
The secret of the Casa Giuliani Frigerio

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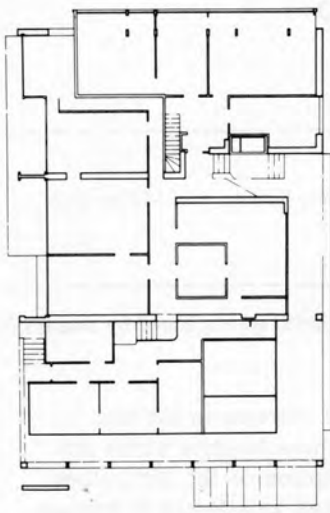
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Abstract. Basic formal characteristics of Terragni's Casa Giuliani Frigerio are explained by means of a parametric shape grammar.

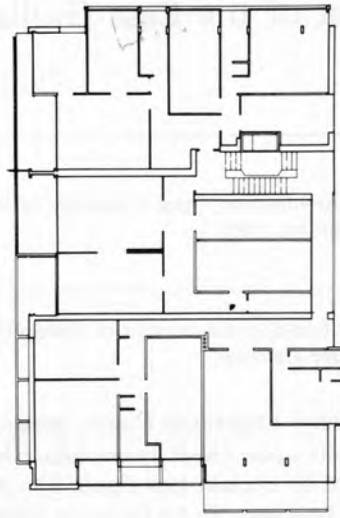
The Casa Giuliani Frigerio at Como, designed by Giuseppe Terragni in the late thirties, exhibits upon closer inspection a host of formal characteristics which are seemingly hard to explain (see figure 1). A detailed description of the difficulties posed by the building can be found in Eisenman (1971), and an attempt to explain its form is made in the same article: Eisenman tries to interpret the building in terms of an underlying syntax, that is, a set of principles or rules which would explain both the shape of the elements in the building and the way in which they are arranged in space. The enterprise was later declared hopeless (Eisenman, 1978). I consider this verdict premature; for the present paper demonstrates that crucial characteristics of the building can indeed be explained through a generative grammar which is not only correct (since it produces a design with the desired properties), but also convincing (since its rules are remarkably simple, yet go a long way towards explaining the properties under consideration).

The building apparently has a basement, a ground floor, three upper floors, and a penthouse. The present paper concentrates on the boundary of the three upper floors and introduces a grammar which produces a partial plan of these floors in the form of a horizontal section through their facades. An inclusion of the remaining parts of the design into the study (or a three-dimensional treatment of its form) would have to be based on a building description which is more detailed than the one given in Eisenman (1971). The grammar itself is formulated as a *parametric shape grammar* and follows the general model given for such grammars in Stiny (1980). The presentation was modelled after the *Palladian grammar* described by Stiny and Mitchell (1978a), who divide the design of a plan into distinct stages and rely extensively on labelled points to signal the transition from one stage to the next.

Shapes are realized in a Cartesian system of coordinates, and the symbols x and y are used to denote, in the usual way, the coordinates of a point in the system. Instead of shape rules, a parametric shape grammar contains *shape rule schemata*, or *schemata* for short; from any such schema a specific shape rule can be derived through an assignment of values, g , to the parameters in the schema. All schemata used in the present grammar are fully parameterized; that is, both the x and the y coordinates of the end points of each maximal line in a schema are given as parameters. It seemed unnecessary to describe the parameters explicitly for each case as long as it is understood that any assignment g must maintain alignments of points parallel to the x -axis or y -axis as they are displayed by the graphic specifications of the schemata; exceptions from this principle will be explicitly stated.



(a)



(b)



(c)



(d)



(e)



(f)

Figure 1. Casa Giuliani Frigerio—(a) plan for ground floor, (b) plan for three upper floors, (c) view of NW corner, (d) view of NE corner, (e) view of SE corner, and (f) view of SW corner. [Reprinted from Eisenman (1971) by permission of Perspecta, Inc., © Perspecta Inc.]

Stage 1: column definition

The initial shape I is shown in figure 2(a). It gives the horizontal section through a rectangular column or post. Its lower left corner coincides with the origin of the coordinate system.

Schema 1 in figure 2(b) generates from I four rows of columns which can be viewed as marking the edges of a rectangle or, in a three-dimensional realization, the faces of a cube in space. Schema 2 inserts an additional column into a shape generated by schema 1. Both schemata introduce auxiliary shapes in the form of arrows whose center points are labelled A or B.

An application of schema 1 to I which is followed by fourteen applications of schema 2 produces the labelled shape S_1 in figure 2(c). Within the present context, this shape represents not only the columns in the north and south facade, but also the eastern and western ends of the internal bearing walls in the Casa Giuliani Frigerio. For purely graphical reasons, the dimensions of the columns are exaggerated and unified in all figures.

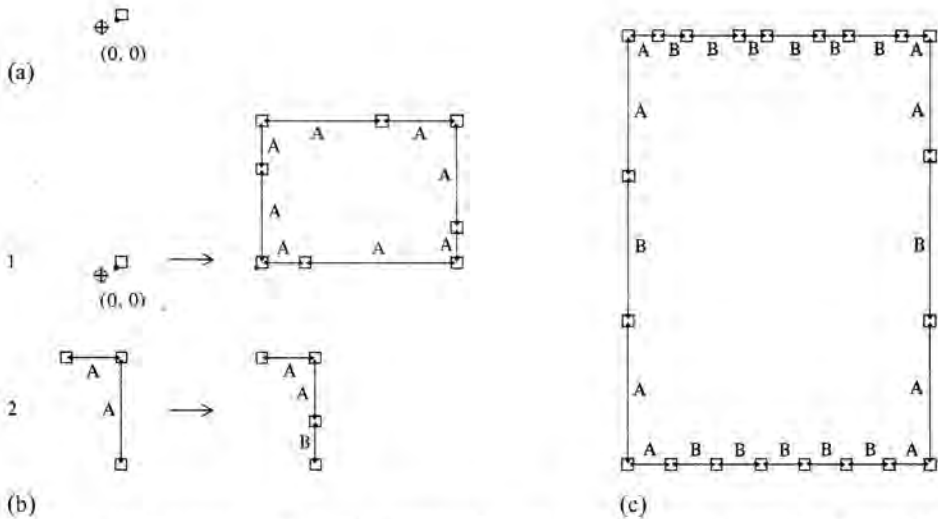


Figure 2. (a) The initial shape I , (b) column-definition schemata, and (c) shape S_1 generated from I by the column-definition schemata.

Stage 2: wall definition

The schemata shown in figure 3(a) add walls at the corners of a shape generated during the previous stage. At each corner column in such a shape, two bays meet at right angles. Schema 3 and schema 4 create a wall by filling in one of these bays. Schema 4 places an additional wall in front of the second bay. Two applications of each wall-definition schema transform shape S_1 into the shape S_2 shown in figure 3(b).

Stage 3: wall labelling

The schemata of figure 4(a) attach labels h or v to a wall. For reasons that will become apparent later, walls with labels h are called *horizontal*, and walls with labels v are called *vertical*. Three applications of each labelling schema are needed to transform shape S_2 into the shape S_3 shown in figure 4(b).

Stage 4: wall development

Figure 5(a) shows schemata which modify certain labelled walls. Schema 7 extends a horizontal wall created by schema 3 past the corner column. A horizontal wall placed by schema 4 in front of a bay is extended by schema 9 over at least one

adjacent bay. Schemata 8 and 10 prevent the modification of vertical walls (note how the labels A and B are used as controlling devices). Shape S_3 is transformed into the shape S_4 in figure 5(b) by exactly one application of each wall-development schema.

Stage 5: wall connection

The schemata in figure 6 connect walls that were generated in previous stages through solid lines defining the outer boundary of balconies or floor slabs which do not end at a solid wall, and dotted lines indicating the position of transparent or opaque panels which run from floor to ceiling and close the gaps left between solid walls.

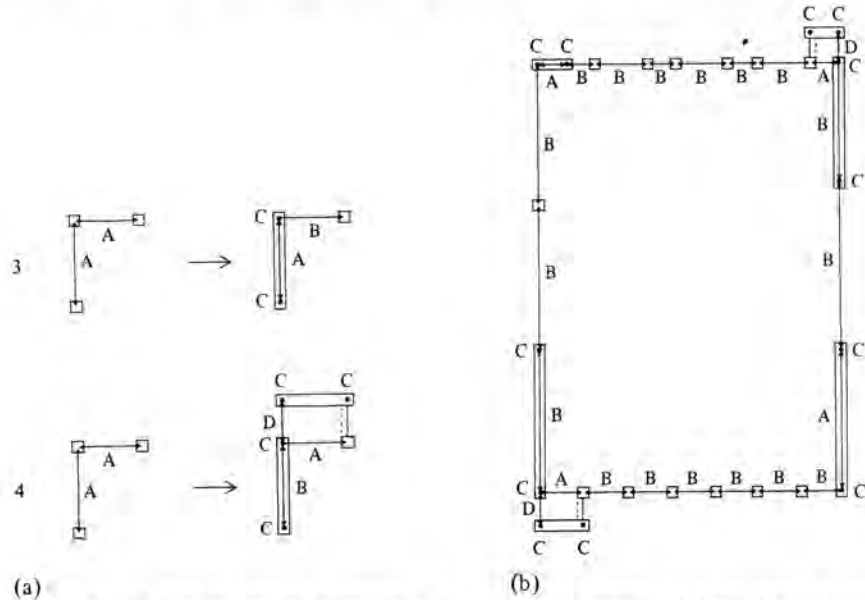


Figure 3. (a) Wall-definition schemata, and (b) shape S_2 generated from shape S_1 by the wall-definition schemata.

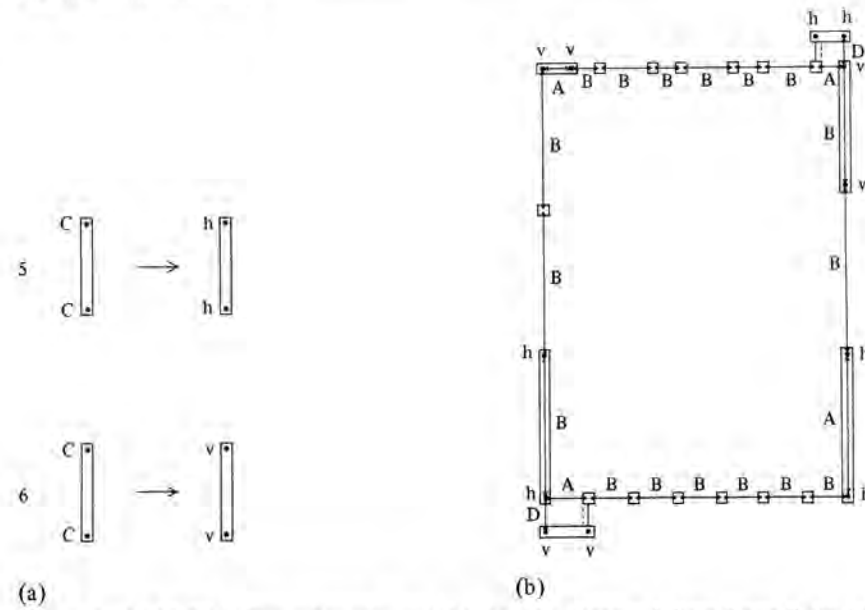


Figure 4. (a) Wall-labelling schemata, and (b) shape S_3 generated from shape S_2 by the wall-labelling schemata.

The conditions given for some parameters in the first three schemata of figure 6 indicate that the formulation of these schemata is quite general. For example, the vertical as well as the horizontal wall in schema 11 can be placed between columns or in front of columns, and the locations of the two walls are independent of each other. The same possibilities exist for the horizontal wall in schema 12 and the vertical wall in schema 13. Note however that a gap closed either by schema 12 or by schema 13

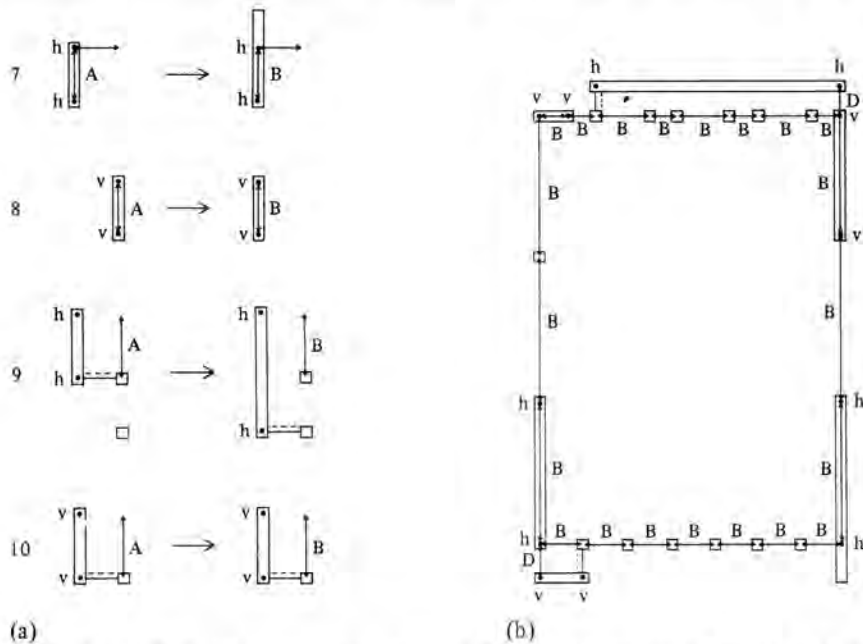


Figure 5. (a) Wall-development schemata, and (b) shape S_4 generated from shape S_3 by the wall-development schemata.

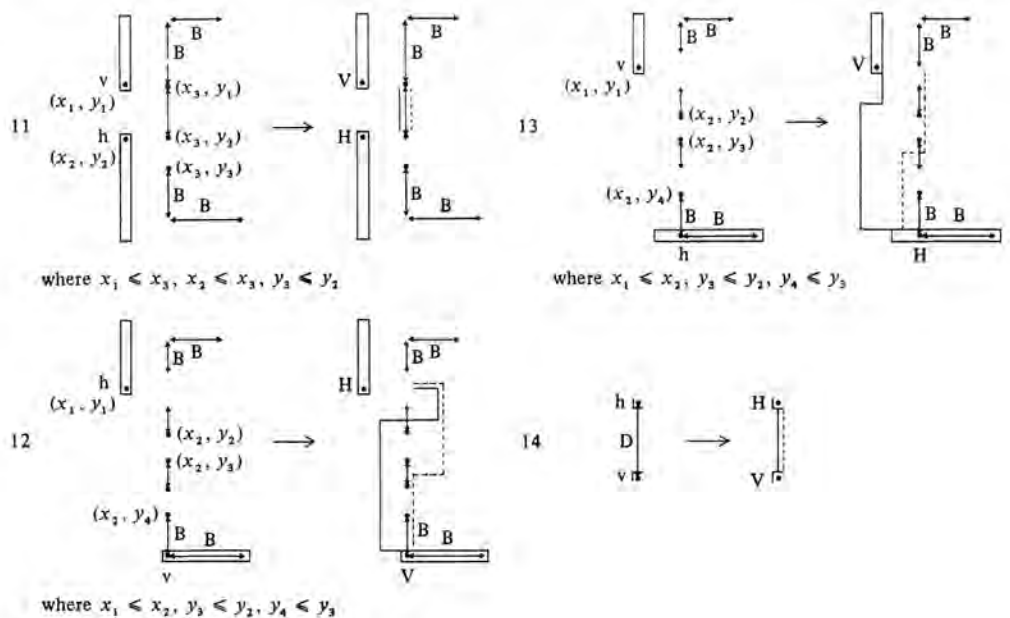


Figure 6. Wall-connection schemata.

must extend over more than one bay, whereas schema 11 closes only gaps which are exactly one bay wide. Note also that the schemata in figure 6 can only be used to connect walls with distinct labels.

In order to transform shape S_4 into the shape S_5 in figure 7, schemata 11 and 14 must be used twice and schemata 12 and 13 once.

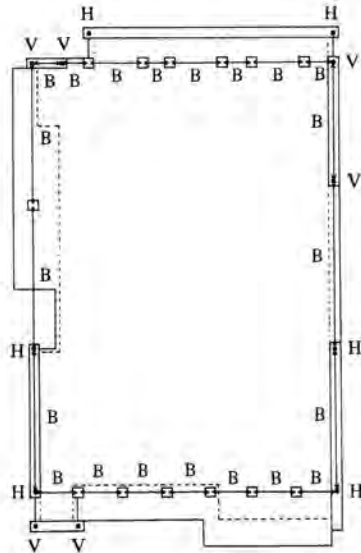


Figure 7. Shape S_5 generated from shape S_4 by the wall-connection schemata.

Stage 6: window design

Figure 8(a) shows schemata which place windows into solid walls and remove their labels. Horizontal walls must receive windows through schemata 15-17; it is to be understood that any such schema can only be applied to a wall with a certain

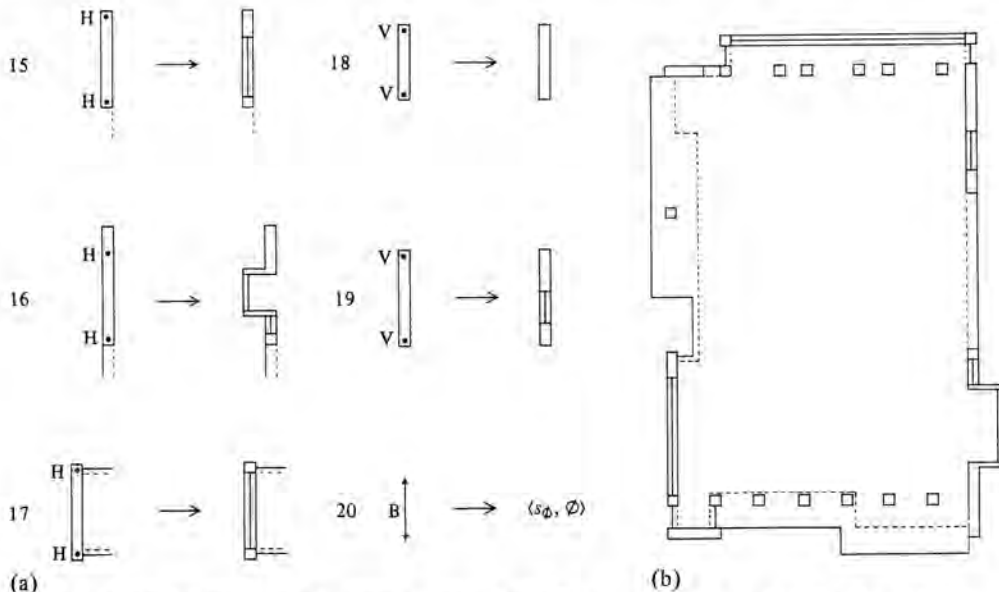


Figure 8. (a) Window-design schemata, and (b) shape S^* generated from shape S_5 by the window-design schemata.

minimum dimension, and that the length of the window must exceed one half of the length of the wall. A vertical wall can remain without windows (schema 18). If, however, a window is placed in such a wall (schema 19), the length of the window must be smaller than one half of the length of the wall. Schema 20 removes the arrows and remaining labels from a shape.

Shape S^* in figure 8(b) is generated from shape S_2 through the window-design schemata; it belongs to the language of shapes generated by the grammar since it contains no labelled points.

The three-dimensional realization of a shape

In order to indicate how a two-dimensional shape generated by the grammar is to be realized in three dimensions, only a few conventions are needed:

- (1) Vertical walls must reach down to the ground level and rise above the ceiling of the third floor.
- (2) Horizontal walls cannot reach below the first floor or above the ceiling of the third floor. Windows in such walls must have sills above floor level. Protruding alcoves cannot touch corresponding alcoves on upper or lower floors.
- (3) All columns must reach the ground level and rise above the ceiling of the third floor. If the bay between two columns is filled in by a vertical wall, both columns must extend above that wall.

Figure 9 shows the three-dimensional realization of shape S^* . The drawing exhibits those elements of the upper three floors in the Casa Giuliani Frigerio that seem to play the most crucial part in the determination of their overall form (floor slabs were omitted from the figure in order to increase its clarity). The basic structure of the design is given through plane, solid walls which are arranged parallel to the faces of a cubic volume marked by four rows of columns. No two walls touch, and the resulting gaps are filled through panels most of which are transparent. The facade formed by these elements has an irregular contour; it folds backwards and forwards so that

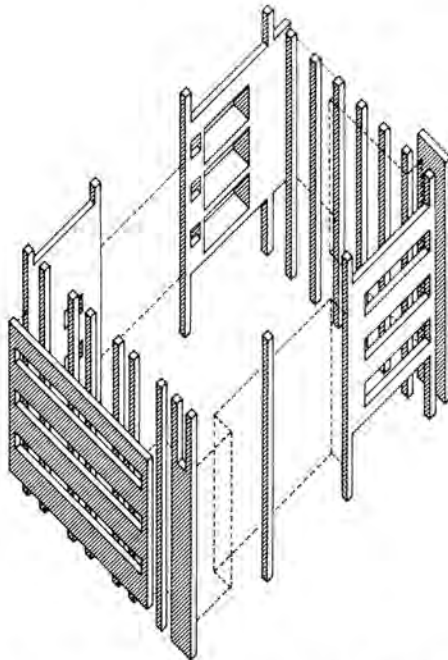


Figure 9. The three-dimensional realization of shape S^* . The design is viewed from the northwest.

parts of it lie behind a face, parts remain in front of a face, and parts coincide with a face of the cube. An inspection of the schemata producing this facade shows how tightly its contour is controlled by the pattern of columns in shape S_1 : the facade never becomes independent of the cage of columns it surrounds. The regular geometry of this cage and the irregular form of the facade result in a contrast which can be perceived from all viewpoints.

Vertical walls appear to rise from the ground to the roof and induce the observer to look up or down along their dominant dimension. Horizontal walls, in contrast, seem to be suspended in the air or stretched out between columns; they might even cantilever past a corner of the cage. The observer is consequently induced to follow their main dimension from left to right or from right to left, an effect which is greatly enhanced by the form of the windows and alcoves. The grammar assures that horizontal and vertical walls alternate as one moves around the building: the contrast between these two types of elements is thus, again, utilized in a very controlled manner.

The two types of contrasts are combined in the design and produce remarkable effects. For example, no two corners of the building are the same. The north-east corner is formed through two walls one of which is horizontal and placed in front of the columns, whereas the other wall is vertical and located between columns. The situation is reversed at the south-west corner where the horizontal wall is placed between columns and the vertical wall rises in front of them. Each of the remaining corners is formed through only one wall. But this wall is vertical at the north-west corner and horizontal at the south-east corner. The variations of the corner configurations induce similar contrasts on the elevations of the building, and the resulting design offers an extraordinary variety of impressions.

The sharp contrasts caused by the juxtaposition of two types of walls are softened through ornamental patterns formed by windows, railings, parapets, or outriggers which grow into and over the voids in the basic structure. A more detailed analysis of these secondary elements cannot be given here.

Discussion

A corpus containing exactly one shape, σ , can always trivially be produced by a shape grammar consisting of an arbitrary initial shape I^* and a single rule $I^* \rightarrow \sigma$. In order to become interesting, however, a grammar generating σ must demonstrate how σ can be constructed from basic principles. The grammar presented here expresses such principles through schemata which are simple in a double sense: (1) each schema defines only a very limited range of properties, and (2) it influences only a small portion of a shape. Grammars of this kind are likely to produce, through the combinatorial nature of the generation process, shapes other than σ (see, for example, the enumeration of Palladian plans in Stiny and Mitchell, 1978b). Three-dimensional realizations of the different shapes generated by the present grammar are shown in figure 10.

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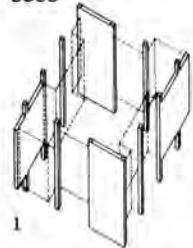
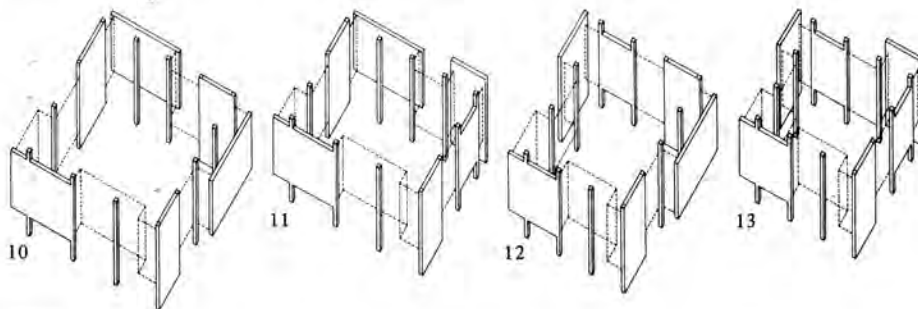
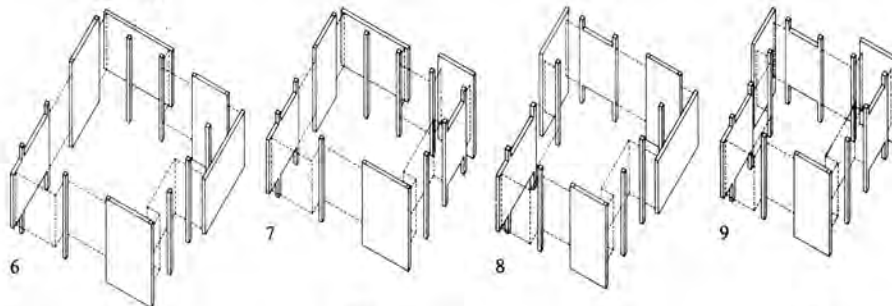
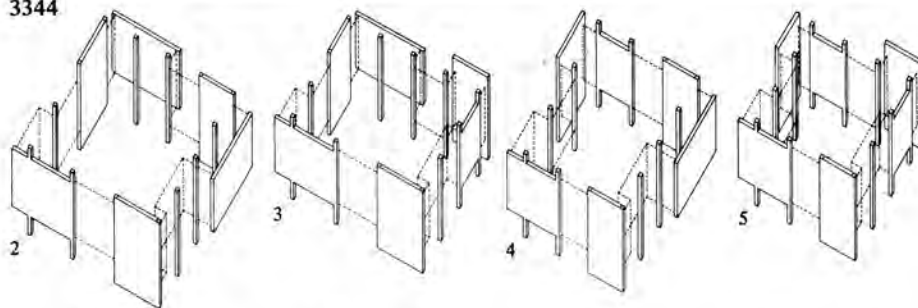


Figure 10. Representatives of the classes of shapes generated by the grammar. The shapes shown are classified according to the sequence of wall definition schemata used in their generation. The sequences 3333, 3344, 3434, and 4444 are ordered clockwise, starting at the nearest corner.

3344



3434

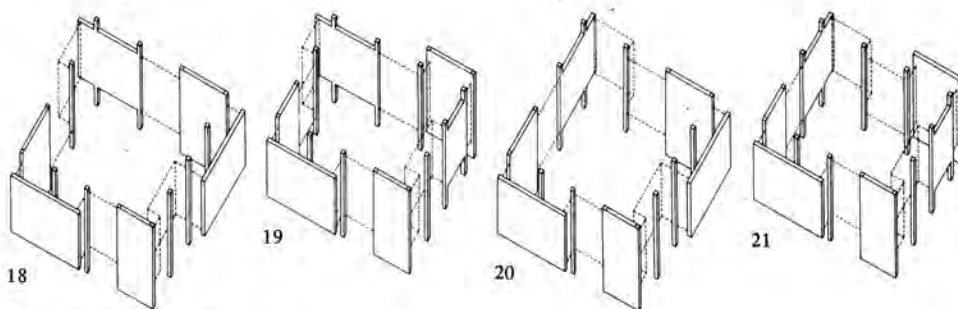
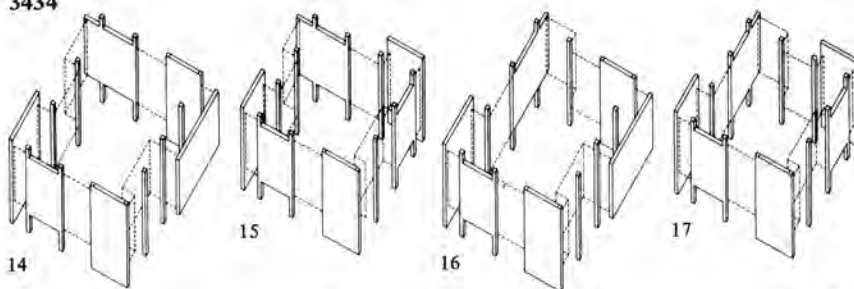


Figure 10 (continued)

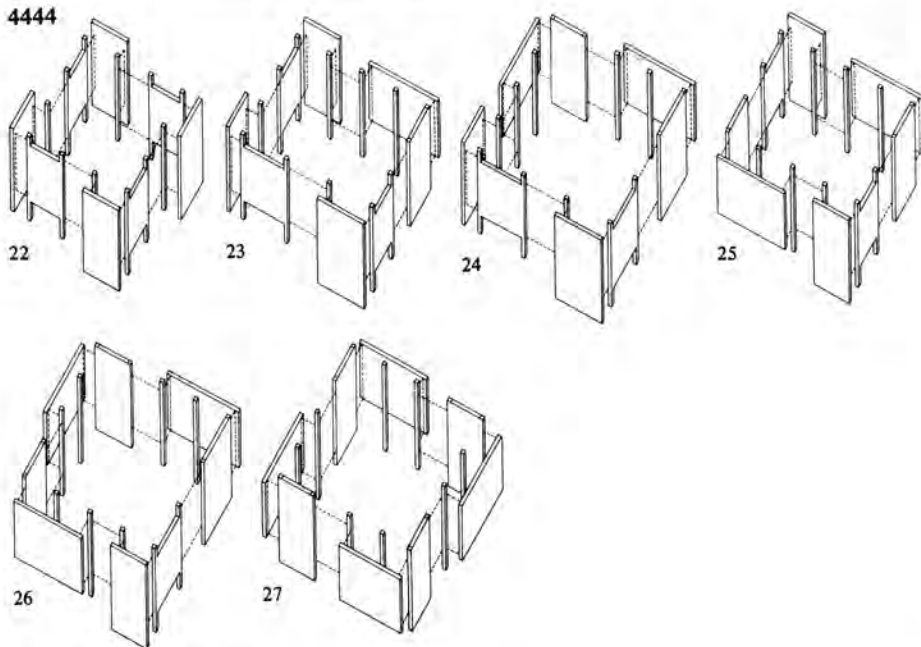


Figure 10 (continued)

This enumeration abstracts from variations caused by rotations, reflections, dimensional differences or varying numbers of columns. Each shape in the figure therefore should be viewed as the representative of an entire class of shapes which differ from each other only through properties neglected in the enumeration.

Shape 21 represents the class to which the Casa Giuliani Frigerio belongs. Note that the grammar always produces local contrasts at corners or within a facade, but does not prevent the repetition of wall configurations at different corners or the creation of rotational symmetries. As a result, not all of the generated shapes display the range of contrasts found in Terragni's design. In order to eliminate the more regular forms from the language generated by the grammar, one would have to introduce schemata allowing for a tighter control of the more global properties of a shape.

The attentive reader will have noticed that the eight schemata used in stages 2-4 generate exactly four different wall configurations at the corner of a shape. These schemata could be replaced by four more powerful ones which would produce the outcomes of stages 2-4 in one step. The simpler schemata were used here in order to isolate the principles found for the design under consideration and to demonstrate how its apparent complexity can be explained through the combined effects of very simple operations. This, to me, is the secret of the Casa Giuliani Frigerio.

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