

48-747 Shape Grammars

THE BUNGALOWS OF BUFFALO

by Downing and Flemming

originally, small vacation house or country retreat

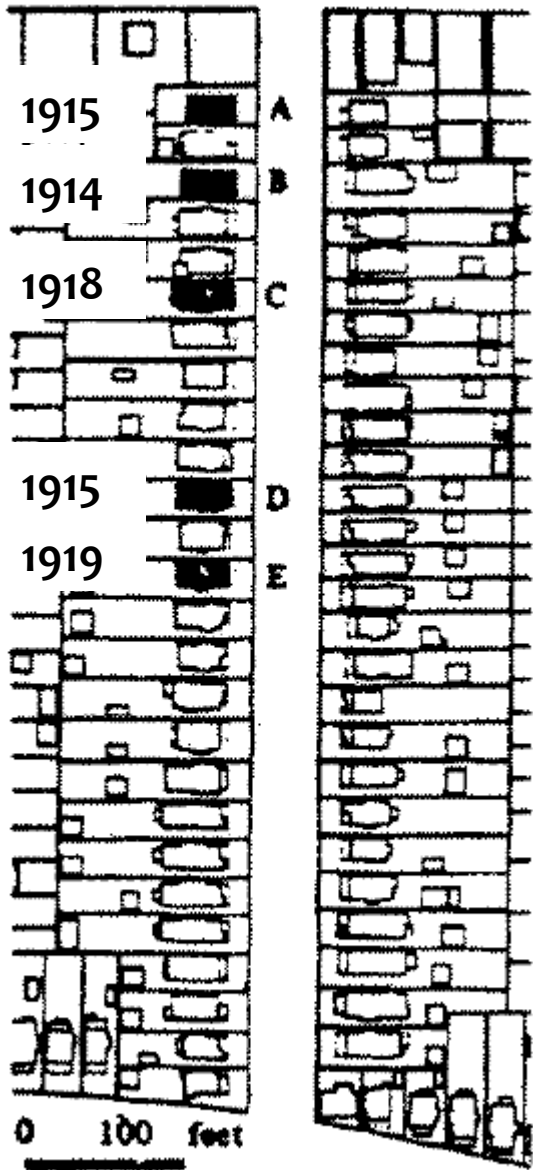
at the turn of the 20th century, it also referred to permanently occupied suburban houses that share features with the original

this led to **conventions and principles** that regulated their exterior appearance and internal organization, i.e., **pattern books**

paper concentrates on one aspect, viz., **spatial organization** as seen in their **first floor plans** or rather

different geometric realizations from the same set of conventions

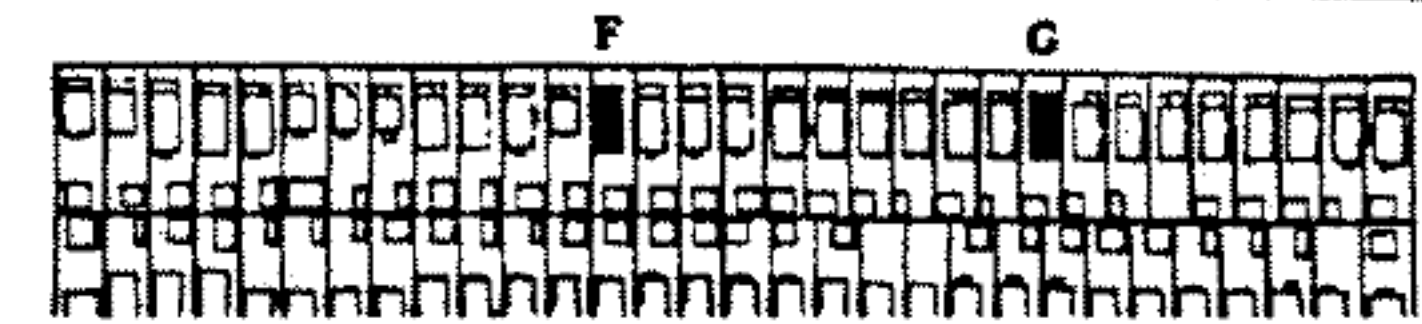
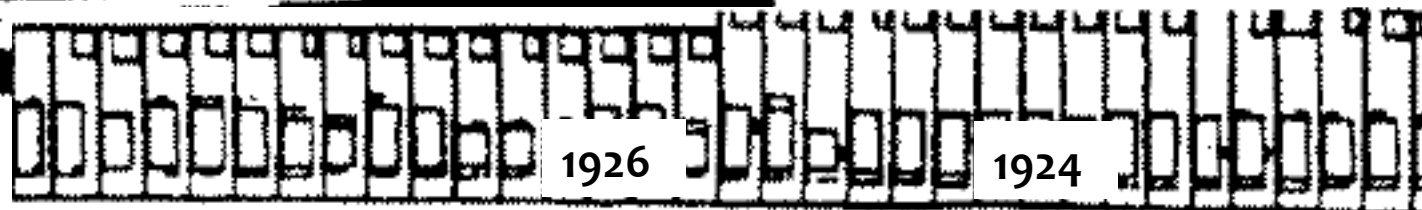
bungalow



(a) Street 1

the sources - two streets and seven bungalows

- Street 1 and five bungalows



100 feet

the sources

- second street and two bungalows

This paper represents the **first** application to buildings in the popular tradition

bungalow grammar

analytic shape
grammars are
intended for a
particular style

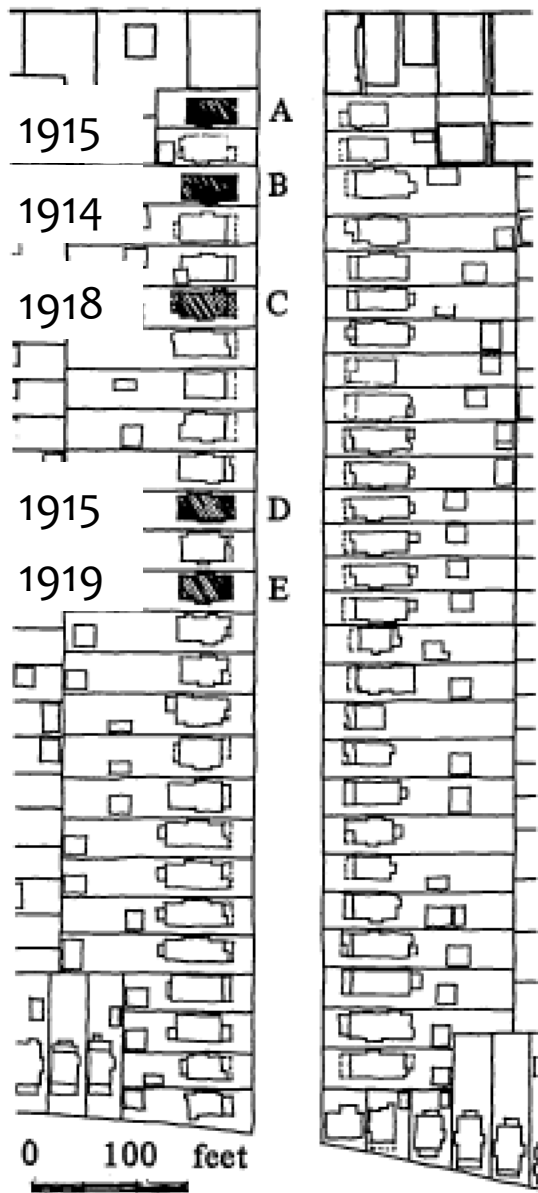
clarify **commonality of structure** and appearance
manifest in buildings in a corpus; here,
7 measured drawings of houses
from 1914 to 1926

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

the corpus



(a) Street 1

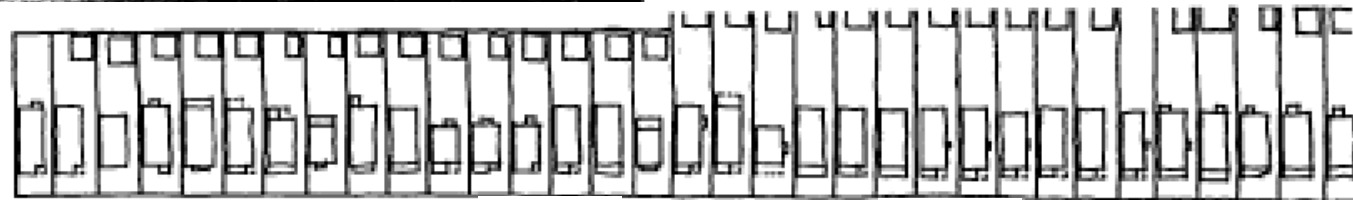


Street 1 and five bungalows

the sources – two streets and seven bungalows

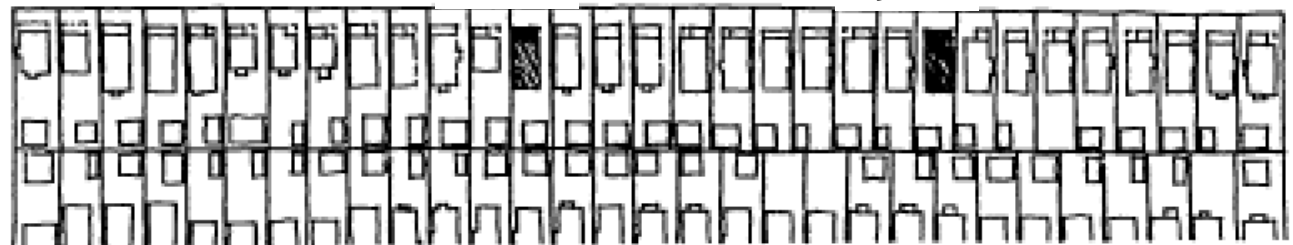


Street 2 and
two bungalows



1926

1924



0 100 feet

b) Street 2

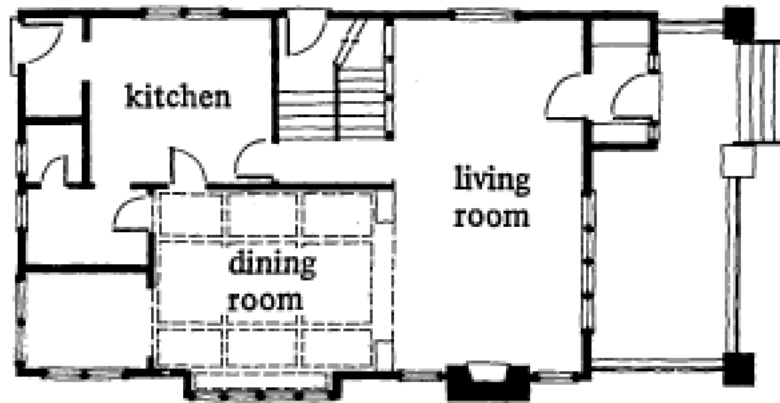
the sources



east elevation



north elevation



plan of first floor

bungalow A

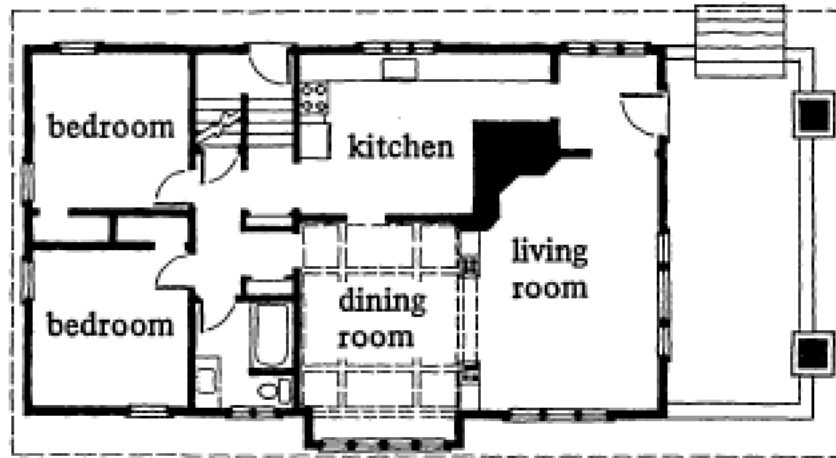
the bungalows



east elevation



north elevation

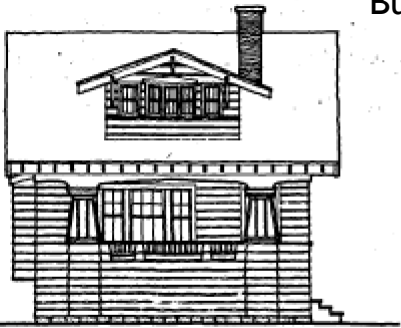


plan of first floor

bungalow B

the bungalows

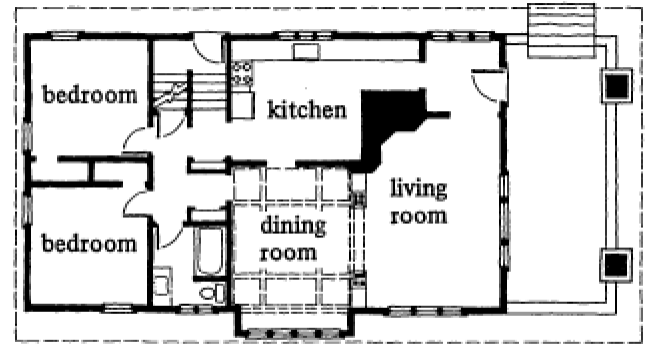
Bungalow B



east elevation

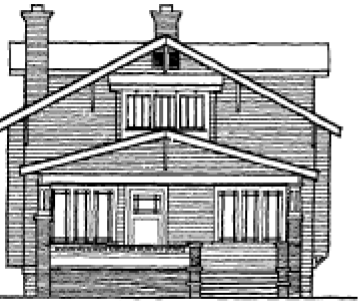


north elevation



plan of first floor

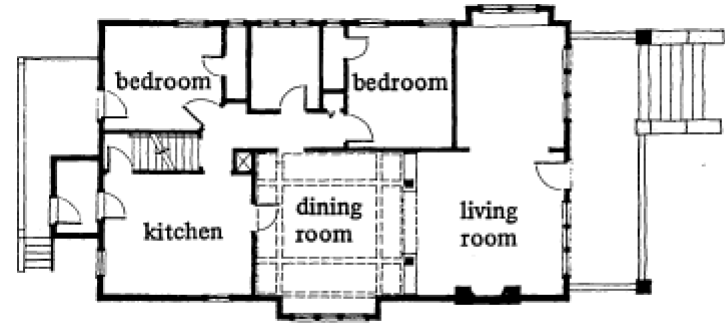
Bungalow C



east elevation



north elevation



plan of first floor

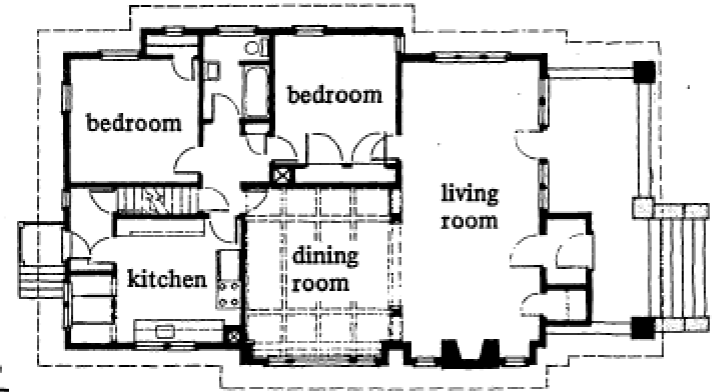
Bungalow D



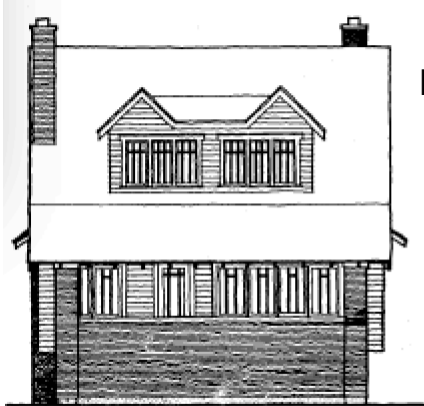
east elevation



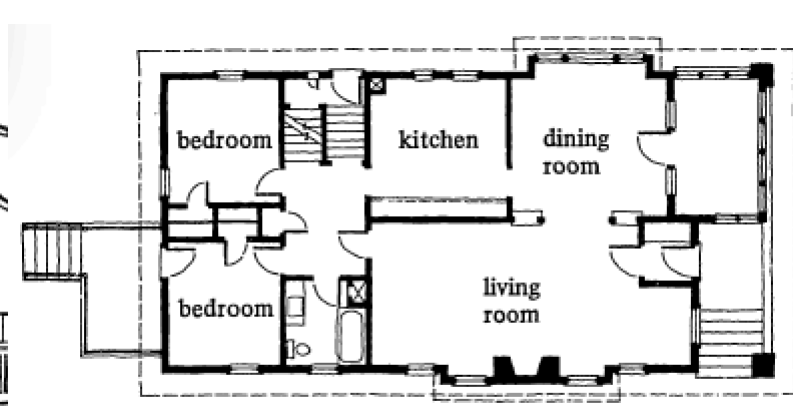
south elevation



plan of first floor



Bungalow E



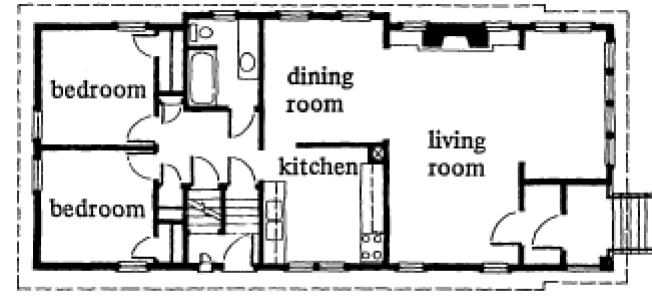
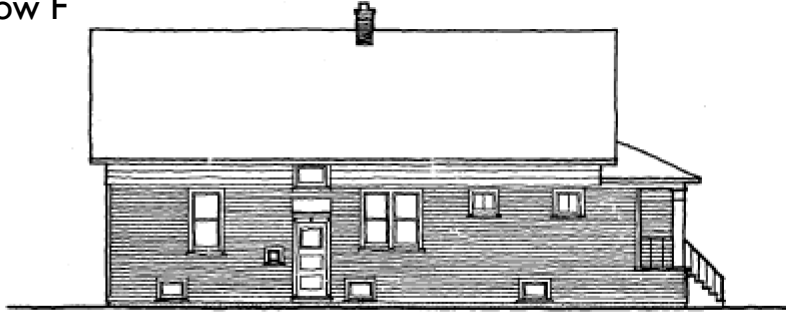
east elevation

north elevation

plan of first floor



Bungalow F



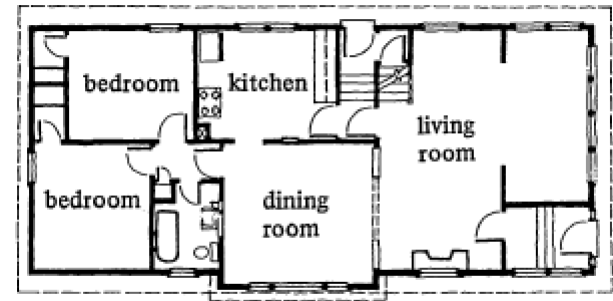
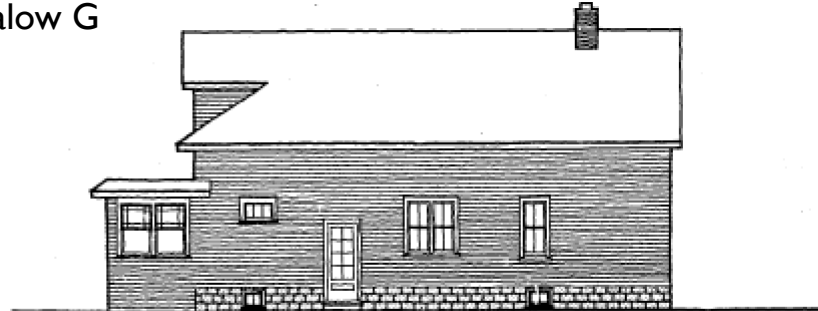
north elevation

east elevation

plan of first floor



Bungalow G



north elevation

west elevation

plan of first floor

Each bungalow contains on its **first floor**:

a living room, a dining room, a kitchen, and a staircase leading both to the basement and to the upper floor.

Houses B to G contain also two bedrooms and a full bathroom on their first floors (in house located in the second floor)

To these rooms are added in each **plan ancillary spaces, such as storage areas or halls**, in various combinations.

Spaces are identified by the grammar through simple **letter symbols**; the meaning of the symbols used is given in table (see next)

the bungalows

primary spaces: living, dining, kitchen, bedrooms

secondary spaces: all other rooms

requirements: functional | contextual | formal

spaces are identified by **symbols**

symbol	meaning	symbol	meaning
b	bedroom	m	additional living
c	closet	n, o, p	open porches
d	dining	q	enclosed porch
h	hall	s	staircase
K	kitchen	t	bathroom
l	living	v	vestibule

(0,0):K,1

Initial shape

conventions for the shape grammar

Functional requirements determine the nature and size of the spaces in a plan as well as certain connectivity relations between pairs of spaces or a space and the outside

Context requirements are imposed on the plans by the long and narrow shape of the lots, which face the street along their smaller side. The street, in turn, orients the buildings: it gives them a 'front' and a 'rear', and all plans respond to this orientation according to well-defined conventions.

Formal requirements or aesthetic conventions reflect strong notions of 'good shape'

requirements

the grammar

allocation of spaces

starting pattern

primary spaces

+ staircase, bathroom & hall

extension of spaces

+ built-in closets

merging of spaces

+ porch

generation of connections

front entrance

second entrance

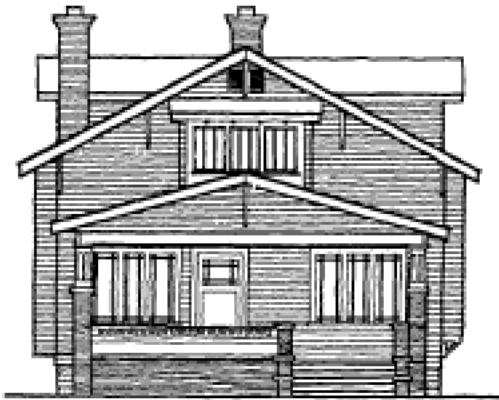
internal doors & openings

windows

termination

stages in shape grammar

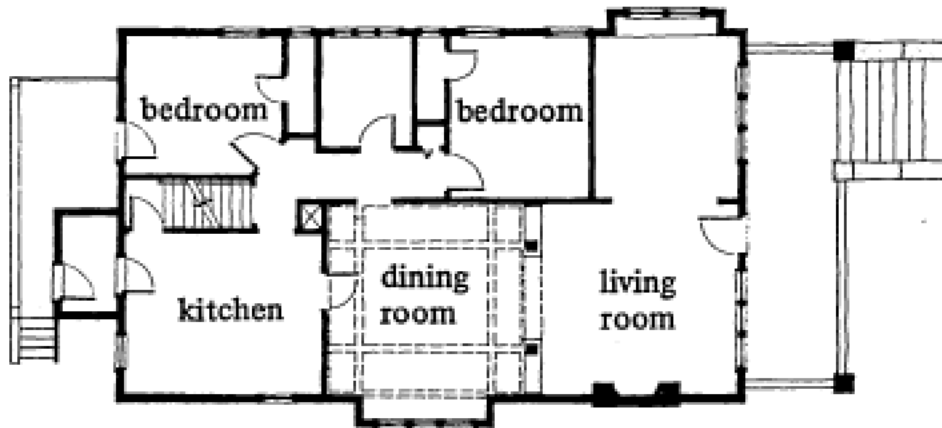
allocation of spaces



east elevation



north elevation



plan of first floor

bungalow C

exemplar

All known shape grammars that deal with the generation of architectural plans create, in a first stage, a geometric pattern which determines certain global characteristics of the plans and guides, possibly, also the development of some of their local properties.

- The generation of a Palladian plan starts with the production of a tartan grid which determines the possible locations of internal or external walls (Stiny and Mitchell, 1978).
- The design of a facade in the style of Terragni's Casa Giuliani Frigerio is governed throughout by the rhythm established through four rows of columns generated at the start of the process (Flemming, 1981a).

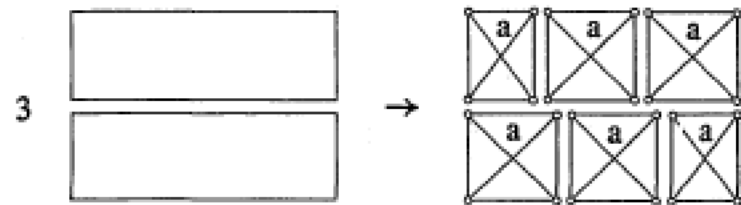
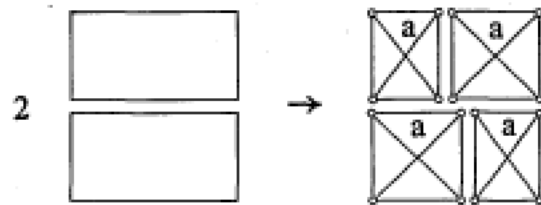
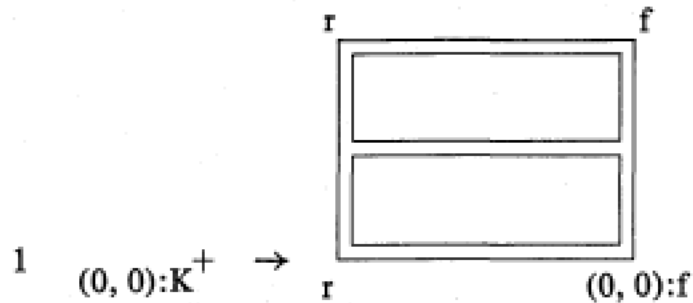
starting pattern

“In the East, even the cheapest house, except when it is occupied only for a couple of months in the summer time, requires a cellar and a comparatively substantial foundation and as this foundation is the chief sources of expense the tendency is to make it cover as small an area as possible and to build over it a comparatively high square box of a house. The necessity of providing a roof with a slope sharp enough to shed the snow readily tends to make our cheaper Eastern and Middle Western house a stiff, angular little building, which is rather perched upon the site than highly fitted tightly to it”

Hodgson, 1912

from the pattern book

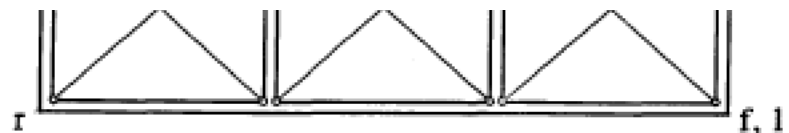
– a rectangular box with a large pitched roof



Schema 1 defines **the external walls** that form the enclosure for this type of structure; the lines with endpoints f and r mark, respectively, its front and rear (with respect to the street).

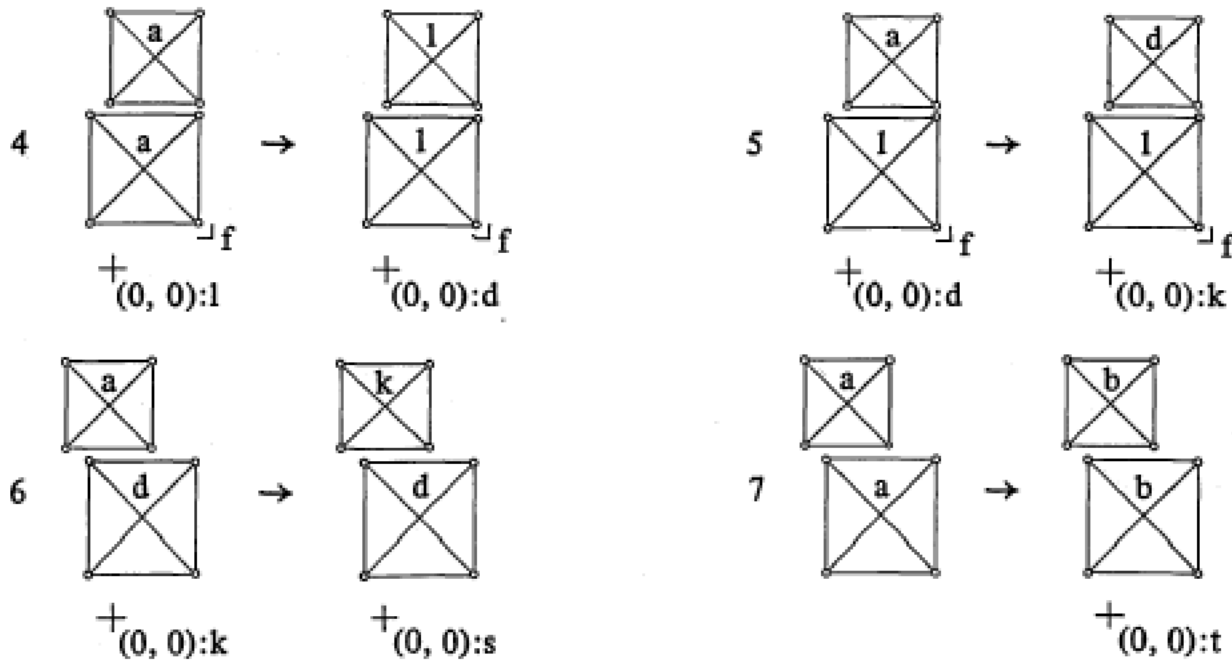
The schema also generates **an internal, load-bearing wall** which divides the enclosed area into two parallel zones.

creating a starting pattern



Bungalow	Length	Width	Clear width uz	Clear width lz
A	39'6"	24'9"	12'0"	11'0"
B	44'0"	24'6"	12'0"	11'0"
C	44'0"	26'0"	13'6"	11'4"
D	44'6"	26'3"	13'6"	10'6"
E	47'0"	27'0"	12'6"	12'3"
F	45'0"	23'3"	10'0"	10'6"
G	44'0"	22'6"	11'0"	9'10"

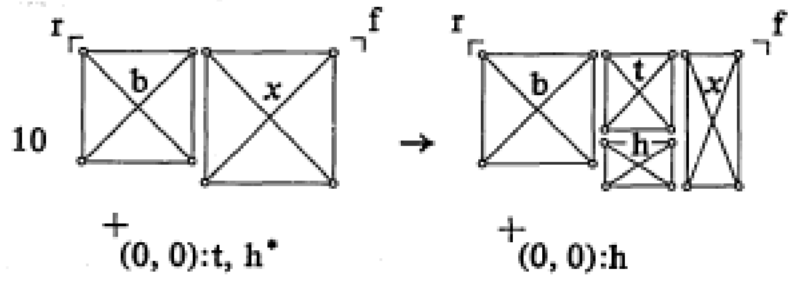
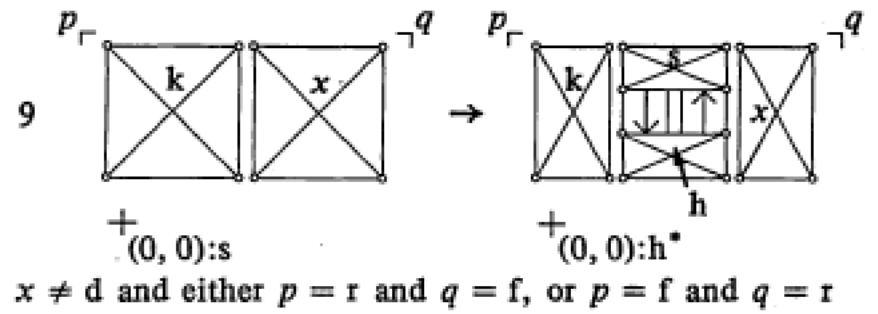
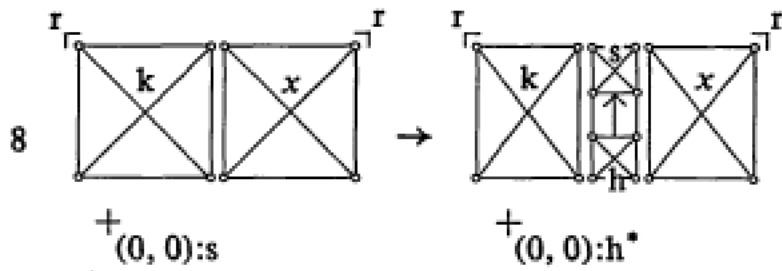
(common) measured dimensions



In all plans, living room, dining room, and kitchen form a cluster of public spaces, and the bedrooms form, together with some secondary spaces, an additional cluster of more private spaces so that the spaces in each cluster are related to each other or to the outside in a well-defined way.

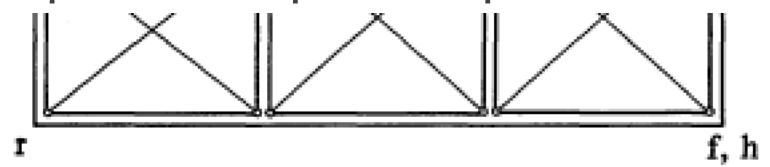
allocating primary spaces

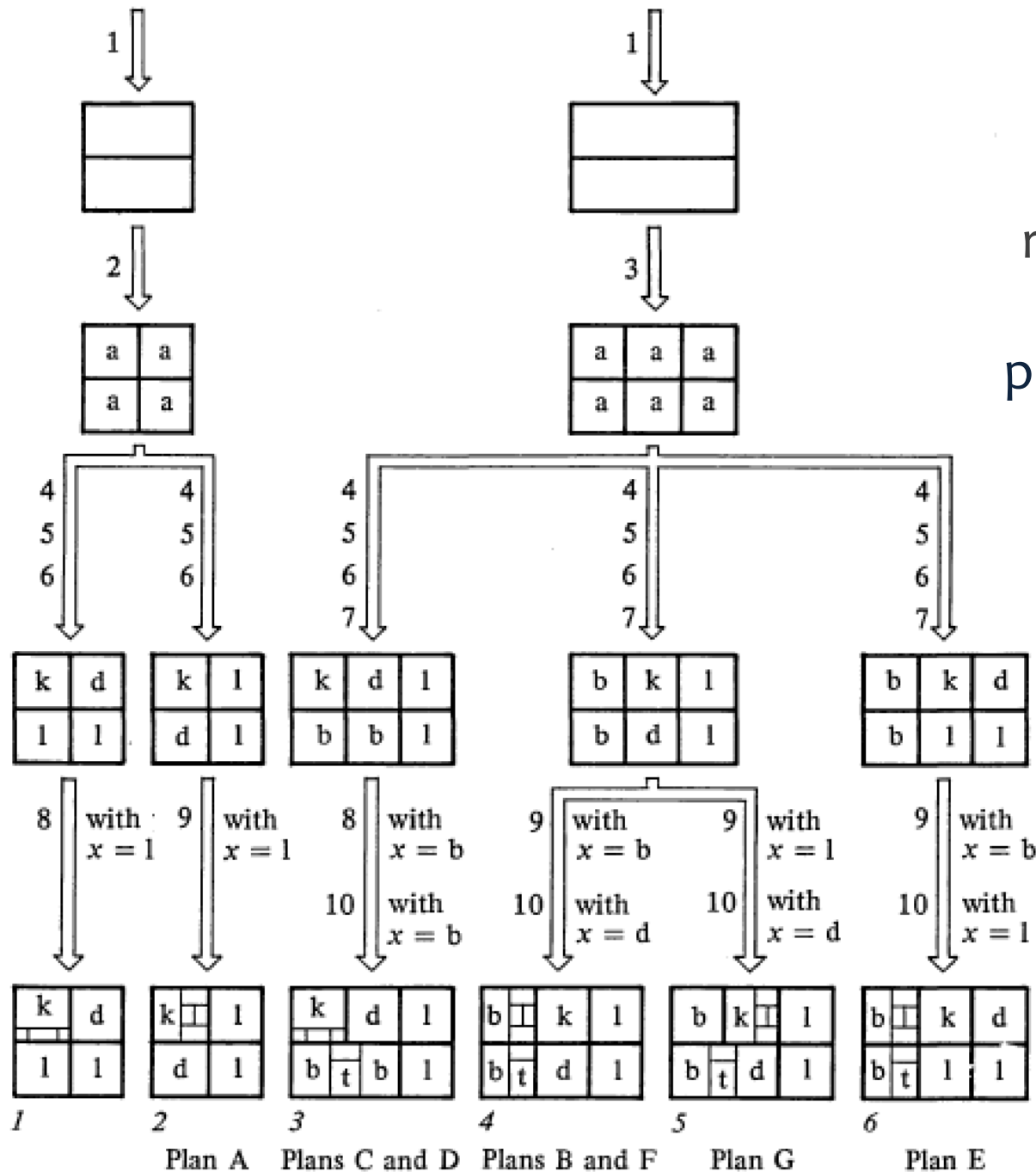




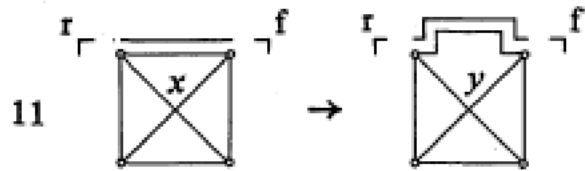
All bathrooms and staircases in our sample border an external wall, but are never allowed to face the front of the plan or to occupy one of its corners. The bathrooms, furthermore, are accessible only from an internal hall, which is also connected to the bedrooms and one other primary space; the hall thus acts as a buffer between the public and private spaces..

allocating
staircase, bathroom and hall

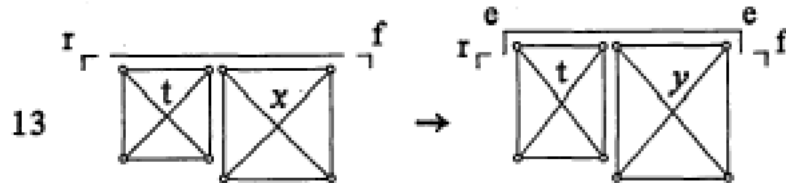
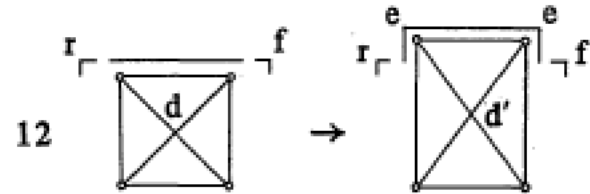




rules as a
tree of
possibility



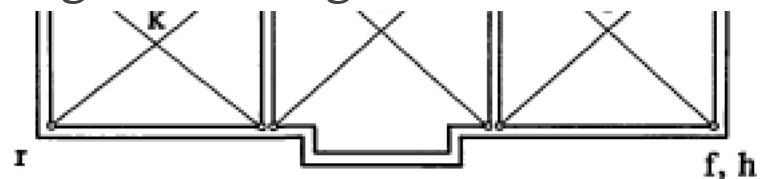
either $x = d$ and $y = d'$ or $x = y$ and $y \in \{l, l'\}$

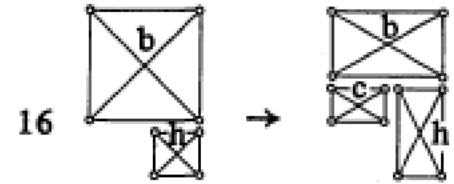
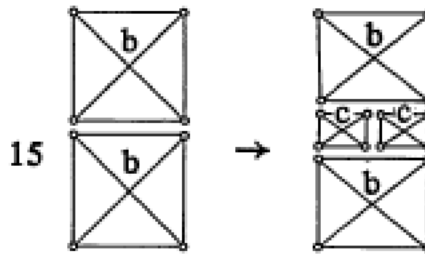
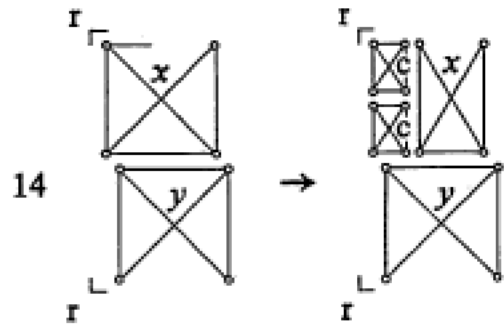


either $x = d$ and $y = d'$, or $x = y = b$

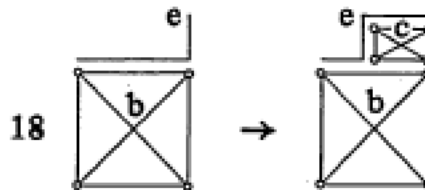
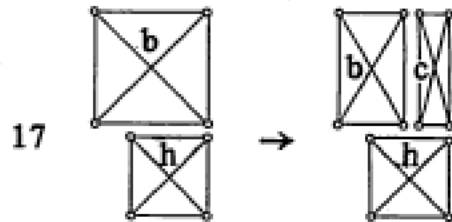
A most noticeable feature of the bungalows are bays or projecting rooms which interrupt the rectangular enclosure of these houses. Most bays are necessarily **not required for functional reasons** as they do not increase the usable area to any significant degree.

extending the spaces



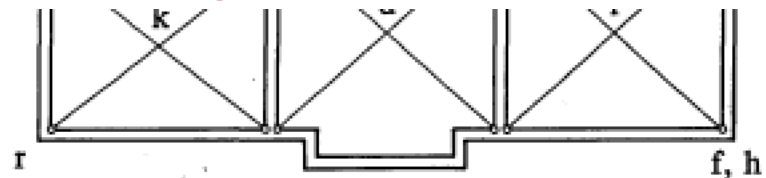


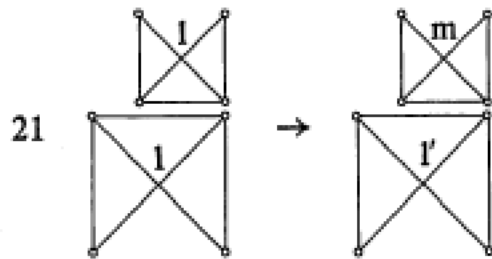
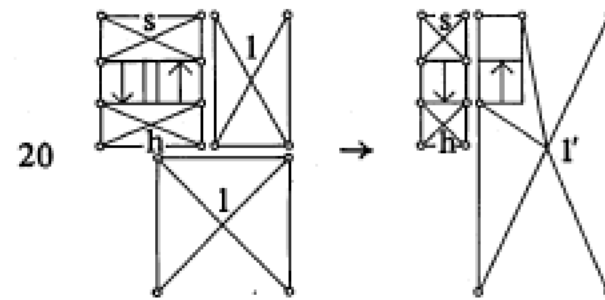
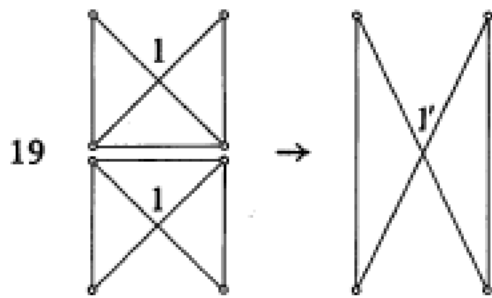
either $x = y = b$, or $(x, y) = (k, d')$



All bedrooms in the corpus have direct access to a built-in closet. The placement of these closets assures that the boundary of the bedrooms retains its regular (**mostly rectangular**) form.

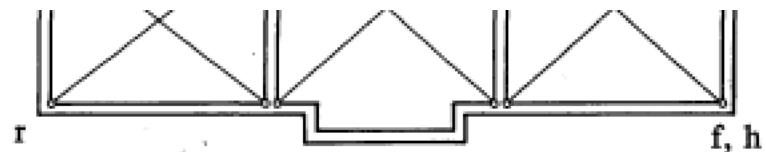
adding a built-in closets

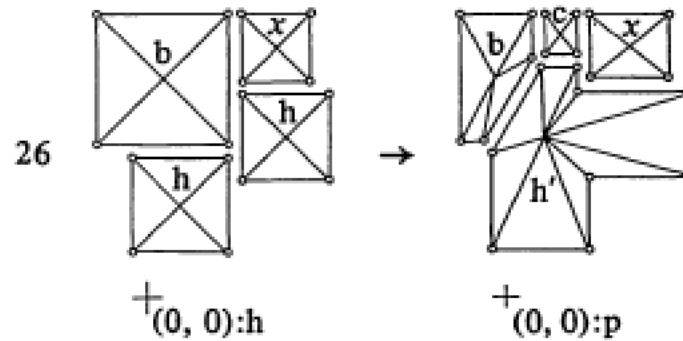
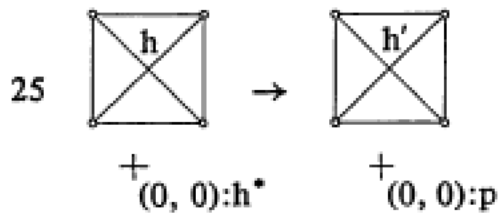
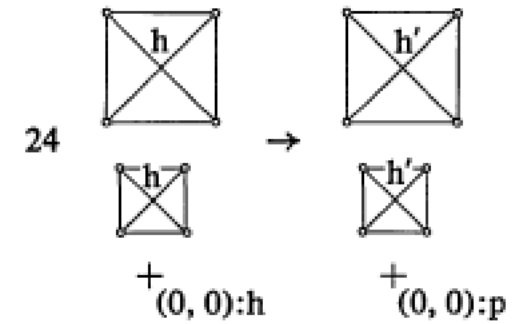
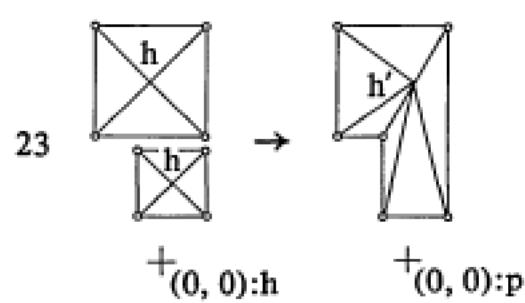
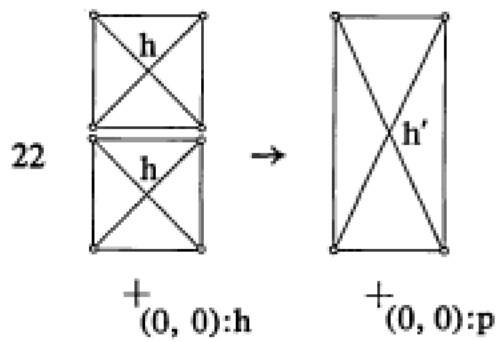




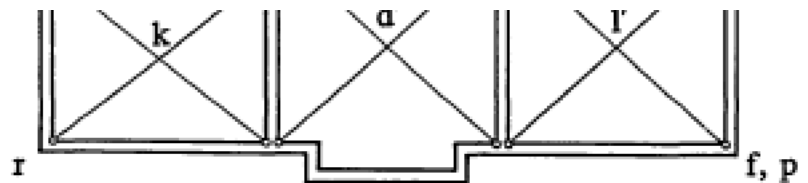
To generate most of the plans in the corpus, adjacent halls or living rooms that were generated in previous stages must be merged into larger, continuous areas.

merging or identifying
living spaces

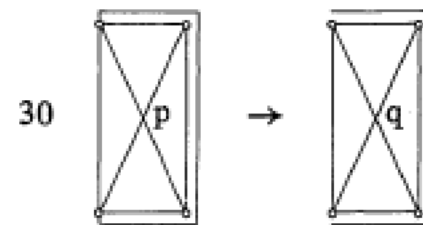
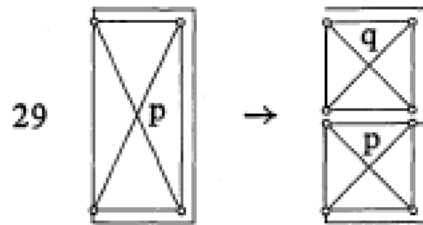
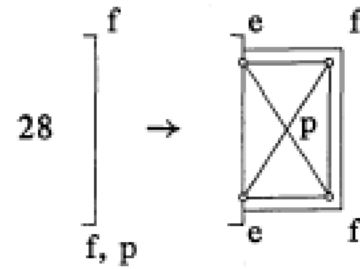
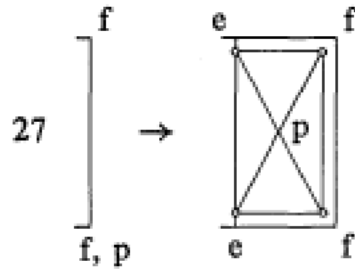




Halls can only be combined if the shape of one of the surrounding spaces is also changed.

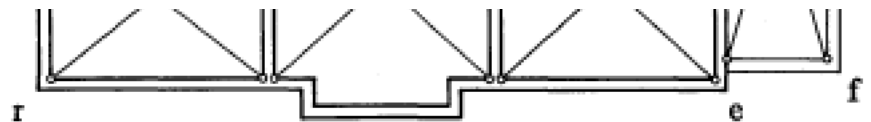


merging or identifying
hall spaces



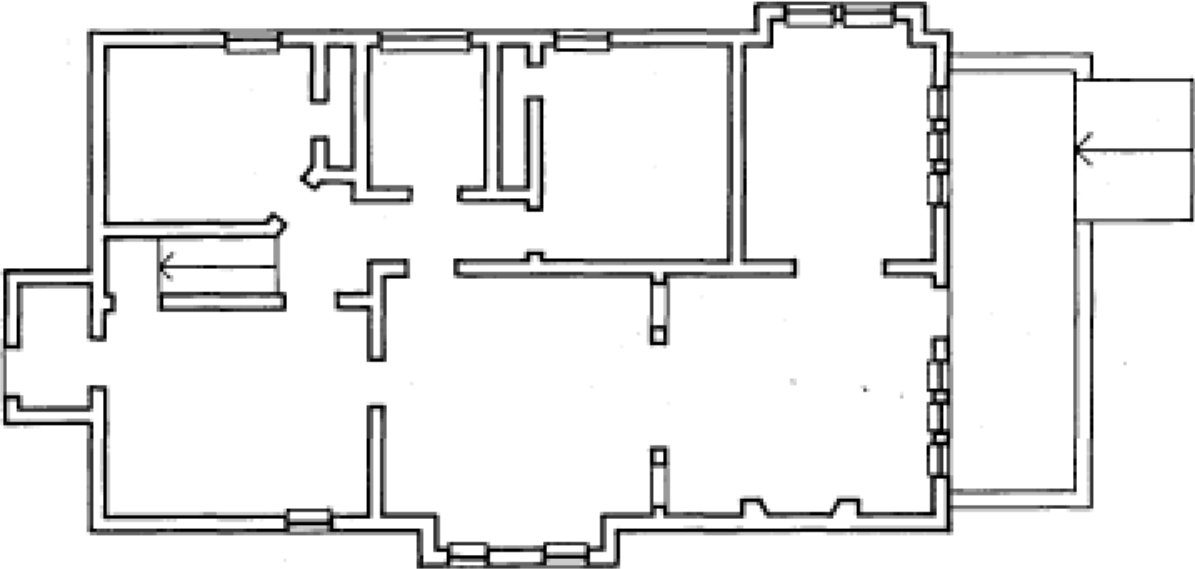
All bungalows in our sample contain a porch facing the street. It can be open or enclosed, but is always centered about the longitudinal axis of the plan.

adding a front porch



generation of connections

Normally I would tell my students to read the second half of the paper and follow the rules and see if they can produce the final configuration



However ...

exercise

allocation of spaces

starting pattern

primary spaces

+ staircase, bathroom & hall

extension of spaces

+ built-in closets

merging of spaces

+ porch

generation of connections

front entrance

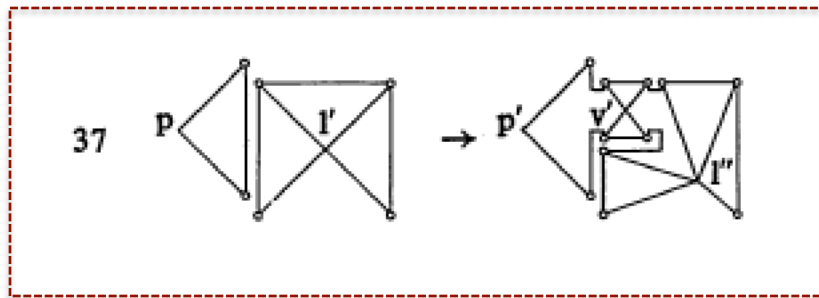
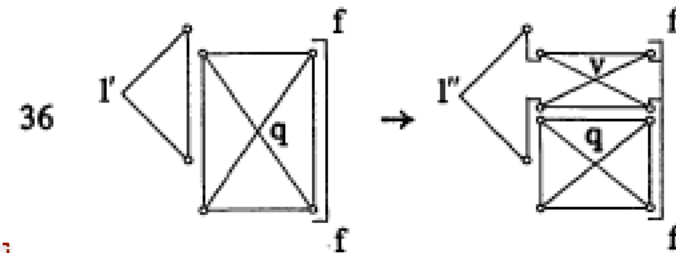
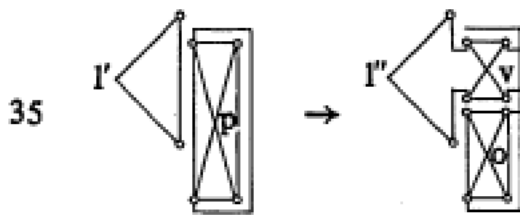
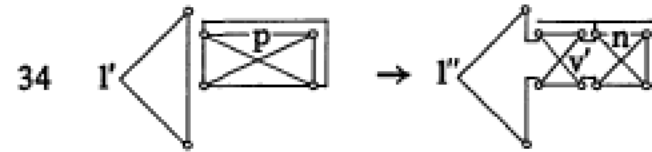
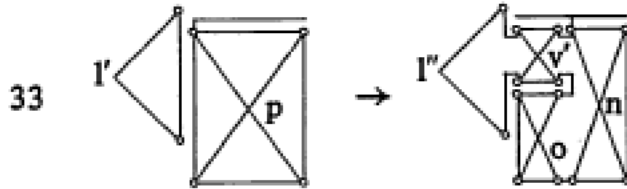
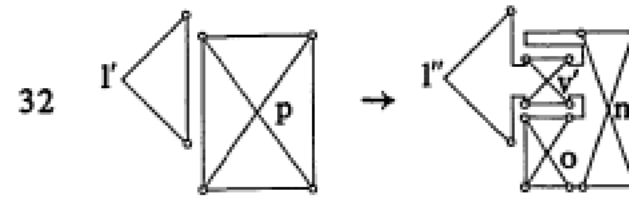
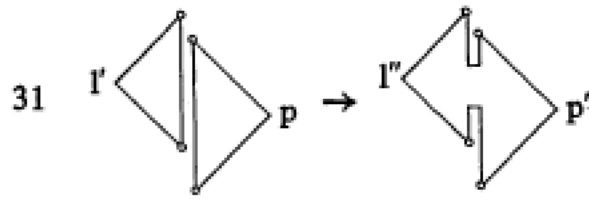
second entrance

internal doors & openings

windows

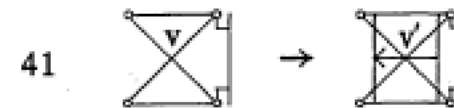
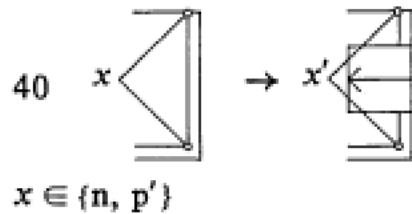
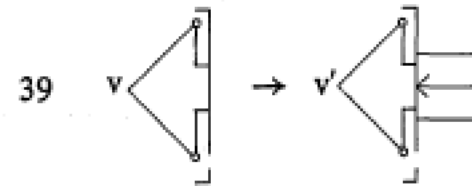
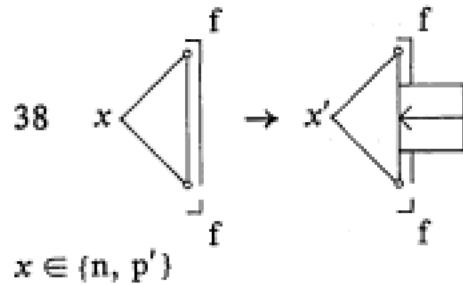
termination

recap – stages in shape grammar



adding a front entrance

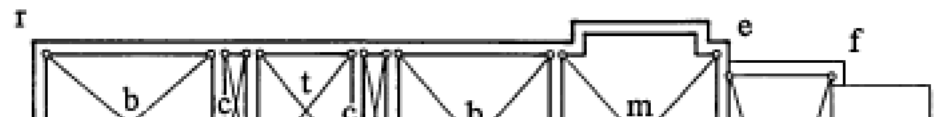
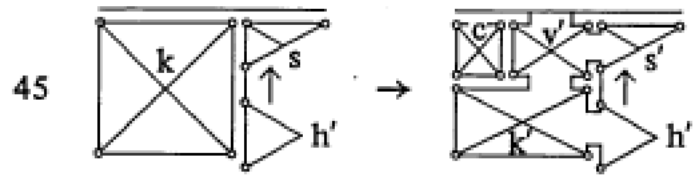
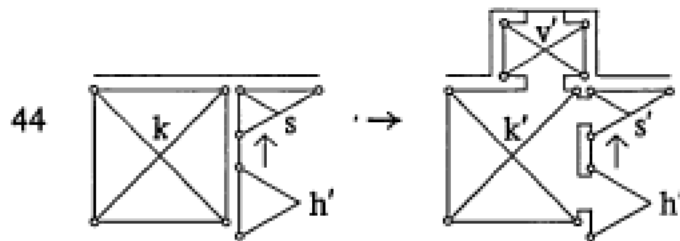
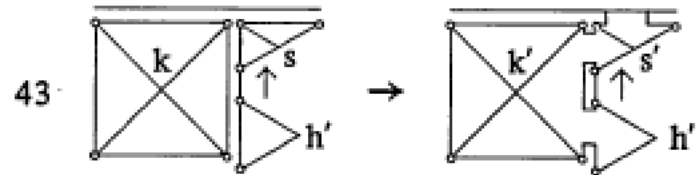
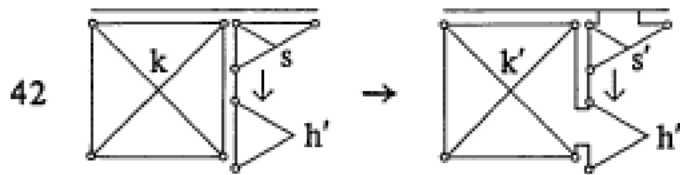
Front entrances always make the living room accessible from the street either directly or through a vestibule which serves as an air lock between the inside of the building and the outside.



Schemata 38 and 39 resp^{ly} place stairs in front of a porch and a vestibule.
 Schema 40 adds stairs from the side of a porch (plans B or E).
 Schema 41 allocates stairs inside a vestibule (plan G).

and front stairs

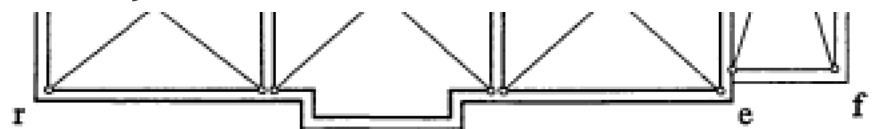




Each bungalow contains, in addition to a front entrance, a second entrance at the side or rear.

Kitchen and basement stairs are always accessible from that entrance.

and front stairs



Internal doors are used to connect :

- Bedroom ↔ hall, bathroom ↔ hall,
- Closet ↔ either bedroom or some other adjacent space.

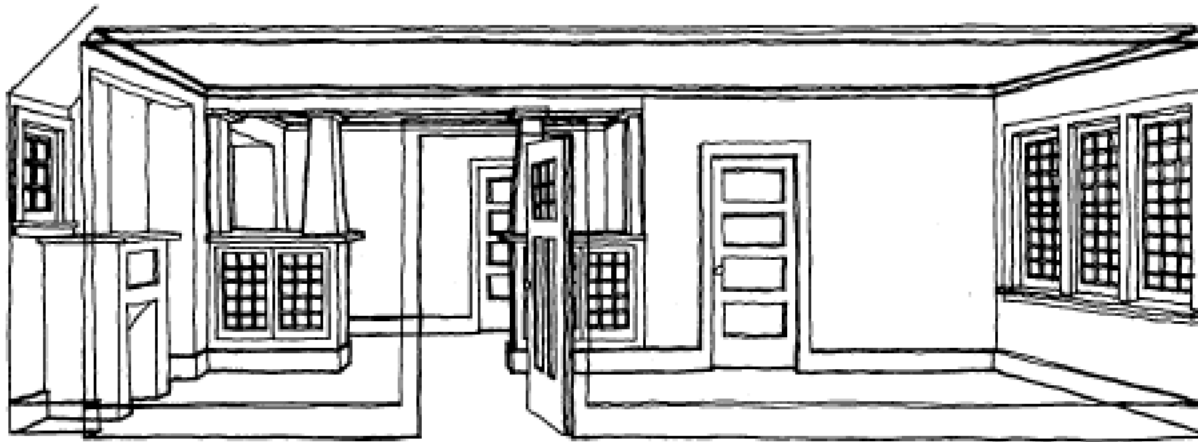
Additional doors connect the following :

- dining room ↔ kitchen, hall ↔ living room or hall ↔ dining room.

Large openings are used to connect the following pairs of spaces:

- living room ↔ dining room, two adjacent living spaces,
- enclosed porch ↔ living room or enclosed porch ↔ dining room.

generation of internal doors and openings

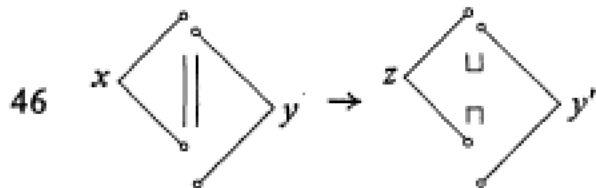


Screen or window walls are used to enclose parts of the openings.

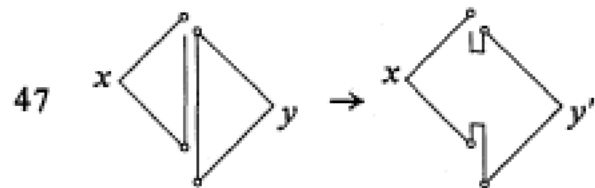
Most conspicuous are the screen walls placed in the openings between living rooms and dining rooms.

These openings are large enough to generate continuous areas which can extend over several spaces (especially in plans F and G), but are never allowed to dissolve completely the walls in which they are placed; the formal integrity of the connected spaces thus remains intact.

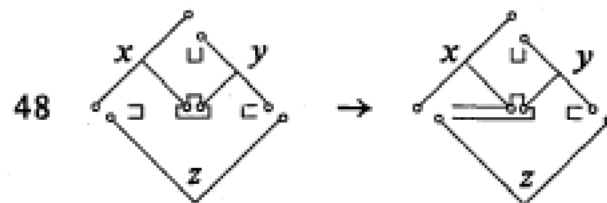
screen walls



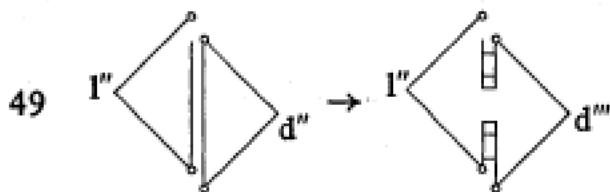
- either $x = z = k'$ and $y = d'$
- or $x = z = h'$ and $y = b$
- or $x = z = h'$ and $y = t$
- or $x = z$, $z \in \{d'', l''\}$, and $y = h'$
- or $x = b'$, $z = b''$, and $y = c$
- or $x = z$ and $y = c$



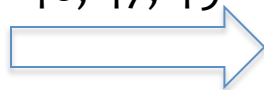
- either $x = l''$ and $y \in \{d'', m\}$
- or $x \in \{l'', d'''\}$ and $y = q$



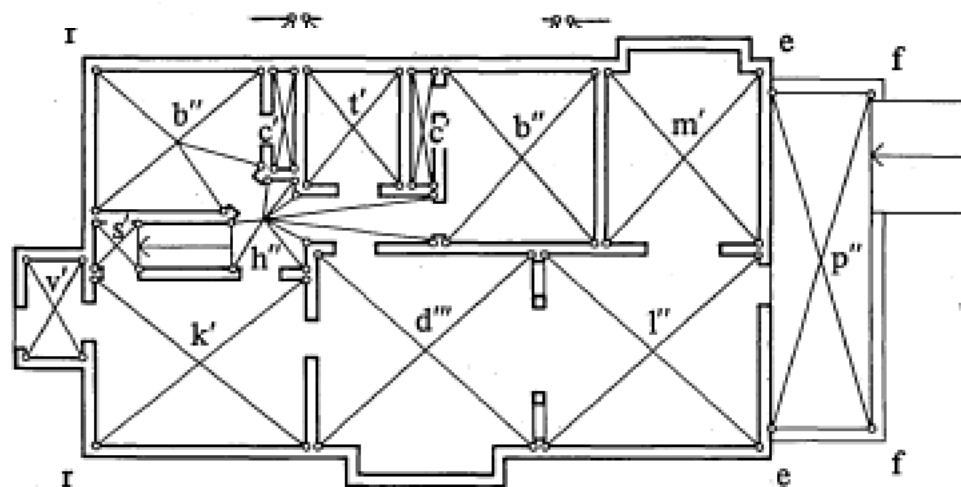
- either $x = k'$, $y = h''$, and $z = d''$
- or $x = d''$, $y = k'$, and $z = h''$



46, 47, 49



generate
internal connections

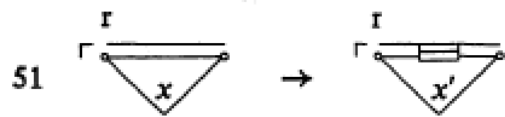


In the bungalows, **all primary spaces and some secondary spaces are connected to the outside through windows.**

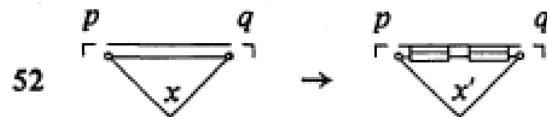
The buildings also contain fireplaces which are mostly purely decorative features, that is, not connected to a flue.

The locations of windows and fireplaces are closely related; our grammar therefore generates these elements simultaneously.

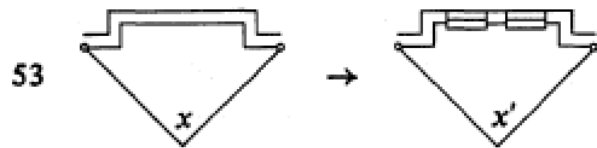
generating windows and fireplaces



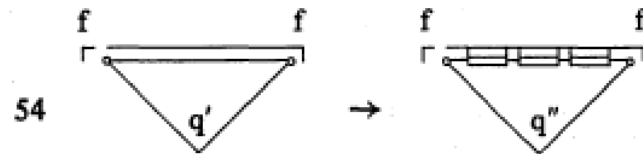
$x \in \{b'', k', t'\}$



$x \in \{d''', m'\}$ and either $p = q = e$ or $p = r$ and $q = f$

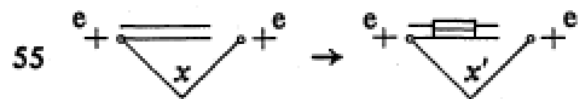


$x \in \{d''', m'\}$

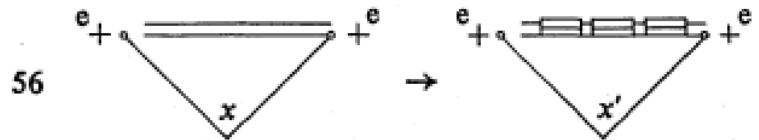


54

q''

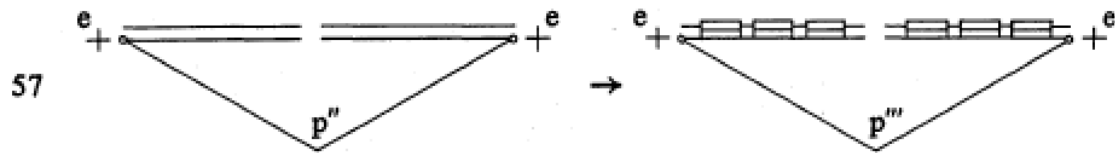


$x \in \{o, p''\}$



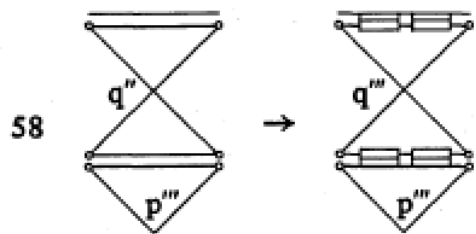
56

$x \in \{o, p''\}$

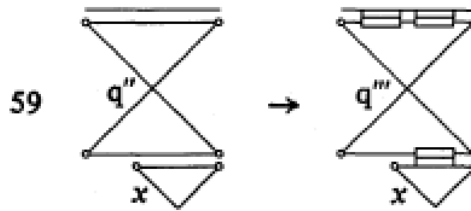


57

p'''

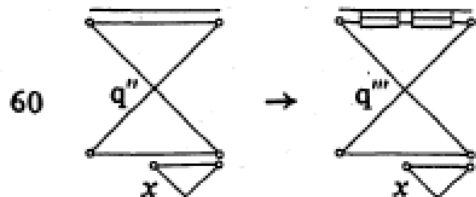


58



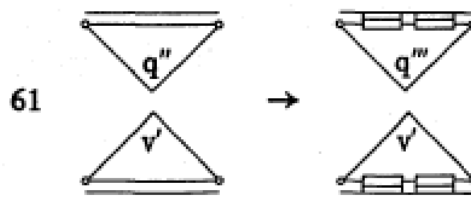
59

$x \in \{n', p'''\}$



60

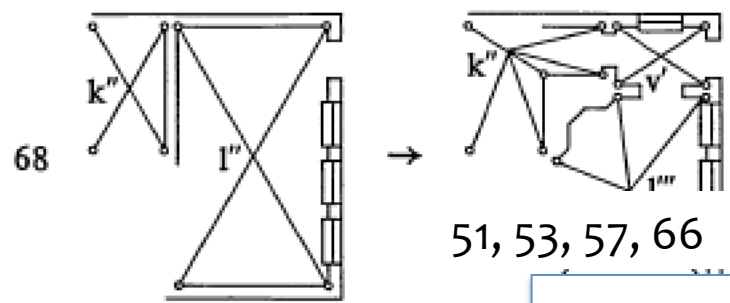
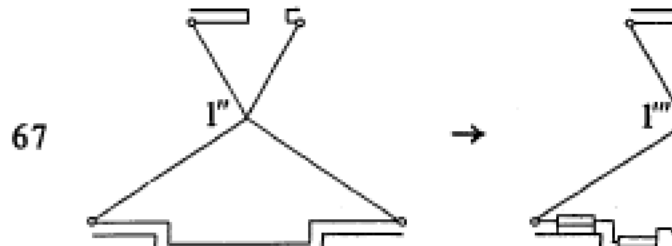
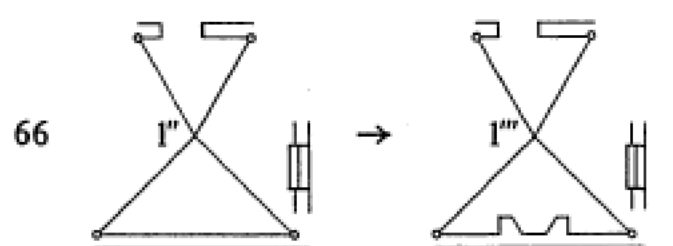
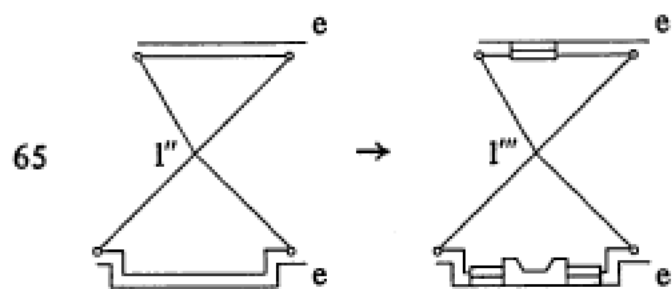
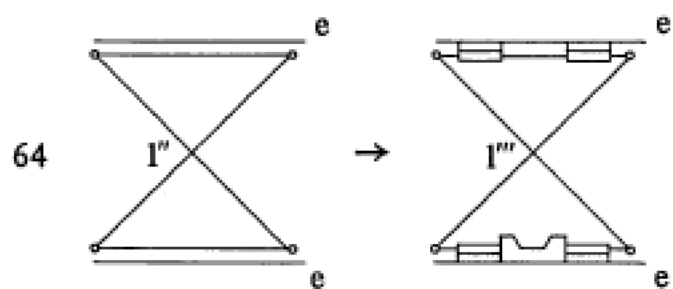
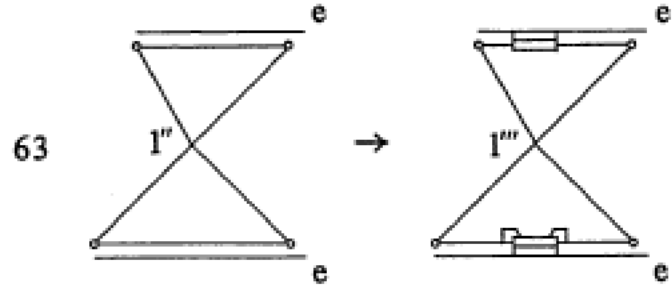
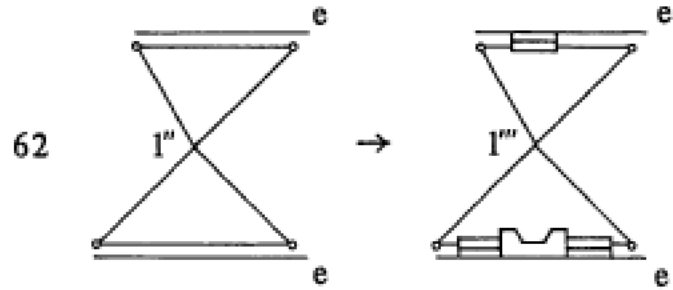
$x \in \{n', p'''\}$



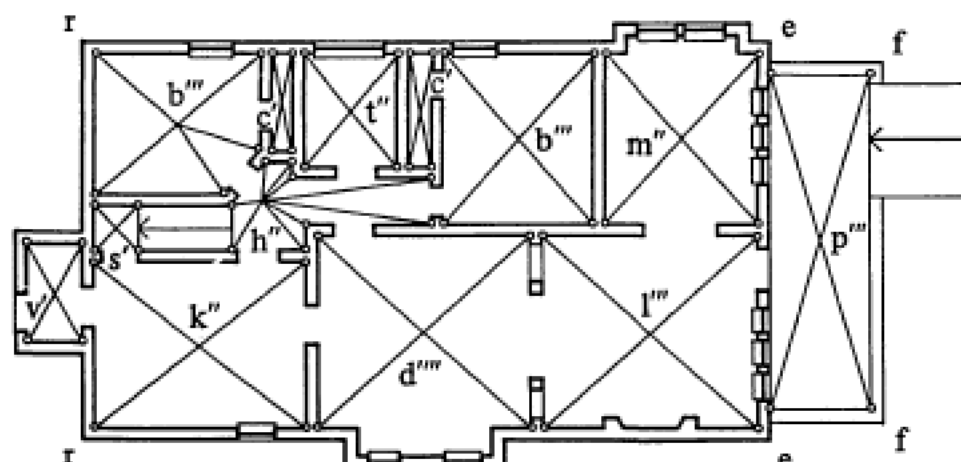
61

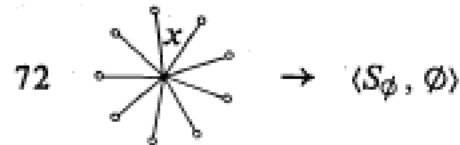
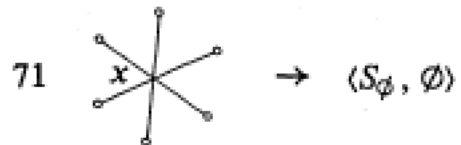
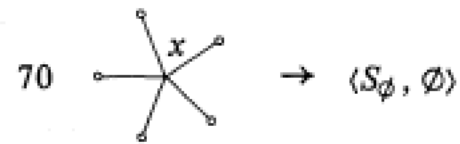
q'''

v'



51, 53, 57, 66



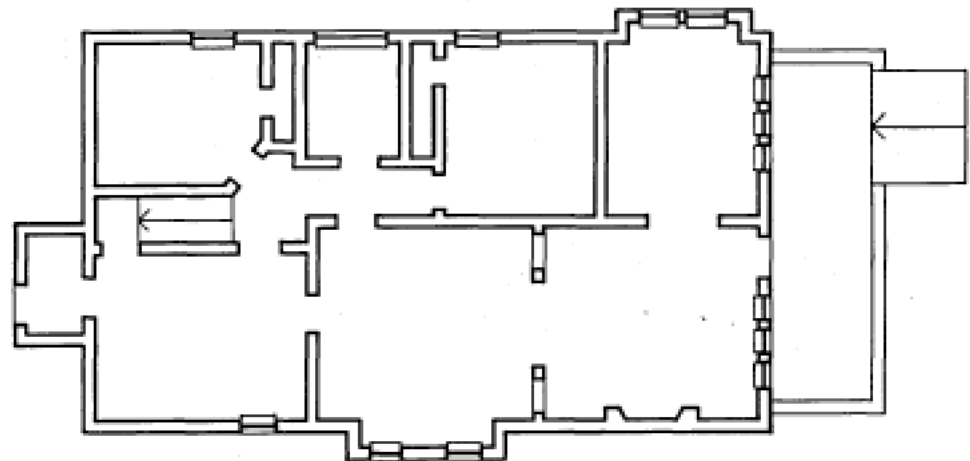
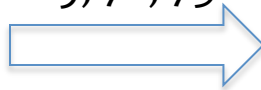


$x \in \{b''', c', d''''', h'', k'', l''', m'', n', o', p''', q''', s', t'', v'\}$ for schemata 69 to 72

73 $p + \rightarrow \langle S_\emptyset, \emptyset \rangle$

$p \in \{r, f, e\}$

69, 72, 73



termination