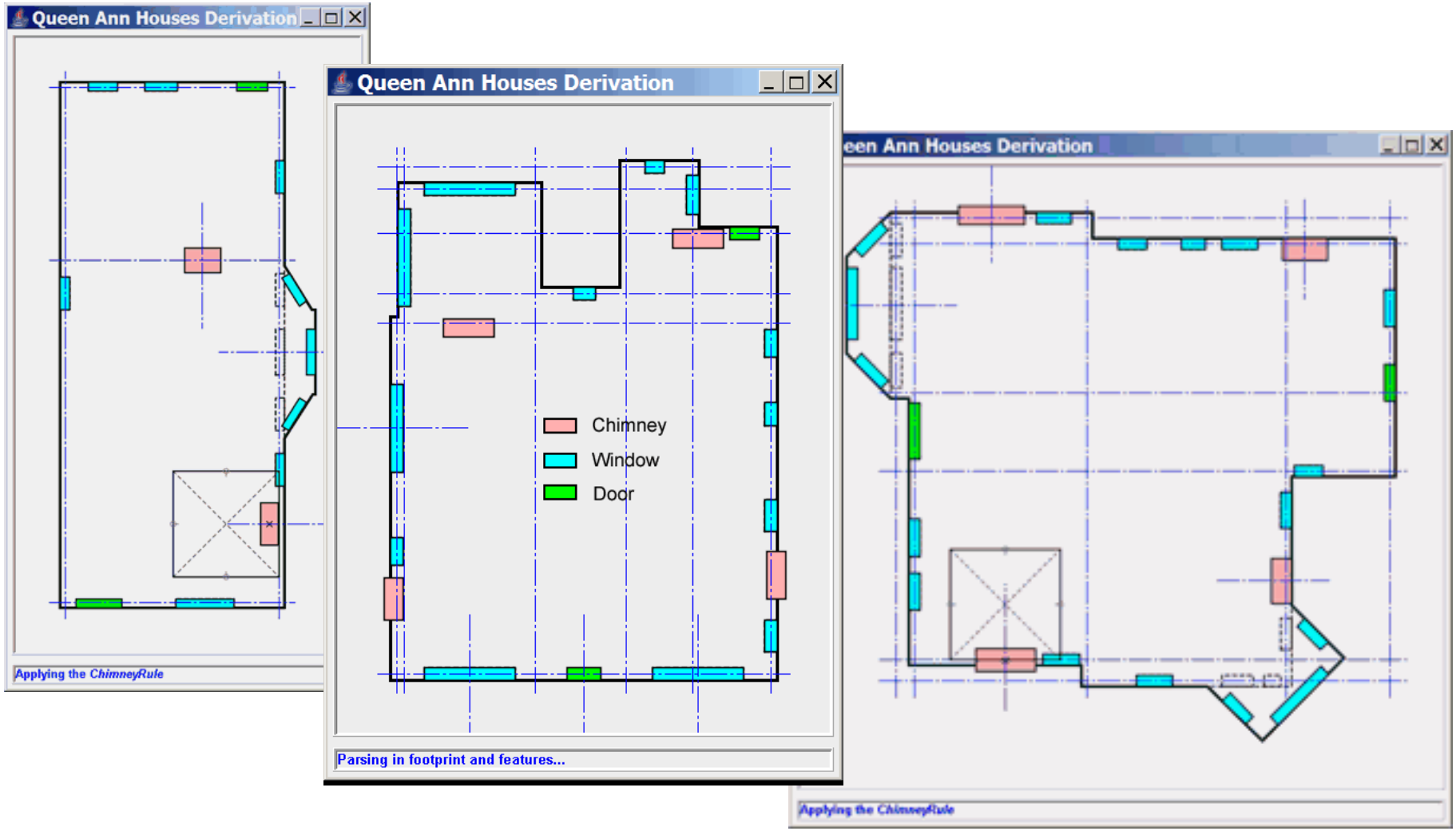
input features



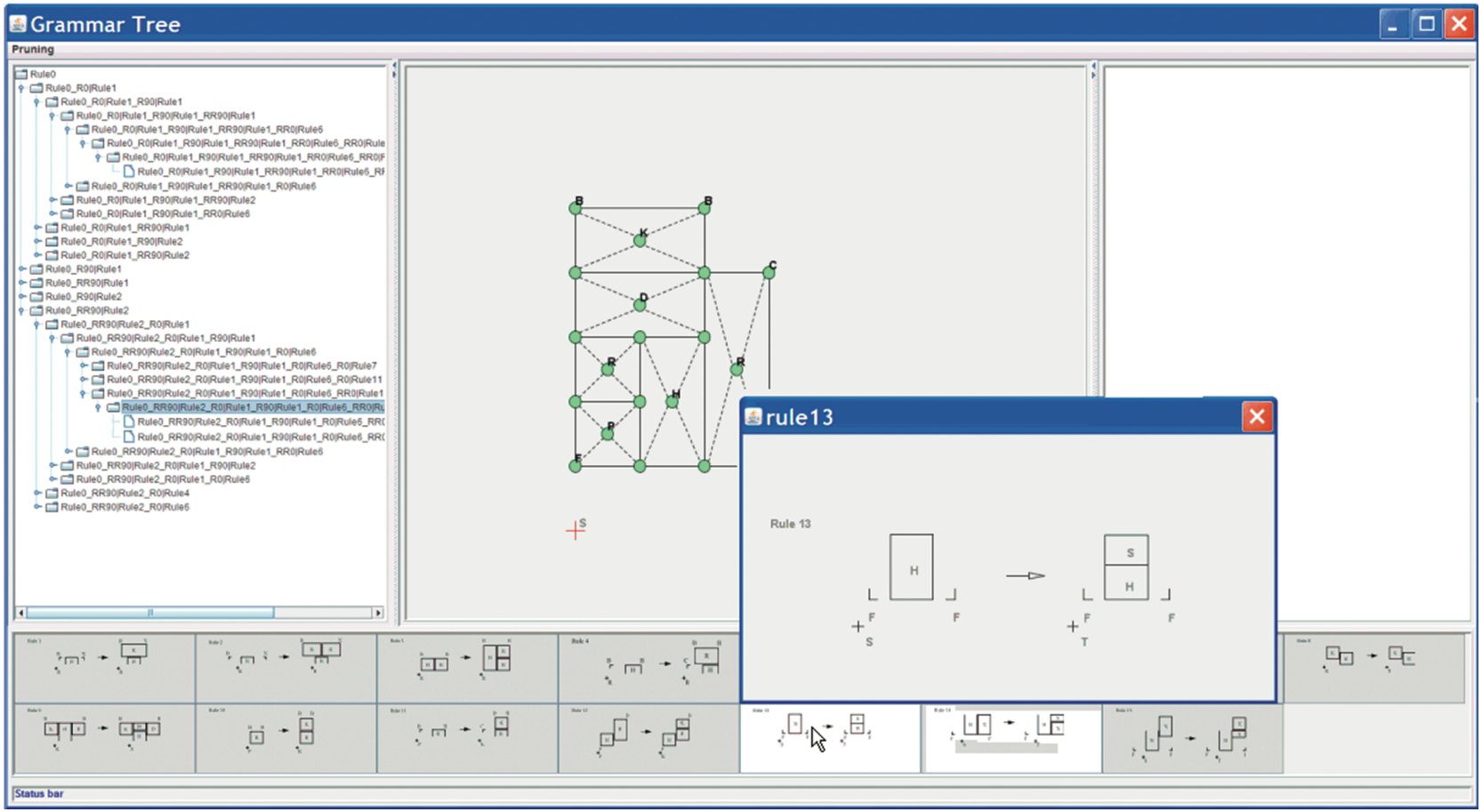
shape **grammar**



Interpreter



and it does seem to work !


Grammar Tree
Pruning
Rule0
Rule0_R0|Rule1
Rule0_R0|Rule1_R90|Rule1
Rule0_R0|Rule1_R90|Rule1_RR90|Rule1
Rule0_R0|Rule1_R90|Rule1_RR90|Rule1_RR0|Rule5
Rule0_R0|Rule1_R90|Rule1_RR90|Rule1_RR0|Rule6_RR0|Rule
Rule0_R0|Rule1_R90|Rule1_RR90|Rule1_RR0|Rule6_RR0|F
Rule0_R0|Rule1_R90|Rule1_RR90|Rule1_RR0|Rule5_RR
Rule0_R0|Rule1_R90|Rule1_RR90|Rule1_R0|Rule6
Rule0_R0|Rule1_R90|Rule1_RR90|Rule2
Rule0_R0|Rule1_R90|Rule1_RR0|Rule6
Rule0_R0|Rule1_RR90|Rule1
Rule0_R0|Rule1_R90|Rule2
Rule0_R0|Rule1_RR90|Rule2
Rule0_R90|Rule1
Rule0_RR90|Rule1
Rule0_R90|Rule2
Rule0_RR90|Rule2
Rule0_RR90|Rule2_R0|Rule1
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_R0|Rule6
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_R0|Rule6_R0|Rule7
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_R0|Rule6_R0|Rule11
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_R0|Rule6_RR0|Rule1
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_R0|Rule6_RR0|Ru
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_R0|Rule5_RR
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_R0|Rule6_RR
Rule0_RR90|Rule2_R0|Rule1_R90|Rule1_RR0|Rule6
Rule0_RR90|Rule2_R0|Rule1_R90|Rule2
Rule0_RR90|Rule2_R0|Rule1_R0|Rule6
Rule0_RR90|Rule2_R0|Rule4
Rule0_RR90|Rule2_R0|Rule6
B
B
K
C
D
R
R
H
R
F
S
rule13
Rule 13
H
F
F
S
S
H
F
F
T
Status bar