THE PROBLEM OF DESIGNING FACADES WITHIN AN INDUSTRIALIZED BUILDING SYSTEM/
A TECHNICAL ANALYSIS FOR CRITICISING AND EVALUATING CONTEMPORARY BUILDINGS.

by

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Submitted to the Department of Architecture on August 5, 1985, in partial fulfillment of the requirements for the Degree of Master of Science in Architecture Studies.

ABSTRACT

Designing facades is one of the most important and delicate problems in contemporary architecture. The facade is the changing zone par excellence within which the structural elements of technology meld into refined details of art and together constitute Architecture. The facade is also an interface, or link, between two faces and phases: the facade reflects the evolution of the plan for the private interior side, and is also the expression of the plan on the public exterior side. Very strong tensions, defined spatially, temporally, and architecturally are generated and constantly renewed by interior and exterior forces. Resolving these forces architecturally and artistically through building systems design, modern technology, and a vocabulary meaningful to users is tremendously problematic in the evaluation and critic of three case studies. This will be the subject of this thesis, in which the aspect of repetition in facades will be a dominant aspect.

KEY WORDS: facade, continuity, Modern Movement, Post-Modern Movement, component, modular coordination, standardization, limitation of components, industrialization, assembly, building system, system building, additivity, adaptability, changeability, diversifiability, durability, flexibility, permutability, tractability, variability.

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1 The Latin root of the word 'facies' is synonym of the words 'face' and 'appearance', as defined in the Penguin Dictionary of Architecture, pp. 14.
TO JEANNINE AND GEORGES,
MY PARENTS.
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INTRODUCTION

PROBLEM

This thesis addresses the problem of designing facades using building systems in the context of post-World War II low-income housing projects. This kind of facade design, based on the repetition of the same components, was used in low-income prefabricated housing projects, following the principles of industrialization. Sooner or later, a whole range of buildings have become dissatisfactory to their users and to the community in general, and have engendered not only an architectural burden for the environment, but also unsolvable social and, consequently, economic problems in the communities where they have been implanted. Some have failed dramatically and have subsequently been either destroyed, redesigned or reconverted according to architectural and social standards that should have been considered valid at the time of their original conception and construction.

Many of the post-World War II low-income housing projects were built with industrialized building systems based and developed on the very strict principles of the International Style. They were the prelude to what has later been called the Modern Movement. Other projects, such as the Pruitt-Igoe public housing project in St. Louis, were built using traditional building methods, but nevertheless followed the same principles. Among ideas carried out by the initiators of the Modern Movement were the modular coordination of components and structure, the high level of standardization of production, and the
introduction of new materials and technologies leading to industrialization. They were the main achievements that defined and maintained this new movement.¹

METHOD

Through a clear understanding of the concepts of facade and continuity in architecture, of the basic principles of the Modern Movement, and of the criticisms of the Post-Modern Movement, it will be possible to establish a set of criteria, for evaluating the building systems of projects built recently. The case studies considered for this thesis are: Ricardo Bofill’s the Arcades du Lac and the Viaduc, St-Quentin-en-Yvelines, France; Lucien Kroll’s la Meme, Woluwe, Belgium; and Herman Hertzberger’s Old People’s Center, Amsterdam, Holland.

These projects have been chosen because they represent various types of contemporary prefabricated buildings. The architects used various approaches and different, almost opposite, methodologies to attain what they claimed to be full industrialization, which is the ultimate goal for producing low-cost housing. The analysis takes into account the aspect of repetition in facades and is based on a study of the decomposition of the facade elements of these three projects, their reinterpretation within a technical vocabulary, and their evaluation through performance criteria.

Technical Criteria

The criteria this method uses for determining whether a building has been built according to industrial principles, as explained by Philip Johnson, are: modular coordination, standardization and limitation of components, prefabricated production

¹ Philip Johnson. The international Style.
and industrialized methods and processes. It will be explained in chapter three that these industrial criteria are derived from the three basic principles of the Modern Movement which are the concept of surface of volume, the concept of regularity, and the concept of elegance of materials. Through a technical approach, this thesis will exploit the aspect of repetition in facade design as a unifying theme among the above criteria.

**Performance Criteria**

To evaluate and criticise the building systems of the three case studies, the following criteria will be used as a means of qualification and comparison among them. These measurable criteria adaptability, additivity, changeability, diversifiability, durability, flexibility, permutability, tractability, variability contribute to evaluating the quality of a dwelling and of a given building system.

**GOALS**

Besides the main goal of this thesis, which is to criticise and to evaluate the building systems used in three low-income housing projects, there is another goal which is to apply this methodology to the selection of a particular building system for a given project. Moreover, the author hopes that the various technical guidelines will inspire the design of new building systems and, as such, stimulate research and interest in building technology, and generate improvements in building systems already on the market. This study is also a demonstration of the relation between a building system and its environment, built or natural, and how unexpected and unanticipated its aesthetical, social, and economic
performance can be when these facade considerations are not seriously taken into account.

Alternatively, this study could also be used to adapt building systems that are prefabricated or industrialized systems into the American context, and to demonstrate how they could generate, through careful architectural design, a good quality of life.

To a very large extent, the failure of post-World War II housing projects can be attributed to incomplete interpretation and perhaps an incorrect conception of the facade. In the author's view, the facade should be understood first as an architectural element with certain characteristics, second as a sociological and psychological separation between inside and outside, and third, as a tridimensional carrier of forces generated by individuals and communities in response to interior space, function, taste, and fashion. For this reason, an understanding of the facade and its various aspects have to be deepened and clarified so as to allow common ground for the evaluation and critique of the three case studies.
PART ONE

INTRODUCTION

The purpose of this section is to present, as clearly and as succinctly as possible, the many facets of the facade as an architectural element and its relationship with the inside and outside of a building. To do so, the study will present generic facade typologies and considerations related to continuity; then it will focus on the antithetic positions on facades of the Modern and Post-Modern Movements. It will conclude with selected characteristics of facades derived from the above themes. The performance criteria, to be explained in section two, will be used to evaluate a given facade characteristic, while the technical criteria will be used to describe the building system of a facade.

Three major facade typologies will be identified: the individual, the collective, and the repetitive. The concept of continuity will explain the latter, especially with regards to history and tradition, buildings and streets. Other aspects of continuity will be discussed as well, along with the points of view of the Modern and Post-Modern movements on facades.

Then the thesis will focus on the radical position of the Modern Movement on the problem of designing facades. Its position is founded on three basic principles, namely the concept of surface of volume, the concept of regularity and the concept of the intrinsic elegance of materials, as explained by Philip Johnson. The unequivocal influence of these principles on architecture, in general, and on the numerous components and characteristics of the facade, in particular, as evident in so many post-World War II office and housing projects, will be explained. These principles will not only be sharply criticised,
but also reinterpreted in form, if not rejected in content, by the advocates of
the Post-Modern movement. Its position will then be discussed in terms of its
contradictions, objections, and counterparts to the same issues.

This complex process is intended first to clarify the meanings and implications
of the facade, both as a 'term' and as an architectural 'element' over the last
65 years. Second, it is intended to enable the author to establish technical
criteria derived from the very principles of the Modern Movement and
performance criteria that are more related to many recriminations of the
Post-Modern Movement.
CHAPTER ONE
TYPES OF FACADES

From observation of the built environment, facades may be classified into three generic types: the individual, the collective and the repetitive.

The INDIVIDUAL FACADE is the simplest to characterize. It is the front side of a single detached building, physically independent of other buildings, and may or may not be related to the surrounding context. Having architectural strength by itself, the facade stands for what it is without any pretension. In that sense, the facade may express architectural intentions and be either functional, technological, canonical, or may simply present what is built. The American bungalow is a good suburban example of the individual facade, while the church would be an urban one. (4)

The COLLECTIVE FACADE is more problematic to define. This type usually appears on a single building, often of large dimensions, either isolated or woven into the urban fabric. The building may present a facade with regular or symmetrical patterns following rules of proportions and aesthetics. However, such a facade need not necessarily proceed from the plan and, therefore, often does not represent what is behind it. To a certain degree, a collective facade of that type is 'false' and pretentious because it announces something that seems, with today's eyes, not really consistent with what is behind. It is a show for the public realm only, as Bofill's project in St-Quentin-en-Yveline is. Minimal and unsanitary apartments and utilitarian rooms do not correspond to the luxurious exteriors of grandiose facades of many Italians palaces and French Hotels Particuliers which were both designed only for the sake of great architectural styles with no reference to functional requirements or people's
needs.\textsuperscript{1} The discrepancies or incongruencies between plan and facade are especially amazing when stables and ballrooms share the same facade design. There was, at the time such facades were designed, no consideration for human well-being. These facades are the symbol of what the International Style was fighting against. The reaction of the Moderns was very strong: they denied the "styles" and they modified the design of the facade through the use of modern technology, like plumbing and ventilation, so as to ameliorate the living situation of people and to relate them to their life style and condition as workers, in many cases, in a machine-era.

"Il semblerait, en verite, que les maisons de Paris et des grandes villes qui construisent a l'instar de Paris, sont faites, non pour ceux qui les habitent, mais pour offrir aux regards des passants certaines ordonnances monumentales dont, d'ailleurs, ils ne se soucient guere; qu'elles sont elevées pour la montre avant tout. On se donne ainsi aux étrangers des apparences [faces ou fa
cades] de palais quand, derrière des facades, on ne trouve que logis étroits et insalubres. Richesse au dehors, gène au dedans: n'est-ce pas là le programme de la plupart de nos constructions a locations? N'est-ce pas la matérielle expression des infirmités morales qui nous conduisent à une prompte decadence? Peu de fond, beaucoup de désir de paraître; par suite une société dans laquelle l'envie devient le souverain mobile: c'est-à-dire un désir incessant et immodéré de paraître plus qu'on ne peut être, et une secrète haine pour tout ce qui se produit au-dessus de ce que nous pouvons montrer”. \textsuperscript{2}

Viollet-Le-Duc

The last type, the REPETITIVE FACADE, is of greatest interest for this thesis since it is, in many ways, its starting point. To a very large extent, repetitive facades were the technical reply of the new style to the collective facade of the "styles". They occurred either vertically or horizontally in all kinds of buildings: commercial, office, industrial, and housing. It is from observation and personal

\\textsuperscript{1} Stanford Anderson (ed). On Streets.

experience that I became acquainted with and interested in the problem of repetitive facades, especially in low-income housing projects. First concerned by the aesthetic aspects, I realized how boring and uninteresting most of these facades were, how badly they influence users and passers-by socially, and how destructive they may be for the built and natural environment (fig. 1). The author was shocked by the fact that repetition in facades built before 1920 in a traditional way, like Place des Vosges in Paris is far less damaging to people and the environment than repetition in those built after World War II using industrialized methods and processes. My interest, therefore, is to understand why and then how this situation can be changed and improved, within the context of industrialization. To do so, three case studies will be explored after the discussion of the situation of industrialized housing in Europe and America.

Repetitive facades are prevalent in most peripheric low-income housing projects built in Europe and America after World War II. The general purpose was clear: to provide, as cheaply as possible, a large number of dwellings outside the city, but still not too distant from the place of work of the inhabitants. To do so successfully and according to the principles of the Modern Movement, the means adapted to achieve this were systematic modular coordination, judicious selection of standardized and repetitive components, and eventually industrialization. The examples of repetitive facades are very interesting because of their crucial position in the center of the architectural, sociological, and economic debate around low-income housing occurring between Moderns and Post-Moderns.

Before going further in this inquiry into facades, I would like to address some considerations on the concept of continuity. Continuity of history, tradition, and material for instance, is a property a facade may or may not have: in the
context of repetitive facades it is significant in architecture, especially in the three case studies to be analyzed. Continuity like repetition is, in fact, a recurrent theme approached and expressed very differently by Bofill, Kroll, and Hertzberger.
Fig. 1: Apartment Houses at 860 Lake Shore Drive.
CHAPTER TWO
CONTINUITY IN FACADES

Continuity in the context of a repetitive facade is defined by several considerations such as history and tradition, surfaces and streets. The continuity of space (inside/outside), plane, material will be explained and discussed later on, along with the characteristics of facade. The other levels of continuity are of greatest importance for they are associated with the three basic principles of the International Style, namely the concept of surface of volume, the concept of regularity and the concept of the intrinsic elegance of materials.

In a broader sense the explanation of continuity is the next step in understanding forces that are shaping the inside as well as the outside of the built environment. These forces are defined as change of functions, need for more space or simply taste and fashion. They are expressed in the facades by tensions that are concavities, convexities, void and solid. Continuity in facades will also clarify the positions of the Modern and the Post-Modern Movements in their development.

Modernism rejected the concept of street, continuous facade and traditional patterns and instituted new visions, from linear cities to Cite Radieuse (fig. 2). During the Modern Period, the historical and volumetric continuity were not considerations of facade design. As a result, discontinuity with traditional architecture became an unspoken feature of the Modern Movement by the exclusion of most links with the urban context. The 'folkloric attitude' of integration into the fabric was consciously avoided by most modern architects who carefully 'plopped' onto a site the free-standing construction as a single object. In the new style of architecture, the four facades of a building were
identical and neither physically nor architecturally related to the next buildings. Consequently, modern buildings were part of that new urban vision that excluded streets and facades as continuous elements. Therefore, most modern buildings were not intended to be related or integrated into the urban fabric, but rather implemented as an independent physical statement of the new architectural order (fig. 3). This was particularly evident in new towns and high density projects built on the periphery of cities where no attempt was made to relate in scale, form, and material to the near-by urban order and to the surrounding context (fig. 4). In fact, these projects established the new structural and architectural order. They are the consequences of the three principles of the Modern Movement that themselves introduced new dimensions to the concept of continuity.

CONTINUITY OF HISTORY AND TRADITION

Historical comparisons engender continuous traditions in architecture (44), but if tradition consists of slavishly following the ways of the immediate generation before us, tradition as imitation should be discouraged. Tradition is to be taken for granted: it involves historical sense which involves perception and memory. Modern architecture pointed out what is different in our time, like new lifestyle, modern building technology, and HVAC and sanitary equipment, and forgot what is the same, i.e., basic needs and primary values for western cultures, such as individuality and freedom of self-expression. And it seems that what is the 'same' over generations might be the most important and relevant aspect of what should be today's architecture as opposed to what is different, as advocated by Robert Venturi. For him, historical continuity, or the sense of tradition in buildings, is insured by complexity and contradiction of layers of
interventions appearing mainly on the facade through the years. The facade becomes a sort of architect's palette offering infinite variations of innumerable architectonic elements.

Ambiguity, confusion, and even disorder result from this freedom of composition in facade design. The clear, clean, flat, sharp, and edgy facade promoted by the Modern Movement voluntarily disavowed the marks of the past, and promulgated the dogmas of purity and clarity to establish the new architectural order (fig. 5). Orthodox modern architects, intending to clarify their intentions, denied the 'both-and' tradition, characteristic of popular architecture, and supported the 'either-or' concept in architectural design in order to express clarity. Another aspect of continuity that was brought up by the orthodox of the Modern Movement was the continuity between inside and outside. The Modern Movement translated the continuity between inside and outside by creating a continuity of the flowing space through an ephemeral skin, the so-called curtain wall (fig. 6-7). This was most evident in office buildings and in some private houses. This trend opposed the Renaissance tradition in which the continuity in the churches, for instance, was insured through the use of the same vocabulary inside and outside: columns, pilasters, cornices and mouldings were the same in scale and materials.

On the 'Modern' facade, continuity was expressed by related vertical and horizontal panels mostly made of glass or other light materials. The 'enclosure' aspect of the interior space disappears through the transparent facade in which the window is not anymore an opening in the wall, but rather a full interruption of it. Propelling the unlimited space in both directions results in the negation of the specificities of the inside and the outside realms by unifying
them in a sort of static equilibrium. The tensions created by the inside and outside forces that used to appear on the facade were not expressed any more, leaving the thin skin facade, free from concavities and convexities, mostly flat and with a certain dull uniformity. The values of protection and individuality of the interior space initially protected by the thick facade and fixed partitions, could find no means of expression on the continuous weather-protection and light infill screen and on the open plan, and have disappeared as well (fig. 8).

"The surface is to be as little broken as possible so as to emphasize the continuity of the whole wall and not to produce symmetrical patterns as in previous architecture. The surface has also to remain a plane, without concavities and convexities, avoiding picturesque effects and destroying the sense of equal tensions in all directions".  

Philip Johnson.

Facades designed to correspond only to functional needs of the interior planning are consistent with the Form Follows Function dogma of the Modern Movement. The unadorned facade, which proceeds from inside out, only represents what is inside and fails, if placed in it, to recognize the traditional context of the built environment in which it will appear. In reality, function and efficiency have chiefly influenced the plans for Modern architects, while industrialized production of materials, new technologies and equipment were a major concern of expression on the facade. For example, the facade of Mies' Seagram building in New York, is inconsistent with the functions in the building. On the first floors of the building, the concrete blocks of the mechanical room's walls are not clearly expressed in the facade as made of solid material, so as to maintain the continuity of surface of volume and of materials. Mies was more preoccupied by the industrialized production of facade components than by what

1 Philip Johnson. The International Style. pp. 51.
lay behind that facade and did not bother with strict obedience to all modern principles. However, even the functionalists, who deny the necessity for aesthetic expression, as Philip Johnson said, must admit that the essential character of the plan should be reflected in the exterior of the building.

Modern Movement buildings barely express the social and human realities of the generations of dwellers who are naturally used to telling their own life story and making the buildings organic and livable. Livability was for the Modern Movement the capacity of making a building good for people to live in in terms of their well-being by adding equipment and services. Therefore, flower boxes, awnings, shutters and colors were almost never found in Modern facades, because as opposed to plumbing and ventilation they were not essential to the well-being of people. As a consequence, the secular tradition of self-expression was denied to the users by the Modern Movement which wanted to have control of the built and natural environment, and more subtly, of social values by imposing a utilitarian order corresponding to the Form Follows Function dogma. The architectural results were not so great according to users' needs and taste, mainly because utilitarianism was confined by limited resources: technical and/or economic.

Until the mid-70's, the general opinion prevailing was that the clear dichotomy between Modern architecture and what had gone on before was considered as part of an irrevocable process, which would continue irreversibly from the industrial to the electronic revolution. Nowadays, almost nothing is left of the rich turn-of-the-century architectural and stylish palette previously used for facades. Much of it has been replaced by some machine-shaped components created out of new materials and which are perhaps for the users the
meaningless fruits of modern technology. These components are shaped to be perfectly adjusted to each other; their jointing becomes the focus of architectural resolution and does not leave much space for either new additions or transformations, nor the possibility of removal. This kind of architecture, built and intended for a classless society but finally devoted to the lower class, has been an immutable monument praised for its purity and order by the theoreticians of the Modern Movement. Mies refers to a need "to create order out of the desperate confusion of our time". However, the lay people can not and do not value Mies's conceptual subtlety. With the Modern Movement, recent architecture now has left the street and addresses metaphysical issues to the so-called elite of society, who claims to understand what is going on, but who in fact could not care less about it. A paradigm of this is I.M. Pei's East Wing of the National Gallery in Washington.

The Post-Modernist Movement is changing these innumerable and isolated monuments. All means are permissible in the battle between the old and the new architecture styles; the end is the resurgence of the "real" architecture: the architecture that, according to the Post-Moderns, people like, recognize, and relate to; the architecture that pays tribute to the past by supporting the return of vernacularism and of classical principles of design.

In this endless battle, what is happening to the facade? Many Post-Modern architects are camouflaging or masking the building's structure with cosmetics to create a more meaningful facade to users and to insure the continuity of tradition and to give a sense of history to buildings that otherwise would not have any. Other Post-Moderns have attempted to blend their facades into surroundings by using elements from the Greco-Roman and vernacular architectural
traditions. But what if the very next building is the best example of the International Style? Should the new building not be related to it also? The answer to this question has not yet found theoretical expression. The facade has been precipitated into a very deep architectural controversy, over which today's architects might give a real contemporary, that is modern, sense in their use of technology in meeting human needs and improving their well-being.

CONTINUITY OF SURFACE AND STREET

"The enclosure of a street is strong when the facades are continuous, the ratio of the facade height to street is regular, and the facade articulation relatively uniform. The street enclosure is weak when none of the preceding conditions reinforce the street space: definition is then left to curb lines, topography and landscape".

Victor Caliandro

Facades make buildings; the continuity of buildings makes built environment and streets; and the continuity of streets makes the urban form and contributes to make cities alive because of people's self-expression. Besides the continuity of a given facade, there is the continuity of the immediate built environment and of the whole urban form. In that respect, each of the three types of facades acts directly on the enclosure quality and the continuity of the street, and on the definition, character and continuity of the built environment. The collective facade that houses buildings open to public, like those offices, banks, stores on Fifth Avenue in New-York, has a very strong enclosure quality.

"due to the relatively uniform facades of the buildings and partly to their height in relation to the width of the street. Because of this emphatic corridor definition—a corridor that gives access to buildings

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along its length— and its prestige, Fifth Avenue is perceived as an important link in the fabric of Manhattan". ¹

Bofill is a partisan of the continuity of traditions and history. Kroll is much more into the continuity of the built environment, the context, and the immediate history of a neighborhood. While Hertzberger deals with the continuity of space, plan, and time in a building, in a way similar to the Moderns.

The Modern Movement's architects were not interested in such concepts of continuity for they were seeking to produce a large number of dwellings in periphery of cities and new towns, and to introduce a new order corresponding to the new way of life widely influenced by the industrial revolution which brought up new materials and equipment. They have denied the original context which means that they wanted to neutralize the city as it was and transform it. They have created a 'fictive' one out of their principles so that 'plopped' architecture did not have to be related to the context. Comparing the new town of Roosevelt Island on the East River in New York, USA, Peter Blake said:

"...it is a real street! A real street with arcaded sidewalks, and shops, and trees, and almost no cars! It is a narrow street...But the street has a turn to it so that, as you look down it from either end, you can't tell what or who is coming around the bend. In short, it is really a very old fashioned sort of space. It may be crowded, perhaps overcrowded; and it is unpredictable, full of surprises. And there are balconies that overlook the street, so people can sit and lean out and watch the passing parade". ²

In America, the skyscraper took over the facade of the Modern Movement which became associated with commerce and office buildings for which it was

¹ Ibidem. pp. 179.

² Peter Blake. Form Follows Fiasco. pp. 94.
not intended in the first place. Architecture was influenced by steel, new technologies, equipment such as elevators, curtain walls and plumbing, while in Europe, architecture remained on a smaller scale and was developed through the open plan and open space. In contrast, housing in the US was therefore very high or very long so as to utilize the latest in technology. The same principle of rentability applied to public buildings, such as offices, was applied as well to housing. As a result, the quantity-based industrialized architecture of most housing complexes has proved to be a gallant and relatively economical effort in satisfying the need for quantity because of technology, but has resulted in the abandonment of quality. Many of these complexes have been in turns deserted by their inhabitants and then destroyed, like the Pruitt-Igoe's which will be discussed at the end of this section (fig. 9). Thus, in the US, industry meant for the Modern Movement a change of material, from cast-iron to concrete, for instance, and has introduced a new dimension, that is the development of transport which allowed the possibility of importing material from outside the cities or to export products in remote regions. In Europe, the Modern Movement concentrated on the open plan and open space in housing, trying to adapt them to industry. In the end, it might be that Europe was more 'advanced' in terms of planning housing while America was far ahead in technology, resulting in more elaborate office buildings in the latter case and better adapted housing in the former.

Shadrach Woods, who was the long-term associate of Le Corbusier, wrote in his last book, "The Man in the Street": "Why should quantity exclude quality? Quantity does not exclude quality and 'more' might be very well better than 'less'. Why should the crowding of people (and their favorite activities) be considered deplorable?" Of course crowding is a social phenomena of great
interest, but crowding in a dwelling can be disastrous because of hygiene and epidemics. These are aspects that the Modern Movement was fighting against with the introduction of new equipment such as plumbing, ventilation and others. Does this statement reflect a change from one of the very activists of the Modern Movement? Not really, for it acknowledges in a certain sense what the Modern Movement has done with the use of technology and new materials to ameliorate the well-being of people and to make possible high density housing projects where interaction between people benefits society.
Fig. 2: The center of Le Corbusier's Radiant City of 1925.
Fig. 3: Le Corbusier's Plan Voisin for the center of Paris, proposed in 1925.
Fig. 4: A street in Boston's Charles River Park, a new Radiant City.
Fig. 5: The joints and the elements form a geometric pattern on the outside walls.
Fig. 6: Farnsworth House, Illinois, 1950. Plan.
Fig. 7: Farnsworth House. Glass and steel elevation.
Fig. 8: Apartment Houses at Lake Shore drive, Chicago, 1951.
Fig. 9: Pruitt-Igoe Housing Complex.
CHAPTER THREE
FACADES -A MODERNIST VIEW

"Less is more".
Mies van der Rohe.

Louis Sullivan was apparently the first to adapt the slogan of "Form Follows Function", which is a fundamental tenet of Functionalism. From its inception, it did become the dogma of the International Style, later called the Modern Movement.

"The Modern Movement finds its roots in the architecture of plain buildings of the nineteenth century, such as the factory mills, rather than in the elaborate architecture of that period. Around 1850, there were some individualistic revolts of the first modern architects who attempted to destroy the prestige of the "styles". At the same time were developed new materials and new technics allowing a type of architecture unknown until then. The Crystal Palace at the London Exposition of 1851 was Paxton's magnificent iron and glass construction. Feroconcrete was invented in 1849 and made possible the enormous window area and the terraces. These materials together with asymmetry of composition produced an architecture infused with a new spirit, more completely freed from the conventions of the past than any thus far projected".¹

The Modern Movement, as it will be referred to in this thesis, covers the period of 1920 to 1970 and includes works of prominent architects like Gropius, Oud, Mies van der Rohe, Le Corbusier (fig. 10-13), and many others affiliated with the Bauhaus in Germany and in the USA like Philip Johnson, and to some extent I.M. Pei.

The principles of the International Style, as described by Philip Johnson, were: emphasis on volume as opposed to weight, mass or static solidity; regularity as

¹ Philip Johnson. The International Style. pp. 31.
opposed to axial symmetry or other kinds of obvious balance; and dependence on the intrinsic elegance of new materials, technical perfection and fine proportions, for aesthetic significance, as opposed to applied decoration. In addition to their effects upon structure and function, these characteristics had a strong impact on the design of the facade.

"In stating the general principles of the contemporary style, in analyzing their derivation from structure and their modification by function, the appearance of a certain dogmatism [on the facades] can hardly be avoided. In opposition to those who claim that a new style of architecture is impossible or desirable, it is necessary to stress the coherence of the results obtained within the range of possibilities thus far explored".  

The concept of volume presented the facade as planes and thin surfaces, covering or bounding the building, so that the prime symbol of architecture was no longer the dense brick, but the glass box, mainly because of the introduction of the curtain wall. Regularity introduced rhythm and repetition that were achieved by standardized elements and modular coordination. And, a focus on the intrinsic elegance of many materials such as aluminum, glass, and concrete, excluding all kinds of decoration to the benefit of machine-made architectural details, was created by new technologies.

In traditional architecture, details were craft-made and used simple tools or forming, even though there was standardization of elements and, to a certain degree, standardization of details. With the Modern Movement, details were produced by machine and expressed the beauty of the finishes and not the art of the artisan. The I beam celebrating the precision of the machine and representing the new industrial workers, became the equivalent of the classical

column. Uniformity and standardization of details, e.g., the window frames and muntins, were both a constant preoccupation, a goal to achieve for the leaders of the International Style.

Consequently, the conception, the composition and the construction of the facade were quite drastically shaken by the principles of the Modern movement. During the twentieth century, especially after World War II, the thick facade has been, in theory, progressively re-interpreted and has became transparent in most buildings, for instance, as a result of the introduction of new design concepts such as the universal and open space, the open plan and unlimited flexibility. In practice, many initiators of the Modern Movement, like Mies van der Rohe and later Philip Johnson have modified the facade, as a solid element, and ignored it as a boundary, because of the development and extensive use of materials like glass, aluminum, steel, and concrete, and because of the introduction of the curtain wall (fig. 14). The glass and concrete curtain wall supported admirably the thesis of the open plan because of the possibility of positioning the partition anywhere on the facade, according to window mullions. They strongly advocated these concepts that were especially important to Mies van der Rohe, which had tremendous effects on resolution of the problems of facade design of that period. Consequently, the opaque, massive and thick facade disappeared totally, or was rather disintegrated and rematerialized for the sake of the open plan and open space. As an immediate result of that new interpretation of materials, the inside was carried out and the outside was brought in. It seems that it was easier for the Moderns to be successful with the office buildings than with housing, for the users' participation was not really involved in the former. As far as housing is concerned. Philip Johnson's 1949 Glass House, as a prototype, is a remarkable example in the US of that
new expanding trend, even though the massive masonry ground floor was contradictory to the lightly glazed first floor. The house shows unequivocal intentions to establish new ideologies and orders in architecture and in society as well. As a matter of fact, the modern architects were most concerned with bringing to people 'technical ameliorations', such as plumbing, ventilation, and sanitation that would improve their living situation and their well-being at home and at work. For high density projects, even though the concept of the free plan was applicable in most of them, the results were not as good, since the human and social dimensions were put aside, and replaced by the necessity of reducing the shortage of housing on the one hand, and on the other the intention of providing people with the newest equipment for their well-being. The need for using modern construction throughout and for serving function directly was peculiarly evident. There is, however, more than the utility-and-nothing-more theory of design. The aesthetic qualities of the new style are evident and are expressed through the concept of surface of volume, in the sophistication of details. The aesthetic principle of surface of volume has been derived from the fact that architecture no longer has solid supporting walls.

CONCEPT OF SURFACE OF VOLUME

In the eyes of most Modern architects, glass was the most suitable material for this new generation of buildings because it contributed, along with aluminum and concrete, to establishing the principle of surface of volume. This concept implies the continuity of surface and of volume obtained by using one material, glass, for instance, and one system, the curtain wall, to cover the entire facade.
and to wrap up the entire building, creating unity between surface and volume through the same material and system (fig. 15).

As a consequence, windows constituted a more important element in Modern architecture than ever before. They were the most conspicuous feature of the modern exterior design and, therefore, raised an aesthetic problem of the greatest importance. Of course, the purists wanted the posts and beams to be clearly identified as load-bearing elements, displaying the true character of their construction and expressing clearly the provision for function. At the same time, Modern architects wanted glass to be expressed as well, as a non-bearing skin or a curtain wall, and to be represented for what it is, a mere film, a screen separating the indoors from the outdoors, but quite obviously without any structural capacity (fig. 16). The glass of the window now became an integral part of the enclosing screen, maintaining the continuity of surface, rather than representing a hole in the wall as it had in traditional masonry construction. Therefore, the breaking of the wall surface by placing windows at the inner instead of at the outer was avoided.

Since new building construction technologies were available, making possible the trading of the load-bearing facade for the curtain wall facade, then the vertical windows, limited in size, forms and numbers by the load-bearing principles of construction traditionally in use, disappeared to the benefit of the long horizontal window. The strip window, as a facade element, then became another important feature of the Modern Movement. In many cases, for instance, only one uniform type of repetitive, undifferentiated window of a unique size or built of related units (61) gives light, without distinction, to various functions. Office buildings, apartment complexes or industrial warehouses were all alike with the
same strip window, running all along the flat roof building, from one edge to the other (fig. 17).

"One of the surest signs of the real existence of a style of architecture is the creation of a fixed type of window detail". ¹

Philip Johnson.

In fact, for the purpose of mass production, a few types of metal windows were perfectly machine made to convey to industrialized buildings a cool and rational approach which was desired as much aesthetically as practically.

"The dominant theme in most Modern architecture continues to be precision,—sleekness, plainness, unadorned flatness, razor-edged sharpness. All very very nice, but all very very difficult and very very expensive to achieve in the real world of building, and all even more difficult to maintain over years, as weather and wear-and-tear take their time." ²

Peter Blake.

The merging of interior spaces which open up into one another behind glass walls and then towards the outside were virtually unbroken because of indefinite circumscribing partitions. The free plan obtained gave the modern interior a new kind of abstract space design unknown in the architecture of the past; this plan is considered an invention of the International Style. But the price to pay was incredibly high due to increased loss of heat, air and water infiltrations and the necessity of shadow devices to prevent over heating and to allow some degree of privacy into what has been characterized by Peter Blake as "intolerable space".

¹ Philip Johnson. The International Style. pp. 70.
² Peter Blake. Form Follows Fiasco. pp. 42.
In spite of the economical problems of the first realizations, the defenders of the Modern Movement expected industry to take over traditional construction and argued that, this 'temporary situation' was unlikely to remain. According to them, the beauty of the pure form in buildings was nevertheless achieved and the artistic object, floating on the landscape, had finally been created out of new materials and modern technologies. The dream of the Modern Movement to surpass the 'styles' with new materials and new technical expressions on facades, was on the edge of coming through, but for whom? Who would be able to afford it? The Modern architects did not intend to make their architecture the symbol of capitalism, they rather wanted a classless architecture for the new man, a architecture based on rationalization and on technology. Unfortunately the few prototype private houses in Europe and the US, are mostly architects' houses, which are white cubicles gleaming with boat imagery details and minimalist sensibility, as seen in Le Corbusier's Villa Savoye and Mies' Tugendhat house, the two finest houses of the new style according to Philip Johnson (fig. 13). They were, however, the very antithesis of the industrialization movement: they are unique objects, one-time-shows, not at all intended to be mass-produced, not even in their elements, celebrating above all conspicuous individuality.

Indeed, many developments in structure and in the articulation of function now incorporated in minimal building, first evolved in these expensive constructions. Early on, all the leading Modern architects of the International Style (Mies, Oud, Gropius, Le Corbusier) showed themselves to be technical as well as aesthetic innovators, as evident in many examples of private houses. However, their very intention was to rebuild the Western world devastated by the War and facing an incredible shortage of housing for all classes of society, especially
the working class. Of course, the results of the Modern Movement were different for the problems to be faced were different, depending on whether the projects were built in America for the poor or in Europe for the working class. In America, the aim was to apply technology in the service of the economy of construction, and to maximize the land value with the incredible development of skyscrapers. Verticalism of the 1930's has rapidly changed from vertical to horizontal emphasis in much recent metropolitan building. It may be seen as a superficial but more general influence of the style.

"The resultant verticality of design is still admired in America, chiefly because it recalls the aspiring [structural] quality of the Gothic towers of the past. For horizontality, which is the most conspicuous characteristic of the International Style, as judged in terms of effect, is still unacceptable aesthetically to the American clients".  

While in Europe the style was more to create the new society for the new man, based on that same technology, said I.M. Pei in a recent lecture at MIT. Nevertheless, he personally wanted to do here what was being done in Germany in low-cost housing, with the same quality, and elevate minimal building from utilitarian to the level of architecture. This means that he wanted architecture to be more than just construction, and to have aesthetic qualities and to promote social values. In America, this hope did not materialize very well. The Modern Movement has failed on the level of anticipating popular taste and, to some extent, has devalued technological evolution because it did not understand industry. Industry was generally more interested in profits, economics,

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1 Philip Johnson. The International Style. pp. 65.

2 Lecture by I.M. Pei, March 1st, 1985.
efficiency, and rationalization than in users’ satisfaction or in the creation of an industrial style.

"The American functionalists claim to be builders first. They are surely seldom architects in the fullest sense of the word. They are ready, as the European are not, to deface their building with bad architectural design if the client demands it. Nor can they claim for houses, the broad sociological justification that exists for the workers’ housing, the schools and hospitals of Europe. On the whole, American factories, where the client expects no money to be spent on design, are better buildings and at least negatively purer in design than those constructions in which the architect is forced by circumstances to be more than an engineer".¹

This idea of populist housing was very noble, but the results of the architecture of the International Style are still being evaluated, discussed and debated, and as John Prizeman said: "small things, done with the best intentions, can sometimes have devastating effects".² Most Modern architects shared this very socially oriented attitude, but some of them, looking at their architecture and its social consequences, started to question deeply the principles of the International Style as well as their own work. Among them, was Mies van der Rohe who, at the end of his life, was very troubled by the impending divorce of form and function and by his concept of universal space, that is a structure capable of accepting almost any kind of function, from city hall to automobile showroom. The concept sacrificed to style too many important factors in creating functional space, and as a result suited none of the functions properly. To some extent, Le Corbusier became perplexed in the same way: after flirting for a quarter-century with pure forms, he turned, after World War II, to what became known as the

¹ Philip Johnson. The International Style. pp. 38.

New Brutalism — a building vocabulary of deliberately rugged, deliberately crude and imprecise surfaces and forms.
CONCEPT OF REGULARITY

On behalf of a new social ideology, modern architects, imitating the car industry, wanted to fight the shortage of housing by making architecture, through technology and industrialization, available to everyone. They strongly encouraged standardization of components, which gives automatically a high degree of consistency in the parts, and modular coordination that were consistent with the principle of regularity (fig. 18).

The second principle, that of regularity, depends on the regularity typical of the underlying skeleton of modern architecture.

"Storeyed construction naturally produces horizontality. Most functions, moreover, require extended development in the horizontal plane—in plan, that is rather than in elevation. Rooms are usually broader than they are high, and are most evidently illuminated by windows of the same proportion. Structural and functional horizontality is naturally expressed in facade design by architects who seek to obtain consistency to the principle of regularity."\(^1\)

It is true that the full application of the principle of regularity to a building's plans and sections induces consistency in the elevations (fig. 19). The principle does not, however, lead automatically to good proportions in the facades (27).

"Regularity, therefore, refers to a means of organization, a way of giving definite form to an architectural design, rather than an end which is sought for itself."

Regularity can approach, almost inevitably, monotony very easily with too rigid application of the principle such as mere and unimaginative repetition and use of uniform components designed and sized for production purposes rather than

\(^{\text{1 Philip Johnson. The International Style. pp. 65.}}\)
for aesthetic concerns. It is not to be forgotten that even minimal-cost housing is potential architecture and not merely a collection of building components. Individual minimal dwellings provide for a function so simple and so little specialized that they are easily built and quite capable of standardization. A project developed as a whole, however, presents complex problems offering so many opportunities for choice that it may become architecture (27), and not simply construction or equipment.

The organization of the parts, of industrialized components, for example, of the complex structure is to be ordered by logic and consistency rather than by axial symmetry. Fortunately for the Moderns, it is proven that economic considerations offer the advantage of regularity over irregularity in the arrangement (27). Walter Gropius, in his early work employed forms and elements based on a consistent industrial vocabulary. He, Le Corbusier and their innumerable followers were literally obsessed by some sort of idea of a modular building system developed according to the principles of regularity.

"From its inception in the mid-nineteenth century, the Modern Movement was preoccupied with the urge to catch up with the Industrial Revolution, the preoccupation became an obsession: technology, -modern technology- and all its images began to represent the one article of faith upon which the Modern Movement either stood or fell.¹
Peter Blake.

"There is no work of Art without a system".²
Le Corbusier's dictum.

¹ Peter Blake. Form Follows Fiasco. pp. 51
Thus, technically, as explained by Henry-Russel Hitchcock, the prime architectural problem of distribution is to adjust to irregular and unequal demands of function to regular [rectangular] construction and to the use of standardized parts. To achieve the machine made-look, deemed essential by the Modern Movement, and standardization, buildings and components were to be mass-produced and then assembled rapidly to fill up the needs of a fast-growing population and to satisfy the benefit aspects of industrialization. Other building components, like concrete slabs and panels as well as opaque, translucent or transparent materials, followed the same path of production. Walls, floors, roofs, partitions and all the rest would be prefabricated, under controlled conditions, on the assembly lines of modern factories, then shipped to whatever site was in need of the precisely machined modular units; and finally snapped, or bolted, or zipped together rapidly to form neatly finished houses or apartment blocks, or schools, factories, offices and so forth, each of them a monument to rational building and to the cool art of the machine.

"standardization, like convention, can be another manifestation of the strong order. But unlike convention, it has been accepted in Modern architecture as an enriching product of our technology, yet dreaded for its potential domination and brutality. But is it not standardization that is without circumstantial accomodation and without a creative use of context that is to be feared more than standardization itself? The ideas of order and circumstance, convention and context —of employing standardization in an unstandard way— apply to our continuing problem of standardization versus variety. Giedion has written of Aalto's unique "combination of standardization with irrationality so that standardization is no longer master but servant" I prefer to think of Aalto's art as contradictory rather than irrational —an artful recognition of the circumstantial and the contextual and of the inevitable limits of the order of standardization".¹

Robert Venturi.

"It is the role of design to adjust to the circumstantial".²

¹ Ibidem. pp. 44.

²
Louis Kahn.

"The great architects, who still consciously practice architecture as an art, add more interesting and usually more personal expression to the simplification and unity of design, which even the functionalists achieve. This development of aesthetic possibilities of the contemporary style is well illustrated in the use of oblique and rounded forms in plan and elevation (fig.). Such exceptions to general rectangularity are only occasionally demanded by function and they may introduce complications [circumstantial accommodation] in the regular skeleton of the structure. They are, of course, a definite breach of rigid regularity. Yet sometimes as in stair, wells, and water-tanks, function is not best served by rectangular shapes."

CONCEPT OF ELEGANCE OF MATERIALS

"Absence of ornament serves as much as regular horizontality to differentiate superficially the current style from the styles of the past and from the various manners of the last century and a half".  

Philip Johnson.

In Modern architecture, ever since Adolf Loos wrote "Ornament and Crime", decoration has been impugned, but the converse - unadorned (puritan) plainness as the supreme virtue - has been one of the guiding principles of the Modern Movement for most of this century.

"...J'ai formule et proclame la loi suivante: a mesure que la culture se developpe, l'ornement disparait des objets usuels...Chaque siecle, disait-on, a eu son style: serons-nous seuls a n'avoir pas de style? On parlait de style, et on entendait l'ornement...Ce qui fait justement la grandeur de notre temps, c'est qu'il n'est plus capable d'inventer une ornementation nouvelle. Nous avons vaincu l'ornement: nous avons appris a nous en passer. Voici venir un siecle neuf ou va se realiser la plus belle des promesses. Bientot les rues resplendiront comme les grands murs tout blancs. La cite du XXe siecle sera eblouissante et nue, comme Sion, la ville sainte, la capitale du Ciel"...  

1 Philip Johnson. The International Style. pp. 64.
2 Philip Johnson. The International Style. pp. 69.
Adolphe Loos.

The International Style was clear about ornament: neither applied decoration nor the incidental features of design were given the slightest attention; related subordinate works of sculpture and painting have on occasion been successfully used to decorate contemporary buildings without degenerating into mere applied ornament. In fact, development of simple forms of standardized details suitable to mechanical production was the only artistic manifestation encouraged to satisfy both aesthetic and economic considerations (fig. 20). In addition, to harmonize with good design, only clear, discrete, sans serif lettering was allowed for advertising and identification, as opposed to overscale and elaborately styled letters. Standards of the Style for decoration were so high that it turned out that it was better none at all unless it was good. Also, colors when approved, were used with great ingenuity to emphasize the effect of the surface without breaking up the unity of volume.

OTHER CONSIDERATIONS

The well-known low-income housing complex of Pruitt-Igoe, USA, is one of the most classic and favorite American examples of the Modern Movement, publicized by the advocates of the Post-Modern Movement to display out the social, architectural, technical and economic failures so as to discredit the entire Modern Movement (fig. 20). Open apartment planning, a constant feature of these new buildings, resulted in children being pushed out of their family environment because of lack of individuality and freedom. They then convened in public spaces and vandalized them. Wherever they were built, the large, modern, outdoor open-spaces (sidewalks in the space/streets in the air), provided
by architects, became the gathering places of children escaping unbearable family life and now ambushing the neighbors (fig. 21-22)! At Pruitt-Igoe in St. Louis, the complex became so hopelessly crime-infested that it finally had to be dynamited less than twenty-five years after completion.

"Pruitt-Igoe's buildings were framed in concrete and faced with a veneer of brick. If they had been substantially taller, the exterior walls would undoubtedly have had to be of a material lighter in weight than masonry, and the facades might well have been handsomer. But it wouldn't have made much difference. "Communities" of exclusively tall buildings spaced far apart, and sealed off from the outside world both physically and philosophically, are inherently doomed, and architectural cosmetics can't save them".¹

Peter Blake.

Pruitt-Igoe's hailed scheme was designed according to the highest standards of the Modern Movement and, like in Zagreb, Yugoslavia (fig. 23-24), is one of hundreds of similar examples around the world that are being in turns destroyed or totally re-designed. Housing principles were imported from Europe, where living in high density communities is part of people's history, and where interactions between people is an important element of daily life, more, one of its qualities. In the more individualistic American context which values privacy, people strongly reacted against that type of high density housing because this was not what they wanted. The bungalow phenomena was spreading over the suburbs, and became a symbol for American people: the so-called American dream. Living in cities, in large complexes was 'reserved' for the working class and for minorities, while the bourgeoisie was leaving for the suburbs. Maybe Pruitt-Igoe was not built at the right time and was not inhabited by the right people. The same complex today would probably be taken differently.

¹ Peter Blake. Form Follows Fiasco. pp. 80.
It would be ridiculous to blame the Modern Movement alone, as some did, for the dubious practice of manufacturers of building products. The industry was, and still is, interested in making profit, and in efficiency rather than considering aesthetic and social problems. But it does not seem unfair to point out that the Modern Movement wrote some very precise specifications for what it wanted the modern building industry to produce. It specified that there should be assembly-line precision, that there should be smooth, impervious finishes, and that there should be the capability of making vast expanses of impeccably sleek sheets of entirely new materials—metals, plastics, composition boards—all impervious to heat, cold, rain or snow, all dimensionally stable (so that no wide expansion joints would mar the vast sweep of any wall) and all light in weight and inexpensive to mass-produce. Mies van der Rohe, as quoted, wrote this about building technology and its relationship to the Modern Movement:

"The industrialization of building methods [is] the key problem for architects and builders. Once we succeed in this, our social, economic, technical [and even artistic problems] will be easy to solve...The nature of the building process will not change as long as we employ essentially the same [traditional] building materials, for they require hand labor...[Our first consideration must be to find a new building material]. Our technologists must and will succeed in inventing a material which can be industrially manufactured and processed and which will be weather-proof, and insulating. It must be a light material which not only permits but requires industrial production...Then the new architecture will come into its own."

"The idea of permanence has always been associated with architecture. But contemporary constructions are seldom as architecture in character as those built to endure. The International Style is so dependent on new methods of construction that it might seem that its principles could only be applied to most advanced known construction. Functionalists, indeed, often deny that building can be sound unless it is radical in its technics. Arguments of economics and question of durability [as a

1 Peter Blake. Form Follows Fiasco. pp. 48.
performance criteria are often regarded or disputed when critics discuss the continued use of wood and masonry.\footnote{Philip Johnson. The International Style. p. 82.}

Apparently, as evident in many examples presented by Peter Blake, these critics might not be wrong. The technicians of the Modern movement have not yet invented the miraculous products (fig. 25–29). Following "Form Follows Function" and "Function Follows Form" there is now, according to Peter Blake, "Form Follows Fiasco". This new motto is not a conclusion to the Modern Movement Architecture. It is, however, a powerful statement that expresses the anger and the frustration of architects and other professionals related to the building of low-income housing. It is more than one man's comment, sharply criticising and rejecting what has gone on before; it is the prelude to what is called the Post-Modern Movement which, barely born, negates and denies the 125 years of gestation and realization of the Modern Movement. The undefined interlude, between the end of a style and the recognition of another one, is for Lucien Kroll and Herman Hertzberger, and for those who refused to belong to any kind of movement, the unique chance to diffuse their own ideas without fearing professional damage and unmerited criticisms, and to find themselves a significant place in today's architecture and finally to influence on the definition and characterization of the new-born Movement.
Fig. 10: Walter Gropius - Bauhaus School, Dessau Germany, 1926.
Fig. 11: J.J.P. Oud - Row of Small Houses, Stuttgart, 1927.
Fig. 12: Mies van der Rohe - Apartment House, Stuttgart, 1927.
Fig. 13: Le Corbusier - Villa Savoye, Poissy-sur-Seine, 1930.
Fig. 14: Mies' Barcelona Pavilion, Plan.
Fig. 15: Apartment Houses at 860 Lake Shore Drive.
Fig. 16: Promontory Apartments, Chicago, 1949.
Fig. 17: Apartment House, Stuttgart, Street Facade, 1927.
Fig. 18: Apartment House, Stuttgart, Plan.
Fig. 19: Apartment House, Stuttgart, Garden Facade.
Fig. 20: Library and Administration Building, I.T.T., Chicago, 1944.
Fig. 21: Elevated Sidewalks in Iran. Fig. 22: Sidewalks in the Sky, London.
Fig. 23: Residential Zone in Zagreb.
Fig. 24: The new Zagreb, designed and built in the image of the Radiant City.
Fig. 25: Self-oxidizing steel curtain wall, after two years of routine exposure.
Fig. 26: Precast concrete curtain wall with typical discoloration.
Fig. 27: ibidem
Fig. 28: Poured-in-place concrete under different conditions of weathering and weather.
Fig. 29: Machine Art fifteen years later.
"Less is a bore".  
Robert Venturi.

"And Le Corbusier, co-founder of Purism spoke of the "great primary forms" which he proclaimed, were "distinct and without ambiguity". Modern architects with few exceptions eschewed ambiguity".¹  
Peter Blake.

Complexity is the antidote to that cataclysmic purism of contemporary urban renewal which has presently brought so many cities to the brink of catastrophe and in which Le Corbusier's ideas have now found terrifying vulgarization".² (fig. 30-31)  
Robert Venturi.

The Post Modern Movement may be viewed as a kind of negative reply of the 70's to fifty years of Modern Movement realizations, as explained by the following quote:

"Recently many people have jumped on the fashionable bandwagon condemning Modern architecture and planning, but whereas most critics have offered only stylistic alternatives or vague exhortations to involve "the people" more in design, over the last 18 years [Christopher] Alexander has developed a highly detailed alternative proposal which, if adopted, would transform the nature of design entirely".³

This new Movement sharply criticises the ruling architecture since the beginning of this century, but does not offer any long-term constructive solutions to do better. The new generation of young architects, perhaps frustrated by the overwhelming power of their elder predecessors, have adopted somewhat the

¹ Peter Blake. Form Follows Fiasco. pp. 16.  
same attitude towards the Modern Movement, as the latter did towards the Neo-Classical architecture of the mid-nineteenth century. The Post-Modernists are rejecting en bloc the ideas and principles—the whole dogma of the Modern Movement—and are now focusing on vernacular architecture, on the one hand, and on classical principles, on the other. They believe these foci make architecture intelligible to common people and will renew interest in architectural matters. However, the eclecticism of the movement seems to be the new leitmotiv and a short-term bandage on Modern architecture's wounds.

"...the limitations of orthodox Modern Architecture and city planning, in particular, [characterized by the either/or attitude] the platitudinous architects who invoke integrity, technology or electronic programming as ends in architecture, the popularizers who paint "fairy stories" over our chaotic reality, and suppress those complexities and contradictions inherent in art and experience".1

Robert Venturi.

One of the important achievements of the Post-Modern movement and of unaffiliated architectural tendencies, is the recovery of the street in cities as an element of continuity and as an irreplaceable spine generating urban life with its good and bad aspects and its controlled and uncontrolled elements. Lucien Kroll, for instance has created street environments characterized by a multitude of scales and by a "nice" disorder and, to some extent, by an "anarchy" in forms, colors, and textures that makes cities so rich and so alive. The streets in the air, the skyscraper, and the megastructure projects are being rejected (fig. 32), and the low-rise/low-density/low-cost housing projects are returning, with squares, street corners, sidewalks, front yards, and back alleys. The facade was reevaluated with the discovery of the importance of the public and private

realms and the values of urban life. The return to construction inside cities, as opposed to construction in peripheral, isolated, and scattered island-sites, characteristic of the Modern Period, is for many the sunrise of a new architecture woven into the urban fabric.

"American architecture, and especially Modern architecture with its antipathy to the 'false front', has emphasized the free-standing, independent building even in the city, —the building which is an isolated pavilion rather than one which reinforces the street line has become the norm. Phillip Johnson has called this the American tradition of "plop architecture". (see examples p.86)." 

Robert Venturi.

To some extent, the Post-Modern Movement is the renaissance of the facade as the major connector between man, built form, and open space. Of course, this is not the trademark of Post-Modern architects only; many modern architects, like Philip Johnson, have been recently "converted" to this notion of facade, and some others, like Lucien Kroll in Belgium and Aldo van Eyck in Holland, are now just breathing more easily since they never really embraced the Modern Movement and its dogmatic principles.

..."James Stirling, in Britain, builds increasingly with bricks; the late Alvar Aalto, in Finland, returned after World War II, to brick, tile, marble and bronze...and others in the United States now finish many of their buildings in brick and other traditional materials rather than with one of those miracle products that seem invariably to invite disaster. The few important architects who still attempt to build with miracle materials, and according to orthodox modern dogma, are just as invariably threatened with lawsuits and, subsequently, faced with bankruptcy"..."Mies, despite earlier lip service to miracle materials, continued to build with bricks; Le Corbusier, who lived to see his hard-edged houses of the 1920's crumble, turned [after World War II] to brute, handmade concrete, and brick; Breuer came to similar

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conclusions, and began to use stone; and Frank Lloyd Wright never really fell into the technological trap in the first place".¹
Peter Blake.

Other contemporary architects, such as Hermann Hertzberger, are neither rejecting everything from the Modern Movement nor are they sitting on the fence, but are taking very openly the best of the two movements. They are really true partisans of the "both/and" attitude. Through their work, the facade is recovering more public attention, acquiring new values, and reconquering its dominant position in the design of building. Some of these values are perhaps very debatable, especially when presented by Charles Moore, as mere cosmetics, or by Michael Graves, as corporate symbols. They are both only marketing a building for more than what it really is. Nevertheless, the Post-Modern Movement has raised the issue of the facade at the very center of the architectural debate; and whatever comes out of it will help clarify the many levels of meaning of the facade, and perhaps, stimulate improvements.

¹ Peter Blake. Form Follows Fiasco. pp. 46 and 65.
Fig. 30: Le Corbusier's vision of a new Buenos Aires, 1929.
Fig. 31: New Apartment Houses in Switzerland, completed in early 1970s'.
Fig. 32: Gropiusstadt in West Berlin, a beautiful zoned residential enclave, without very many pedestrians.
CHAPTER FIVE
CHARACTERISTICS OF "FACADES"

"Si ce probleme de la facade est, par definition, permanent, il doit, au fil de l'evolution historique, se poser en termes toujours differents. C'est le cas actuellement. Apres les hautes vagues du fonctionnalisme qui avait popularise sa conception propre de la facade, le probleme se trouve rearmorce. La these fonctionnaliste est discutee, souvent recusee. Au premier rang des opposants, il y a Ricardo Bofill et ses complices du Taller de Arquitectura. L'operation qu'ils sont en train de terminer a St-Quentin-en-Yvelines se presente dans ce debat comme un cas exemplaire. L'intervention de Bofill est explicite. Elle va a l'extreme de la reaction contre la these qui avait prevalu jusqu'a ces dernieres annees".1

Architecture is, without any doubt, the most public of the Arts and the facade is certainly its most eloquent materialization. The very controversial and always fashionable subject of facades in architecture is complex and has left room for various architectural expressions over this last past half century. The subject is controversial because the word 'facade' itself is unquestionably one of the most imprecise of the architectural vocabulary. Especially with the emergence of Post Modernism, the meanings, roles, structures, materials, elements, proportions, rules, aesthetics, colors of the facade have been in turns examined, described, explained, discussed, and debated over time. In today's architecture, the 'element' facade is conceived and interpreted in so many ways in architectural discourses and works, that the whole field of architecture sometimes looks like the Tower of Babel! Why is this so? Because it is impossible to find a broader agreement on the architectural definition of the term "facade" that includes all connotations and satisfies a majority of architects. Lexically, the Latin root of the word,

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'facies', is synonym of the words 'face' and 'appearance', and one definition states that the facade is:

"the front or the face of a building emphasized architecturally". But, this definition is far too general for a word that includes so many connotations and that implies a constant architectural evolution. So there is actually no inclusive architectural definition or principle that can be a rule or a reference on which to base any work on facades, and that would satisfy the architectural field. As a consequence, the rule about the facade is that there is no rule and everything said or written about facades is, to some extent, both true and false. This situation is inherent in the intrinsic complexity and ambiguity of what the word signifies and implies, as stressed by Robert Venturi in "Complexity and Contradiction in Architecture".

The signification of the element facade is constantly changing, adjusting itself to the conception of those who discuss it and to physical modifications that alter it and that make it now so important to ordinary people as well as architects and other specialists of the field. As a result, the facade cannot be a clearly, defined, stable nor immutable architectural object because its signification falls into the category of concepts or diffuse ideas susceptible to vogue, momentary trend or architectural fashion.

"Historians have been able to identify the passing of time through changes expressed in the facade, pointing out the shift from one period or style to another. This effort has provided us with an historical frame of reference to evaluate conditions and speculate in the future".  
A.D. Brady.

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2 A.D. Brady. Design from the Outside In. pp. 7.
"To plan we must know what has gone on in the past and feel what is coming in the future".1
Siegfried Giedion.

The passage of time and social evolution continuously brings changes in human needs that have to be continuously re-interpreted socially and architecturally for us to understand its complexity by adding more layers of architectonic information to the facade.

..."The old monumentality was the symbol for a static conception of this world, now this over-rules by a new one of relativity through changing energies. I believe therefore, that the equivalent for monumental expression is developing in the direction of a new physical pattern for a higher form of civic life, a pattern characterized by flexibility for continuous growth and change". 2

as it was explained by Walter Gropius in 1948, in a symposium entitled "In Search for a New Monumentality", Walter Gropius said in reference to low-income housing. Could it be then that the facade in buildings used for housing, for instance, is the new symbol of monumentality?

"The facade is [still] the most essential architectural element capable of communicating the function and the significance of a building".3
Rob Krier.

The facade is the voice of the building and all its elements are the vocabulary. Their association and juxtaposition in harmony and contrast are the syntax, which is ruled by a very unique grammar of orders, styles, and principles. This

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1 ibidem.
physical medium communicates constantly to people but, somehow, only a few listen to it or are capable of understanding and interpreting the message transmitted by the facade. The facade tells a great deal about materials and methods of construction, style and decoration. But more important than that, the facade reveals the interior organization through the building's changes over the years, and tells us, as Krier said,

"about the inhabitants, [it] gives them a collective identity as a community, and ultimately is the representation of the latter in public".

The facade influences people and environment socially, culturally and psychologically in so many ways that everyone is affected, consciously or not, by the resulting built environment and the enclosed spaces in between. A paradigm of these effects is the urban Italian hilltowns, such as Siena,

"with their endless adjustments to the counter-requirements of inside and outside and their inflection with all the business of everyday life: not primary sculptural actors in vast landscape [...] but complex spatial containers and definers of streets and squares." 1

Following these considerations, my personal interpretation would define the facade, among many other things, as any vertical surface. It can be real or false, opaque or transparent, plain or decorated. Like the human face, it is the true or the false representation of what is behind it. Emotion or organization makes no difference. Does it mean that facades should be reduced to cosmetic elements, as supported by some advocates of Post-Modernism like Charles Moore, and be simply some kind of false front like the Hollywood sets? Is it a

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face-lift for old buildings independent of the structure? Should it be related to the exterior environment only, as supported by Bofill, and assume a public role of appearance or decor in a contextual but not very legitimate architectural scenario? Fortunately, it is impossible to give a universally applicable answer to these questions. The answers should be specific to each individual case; as such they strongly emphasize the fact that the word 'facade' is architecturally undefinable, which most evidently makes architecture so rich. It is, therefore, important for the development of this thesis to understand how other people define the word 'facade' and how they use its meaning in their own theories and projects.

From its official definition, it is clear that the facade is the main side of the building, facing the street, the side being seen by people. By opposition, the back side is considered assigned to semi-public or private exterior spaces. The meaning of the word facade, far too generally defined, gradually lost its physical or material sense as an operational element that encloses the building and protects against weather, wind, water, and insects. The facade now includes various social aspects due to the increasing participation of users in the shaping of their environment. In many theories and works of architecture, the evocative word 'facade' has virtually transformed its architectural representation from a very 'thick wall' into many other expressions. The facade may be: a skin for a building such as the curtain wall, metaphorically often compared to the body skin as a protective membrane that encloses the vital life functions; a layer of continuous interventions, referring to the participation of unidentified users through the years; a two-dimensional surface, flat, repetitive, uniform and therefore qualified as international; a three-dimensional surface, an organic wall growing constantly and to which are added recesses, projections, and shadows;
an interface between inside and outside which communicates, as Krier explained, with the built environment and the interior space; a link between mass and space or building and outdoors; an enclosure of interior space as a volume, or a definition of exterior space as a street.

Furthermore, the facade may also be seen as a zone of exchange between the public and private realms. Trading off forms and elements, colors and shadows, privacy and publicness, space and environment may be enclosed today within the thinnest of walls.

To some others, the facade is either an infill or, by opposition, a support. In the design philosophy of the SAR Methodology, largely developed by N. John Habraken, the facade may be, as a detachable unit, part of a user-controlled infill system or, as a fixed element, part of a community-controlled support system. Moreover,

"the facade is the point of change, since the inside is different from the outside, the wall becomes an architectural event created by tensions in designing from the outside in, as well as the inside out".¹

Designing from outside in, when function follows form, or from inside out, when form follows function, is not relevant to this study since in both cases inside and outside meet at the same point: the facade. But the results are different, as evident in the works of Bofill, Kroll, and Hertzberger, and this is what is interesting.

"Architecture occurs at the meeting of interior and exterior forces of use and space. These interior and environmental forces are both general and particular, generic and circumstantial. Architecture as the wall between the inside and the outside becomes the spatial record of

this resolution and its drama. And by recognizing the difference between the inside and the outside, architecture opens the door once again to an urbanistic point of view."  

Robert Venturi.

The facade is a place of changes, but also a place of respect or consciousness of community: the back facade, more private, will show freedom of expression while the front-facade modifications will be controlled and restricted to building codes and city guidelines. The ambiguity and the complexity of the word 'facade' in its characteristics and its architectural expressions is more and more recognized, if not largely admitted. This multiplicity of meanings should forever remain in order to revitalize modern architecture without sinking in the Post-Modern Movement. Therefore, facade will sometimes refer to one, or more than one, of the above characteristics at the same time.

To summarize: the facade, as a three-dimensional zone, acts as a transition between interior and exterior and should express by concavities and convexities, the passing of opposing forces coming in and out through it. The greater the difference between the inside and the outside is, the more defined the facade should be. A neutral inside, such as the office building, will not be expressed that much on the outside, especially if the building is located in a business sector. This trend has, however, begun to change with the new fever for corporate architecture. A very personalized inside, like the dwelling, will have a stronger expression on the facade. The facade can incorporate personalizing characteristics related to users over the years. Ideally, the elaboration of the

1 Ibidem.
facade should find its development on all levels: massing and details should stimulate the reading and the discovery of the building from the furthest and nearest points of observation and gradually give the observer the full story and message of the building.

The above characteristics of the facade will be utilized when analyzing the three proposed case studies along with the technical and the performance criteria. The technical criteria are issued from the Modern Movement and seen as the actual industrial requirements. They have been chosen to describe the building systems for the case studies. The following performance criteria will be defined in and used to evaluate and complement the technical criteria. These criteria are: adaptability, additivity, changeability, diversifiability, durability, flexibility, permutability, tractability and variability. This section of the thesis will be analyzed in part two.
PART TWO

INTRODUCTION

The housing shortage in the USA, and especially in Europe, is the immediate result of a tremendous demand. In the former case, unfortunately, the building industry is still dominated by old-fashioned production methods and patterns of organization. The capacity is, therefore, unequal to demand, and communities are left with a shortage of houses even though there are now more living spaces per inhabitant than before World War II. Increasing productivity is an obvious solution to increasing production in the building sector. The modular system is one means of aiding development in the building industry, and it is also, per se, one of the very beginning steps towards an industrialized process of construction. The industry has accepted for itself the validity and the appropriateness of the technical criteria to be discussed.

This second section will focus on the following criteria: modular coordination, limitation and standardization of components, prefabrication, and industrialization of production with regard to contemporary building technology and industry. These criteria are technically consistent with the basic principles of the Modern Movement explained in chapter three. The discussion of these technical criteria will be accompanied by the explanation of many performance criteria related to the development of facades such as: additivity, adaptability, changeability, diversifiability, durability, flexibility, permutability, tractability, and variability. These criteria are, in fact, either derived from the numerous characteristics of the facade, or from the theories of architecture propounded by the two
architectural movements, or from the very important thoughts of unaffiliated, not to say marginal, architects.
CHAPTER SIX
TECHNICAL CRITERIA

The technical criteria permit us to describe the building systems of the three proposed case studies, from the point of view of industry and also to compare them using the same technical vocabulary.

MODULAR COORDINATION

"De la naissance fatale de l'architecture. L'obligation de l'ordre. Le trace régulateur est une assurance contre l'arbitraire. Il procure la satisfaction de l'esprit. Le trace régulateur est un moyen; il n'est pas une recette. Son choix et ses modalités d'expression font partie intégrante de la création architecturale."\(^1\)

Le Corbusier.

The Classical epoch offers many examples of the use of repetition of principal dimensions, as a means of modular coordination, to express the rhythm of an entire building over an axial system or a modular grid. However, architectural rhythm, which is not necessarily identical with repetition, may conflict with structural requirements. The Doric problem of a corner is a paradigm illustrating that situation. The frieze in temples was constructed from metopes and triglyphs with the same dimensions, \(a\) and \(b\), across the whole facade, including the corners. The same applies to the beams which span over the openings between the columns; they are of uniform length throughout, even across the corner spans. In order to avoid an unsightly and structurally unsound support on the corner columns, they have been displaced inwards to obtain a shorter span \(B\), which immediately gives the facade a certain degree of

\(^1\) Le Corbusier. Vers une architecture. pp. 51.
excitement by breaking the strict rhythm of the column intervals, but maintains the modular dimensions of the beams.

"The modular system is a link in the industrialization of the building industry".¹ Henrik Nissen.

Modular coordination is a means, based on arbitrary dimensions, for establishing the position of structural elements, for giving dimension to the space between these structural elements, and for defining the size and position of these elements. Modular coordination also determines the size and the geometry of the equipment to be installed in the usable space. Modular coordination has been one of spurs in the development of the building industry and has moved it toward industrialization. With modular coordination, building systems have been developed on the basis of a planning grid and/or a structural grid, and components have been sized to fit the grid which determines their positions.

Sources of modular coordination can be found in the Classical period, as evident in the above example, and also in the Pythagorian geometry, in the Cartesian space grid of 100 mm in three directions as well as in various proportional systems. Already highly advocated by many theoreticians and practitioners of architecture, such as N. John Habraken with the development of the SAR methodology, modular coordination has been interpreted and used differently by architects. The problem, if any, with modular coordination is to know how to use it and why. As a practitioner, Lucien Kroll, whose project la Meme will be studied, based his utilization of industrialized components on it.

However the way they use it, architects all agree that modular coordination in any building system or any project is intended for clarification and order; in that sense, modular coordination is an element of the principle of regularity established by the Moderns. Repetition of identical dimensions for structure and plan of the same components and details makes the whole process of designing more organized and comprehensible, and less interpretable. As a result, rapid production and execution will be possible, and corollary cost saving is expected for industry and client as well. Lengths, surfaces, and rooms are related to the function and to the constructive method and, therefore, have to be dimensioned in relation to each other. In general, building components have to be designed, constructed, and assembled with due regard to functional, technical, and aesthetic requirements, but especially if the buildings to be built are prefabricated or industrialized.

In the SAR methodology, for instance, the dimensions coordinate the location, the size, and the position of support elements and infill or detachable elements. Modular coordination is achieved through the use of a two-way tartan grid made of alternating narrow and wide bands. The dimensions can be expressed in terms of the basic module "M" of 10 cm, which is equal to the narrow band. The distance between the center lines of the narrow bands will be 3M, as will be the distance between the center lines of the wide bands. In Holland and most of Europe, a tartan grid of 10 cm/20 cm has been widely accepted and used successfully. The tartan grid is underlined by a main module of 30 cm or 3M, which is a dimensional standard in Europe.

The concept of repetition, which is also an element of the principle of regularity, is of major importance in the design of a facade and, as such, in
the appreciation of the aesthetic qualities of a building. Repetition in a facade means repeating an element or a dimension over and over again, such as the sequence of A, A, A, A, while uniformity means that the constituent elements lack individuality or variability: all the A components are identical. The repetitive arrangement of uniform elements has been argued to engender monotony. The repetition of one unit along the whole facade as a steady continuous expression of a single beat without accent and rhythm is found in many, if not most, of the buildings of the International Style.

However, repetition is the core of what is called rhythm in architecture. Rhythm denotes the repetition of various dimensions that create a harmonious entity. The dimensions are transposed into many different types and sizes of components arranged in all sort of ways and not necessarily positioned regularly on a grid. These creative combinations can lead to appearances having all kinds of rhythm with or without repetition or accent, such as A, A, B, A, C, B, or A, B, C, A, B, C. In that perspective, repetition associated with different rhythms is truly a positive quality in architecture; otherwise, it is merely a succession of identical components with a single repetitive rhythm, joined to each other to form an enclosure (fig. 33).

During the design process, many vital dimensions may be repeated. Uniform sizes recur in rooms with the same function; many structural details have the same function and are, therefore, given the same dimensions. Standardization of sizes and details will open the way to the repetition of components and then to industrialization of production and processes. The principle of repetition is justified by both the functional requirements and structural condition, and facilitates the design and the execution of the work. But, the expression of the
principle of repetition must take into account what has been said above about uniformity and rhythm. It will allow the facade to go far beyond the expression of functional requirements and structural conditions and to introduce aesthetic concerns that may be based on various rhythmic organization of components.

The smaller the grid is, the greater the possibilities are for dealing successfully with repetition and rhythm. As explained by Bruce Martin, a nominal grid design of 100 mm enables a building plan and facade to be tailored to satisfy very closely users' needs, requirements, or preferences. Lucien Kroll says that such a grid is more permissive: more components, perhaps already commercially available, will be judged in terms of ability to achieve the particular aesthetic and performance standards required for a given building. Kroll adds that a smaller grid will also enable a greater theoretical perfection of technical dimensions. It is easier to create an alignment of objects of more than 1 m on a 10 cm grid than on a 30 cm one, for instance. It is, therefore, as easy to 'correct' components in a 10 cm grid. A sanitary room, for instance, which by accident would be 2.75 m could be reduced to 2.79 m, which is a difference of less than 5%. The 30 cm grid would impose in the same case a modification of more than 10%. The percentage, as Kroll says, depends on materials, technics, norms, building codes, and local building habits. A wall may vary from 16 to 15 cm (4%), not from 15 to 20 (25 or 33%). He goes further by saying that a normalization of wall with an increment of 2.5 cm with preference for 5 cm

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2 Lucien Kroll. "Les Composants -faut-il industrialiser l'architecture?" Editions Socorema, Bruxelles.
makes a lot of sense as far as materials are concerned: 10, (12.5), 15, (17.5), 20, (22.5), and 25 cm are all possible dimensions for a wall. Distance himself from the SAR methodology, Kroll advocates that the modular grid should have many levels of intervention. If \( M = 10 \) cm, then it is necessary to have also \( 3M, M/2, M/4 \) according to the thickness of the elements.

For a efficient system of standards and modular coordination to efficiently lead to an industrialized process of construction, collaboration must be established between those who decide upon a building system during the design process, and those who produce standard industrialized building components. Modular coordination should be used by those who wish to utilize such systems and components to make sure that every part will be put into its proper place during the erection process. In addition, modular coordination, since many of the imponderables of site coordination can be avoided through and to allow communication between all the interveners in the building process, should be seen as a means of efficiency on-site, and of cost saving in building construction, and not as a limiting constraint.

STANDARDIZATION

When looking at standardization, it is important to consider the difference between the standardization of structural elements which enclose spaces, like bearing walls and columns, and the standardization of elements assembled to create objects, like the metal studs in a partition or a facade component.

Auguste Perret said that standardization means something more subtle than the mass production of an object according to technical or users' requirements. He argues that everything in the building should be 'made to measure'. Besides
materials and spaces, standardization implies detailed dimensions and quality requirements or construction performance.

In the article "Standardization in Urban Space", the author raised the following questions that will be answered to explain standardization.

"Is standardized organization more desirable than the picturesque kind of building, in which there is no attempt to create uniformity? If we assume, for the sake of the argument, that it is considered desirable to build according to a uniform standardized scheme, how can this be accomplished and how can the uniformity be maintained? How logical is it, from the point of view of building technology, to build in a completely standardized way? To what extent does that kind of standardization allow sufficient adaptability to suit the needs of individual plans?"

The word standardization is derived from 'standard', which means unity, and can thus be regarded as an agreement, a compromise or a convention between interested parties. Standardization allows the attainment of three objectives necessary for any industrial development: specialization by subcontractors in the manufacture of components; international marketing of these components, as it is extensively done within the European countries; and collaborative assembly by diverse firms of elements and components into the final product.

The use of prefabricated building components requires a strict dimensional standardization. The building site and workshop or factory must operate on the basis of a common and unambiguous system of dimensions. The dimensions must be observed within tolerances: a suitable degree of accuracy. The latter implies no further shaping, which depends on the construction methods, the materials, and the type of joints. In other words, in each case, units must be

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specified within which the unavoidable variations in dimensions, inherent in any system of tolerances, must be retained: limits must be laid down within which the variations of a given dimension can be tolerated. When the dimensional system has been agreed upon, the prefabrication of building components under favorable workshop conditions can be mechanized and rationalized, and gradually the ultimate aim will be achieved—an industrialized production of standardized building components.

At another level, there is also the standardization of details that can be applied to both categories of standardization, such as the jointing of window mullions or the attachment of joists. The standardization of joints allows standardized components of various systems to be used together, which is consistent with the concept of product compatibility. This concept will be especially useful when components of various systems are to be coordinated. Product compatibility will, therefore, allow for diversity in designing facades without the necessity of creating new components and products; it will instead permit the use of those already available on the market. Product compatibility enables diverse elements to be used cost efficiently. Many products have a standard design, which implies standard dimensions and details, and can then be manufactured at several different factories and still be used within the same structure.

In spite of the numerous advantages of the standardization of space, structures, dimensions, and components, and the more rational industrial production achieved by it, Robert Venturi is against this Modernist principle, not as a principle, but for the results that it engenders:

"standardization, like convention, can be another manifestation of the strong order. But unlike convention it has been accepted in modern architecture as an enriching product of our technology, yet dreaded for its potential domination and brutality. But is it not standardization
that is without accommodation and without a creative use of context that is to be feared more than standardization itself? The ideas of order and circumstance, convention and context —of employing standardization in an unstandard way—apply to our continuing problem of standardization versus variety. Giedion has written of Aalto's unique "combination of standardization with irrationality so that standardization is no longer master but servant". I prefer to think of Aalto's art as contradictory rather than irrational—an artful recognition of the circumstantial and the contextual and of the inevitable limits of the order of standardization.¹

LIMITATIONS OF COMPONENTS

Normalization, in the context of this thesis, is the creation of standards for dimensions are based on their performance in meeting minimum requirements or permitted range for social and technical needs. Both standardization and normalization have led to the limitation of components which are produced according to these 'laws'.

Already proposed by Gropius and Wachsman, the concept of components was, according to Bruce Martin² developed after World War II, and is still not properly understood. Martin defines a component as the smallest unit of a material such as brick, block, and tile; it is also an operable unit, such as a door or a window, that may be made of many elements. The concept of component is extended further to cover equipment that is made of several subcomponents, such as kitchen cabinets, bedroom cupboards, and washing machines. It includes sheet materials of all kinds, such as metal decking, plywood sheets, plasterboard and insulating slabs that will be incorporated into a larger process of production to create a component that will have a special

¹ Robert Venturi. Complexity and Contradiction in Architecture. pp. 44.
function. Martin’s definition of component applies to timber joists and steel sections, especially when cut into predetermined lengths. Components for buildings include every article for use in building construction or for use in a building and its surroundings that is made in a workshop or factory with tools and machinery.

The criterion of limitation of components, or rationalization, was implied by the Modern movement as an element of the principle of regularity, which requested the repetition of basic dimensions. In fact, there were few other ways to carry out mass-production other than by limiting variety of the components. One of the advantages of the limitation of components is the high degree of standardization of information, as Martin says, which thus minimizes the possibility of choosing the wrong component from a large selection. Furthermore, any changes made in any characteristic of any component can be immediately taken into account and the information updated. Elements, subcomponents, and components as opposed to a large, closed assembly, can be changed, replaced, and repositioned in a design without affecting other components. It is technically and materially easier to replace a facade component than an entire box cell. Limitation of components induces also the limitation of details and joints, as already mentioned in the criterion of standardization, and leads to greater efficiency in industrialized production, and to product compatibility.

Throughout the building industry there are thousands of examples of components with uniform functions but also with slight variations in dimension. This situation will remain until agreements are made concerning normalization and standardization of certain dimensions. As a result of dimensional standardization, superfluous or equivalent variants will disappear from the market, and the way
will be opened for the production of other types of components which will allow for diversity to take over variety.

One of the best examples of standardization is the limitation of the floor/ceiling height to 8’-0” which has induced the fabrication of 4’x8’ sheets of various materials. However, it has a strong limiting effect on the design of interior spaces for those architects who scrupulously respect standards and use standardized components in conventional ways.

The limitation of components was a restrictive process that limited the facade composition in most modern buildings, because neither diversity nor variety was fully exploited. Component production was based on efficiency, cost saving, and profit for the industry. The problem did not bear on industrial production itself, which had produced, to some extent, what it had been asked to do. Architects were largely responsible for using conventions, elements, and methods of building in a conventional way, thereby producing buildings that were mere applications of principles with little artistic inventiveness, that is creativity, and few ‘surprises’, that are architectural variations or deviations of the systems and conventions. An unconventional and unfamiliar sequence of components could have created new architectural meanings in the whole and enriched a given context, as opposed to the usual and expected repetition of components uniform arrangement found in many modern buildings.

It is the role of the architect to influence the industry and to value the production of components based on criteria other than cost saving, efficiency, and profit. Architects should convince industry that criteria such as diversity and variety, and aesthetic concerns will, in the long-run, be very beneficial to it as well because the components produced in that way will respond to users’
needs, requirements, or preferences. Architects should not count on industry to decide what is to be produced, but only how it can be produced. It seems that an attitude of responsibility toward a production that shows diversity and variety has not been prevalent among modern architects. As a result, many buildings became only equipment or mere construction instead of decent architecture.

In spite of past unsuccessful experiences, it is crucial not only to limit the amount of components but also to use them in many different ways to give buildings new form and new meaning. By doing so, the 'instant' modern building will approach the architectural qualities of the traditional and continually built form and will be elevated to the level of architecture rather than just being a utilitarian or functional construction, as advocated by the radical architects of the Modern Movement, the functionalists.

In North America, many industrialized projects were unique, such as Habitat in Puerto Rico and Montreal, and were not necessarily intended for repetition (fig. 34-35). In other developed countries, it is the common practice to either repeat projects or to create a huge complex once, such as the 1 km-long low-income housing complex built recently on the periphery of Rome. In such cases, the limitation of the number to components of those that were the most appropriate and the repeated use of these components was, and still is, a major concern for Modern and today's architects who are interested in the construction of industrialized buildings. The limitation of components was necessary not only to avoid economic problems and the failure of the modern principles, but also to stimulate construction firms to switch to prefabrication and industrialization. As a result of a better rationalization of components, variety and diversity should
have been introduced into the production process. Therefore, the so-called failure of the Modern Movement would have been based on something other than its facades only, and its opponents, such as Robert Venturi and Peter Blake, would not have put aside all the technical improvements such as plumbing and ventilation.

PREFABRICATION

Prefabrication, or fabrication in advance, literally means off-site or on-site production of building components for immediate or later use and assembly on a building site. It can be part of a craft process of building when the components are manually produced as well as an industrialized one. Prefabrication is not a new idea and the principle can be seen in buildings throughout the ages. We know, for example, that at the end of the 17th century, wooden precut houses were shipped from England to its overseas colonies, ready to assemble, as Victorian Houses were shipped from New England to the West Coast during the Gold Rush.

Unfortunately, prefabrication of houses has a bad reputation. Peter Blake\(^1\) refers to it when talking about low-income housing as cheap stuff, unstylish, boring, inflexible, and difficult to adjust to various sites, and above all, as the symbol of lower class housing. It is generally perceived to be a very limited way to build as opposed to on-site construction which may accommodate itself to most situations or circumstances. Even though prefabricated buildings were intended for low-income housing, in the US the cost aspect is actually not

\(^1\) Peter Blake. "Form Follows Fiasco".
favorable since these buildings can be erected for a little less or for just about the same price as conventional buildings, as shown by Venturi. For Henrik Nissen, mass production, with strict obedience to modular coordination and standardization, is the only key for solving the cost problem and for allowing prefabrication to survive and to do what it has been developed to do.

For the time being prefabricated components, like partitions, bathroom units, kitchen cupboards, equipment, and other standardized components, receive more and more consideration from the building industry which shows its evolution, and they are gradually reversing the negative perception of prefabrication for the general public, because of easy availability, variety and diversity, good quality and low price, and a certain fashion towards high-tech.

1 Henrik Nissen. "Industrialized building and Modular Design".
INDUSTRIALIZATION

Mies van der Rohe said:

"The industrialization of building methods [is] the key problem for architects and builders. Once we succeed in this, our social, economic, technical [and even artistic problems] will be easy to solve...The nature of the building process will not change as long as we employ essentially the same [traditional] building materials, for they require hand labor...[Our first consideration must be to find a new building material.] Our technologists must and will succeed in inventing a material which can be industrially manufactured and processed and which will be weather-proof, soundproof, and insulating. It must be a light material which not only permits but requires industrial production...Then the new architecture will come into its own". 1

Today, in modern society, efficiency, especially industrial efficiency, is continually being improved by technical measures such as rationalization, mechanization, standardization, production analyses, and production control. Industry has recognized the importance of these measures for many years, and the debate concerning the application of industrial methods and principles to the building trade has been going on for so long that there is now general agreement about the necessity for this development. An increasing degree of industrialization is required to provide society with the quantity of buildings it needs. The question is not how to do it, but what to do, and what results should be expected in terms of facade design and its relation to users.

Therefore, industrialization refers to:

"programmed and systemized building using highly mechanized flow of line production throughout the entire operation...Prefabrication is not a prerequisite to industrialized building, even though it plays an important role in it. Prefabrication, per se, does not necessarily mean industrialization: for instance, the precast concrete panels currently produced in the US fall under the heading of partially mechanized

1 Peter Blake. Form Follows Fiasco. pp. 48.
craft process. Industrialized building encompasses both system building and prefabricated building. The two differ in their response to the needs of consumers and manufacturers. In system building, an architect designs individual buildings or projects within the framework of the system discipline. This has evolved from combining traditional site building with prefabrication of assemblies using industrial organization and mechanization and responds to varied consumer performance requirements. With prefabricated buildings, sectionalized 'packages' are predesigned like any other industrially made product. These buildings evolved from the industrial concept of mass fabrication of a product intended to respond to consumer needs as interpreted by the manufacturers".  

Fig. 33: Hans Schmidt - Professional Women’s Residence, Switzerland.
Fig. 34: Abandoned Habitat Project in Puerto Rico.
Fig. 35: Habitat in Montreal.
CHAPTER SEVEN
PERFORMANCE CRITERIA

The performance criteria are used within a specific case study and will permit the evaluation of a building system's effectiveness, according to the characteristics of facades, widely explored in chapter five, and also according to the technical criteria. Among the following criteria, some of them, such as flexibility and tractability, are more directly related to the floor plan, while others, such as adaptability, additivity, changeability, and permutability are more directly related to the facade after the building is completed. Some others, such as durability, changeability, and diversifiability are also related to the facade, but mainly during its design process. To illustrate most of these criteria, many projects transformed by users in Hong Kong will be presented. They are part of a survey made by Jerzy Wojtowicz called "Illegal Facades".

ADAPTABILITY

This notion refers to the ability of a component that has not been created for the function for which it will be used to be made suitable for a new function. We may, for instance, think of a component that will have to be altered to fit a specific position in an assembly for which it has not been designed. This situation might occur when a special position or junction of a component within an assembly is not taken into account during the early stage of design, for the purpose of maintaining the integrity of the production line. Once installed, a component may be adapted also to climate, use, or fashion by the addition of technical devices to maintain its integrity.
ADDITIVITY

According to Webster's, additivity is the quality or state of being additive; a substance added to another in relatively small amounts to impact, or improve desirable properties or suppress undesirable properties. For the purpose of this thesis, additivity is the capacity of a component to accept an additional element temporarily or permanently. The installation of shading devices in front of a window component, for instance, is an addition. Other elements may be hooked on or nailed in the components. The process of additivity is the result of users' participation and will occur after the building is completed (fig. 37).

CHANGEABILITY

Changeability implies the possibility of changing as a property (as in form or quality). This change may result in physical transformations within a component following a modification of a function. For instance, the configuration of a component may or may not allow the transformation that will modify its structure and aesthetic, such as the opening of a window in a wall component. The change may also be the replacement of parts of the component that are aging, deteriorated, being destroyed or simply not suitable anymore for the function for which they have been required. Changeability is also the replacement of an entire component by another one of the same type (fig. 38).

1 Webster's New Universal Unabridged Dictionary.
DIVERSIFIABILITY

The notion of diversifiability introduces the ideas of variety and diversity. The former refers to the numerous components of the same type and the latter to the numerous types, differing one another in size, form, or material (fig. 39). Within the architectural context, and especially when related to industrialization, diversifiability is twofold. We may first have diversifiability of components, that is various components having the same function but with slight variations of colors or materials, for example. We may also have components with the latter characteristics, but retaining slightly different functions and that may require deteriorations to perform better. In both cases, the designer refers to a catalog of components available to the user as well, and from which they may choose the most appropriate component to satisfy the requirements of the function (fig. 40). This criterion has been extensively discussed by Robert Venturi in "Learning from Levittown", from which the following is quoted: "These houses are exactly the same. They just look different" (fig. 41).¹

DURABILITY

Durability means that the component has the quality of being long-lasting with the retention of its original qualities, abilities, and capabilities. For the purpose of this thesis, it implies endurance and permanence and, as such, might be considered the opposite of changeability and permutability in some cases. A component, however, does not necessarily become obsolete in its nature, but rather in the evolution of its usage.

¹ Virginia Carroll, Denise Scott Brown and Robert Venturi. "Learning from Levittown."
FLEXIBILITY

As mentioned by John A. Stevermer,¹ flexibility (in the building stock) could be explored primarily through reinterpretation and rearrangement of space. Flexibility is characterized by ease of modification or change by variability, and often by consequent adaptability to new situations. Flexibility is the ability to achieve a change of conditions without changing the basic system as such.² In the context of this study, flexibility will be regarded as performance criterion for the floor plan and may include some of the other criteria.

PERMUTABILITY

The criterion of permutability is of greatest interest. It means the exchange of one component for another. As such, it goes further in the process of trading off than changeability. With the criterion of changeability, for instance, a part of the subassembly of the component can be exchanged, while permutability refers to the whole catalog of components as a source of variation in assemblies. Nevertheless, the criteria of variability and permutability are very close and differ only in the scope of their activity (fig. 42-43).


TRACTABILITY

Tractability is defined as the capacity of being very easily led or controlled and refers to the redevelopment of the interior space toward the inside or the outside. Thus, a tractable space, like a flexible one, may easily engender transformation of the plan according to a change in function. Therefore, tractability of space may result in either adaptability, changeability, permutability or variability in facade components (fig. 44).

VARIABILITY

Variability means being susceptible to variation and changes and is closely related to diversifiability. Variability refers to differences in colors, textures, or others in the same type of components, as opposed to diversifiability which is related to components of various types different in form, material, and size. As far as prefabrication is concerned, variability is surely less harmful to the production process because it does not interfere with it, by requiring more operations. It necessitates, however, more factory coordination at the end of the production line to identify, stack, and ship the components, and also more site coordination to make sure that the components are delivered at the right place at the right time. The erection process may, therefore, suffer a lot if both factory and site coordination are lacking. Variability in a project may be more conducive to cost saving than diversifiability and also may insure that the panels and the entire design have pleasing aesthetic qualities (fig. 45-46).
Fig. 41: missing
Fig. 42.
Fig. 43: Computer Organization.
PART THREE

INTRODUCTION

In the third section, bearing in mind the principles of the Modern Movement, the criticisms of the Post-Modern movement, the characteristics of facades along with the technical and performance criteria for building technology, these criteria will be used as basic methodological framework to evaluate and qualify the building systems of the three case studies in relation to contemporary technology. The case studies are: Les Arcades du Lac and Le Viaduc, France, by Ricardo Bofill; la Meme, Belgium, by Lucien Kroll; and Old People’s Center, Holland, by Herman Hertzberger.

The reasons for choosing these cases will be explained in an introduction. Their building systems will be discussed from a constructive point of view, keeping in mind the concept of repetition, the problem pointed out at the beginning of this thesis.

The facade will be broken down into its components and evaluated with the technical criteria, but, prior to that, it is necessary to introduce vocabulary inherent to building technology: system building and building system, assembly, components, parts, and open and closed systems.
CHAPTER EIGHT
BOFILL'S THE ARCADES DU LAC AND THE VIADUC,
ST-QUENTIN-EN-YVELINES, FRANCE

In the early 1970's, France's leading party, the Gaullists, expressed a very strong political will to decongest Paris. Programs and plans were called for to create new towns on the northern axis: Cergy-Pontoise (where Lucien Kroll realized Les Vignes Blanches) and Marne-la-Vallee; and on the southern axis, there were three other projects including St-Quentin-en-Yvelines, the location of which is close to Versailles(69). Bofill's arrival at the Hexagon coincided with this boom period of French building construction.

PROJECT

Ricardo Bofill and the Taller de Arquitectura were commissioned for two of these projects. This thesis will analyse the project in St-Quentin-en-Yvelines (fig. 48). It consists of two parts: Les Arcades du Lac (fig. 49), which is a continual built mass set along rigid orthogonal axes, and Le Viaduc (fig. 49), which stands as a complementary linear building above the artificial lake of St-Quentin. Each apartment is 8 to 10 m deep, has double orientation and overlooks both a green space and a street (65).

"Le caractere le plus marque de ce 'dessein', c'est l'importance quantitative des facades. Leur exceptionel deploiement ne s'explique pas seulement par la disposition des divers batiments, mais plus encore par la minceur de ces batiments, en sorte qu'elles sont toutes et de partout bien visibles, donc mises en valeur. Ici, en somme, il y a multiplication des facades" (fig. 50).1

The axes of the area and the tripartite facades recall respectively the boulevards of Paris and the neighboring palace of Versailles (fig. 51), both the urban and the monumental aspects of housing. The project is agreeably human scaled and might be compared to parts of Bath and Nancy (69). It sits on a generous site and gives -at least externally- a sense of well-being and expansiveness which is expressed by the courtyards and the horizontal development of the project into familiar block-size buildings (fig. 52). There is a perfect scale of proportions established between the buildings' surface, width, and height (55). Bofill built his housing complex more in keeping with an earlier Parisian tradition: tall, densely packed apartment blocks (63).

In St-Quentin-en-Yvelines, 386 flats were requested for the Arcades du Lac and the Viaduc in (57). The clients are semi-private housing corporations aiming at the lower end of an aspiring owner-occupier market, that is the upper bracket of the lower-class of commuters working in Paris. So as to attract a larger and more diversified work-force in the capital periphery, most dwellings are largely subsidized by government agencies supporting the petit-bourgeois owner-occupiers as well as the construction entrepreneurs. For that reason the complexes are designated HLM, which stands for *habitations a loyer modiques.*

Behind these two projects, architecturally highly praised by the Socialist Party of President Francois Mitterand, is a real political intention to build something popular, that is for popular taste, for which the party will be remembered at the next election time. The projects, in that perspective, are real vote-catchers. Therefore, they could not be just like any other low-income housing projects.

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1 Known are low-rent housing buildings.
like those earlier concrete boxes spoiling the soil of France, which has an incredibly dull record of public housing (5), and of other European countries. Because of a difficult and very competitive market in a recession period, Bofill and the Taller had to introduce a new concept of housing into the French landscape, i.e., a new symbol emerging right in the middle of the nation's most sensitive, emotionally charged, and historic site: the Ile-de-France. Because of all these factors, Bofill relied on a monumental and classical prefabricated housing complex so as to fulfill his twofold goal of meaningful buildings and inexpensive apartments.

CONCEPT

"Today, I define architecture as the art of structuring spaces, of creating symbols, of developing the Classical language."  
Ricardo Bofill.

Bofill's aim was to satisfy the buyers' need for 'security' in cultural and material terms. Culturally, he adopted Versailles and the concept of inhabitable gardens as an architectural idiom familiar to all Frenchmen and, materially, he used thick and carefully detailed facades (60). He cleverly built for his clients tastes (60). In Bofill's eyes, industrialization was without any doubt the technical solution to compete with very powerful and very well established developers and to make the projects economically viable. However, it was the elitist and aristocratic symbol of power, success, and social achievement that really attracted people and became the counterpart of the petit-bourgeois' dream of housing. For this social symbol, the French petit bourgeois gave up his

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life-long goal of living in a suburban detached villa, so as to inhabit a palace and to show an image of himself as being socially successful.

Prefabricated building systems of all sorts, assembled into individual houses of various types, had already overgrown the site when Bofill invaded it with his classical giant-order project. The French petit-bourgeois, who traditionally flees the anonymous housing complex and buys these individual suburban villas as soon as his financial situation improves, literally rushed into the Neo-Classical complex. The gimmick is a palace! Ricardo Bofill built 'Versailles for People', on a truly monumental scale, with the blessing of the socialist government! Mass housing as a monument! "The machine for living in is tending to be replaced by the monument for living in" (48). The idea of using a monument for housing is not new, however. As early as 1829, Charles Fourier had proposed large structures with strong and identifiable images for housing based on the formal interpretation of the Versailles palace to replace the foulness of the petit-bourgeois' dream house filling out the banlieues (55). Bofill materialized that incredible and, for some, outrageous idea and created inhabitable imperial palaces, triumphal arches, theaters, aqueducts and arcades with evident inspirations from the Versailles palace, the Arc de Triomphe, the Theater of Marcellus, the Chateau de Chenonceaux (69), the Place des Vosges, not to mention the French gardens for the general planning (fig. 53). He unscrupulously imitated the same forms, colors, materials, and layouts. Form triumphing over function, French lower-class people were now living in monumental symbols!

..."the house should never be anything other than a decent home for the individual or the family. Housing as a monument is a conceit of planners and architects which needs laying to rest".1

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Is it not paradoxical, however, to see a socialist government relying on the grandeur of classical architecture to soften up the populace in such a traditional monumental fashion, in order to attain its political goals and to make its tenure for posterity? The whole issue of political interference in architecture will not be debated in this thesis, but it raises, however, questions that are nevertheless a constant preoccupation for today's architects.

"In an age of insidious and creeping state intervention the home is even more important as a refuge, a stronghold from the uncertainties of public life. It should be a symbol of the individual's or the family's way of life, as a symbol of shared community values, certainly, where those actually exist, but never a symbol of political gamesmanship and civic pomp. Even the Nazis avoided that pitfall. Monuments like those of Ozymandias fall."¹

**APPROACH**

To achieve his Neo-Classical design, Bofill depended on: an extensive use of the geometric principles of Classical architecture (fig. 54), a systematic utilization of prefabricated building systems and industrialized methods, and a strict application of the building codes in use in France. Not only did Bofill respect the rules of French Classic architecture while using its masterpieces as models, but also he was fully aware of the present condition of the French building construction industry. He manipulated structure and building techniques along with elements of the classical vocabulary with an unprecedented dexterity; he designed the entire project in total consistency with the actual state of French building methods, to the great displeasure of many French and international historians.

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¹ Ibidem.

and architects. They were outraged by prefabricated classicism and refused to accept that porticoes, pediments, and pilasters can be cheaply and quickly built (62)(fig. 55).

The French methods of construction are mostly based on the overwhelming presence of the concrete industry, on extensively used participation of unskilled foreign labour, and on the still-utilized 'heavy prefabrication' which has dominated low-income construction for more than three decades. More, Bofill clearly understood the divisions and contradictions of labor, such as unskilled workers working with highly specialized products. He consequently modified the technical conditions and criteria of his projects and, therefore, adapted symbol, language, and design to technology and building, and vice versa. (63) Did he, however, really understand the users' background -the East Asian refugees who are living in many of the apartments (67)? There seems to be some contradictions between program, product, client, and user!

SYSTEM

"Vous y voyez des grues hautaines et impavides. De lourds panneaux prefabriques. Et deja vous apercevez, s'alignant en bon ordre, les cases ouvertes des futures 'cellules'. Bref, ici, les structures du batiment ne se distinguent pas de celles qui sont communes a l'ensemble des constructions en beton d'a present".1

The Coignet tunnel form structural system is made of load-bearing, poured-in-place concrete walls and slabs, while the cladding is of precast and treated concrete

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panels (fig. 56). Tile, wood, and reflective glass are the other major materials used in the project of St-Quentin-en-Yvelines (fig. 57).

The 150 mm thick prefabricated cladding, cast with utmost care in a concrete factory, is assembled on-site (fig. 58). Precast architectonic e panels, developed in conformity with the Coignet system, are integrally colored (49), which allows their aesthetic qualities to last longer (fig. 59). They are also meticulously detailed and joined. They have a thick and traditional appearance appropriate to the Classical vocabulary of the facades of French architecture, and their thickness serves to lend greater rigidity to the poured concrete structure on which they are mounted (49).

The attachment method is one of the characteristics of the building system because the prefab panels are articulated independently from the pattern of the cross-walls. This is an indication of the inward design process. Working out the facade panels independently from the structural system seems to be a contradictory approach to that of the French building industry where 'heavy prefabrication' is used to, i.e., working out the cladding and the structural systems together, from the inside out, without regard for the ideological and cultural necessities of present French society (60).

The system of erection in St-Quentin-en-Yvelines is achieved by tower cranes, lifting precast piece by precast piece and slotting them into position (63). Curiously enough, the system of erection follows the principle of modular coordination, as presented next (fig. 60).

MODULAR COORDINATION
"It was Durand's teaching at the Paris polytechnic that demonstrated how to arrive at a synthesis between plan, structure and form based on a careful selection and modulation of a purified Classical vocabulary capable of infinite variants according to the new complexity of the programme."¹

Peter Hodgkinson.

Until recently most modern buildings were designed from the inside out, according to the Modern Movement principles. The facade was the expression of the plan; it interpreted, on a vertical surface, the floor plan layout which itself was determined by a structural span module. Bofill, like most Post-Moderns, and many unaffiliated architects, proceeded the other way around, i.e., from the outside in. Instead of starting with very small-scale dimensions, such as a one-meter or a room-size module, and developing it as the project grew, he began by ruling the entire site into squares, and drew axes and diagonals across his model (fig. 61). The scale of the site is so immense that it is rather difficult to demonstrate clearly what the basic proportions were that determined the layout design, but the entire project is generated by the utilization of grids that are directional vectors; they determine the major axes that direct the project's design and emphasize the natural and built forces shaping it (fig. 62).

"Block, street, network, square, an intentionally simple urban network, based on the right angle, like the system employed in towns in the past...Only by using a simple network can we master the city...arcs, ellipses and more complex forms can only be used once we have mastered this basic system (fig. 63).²

Ricardo Bofill


The grids also determine the positions of the buildings as they were laid out, with their sternly ordered facades and uniform parapet lines (55), after the manner of French classical gardens. The grid system gives consistency and coherence to an environment that does not have any, as Bofill said, and as used for layout, it is Bofill's first step in recreating the urban form in a no-man's land. Bofill wishes to recreate a urban form with streets, facades, squares, and gardens, so as to bring a urban life that is desired by the users to the suburban areas. Will they become monumental suburbs?

The axes and diagonals extend beyond the built-up zones across the gardens and break off either on sites to be constructed, or in the lake (48).

Par la clarté et l'apparente simplicité de sa géométrie, cette composition, directement intelligible, s'offre aussitôt en spectacle. Voici quatre bâtiments carrés. Chacun enclot un ample espace intérieur, dont la diagonale est marquée par des peupliers déjà plantés. Voici quatre immeubles, eux, rectangulaires. C'est parce qu'ils sont, tous les quatre, face au lac. Au centre de cet agencement, observez l'espace circulaire coupé par quatre ouvertures, dont l'une donne la vue sur le lac. Le trace de la circonférence est matérialisé par des bâtiments d'habitation. C'est sur cet emplacement rond que s'articulent les deux rectangles et les quatre carrés..." (fig. 48)¹

From the point of view of the erection process, "the axial layout and the repetitive facades seem ideally suited for the cranes of French construction sites (even low-rise ones), the axes allowing for their tracks and the circus at the crossing accommodating the rotating boom - the classical ground plan becoming a permanent trace of the erection process (53-55)."²

¹ ibidem.

² John Morris Dixon.
Full-site modular coordination and the strict application of simple geometry have contributed to the development of the Classical architecture of Bofill's project from his concept of inhabitable French gardens. Bofill relied on a geometric discipline that embodies laws of proportion, ratio, and size and used classical forms, such as circles and rectangles, to design the entire project as a comprehensible and harmonious environment. "The scheme organizes space in a Classical urban way, synthesizing street, square, garden, circus, and lake through the modulated repetition [of facades] of different apartments", as suggested by Durand. As Bofill proceeded inward from the site planning, he then applied the same principles of grids to the elaboration of facades and to the planification of individual apartments, which means that the giant order of the gardens, previously elaborated with these grids, were used as a leit-motif in elevation (63)

As a result, "two basic rhythms based on the same dimensional coordination can be discerned, that of the arcades and the elevations of the garden and street sides. The top two areas have a steady beat which on occasion doubled. On the garden side the bottom three storeys make up a single bay which may be considered a window-pilaster, which has a symmetrical rhythm: A,B,B',B',B.A. The arcade rhythms are more complex and syncopated, running horizontally out of phase. All these rhythms recall the grand Baroque Order proposed by Mansart and Bernini for the Louvre" (50).

COMPONENTS

Most likely, the predominance of repetitive facades, personified in the old Paris suburbs, will strangle the inspired individuality of French petit-bourgeois
owner-occupiers. The finished product as a whole, however, rises above its repetitive origins: it is an astonishing articulated facade with many of the attributes of Classicism. Proportion, size, ratio, and rhythm are perfectly ordered in a harmonious way, from the largest directional vectors organizing the site and shaping the project, to the smallest architectural details modulating and embellishing the facades (fig. 64). Bofill succeeded in doing the tour de force of St-Quentin-en-Yvelines by using only two different materials on the facade: tiles in two modules and integrally colored concrete (49) in four colors, adopted from the Grand Trianon (63). The colors range from pink to mauve and are drastically affected by seasonal and climatic changes (69). He used two superimposed prefabricated panels on the facade: one for the ground floor and the two first floors and one for the attic and the balustrade (fig. 65).

In St-Quentin-en-Yvelines, the narrow concrete panels with their numerous layers of details have given the project an aspect of architectural grandeur that many modern projects are lacking (fig. 66). In addition to their structural and technical qualities, the panels provide the facade with a sense of finish, thickness, and verticality that contrasts with the usual crudeness, thinness, and horizontality of post-World War II projects. The inevitable repetition of identical and uniform panels and the vertical joints disappeared behind Bofill's classical expression of industrialized components. Mass housing designed with sensivity and creativity, as evident in Bofill's work, should be encouraged because it does not alienate users and visitors with its boredom and platitudes, as seen in many, many facades of post-World War II housing projects.
"Daily life should not be banalized, but exalted to become rich and meaningful".¹
Ricardo Bofill

The catalog of components (apparently more than 350) used in Bofill’s complex, mainly on the street side and garden side, appears to include a limited number of standard elements only, and demonstrates, nevertheless, a great deal of rationalization (fig. 67-68); while the circus and the building’s extremities use another set of components (fig. 69-71). In the circus, the veneer tile panels are used along with arcaded panels, and are tied together in a special fashion which allows for the curvilinear installation but which leaves a very large expansive joint(fig. 72). These components, such as the corner and the pediment components, show a greater degree of diversity among one another and, therefore, a lesser degree of prefabrication. In fact, most of these special components express rather punctual interventions and are not repeated extensively all over the project, which makes prefabrication less effective as a production system (fig. 73). For that, it is believed that they are probably poured-in-place to make sure that they can be perfectly adjusted to their adjacent prefab components. This does not exclude the possibility that they may, nevertheless, be prefabricated on-site if necessary.

The Viaduc also displays components slightly different from those used in the Arcades (fig. 74). Even though Bofill used the same classical vocabulary in both parts, he introduced diversity in most panels of the Viaduc: ballustrade, corner and facing panels are part of another catalog of components, although they appear at the same position and fulfill the same functional requirements as in

the Arcades. Therefore, for facade design purposes, Bofill considerably increased the numbers of components. Subassemblies, windows for instance, have been widely used as parts of various assemblies in the facade panels. However, these assemblies vary a lot within the two projects and, consequently, diversity of panels may be very harmful to the entire building process of the project.

STANDARDIZATION

Standardization of components and dimensions was especially tailored for this project. Panels, windows, doors, balconies, and other components were created for this specific project and are not part of kits commercially available on the market. Standardization of elements and subassemblies occurs, as it does in traditionally built buildings, but standardization of assemblies has not been really achieved, because there was more diversity than variety. In fact, some of the components of the Arcades du Lac are not used in the Viaduc project, which required the creation of some additional components. For this reason, prefabrication in Bofill's project seems to be a very doubtfull means of cost saving.

In Bofill's project, image is definitely dissociated from program, which means that the symbolic facade is totally independent from the floor plan layouts behind it: inside and outside are two separate and unrelated things. Repetition of standardized apartment types is consistent in each part of the project. The design layouts of the apartments are determined primarily by the requirements of facade rhythm, and are subjected and submitted to panel dimensions that are 1,400 and 2,800 mm, while the dimensions of the apartments are determined by the structural system. The center axis of party walls that are perpendicular to
the facade is estimated at 5,550 mm, while the available space in between is 5,400 mm, which leaves an approximate 150 mm for the concrete party wall (fig. 75). The position of party walls may or may not occur at the jointing of the facade panels, while the positions of some partition walls are free from the structural system and are determined only by the requirements of room dimensions. In the other direction, parallel to the facade, the center axis dimension is 8,250 mm and, therefore, the usable space is 8,100 mm. In both cases, the partitions are 60 mm thick. By deduction, the outer wall would be 250 mm thick. Standardization of the heavy wall structural system has really limited the usable space as will be demonstrated with the performance criteria of flexibility and tractability.

PREFABRICATION

As defined previously, prefabrication may be the production of components off-site in order to be used later on-site. Prefabrication, like modular coordination, limitation of components, and standardization has not been fully achieved in Bofill's project, even though it was one of his aims. It may be possible that the lack of skill for produce the idiosyncratic facade cheaply, and not a desire to standardize, led to production in factory. It is probably also why the cross-wall and slab structural systems have been poured-in-place instead of prefabricated as the facade system was. However, the French industry which is used to that kind of 'heavy prefabrication' could have done it just as well.

Little was really achieved as far as limitation and standardization of components is concerned, so that many special components were fabricated on-site to fit
particular positions. What seemed to have been produced according to the principles of industry, and advocated as such, is in fact a monumental joke. Too many bits and pieces here and there have carried enterprises to bankruptcy because diversity outproduced variety (fig. 76). Many architects argue that Bofill's project cost more than a traditionally built construction by as much as 10%, while the prefab entreprises estimate the cost of prefab pieces to have been twice as much as normal ones (67), which represents 50% (30% according to Bofill's office) of the total cost only for the facade (48). This can be partly explained by the fact that only a few panels of each of types were produced which, consequently, increased the building cost by reducing the impact of mass production on the overall building. A greater standardization of components would have eliminated the superfluous components and would have profited the entire system without limiting the facade design because of the diversity and variety of components. In both parts of the project the ballustrade panels, for instance, could have been of the same type and simply differed by variation of colors and texture instead of being totally distinct (fig. 77-78). Modifying colors or textures does not involve major changes in the production and assembly lines, as long as details remain standardized, but the result would have insured the same distinction between the two parts of the projects.

"La realite des solutions techniques employees par le Taller est plus prosaïque. Sur sept chantiers ouverts depuis 1972, presqu'autant de solutions techniques de façades pour un produit quasi-identique ont été adoptées par cinq entreprises différentes. Prefabrications lourdes ou légères, façades coulées en place, système mixte, chaque solution dépend pour beaucoup des logiques habituelles d'entreprises ou les disponibilités financières, les structures de groupe possédant ou non une usine de préfabrication, les opportunités de matériels et de main-d'œuvre jouent un rôle décisif. Pour preuve, la seule entreprise (Bouygues) qui a construit trois bâtiments pour la Taller a alterné les choix techniques en revenant pour Cergy à un système de coulé en place sur deux niveaux. Innovation technique: entreprises et architecture refusent le terme. Plutôt une application au logement social des techniques de

PART THREE/CHAPTER HEIGHT: BOFILL'S THE ARCADES...
prefabrication abandonnees depuis 20 ans et reservees aux ouvrages fonctionnels.\textsuperscript{1}

David Mangin

INDUSTRIALIZATION

..."la mise en oeuvre de facades bofilliennes serait a l'avant-garde des techniques constructives. Cette rumeur, en depit du slogan de "l'industrie de la Renaissance" ...

The architectural work of Bofill's project is said to be quasi-historical and fully industrialized (69). Bofill and his team wanted to adapt the Classical vocabulary to the industrialized system, using the factory-produced precast elements prevalent in French construction. Cornice, frieze, columns, and pediments were taken out of their original context, copied, and reinterpreted in terms of Bofill's conception of industrialization. Bofill and his team changed the color, texture, and the connotations of these components; they solved the compositive problem of panel joints, and understood molds, cranes, vibrators and building ordonnances, so as to produce an architecture parlante explained by Krier, through industrialized technology (55). In both parts of the St-Quentin project, industrialization does not appear to have been the governing production process. Since mass production was not possible, due to the small numbers of dwellings and the large numbers of components, industrialization, through production, assembly lines, and systematization of work is barely a realistic intention. However, the project is industrial because in its pursuit, it has depended on product development to enable it to proceed. Industrialized methods were used to develop or create

\textsuperscript{1} David Mangin. "L'Homme de Marbre", in Architecture d'Aujourd'hui. No 236, December 1984, pp. VII-XIV.

\textsuperscript{2} ibidem.
products with a classical vocabulary, and the analysis of the technical criteria shows that the project of St-Quentin-en-Yvelines, even though not fully prefabricated, is tending toward industrialization, and shows a trend to abandon traditional ways of building. Characteristics such as mechanization, site coordination, and the erection process are improving considerably when compared to traditional French methods of construction. Due to the quality of labor and the present state of the industry, it will take some time for construction to be really industrialized while fully retaining qualities of diversity and variation as found in Bofill’s project. Construction was much more industrialized during the 1950’s and 1960’s, but emphasis was not on aesthetic concerns. Compared to the buildings of that period, Bofill’s is probably less industrialized, but presents a more interesting facade from the point of view of the users’ taste and requirements, for whom, after all he is supposed to design.

"Despite appearances to the contrary, the Taller wishes to set up a kind of hommage to industry where the return to order is utilized as a standardising and rational system in a modern science of construction. Such a step is not without its reminders of A. Perret’s argument that a building should be designed in relation to the great tradition of architecture while making full use of the resources of modern materials and techniques".  
Marc Bedarida

However, given this high degree of mechanization, could large-scale public housing, deprived for so many years of any character, ever gain a Classical face? And, since when does mechanization equals humanism (63)? It is expected that following Bofill’s footsteps, other architects will offer Gothic or Tudor facades in the near future! If mechanization allows symbolic architecture to be

built and all kinds of social traps, such as elitism and aristocracy that especially French people have tried to get rid of, to be used to attract inhabitants, is it worth the money spent on its development? After the machine to live-in, will it be the machine to live-with?

Bofill used technical criteria during the early stage of design, the production period, and until completion of the project. When evaluating the project, however, the performance criteria must be relied upon with the arrival of a major intervener: the user. Even though the outcome of the evaluation with the performance criteria is somewhat predictable as soon as the design is completed, because of technical criteria, it is only when the building or the apartment is inhabited that an analysis will evaluate how well and how poorly these criteria really performed.

PERFORMANCE CRITERIA

The facades of St-Quentin-en-Yvelines do not perform very well in terms of the criterion of additivity. The rigid Classical vocabulary, the order and harmony of the facade, and the building system leave simply no room for any additions. It is virtually impossible to add any elements to the facades that would match the Classical vocabulary without encountering a major disturbance in their composition (fig. 66). Even thin layers of interventions, as defined in the characteristics of facades, are not allowed to users. No colors, for instance, can be applied by subsequent generations of users who want to identify themselves and personalize their dwelling: colors have been already preselected and are integrally incorporated into the component’s composition. In fact, Bofill is so respectful of classicism, which never even considered 'personalization', that
he has predetermined almost all the characteristics of the facade to preserve the integrity of his design; however, he totally forgot the epoch in which he is living. The three-dimensional facade has emerged as a full-fledged adult right out of the mold and its evolution or development has died at the very first moment of its installation on-site. Yes, the facade has shadows, recesses, and projections, but they are part and parcel of Bofill's selected classical vocabulary, which is the result of an elitist taste and not of the users' interventions. Bofill has overcontrolled the building, the users' actions, and even the greenery! He has created a thick wall on which forces from the inside and the outside can not be expressed in terms of concavities and convexities. The facade, as an interface between inside and outside, does not communicate with the built and natural environments and with the interior spaces as one would expect it in the present time. The building does not exchange nor dialogue with the environment, Bofill's design is a 'fait accompli'. Thus, it becomes a boundary between the two realms or worse, it is simply an enclosure of interior space. Additivity, as defined previously, which should be the criterion with the greatest relevance for the users, is severely constrained by the requirements of the building system and considerations concerning Classical aesthetic. Therefore, the facade can not fulfill its role as a zone of exchange between the public and private realms; rather, it acts as an impenetrable and immutable wall between the two. The facade is a theatrical decor which offers a public spectacle: is the play today's human comedy?

Curiously, in this project the infill facade system is part of a support system just as the structural system is. Both are far away from any users or even community control. The only personalized items found in the entire project are flower boxes, resting uncomfortably on the window sill, unattached for lack of

PART THREE/CHAPTER HEIGHT: BOFILL'S THE ARCADES...
hooks, and potentially dangerous (fig. 58). But people like flowers; at St-Quentin they are actually the only means of personalizing one's dwelling. Moreover, curtains seem to be a totally inappropriate element because they interfere with the orderly facade. They break up its rigid vertical linearity, disturb its organized complexity, and detract from the unity of its composition with their colors, materials and dispositions (fig. 65). Maybe Bofill should have ruled on the use of curtains as has been done so often in many modern buildings! After all, other devices, like the anti-theft metal roller curtain, are fixed to the inner wall of the facade in a very awkward way so as to protect the integrity of the facade (fig. 79). Does living in a monument mean living in a golden cage?

This case study does not satisfy the criterion of adaptability because of the great diversity of components. The facade components are used in such an organized and specific sequence that when a component does not fit a particular position, a new one is created to meet the requirements of the position and/or the function. To adjust to the imponderables such as climate, change of function, fashion, or users' taste, there are very few ways that a component can be trimmed to satisfy new requirements. Furthermore, many corner and pediment components, in both the Viaduc and the Arcades, have been designed to fit the aesthetic requirements of the facade. In this project, the panels' design integrity was based on proportion, size, and ratio and had to be maintained to preserve the overall facade design. In that respect, the entire project requires a very close site coordination because of a more complicated erection process that is impossible to attain without a high degree of dimensional accuracy or good technical control. Modular coordination and standardization are the keys to the erection process. A more systematic rationalization, however, would have done just as well and would have reduced
the number of components and, therefore, would have achieved an optimum standardization of details and subcomponents. It becomes, therefore, more and more evident that the aim of this project is not 'rational' design in technical sense.

As far as the criterion of changeability is concerned, the project as a whole and the building system itself do not allow any physical or spatial transformation. The concrete panels, in the first place, can not be modified properly without the inevitable destruction of some of the material due to the use of imprecise equipment and methods and to the fragility of the edges, not to mention the complexity of the facade design. The cutting of a window in a panel, for instance, would result in breakage of the facade material that could not be easily repaired to match the integrally colored panel. Moreover, even if technical problems can be solved, the rigid, ordered, and complex facade design would suffer from the introduction of an unplanned element, the position of which would not have been considered in the early stage of design. The addition of such an element would probably destabilize the facade and engender aesthetic chaos. It is clear, therefore, that no further transformation due to functional requirements can be performed after the completion of the design.

The project in St-Quentin-en-Yvelines is highly satisfactory when evaluated by the criterion of diversifiability. This project is among the best examples of diversifiability in prefabrication, especially prefabrication as a method of production for introducing modernity in a classical complex rather than a means of cost saving. Industry has became so skillful that it can produce any shape and form—for a price. Nevertheless, Bofill succeeded in juggling prefabrication, variety, and diversity all together. The diversity of components is related to the
number of different types of components as opposed to variety which refers to various components of the same type. Bofill has introduced diversifiability of components by modifying sizes and assemblies of standardized elements. These changes modified the production process and the assembly line by introducing additional operations into the process. Therefore, some kind of factory coordination is necessary at the end of the production line for identification, stacking, and shipping of the panels. The site coordination and erection process may also require more attention, representing some increase in cost to avoid any confusion and to make sure that the components are delivered on time and installed at the right place. Checking operations would not be necessary if all components were of the same type. However the overall appearance of the project makes the energy, time, and money used to accomplish these operations truly worth it, because in the end, the project did not come out that much over the initial budget. The bad side effect of great diversifiability is that it makes prefabrication obsolete as a cost-saving incentive because of the high number of components and the low level of standardization.

Bofill used a material that is durable: concrete as the new stone, a stone that is molded and prefabricated instead of sculpted and handcrafted (fig. 80). His intention was, nevertheless, to retain with the use of concrete the quality of permanence inherent in stone, which is the reason why Roman temples and Renaissance buildings have stood the test of time. Bofill once said that his housing projects will be wonderful ruins! In the meantime, the building has to prove that it can generate a good quality of life, otherwise, it might be destroyed as was the Pruitt-Igoe project for the exact same reason! What an architectural progression!
Among all the materials developed and propelled by the Modern Movement, concrete, with steel, probably performs the best technically and aesthetically. Unlike wood, it does not require special preservative treatment to maintain its long-lasting qualities; unlike brick, it is more resistant and, depending on damage, as easy to repair; unlike aluminum, it is not affected by weather and oxidation. Thus, concrete stays in a stable condition and remains as it is produced. If concrete is well cast, there is then no reason for the developer to repair and to change the facade and adapt it to people's needs or tastes. The material will maintain the integrity of the design over years, such as stone and marble, its classical predecessors. The notion of permanence is, however, most contradictory to any users' participation. Even as owner-occupier, the user can not adapt the exterior of the dwelling easily to changes determined by interior needs, without damaging the component and the near-by elements. In that respect, Bofill's buildings are really built once and for all, and like many modern buildings will engender sooner or later the same kind of social problems as encountered before, due to their overall unmanageability. The very fact that Bofill's buildings satisfy the criterion of durability so well, that is of permanence of the material, maintains the facade's rigidity to change so that it does not show any improvement in terms of users' participation when compared to those modern buildings so criticised for being socially harmful.

"The urban design of our era will take the structure, if not the dimension, of the historical city into account. It will, however, invert the symbolic values. Everyday life will take the center of the stage, while the public edifice and facility will recede into the background". Ricardo Bofill

Flexibility in a dwelling means the possibility of rearranging the interior layout according to the need for rearranging space, to new functions, or simply to accommodate taste and fashion. At St-Quentin-en-Yvelines, the plans and interior treatment of the individual flats is decidedly Modern, while the Classical elements and symbols are reserved solely for the well-engineered facades. Thus, Bofill’s apartments should allow flexible space as did many modern layouts with their open plan. However, Bofill’s apartments, whether they are of one or four bedrooms, are very small and respect the minimum standards of social housing in France. There is no way to subdivide or enlarge a room without disrupting the entire apartment layout. Clearly, these apartments can not spatially afford any transformation and retain the same number of rooms. The load-bearing wall structural system does not easily allow transformations as opposed to a post-and-beam structural system which is more flexible. The plans are an afterthought, forced into overpowering forms, as they were in many neo-classical facade. Bofill is going backward and offers less than before in terms of interior planning to the lower class: his apartments are meager in scale and detailing, their layouts unimaginative and awkward. Even though vertical interruptions have been managed in these structural walls, they do not offer a great diversity of possibilities for modifying the floor plan, which is, therefore, paralyzed in its evolution. Unfortunately, the bearing walls are not only party walls but also partitions since they occur within the apartment, which makes any transformations even more difficult. Had the bearing walls been positioned parallel to the facade, the situation would have been totally different. Free spaces on each side of the bearing wall would make it easier to rearrange the disposition and the size of the rooms, dealing only with partitions instead of party walls and bearing walls. The new layouts
would not conflict with light diffusion and natural ventilation because of wall interruptions. More connections between rooms within an apartment and between two apartments would then be possible, enabling the experience of the so-called free plan without any interference with the facade. If the facade is to be maintained as it is designed, the user should be allowed, at least, to modify his interior. In the case of Bofill's project, a more flexible building system allowing changes in plan would not result in any changes in the facade for all the reasons given before in the explanation of other criteria.

"Strength, form, impact, historical continuity, sophistication, a high standard of construction. these things are worth having; so too are lakes, amphitheatres, pavillions, monuments. Bofill has provided all these. But low ceilings, narrow corridors, minimal windows, elevation ranked above plan, housing built in the guise of public monument, these are not blueprints for late twentieth-century housing". 1

"Can Classicism justify the constriction of windows and balconies for the sake of the exterior composition"(55)(fig. 83)?

Even though the panels are all of the same size, it is impossible to even consider permutability, which is the exchange of one panel for another, for the following reasons: first, a facade panel spans vertically more than one dwelling as opposed to a floor-to-floor panel in other systems and, second, because neither small components nor long components are possible alternatives in Bofill's catalog of components (fig. 65). These restrictions on the catalog of components maintain the integrity of the entire facade as initially designed and have little to do with prefabrication. A monument it is, and a monument it will remain!

Because of the structural and the facade panel systems, this project does not perform very well according to the criterion of tractability. The structural system defines spaces that can be modified only within the limits of the span between two bearing walls. No enlargement of rooms or apartments is possible in this framework which makes the changing of functions rather difficult, and this limitation translates into a somewhat awkward layout. From the arbitrary placement of the windows, it is readily apparent that Bofill and the Taller have designed from the facade inward (fig. 84). Windows often occur in the extreme corner of a room, providing a space that is difficult to use. Such inattention to the private aspect makes one skeptical of Bofill's frequent sociological polemic. Exalting daily life with such theatrical bravura, he has in fact made but few concessions to its enrichment beyond the view from the window (49).

"'Versailles pour le peuple'. Mais derriere la facade, il y a la contradiction de celules tres ordinaires, dans lesquelles on a cherche a produire un maximum d'espace, sans fonctionalite. Dans la plupart des cas, l'acces se fait sur le sejour qui dessert directement les chambres; couloirs et entrees ont generalement ete evacues; il semble que l'on se soit trouve dans l'incapacite de resoudre un probleme de plan dans une forme donnee. mais determine par la facade".  

Openings are so specifically designed and so orderly in their arrangement in the facade layout that it is impossible to widen or shorten any room dimensions and it is also impossible to introduce or to blind any opening without damaging the overall facade design. Therefore, even though the floor plan layout can be somehow reinterpreted spatially, its expression on the outside is impossible because of the frozen facade. The evolution of a dwelling is virtually paralyzed by either the facade or the floor plan layouts. As mentioned earlier, Bofill's

project does not perform well when evaluated by the criteria of adaptability and changeability, which are related to tractability. In regards to the problem of tractability, it is difficult to say whether it is the facade limitation or the floor plan restriction that comes first and which one restrains the other; one sure thing is that the two of them are inextricably related.

"As with the vast majority of other Post-Modernists, Bofill has reacted violently against the Modern Movement concept of working from the inside out. Here this ideology has reached an extreme: if thousands of hours of work have gone into elaborating the elevations, detailing the prefabricated concrete panels, the intricacies of rustication, minimal practical attention has been paid to the flats themselves...But in 'functional' terms it marks a regression from the housing standards of the slabs and tower of the 1950s, so derided by the Post-Modern aesthetes.¹

Variability is a standard for judging the usage of a number of components of the same type that differ by texture and color, as opposed to diversifiability which is used to judge components of different types which differ in form and dimension. By using four different colors and varying textures with exposed aggregates, Bofill's facades displayed a great variety of components that contributed to create zones and differentiate the rectangular and the square blocks from each other in a harmonious environment. As opposed to diversifiability, variability is not harmful to prefabrication since none of the operations of the production line has to be modified. In the end, however, the whole process of stacking, shipping, and erection necessitate more factory and site coordinations. But, as has already been said, the appearance of the project is worth the energies spent on these activities, not because of the specific results obtained by Bofill, but rather because of the influence he and his building will have on

prefabrication. They will contribute, without any doubt, to enhance the aesthetic quality of future industrialized production of building. They will stimulate this type of building production.
Comments from inhabitants of St-Quentin-en-Yvelines:¹

"On vit la plupart de notre journée dans le séjour...et en fin de compte il [Bofill] a tant mise sur le séjour...c'est important un grand séjour...avec l'enfant c'est chouette".
"C'est tant de qualité assez médiocre au départ, c'est simple, mais ce n'est pas le plus important...l'ensemble de base est solide, le reste on peut l'emmenager...on y vit correctement...ce n'est pas du superluxe".
"Un coin enfants, un coin parents, et puis un séjour ou tout le monde vient, ça fait le domaine des enfants ou ils font presque ce qu'ils veulent et nous nous avons notre domaine où ils n'ont pas le droit d'aller...chacun chez soi..."
"Les chambres ont une taille limite...plus petit, ce serait des clapiers".
"Le seul ennui, c'est vraiment cette histoire de bruit...ils pourraient faire plus d'effort au niveau de la construction, c'est quand même dommage de réunir un ensemble comme cela et puis de rater pour des économies...certainement le coût de la construction, l'insonorisation".
"Il y a le problème du standing de l'entrée qui est décevant".
"Je dis que ce n'est pas beau, brun et rouille c'est trop sombre".

"We spend most of our time in the living...after all he [Bofill] put so much effort into it...it is important a large living...it is great for the kid".

"It is rather mediocre, it is simple, but it is not the most important...the basic framework is solid, the rest may be easily installed...we live here correctly, but it is not luxurious!"

"A kid's zone, a parents' zone, and a living where everyone goes and which becomes the kid's playground...we have our domaine where they cannot go...to each his own!"

"The bedrooms are minimal, smaller, they would be like closets".

"The only problem is noise...they could have done better construction-wise, it is very sad to build such a complex and to miss it for economics...probably the construction cost, sound insulation!"

"There is the problem of the entrance standing which is very disappointing".

"I say it is not nice, brown and rust-colored, it is too sombre".

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Fig. 49: The Arcades.
Fig. 49: The Viaduc.
Fig. 50: Facade on Garden Side.
Fig. 51: Versailles.

Atelier R. Boillot, architecte:
Avant projet : P. Hodgkinson.
Maitre d'ouvrage : Foyer du Fonctionnaire et de la Famille.
Entreprise (gros-œuvre, panneaux de façades) : L'Hirondelle.
Fig. 52: Block-sized Buildings.
Fig. 53: French Garden Layout.
Fig. 54: The Viaduc and the Lake.
Fig. 55: Erection of Prefabricated Elements.
Fig. 56: Extremity of the Viaduc during Construction.
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Fig. 58: Panels.
Fig. 59: Joint Detail.
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Fig. 61: Axes.
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Fig. 65: Facade Composition.
Fig. 66: Interior Courtyard.
Fig. 67: Garden Side Facade.
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Fig. 69: Circus Side Facade.
Fig. 70: Elevation.
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Fig. 72: Jointing.
Fig. 73: Various Facade Components.
Fig. 74: Viaduc's Components.
Fig. 75: Apartments.
Fig. 76: Circus' Components.

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Fig. 77: Arcades’ Ballustrade. Fig. 78: Viaduc’s Ballustrade. Fig. 79: missing. Fig. 80: Concrete, the new Stone.
Fig. 81: Arcades Apartment Layouts. Fig. 82: Viaduc Apartments Layouts. Fig. 83: Windows. Fig. 84: Circus Facade.
CHAPTER NINE
KROLL'S LA MEME, WOLUWE, BELGIUM

At the end of the 1960's a very important revolutionary student movement stormed over Europe when De Gaulle fell. Belgium was no exception. The student bodies of most universities were very powerful and forced many concessions ranging from the global rejection of an archaic education system (75) to the improvement of student living facilities. During this period, Lucien Kroll appeared as a strong supporter of radical architecture students.

This troubled epoch also coincides with the development and the evolution of a new trend in architecture: users' participation. The idea has been expressed in Berkeley, Paris, and Berlin, and by members of Team 10, but it was first articulated in Holland, mainly by N. John Habraken's 'supports' before sweeping the rest of Europe, as a possible way to reanimate modern architecture.

PROJECT

During these difficult days, the University of Louvain was sincerely open to some degree of participation. When the students opposed its nineteenth-century type plan for service areas, the university decided, more in an attempt to calm them and to keep them busy than because it really believed it would work, to allow students to take care of the destiny of their housing accommodation and of the new facilities.

The project is located at Woluwe, near Brussels, on the campus of the University of Louvain (fig. 85-86). Its background is a monotonous, uniform, rigid, and rectangular concrete new hospital (84)(fig. 87-88). Unlike Bofill's
isolated complex in St-Quentin-en-Yvelines. Kroll's was articulated like a conversion project (76) characteristic of which was the recreation of squares, houses, and shops to weave the new building into the neighboring villages (fig. 89). The starting point was to design students' housing, known as la Meme, to which, later on, new buildings and a subway station were to be added (fig. 90).

At the Louvain University Medical Faculty, medical students wanted their living and working areas more adapted to their personal needs and professional aspirations. They wanted the practice of medicine to be more closely linked to the everyday life of their patients. The students, therefore, mainly asked the architects to preserve the contact and the continuity with the existing neighboring areas which the University area must maintain (75) (fig. 91).

The medical students chose Lucien Kroll because of his supportive antecedents with the architecture students during the late '60s, and because of his openness to their own preoccupations, while the university administration had confidence in Kroll's abilities to fulfill its programmatic requirements. He was, for the time being, an agreeable compromise for both parties. A curious triangular relationship was established, and immediately Kroll and his Atelier found themselves juggling the demands of students' participation with those of authority's direction. This relationship stimulated creativity on the part of all the participants who developed a satisfactory adaptation of the remarkably well thought-out program of the Medical Faculty.

The project was a technical one, as Kroll's way to introduce modernity as opposed to traditional construction, and was based on the social requirements of the inhabitants themselves, as was true for all of Kroll's subsequent projects.
The users' personal and professional needs influenced the design of their housing facilities which correspond to their life-style and aspirations as well.

"C'est incroyable comme il est plus facile et plus enrichissant de travailler avec les utilisateurs plutot que de tout inventer, ou de ne s'informer que par personne interposees".¹

Lucien Kroll

CONCEPT

Kroll's work is dominated by a generic concept that he and his Atelier tried to apply to their projects: "integration, [meaning] no break in the landscape" (76). A priori, what could seem like a very timid architectural intention not to intervene strongly with the land, is in fact, a genuine concern toward the existing context. Not only do Kroll's works respect the landscape as the natural environment, but also the landscape as the built environment. Therefore, new buildings must fit into the natural landscape and into the existing structures. In his project at Woluwe, la Meme, he achieved his concept by using 'diversity', his unconditional motto, which may be expressed as an interplay of volume and materials, echoing neighboring structures (76) (fig. 92).

"You must mix otherwise you just make modern architecture and you are very unhappy after that".²

Lucien Kroll

For Lucien Kroll, this concept represents a form of courtesy, of respect from both the architect and the building toward the neighborhood. These 'echoes' or 'quotations', as he called them, allow the building to be more 'integrated' with

¹ Lucien Kroll (4)
² Lucien Kroll (5).
its surroundings. These echoes are more social than aesthetic options, because they express people's concerns and needs rather than architects' taste. As Kroll says, the building becomes more fraternal, more sociable, and more rapidly accepted as an element enriching the existing context than one rejected as disturbing it (fig. 93).

In creating a facade, Kroll, as a contextualist, may opt for a reference to the regional landscape or to the history of the neighboring social group. Thus, he maintains the neighborliness and friendliness that is his hallmark. Kroll's work implies constant social and aesthetic options and allows these options to be taken and performed as opposed to rigid and immutable principles of the modern architecture that restrained any involvement. Between the neighborhood and the new structure is the skin of the building which becomes 'porous' to the outside and the inside. It allows real interaction between the two milieus. The new structure is, to some extent, shaped by the environment, or at least, is a reply to that environment. For Kroll, that reply is based on the criterion of diversity: diversity of forms, diversity of materials, textures, and colors, and diversity of spaces (fig. 94). Diversity is really the goal to be achieved and at the same time, it is the unifying theme of la Meme, and also of Kroll's many other projects, built later.

It is clear that, like Bofill, Kroll proceeded from the outside in when designing his building. He started from the environment and moved to the skin; and then from the skin to the internal organization of structures that would support the outside; from the internal organization to the constraints of materials, techniques, and machinery; and from this, to the working man's labor (76). The development of la Meme followed this exact pattern. The building had to adjust
to it. The design process is iterative, self-adjusting, and self-correcting. In la Meme, for instance, columns were placed in a pattern that imitated the irregular position of trees in a forest, so as to avoid the usual, mechanical, and engineered regularity of a structural grid (fig. 95).

**APPROACH**

Social, technical, and design constraints were very stressful for the team because they were found at every level of the design process. Kroll and his Atelier were challenged by the fact that they were probably constructing the first project in which users’ participation was the main characteristic. Moreover, this new approach included other challenges, like workers’ participation and involvement, which requested some adjustments between modern technology and craftsmanship.

> Quant à la participation, il faudrait qu’il soit bien clair que c’est un moyen de l’architecture, que cela veut dire qu’il peut y avoir de l’architecture sans participation. La participation, pour moi, permet d’aboutir à un objet, une construction, une articulation de l’espace qui ait une certaine vie, qui ne soit pas seulement d’une géométrie artificielle, soi-disant rationnelle, qui ne soit pas courte comme l’analyse et les operations mécaniques. 
> 
> Lucien Kroll

As explained by Kroll, this new approach has resulted in an occasional failure, such as the wall of brick and cement blocks at la Meme that did not come out in a very pleasing way, but also in outstanding successes such as the concrete wall at the primary school of Woluwe which the workers made into a network of leaves and branches, echoing the near-by forest (fig. 96–97).

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"The whole area of workers' skill, of the creative aspect of workers' efforts, of the social recognition which this type of work should enjoy, lies on the borderline between social and professional affairs at this particular moment in time emerging to the division of work—all things which may affect the nature of buildings".¹

With this approach, Kroll is no longer an architect who accepts a commission and, buried in his office, conceives a project that will be constructed by others. On the contrary, he wants to work with all those who have a contribution to make in order to add a new component to the landscape without damaging but rather enriching it while respecting the continuity of its history (76). In that respect, it is Kroll's way not to be the only one responsible for the new building. Whether this is ultimately out of fear or concern is difficult to know.

Kroll developed ideas in close relation with the students. They told him what they wanted: pitched roofs, greenhouses, bay-windows, balconies, complete glass walls, and a 16-foot bed sitter (fig. 98). They got what they asked for (1)! The University was quite happy, at the beginning of the collaborative effort, but it became totally displeased when it was presented with the ideas and the schemes. Because of Kroll's rationalization of every single component, the project came out, surprisingly, within the budget. Even though the building integrated not only the programmatic demands of the students but also those of the university, its authorities hated it. It reflected disorder and chaos. In fact, Kroll's position was revoked and he did not work on the other phases of the project which were given to more conventional architects. Despite the university's reaction toward it, the Medical Faculty project showed extraordinary architectural skill in coordinating materials, textures, and joints (fig. 99). To get it built, Kroll

and his Atelier, the consultants, and the contractors demonstrated an outstanding understanding of the process of building (75).

SYSTEM

At the Medical Faculty/Student Residence, the system of construction is rather simple and follows the common practices used for contemporary buildings: it is composed of poured-in-place concrete flat slabs and columns (floor-plate mushroom structure system)(fig. 100). The load-bearing support system is irregular and heterogenous: concrete, masonry and other materials enveloped by lightest structures. The facade infill system is made of various materials that are reminiscent of the surroundings. Asbestos and cement tiles, masonry, concrete, glass, metal, and softwood cladding create a vivid urban image which are characteristic of Belgian countryside architecture and not, as often claimed by critics, mere fantaisies of Lucien Kroll (77–84)(fig. 99). As a consequence of the use of the support system, an underlying structural grid defines the initial regular arrangement of the columns which had been given to the structural engineers to satisfy their requirements and calm their anxiety (fig. 101). The position of the columns was then modified to break their regular and less pleasing and stimulating arrangement. Here and there some reinforcement was added, columns were enlarged to avoid shearing and slabs were thickened to make room for the electrical system and the heating and ventilation ducts. After these adjustments, the initial rigid column arrangement was transformed into a 'promenade of columns' which defines unpredictable spaces instead of a standardized or regular structural grid organization (31) (fig. 102).
The resulting structural matrix became very effective in terms of the flexibility and tractability of the floor plan. The facade was conceived to be entirely free from load-bearing constraints, and, therefore, became tremendously manageable, that is easily changeable, without damaging the edges of the structural system. Elevators and staircases were used as bracings to maintain the masonry walls. In fact, the success of Kroll’s project is partly due to the above type of building system which represents two main characteristics of modern architecture: open plan and open space. An initial result of the irregular placement of the columns was that room dimensions and layouts were different from each other, producing one level of diversity; another level was apparent in the facade with the numerous components. This building system was ideal for Kroll to express his concept of diversity and variety. The free plan and the flat slabs allow the partitions to move totally freely between the columns at the users’ will, and the floor-to-floor *infill* facade panels, which are inserted between columns and slabs, allow the space to be really open, if necessary to the outside, so as to interrelate more closely with the surroundings.

**MODULAR COORDINATION (31)**

It is because of the commission of the Medical Faculty at Woluwe that Kroll and his Atelier really started to explore modular coordination and opted for open and light industrial components. According to Kroll, the building is probably the only one designed on a unique 10 cm grid with some preferences for a 30 cm grid module for the facade componentse. The grid is so small that

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it is almost imperceptible and may be applied on both the plan and the facade (fig. 103-104). The grid is issued from the 10 cm/20 cm tartan grid developed by the SAR methodology (fig. 105). This reference system was very helpful in coordinating a traditional way of building and more easily controlling a great diversity of forms (31).

On the facade, all kinds of openings were permitted as long as they followed an increment of 30 cm. Inside the skin, Kroll found that the SAR 30 cm grid module was too 'barbaric' for the design of the floor plan layout. He reduced the dimensions to 2.5 cm and to even 1 cm so as to allow more flexibility than is possible with the 10 cm/20 cm, narrow/wide, bands system. In his book "Les composants, faut-il industrialiser l'architecture?" Kroll describes how he used and transformed various aspects of the SAR system such as axis, thickness, interior and exterior walls, joints, and how he used industrial components so as to obtain building qualities such as non-sophistication and heterogeneity (fig. 106-107).

STANDARDIZATION (31)

Kroll said that standardization was inspired by SAR in order to use industrial facade components, already described as infill. Standardization allows for diversity in serial facades and for the evolution of the dwelling by additivity and changeability partly because of different levels of the durability of materials. Here, the performance of materials is a very important criterion.

The high degree of diversity, achieved because of the standardization of dimensions, must be supported by other levels of standardization. The standardization of joints, for instance, is critical because of the use of so many components,
made of so different materials, such as wood, aluminum, and plastic (fig. 108). Diversifiability also introduced the notion of product compatibility. It goes far beyond dimensional standardization and cannot be better expressed in any other projects: this is an incredible tour de force and a pledge for industrialization and open systems.

LIMITATION OF COMPONENTS

As explained by Kroll (84), he and his Atelier avoided any authoritarian action on the landscape imposed by bureaucracy, closed building system, isolation, the production process, scheduling and the organization of production. They sought cooperation, osmosis, empathy, fluidity and mimesis. Because of their open-mindedness to the world, they rejected both 'heavy prefabrication' and the closed systems, and used standardization at another scale: the component. This other level of intervention implies a serious research on product and/or material compatibility of the components, and on the jointing system.

When facing a series of various, and, a priori, nonrelated components, the 'ordinary designer', explains Kroll, ignores them and eliminates the extremes; he then reduces the number of components to one or several types of which he will try to find an average profile. The rest, the marginal, exceptional and insignificant, will be discarded. Only then, can he control and 'industrialize' the components. Kroll and his team did exactly the opposite: they wanted as many components as possible (fig. 109-110). They did not want to repeat any element; they were looking for various circumstances -the 'circumstantial', as explained by Robert Venturi- and adapted or adjusted their design so as to give form to the landscape: a form that is inspired by the landscape built and
natural profile and social history. According to Kroll, there were more than 50 facade components.

PREFABRICATION

"Le prefabrique est effrayant. Pour ce qu'on en fait, vaut mieux l'interdire".¹
Lucien Kroll

Kroll’s ideas on prefabrication are clearly established. He believed that prefabrication is part of a building process that should lead to industrialization; it is a step, like rationalization and mechanization, to attain industrialization. Kroll rejects the 'heavy prefabrication' for its brutal conception, its puerile architecture, its mode of fabrication and erection, –in fact, for being so 'primary' without any hope for evolution. Throughout his projects and writings, his attitude is the opposite and supports open systems and light prefabrication. The latter is consistent with Kroll’s concept of variety and diversity and also with his constant preoccupation with contemporary building systems as a means of introducing both modernity and cost saving. This explains, as Kroll mentioned, why he uses widely marketed prefabricated components which are, therefore, less expensive compared to brand new elements. Some components were, however, produced for that project.

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Kroll's approach to industrialization is, in his own words, irrational and rather moral: "yes" to industrialization if it produces an "Architecture"; "no", if by its proposed image and its action it damages social and cultural richesses. Kroll confesses that it took him a long time to come across manufacturers open to these attitudes toward industrialization. Most of them, as he says, were more preoccupied with the mechanical production of shelters for merchandise than concerned with the socially responsive provision of decent buildings for people.

Kroll's aim is to replace the typical closed heavy system with an open light system. To do so, he uses prefabricated components, chooses them according to the requirements of modular coordination, standardization, product compatibility, and users' demands, and composes a facade to meet people's needs and aesthetic concerns. Product compatibility was no problem because of the wooden frame of most components, which allows the use of caulking for jointing.

Quite rapidly, Kroll discovered that designing for users' needs with an open system implies the use of numbers of components in numbers of combinations. This design process satisfies, of course, his concept of diversity, but also represents an incredible increase in time spent at the drafting board to please everyone. With la Meme, he spent more than 90,000 hours on the facade! With this project industrialization was explored to an extent it never was before. But yet Kroll had to find a supportive means for exploring, manipulating, and storing the information necessary for creating the extensive diversity characteristic of la Meme. The computer rescued him from sinking under mountains of sketch paper! Instantly, in front of the user, he was able to produce, change, modify, and even redesign the facade and the plan according to
needs and feelings, or simply to satisfy curiosity. He utilized the computer drawings as a collage. He overlayed facade components on the facade profile and then added various material textures. Designing became a deep exploration into architectural possibilities rather than merely a fulfillment of some programmatic requirements.

In Kroll's hands, Computer-Aided Design (CAD) became more than a tool for drawing perspective and facades; it is the key to alleviating work that is repetitive and time consuming. CAD facilitated and sped up the design of the structural and floor plan layouts, the execution of standardized details, the constant upgrading of information, the cost estimation, the production of drawings, and the communication between client, architect, and factory, especially well illustrated in some of Kroll's other projects. The use of CAD is a further step into the process of industrialization.

The use of the computer in association with the SAR modular coordination system in achieving the various levels of standardization and product compatibility has opened new dimensions in the production of architecture. One of them is that the architect can now spend more time with the client and satisfy the requirements of the users' participation, and less time at the drafting table, making the innumerable corrections that are the burden and also the result of that users' participation.

Kroll proved with la Meme that this design process is not utopian. He also proved that the final product may, to a very large extent, express diversity without adding costs, and represents what Venturi calls a decent architecture and not merely a structural combination of elements with no respect for people, tradition, and environment.
PERFORMANCE CRITERIA

In Kroll's building in Woluwe, it is difficult to differentiate between variability and diversifiability. Variability, as the number of different components of the same type, is rather hard to evaluate because of the high degree of diversifiability of components. Both concepts are inextricably related. The facade of la Meme appears to be built from about 45 components that were assembled together to create a dynamic patchwork, an architectural quilt (fig. 124)!

Here, variability is based on panel dimensions rather than on functional or material concerns. A solid wood panel may be exchanged for an aluminum panel with the same width and length, for instance; the same applies to window and balcony panels. As opposed to Bofill's projects, in Kroll's, variability seems to have surpassed diversifiability: there are more components of the same type than components of different types. In either case, because most of the components were already available at many manufacturers, they were not created for this project. To some extent, they were already mass-produced and, therefore, relatively inexpensive. This was the key in Kroll's introduction of such a high degree of variation and diversity.

With Kroll's extensive catalog of components (fig. 111), there is no need to trim a component so as to fit it into a particular position. The building system is so open that he may, with few restrictions, choose another one already available. They do not exclude the possibility of adapting the component to new functions. Clearly, part of the component may be replaced very easily. The process of trading off between solid and void, between small and large elements, between materials, colors, and textures is theoretically limitless as long as they are
available and compatible with the open system that has been chosen. Adaptability allows the repair process to be very simple and inexpensive.

The one area where la Meme has performed well was in additivity of elements or subcomponents to the facade components. Shadow devices, shutters, flower boxes, flags, and lights are welcomed and can be simply fixed on the wooden frame of most components. In many cases manufacturers have already provided all kinds of hooking hardware, options, and catalog gadgets on the components itself. The components are not exclusive to this project and can be bought from many manufacturers; they are already mass produced and less expensive than newly created and untested components.

Kroll deeply believes that diversity does not cost more than uniformity, but he did not know exactly how to prove it. For him, and for the author as well, it seems that diversity is the "essence of industrialization". Architecture without diversity is only an unpleasant residue of 'heavy prefabrication' and closed system, too much like many post-World War II modern buildings. For Kroll, the repetition in this kind of architecture is an anachronism. The machine-era has the potential to carry Architecture far beyond the production of uniform and simplistic components that only express the mechanical aspect of factory work and production and that do reflect neither the actual conditions of society which are diversified and complex nor its sophisticated way of living (fig. 112).

The main problem with diversifiability is the cost of the facade components which is the result, not only of having to manufacture a new mold for each component, but of having to recycle a mold successively during the production process. Each modification of a mold must meet quality standards of perfection,
which is very expensive as surface, joints, and angles must be transformed (31). An aspect of the solution, as proposed by Kroll, is that the mechanical, electrical, and plumbing subsystems should not be included in facade components but rather be installed in party walls and/or partitions, and slabs. This would make facade components simpler to produce, assemble, and install, and would allow a greater diversity in the facade without encountering problems caused by these 'technical equipment'. Kroll advocates the standardization of the tool (molds) and not the product, or the inhabitant!

From another point of view, Kroll and his Atelier found that designing diversified facades in response to users' needs can be very exhausting and that hundreds of hours may be necessary to finally agree on the final result. As a matter of fact, they spent thousands of hours altogether to design the facade at Woluwe. The introduction of the computer was inevitable and was a blessing for working out a plan that is intelligible, and a facade that satisfies both parties (fig. 113–114). Will we see an Architecture of industrialized components? This is one of Kroll's dreams.

Kroll says that everyone likes the idea of change, but few are brave enough to deal with it and to design a building in this perspective. When one starts with the idea of change, he must have an idea of what the change can or could produce! The idea of change in architecture includes both inside and outside transformations, the latter going far beyond the facade, e.g., roads, walkways, and landscape (84).

Changeability presupposes codes, norms, dimensional and modular coordination, tolerances, control of materials, quality, and of subcontractors contributions to
the assembly (31). Changeability goes further than trading off a subelement for another one. If a drastic change of function is desired, the replacement of a complete component should also be possible. Because of product compatibility, the edges of the components and the joints in the support system should allow the removal of an entire element and its replacement by another of the same type with the same modular dimensions. Such a replacement may be, however, more difficult to accomplish, especially if the replacement of a component or a subelement which is of a material that is incompatible with the adjacent elements. In the case of La Meme, there have been no change since the end of construction.

As flexibility within a room unit may be rather limited if it is of small dimensions, it is, nevertheless, possible to adjust the room to users' needs so as to reinterpret the usable space for each new inhabitant. Within the partition system, the position of a door may be changed, the structural system may be used as an anchor system, and vertical arrangement of furniture may vary according to ceiling heights (fig. 115-118). As far as exterior extensions are considered, there is not much a user can do. On a relatively flat facade, a component may be exchanged for a greenhouse or a bay window. This will allow some additional square footage in the apartment. Terraces may also be covered for the same purpose. However, further development of the floor plan toward the outside does not seem possible unless an additional structural system is provided. This eventuality does not seem to have been forecast; the building is, therefore, unlikely to support exterior extensions easily, as opposed to Hertzberger's project in Amsterdam, where exterior extension possibility or tractability is a dominant feature.
Interior tractability is probably better shown in Kroll's la Meme than in any other project, and especially if compared to those of Bofill in St-Quentin-en-Yvelines and Hertzberger in Amsterdam. In la Meme, tractability is possible only because of the building system (fig. 119). The 'promenade of columns' is the first indication that there is no regular interior order to be respected as defined by structural alignment, and that these columns fulfill the only purpose for which they are intended: transferring load (fig. 120). In no case, are they limiting or bounding interior spaces. This is why Kroll found that there was no reason to position the columns in a rigid way, as the structural system of most modern post-World War II projects had been designed. As a result of this free positioning, a column may appear anywhere in the floor plan layout and, as such, becomes a very positive element in space definition within the room unit, or as a support structure for furnishings such as bookshelves (fig. 121-122). Like Hertzberger, Kroll sees the multi-use of a component as the key to reinterpreting space and to stimulating people's participation. In addition to the irregular column arrangement, plan tractability is permitted because of the flat slabs. Thicker than normal, they contain ducts and piping. The partitions, since there is no party wall, can be moved freely, without being interrupted by any protrusions on the ceiling or the floor. The floor may be, therefore, modified at any time around a fixed central service core that includes stairs and sanitary (fig. 123). Kroll mentioned that flexibility and tractability are not permitted at la Meme: university management.

La Meme does not perform very well when judged by the criterion of tractability, i.e., defined as the extension of one's dwelling. In fact, the building was not intended for transformation of that kind. The building system, in its actual form, is responsible for preventing the built form from growing. As
compared with Bofill's project, however, it leaves open the possibility of extension with some relatively small technical efforts, since additional masonry or poured-in-place concrete can be easily put in place. Moreover, an extension would not disturb the actual facade composition: it may even enhance it. Kroll's anarchitecture, as described by many, is rather a nice disorder that would profit from continuous growth. There is no risk of engendering chaos in the facade: it is already there! These allusions to nice disorder and chaos are meant to relate Kroll's architecture to vernacular architecture or to architecture without architect, which is, in the eyes of many, the real architecture because it expresses people's needs, tastes, and feelings, rather than architects' art. Unlike Bofill's project in St-Quentin-en-Yvelines, la Meme has no static equilibrium to violate because it is a dynamic built form.

Kroll's system is so adaptable that, theoretically, it should accept components that do not exist yet. This is feasible only because of the simplicity of the infill components and the sophistication of the support systems. Kroll is following the SAR methodology very closely with its notions of infill and support. Subsystems such as electricity, plumbing, and heating, do not interfere with the replacement of the facade components because they are part of the structural system and are included in the slabs and party walls. The infill system which is under the users' control, is in many ways transformable. The support system, as its name indicates supports the infill and allows for flexibility within the apartment and tractability if the dwelling is to be extended.
Durability of the infill is not a criterion of the greatest importance in Kroll’s la Meme, as far as permanence of the materials is concerned. Kroll did not bother with material life cycle when he decided to have diversifiability be his main design criterion. He noted that the materials used in the buildings surrounding his project were constantly being replaced and/or repaired, according to necessity. This process of replacement and repair is evolutionary and allows the introduction of new materials and also new shapes into existing forms and patterns. Kroll wanted the same thing to happen in la Meme: to bring to it the same 'building life' found in the vernacular architecture. His collection of components is, therefore, not only a melting pot of dissimilar elements, nor is it a fantasy effort at originality: it is a 'carbon copy' of what has occurred in the neighborhood. Durability, understood as permanence of materials, is irrelevant in this project, as long as only facade components are involved. Criteria important to Kroll were the permanence of choice, changes, and evolution that express users' needs and preferences. It is possible that Kroll consciously wanted short-life cycle materials so as to get people involved, as soon as the building was completed, in the process of change by using, adapting, and transforming their environment.

Kroll’s idea of durability is thus diametrically opposed to Bofill’s in his project in St-Quentin-en-Yvelines. Permanence and durability were for Bofill priorities that a building should have to remain as constructed: i.e., as a monument, as a symbol. For Bofill, the integrity of the design must be maintained above everything, even above people’s well-being, to ensure the continuity of the architect's work throughout the ages. Bofill's choice of using concrete is consistent with this goal. On the one hand Kroll builds for people and creates an 'Architecture without Architect' where the architect is rather a tool than a
creator in the process of designing a building. And on the other hand Bofill, imbued with the spirit of the classic architect, transmits his fame and masterpiece to posterity without paying attention to the people for whom, after all, he is designing. Is he designing for himself and for the architectural magazines? A pragmatic architect looking for users' satisfaction, and an extravagant architect looking for celebrity: they both have transposed, to a high degree of implication their personality into their projects.

The aspect of permutability is probably better shown and better achieved in Kroll's project of la Meme than in Bofill's and even in Hertzberger's (fig. 125). La Meme is less geometrically rigid and more spatially flexible than Bofill's project; the facade composition is virtually unassailable in the latter case. Permutability is possible throughout the facade, as long as the components to be exchanged, whatever their type is, are of the same modular dimensions. A solid panel may be exchanged for a greenhouse one, for instance, or a wooden window panel for a aluminum balcony, just as well. What would have been possible and easier with Bofill's all-concrete panels is, with la Meme, a little more complicated, because of the diversity of joints and materials. Not only is dimensional coordination necessary to allow the criterion of permutability to be fully achieved without damaging the building's integrity, but also of crucial importance are the notions of joint standardization and product compatibility. Kroll could not have neglected these two aspects that, otherwise, would have simply ruined the entire facade. In fact, the facade would not fulfill one of its primary roles which is to be an enclosure of a structure and a protective skin against rain, cold and heat. It is not clear how Kroll managed to insure
product compatibility and how he standardized the joints between materials of identical and different kinds.
Fig. 85: Site Plan.
Fig. 86: Perspective.
Fig. 87: La Meme with Hospital. Fig. 88: ibidem.
Fig. 89: Restaurant and Services.
Fig. 90: General View. Fig. 91: "Links" with the Neighbourhood.
Fig. 92: Collection of Materials.
Fig. 94: Materials, Textures, and Colors.
Fig. 95: Structural Arrangement.
Fig. 96: Workers' Art Work.  
Fig. 97: ibidem.
Fig. 98: Architectonic Facade.
Fig. 100: Structural System.
Fig. 101: ibidem.
Fig. 102: Floor Plan Layouts of la Meme.
Fig. 103: Tartan Grid on Floor Plan. Fig. 104: Tartan Grid on Facade.
Fig. 105: Explanation of Tartan Grid.
Fig. 106: SAR Tartan Grid. Fig. 107: Kroll Tartan Grid.
Fig. 108: Facade Components.
Fig. 109: Catalog of Components.
Fig. 110: ibidem.
Fig. 111: Catalog of Components.
Fig. 112: Sophisticated Building for Sophisticated Society.
Fig. 113: Tartan Grid on Plan.
Fig. 114: Tartan Grid on Facade.
Fig. 115: Interior.
Fig. 116: Interior. Fig. 117: ibidem. Fig. 118: ibidem.
Fig. 119: Interior Open Space. Fig. 120: Position of Columns.
Fig. 121: Interior spaces.
Fig. 122: ibidem.
Fig. 123: Various Interior Arrangements.
Fig. 124: Architectural Quilt.
Fig. 125: Permutations.
CHAPTER TEN
HERTZBERGER'S OLD PEOPLE'S CENTER/'DE DRIE HOVEN'.
IN AMSTERDAM, HOLLAND

In Holland, the social problem of disabled and old people's care is taken very seriously and raises a high level of community concern. The Dutch tend to gather their old people in large community buildings so as to offer them the medical services and personal care that their condition requires. Therefore, the designer is faced with the conception of a building that should meet the specific needs of life for an aged community (88).

PROJECT

Herman Hertzberger was concerned with and aware of the problem of housing for elderly and disabled people many years before obtaining, in the early 1970's, the commission for designing the Old People's Center in Amsterdam (fig. 126).

The Old People's Center, also called 'De Drie Hoven', has been constructed primarily for an aged population who may be physically or mentally disabled and needs special care, and more important, attention (96). 'De Drie Hoven' is a large housing and medical complex composed of several 'functional' wings. These various sectoral wings are elaborated by means of an amoeba-like floor plan organization (fig. 127). They all converge at a central building where they connect, and where facilities including kitchens, workshops, laundry, store-rooms, and the central meeting place are located (88-96) (fig. 128).

The complex includes 55 apartments for married couples. The layout of these apartments accommodates the special needs of married couples as well as of
disabled people (fig. 129). The Old People's Home consists of 171 living units for 190 people. Each unit has its private room, complete bathroom, and kitchen facilities. The Institution for permanent care provides 20 beds for chronic invalids and mentally disturbed people. One, two, and four bedrooms are grouped in clusters of 25 people around a common meeting place (fig. 130). These groupings are close to the nursing home which provides comprehensive medical services. To support the center, a staff quarters of 21 two-roomed apartments with cooking facilities, 16 rooms for nurses, 3 rooms with cooking facilities, administrators' apartments, and one technician's apartment has been provided (fig. 131).

**APPROACH**

The main goal of this project was to provide people with a community life similar to that they had been accustomed to before coming to the Old People's Center. Social interactions between the residents, the staff, the visitors, and the neighborhood are central to the design of this project. This approach is very responsible socially, as far as health care is concerned, and tends to differ from other developed countries where older people stay in their original, familial, and neighborhood context. The Dutch are very concerned with the medical care and attention old people require which they consider more important than maintaining people's original living situation. Projects such as the Old People Center tries to recreate a community context in association with medical facilities (88)(fig. 132–133).

In this specific project, Herman Hertzberger was dealing with the users, not only in terms of their needs, but also in terms of the duration of their stay at
the Old People's Center, which is often until death. Residents were regarded as temporary or permanent. This simple distinction creates a very interesting challenge for the architect in the interpretation of space and program. These two categories of residents made it necessary to introduce the notions of reinterpretation and transformation of space and function according to people's health condition. Hertzberger had to forecast transformations within the room units and within the entire complex (88). In addition, the architect had to consider that the building was not only intended for residents under care, but also for the staff providing it.

CONCEPT

Unlike Bofill's and Kroll's projects, which dealt for one with the facade and the other with the exterior environment as a design-guiding factor and from which they proceeded, that is from the outside in, Hertzberger had a totally different design approach. As a primary source of information, he focused on the users with their specific requirements arising from physical or mental deficiencies and based his design on ergonomics. He explored the vertical changes in the position of 'things and sights' according to people's ability to reach and look through them (fig. 134). Paying careful attention to users' needs and capabilities, he designed from the inside out in a fashion more characteristic of some of the Functionalists of the Modern Movement (fig. 135). One of Hertzberger's main preoccupations was, therefore, to fulfill with a clear understanding of the users' needs, the programmatic aspects of the project before any other concerns.
Hertzberger is well aware of the alienation that exists between modern architecture and its users, and he believes that the only way to end it is to involve the residents of his buildings in the physical transformation of their own environment by offering them the mechanisms to do so. In that concept, he follows, as Lucien Kroll did, in the footsteps of his countryman N. John Habraken who in the 1960's developed and elaborated the SAR infill and support concept. Hertzberger advocates the SAR methodology because he believes it allows a greater involvement of the client and a considerable degree of choice for the users (95).

"The point, therefore, is to arrive at an architecture that does not lose its identity and become chaotic when the users do something else with it than originally envisaged. To put it more strongly: architecture should indeed encourage the users to influence it wherever possible, in order thus not only to strengthen the architectural identity but also to use the building in such way that it contributes to their own identity. Structuralism has shown how effective this process is in language, and our persistent reference to this is because it thus indicates a direction for architecture". 1 Herman Hertzberger

While many theorists, including Lucien Kroll, advocate freedom and flexibility, Hertzberger supports the primacy of architectural form in the same vein as the Modernists. The project of the Old People's Center is, therefore, not elaborated of the same level of users' participation or involvement as Kroll's la Meme was. Hertzberger deeply feels that it is the architect's role and responsibility to provide people with a basic architectural framework and a scenario of interventions for some creative participation (fig. 136).

"Although I consider the use as main source of inspiration for my work, I never dealt with participation in design in the sense of leaving parts of the design to users and inhabitants. The idea of my work has

been essentially different and based on the principle to make form
and space such that it will be interpreted in different ways, according
to individual requirements".¹
Herman Hertzberger

For the Old People’s Center, he made all the decisions, believing that they were
in the users’ best interests and gave them the limited or controlled responsibility
for expressing their own interpretation of space. He thus expected that forms
and spaces would invite users to take possession of them, and hoped to interest
and implicate the inhabitants in their environment after the building’s completion.
Interventions such as adding concrete blocks to modify or adjust the spaces to
various situations were possible and encouraged (fig. 133–134). In that sense,
Hertzberger defines creativity as the ability to see secondary and tertiary
possibilities of intervention in forms and objects (95) (fig. 137).

SYSTEM

Changeability was as important for Hertzberger as diversifiability was for Kroll
in la Meme. Changeability, which in the case of Hertzberger includes the idea
of mobility as a performance criterion, is also his leading motto in guiding the
design process of ‘De Drie Hoven’. To fully express his design approach,
Hertzberger relied upon an idiosyncratic building system that is composed of a
visually impressive concrete structural frame and a catalog of facade components
so that the enclosing walls can be made to suit changing purposes (fig. 138).

This prefabricated building system is fairly simply elaborated and includes a post
and beam structural system with slabs and infill facade components (fig. 139).

¹ ibidem.
The structural system is composed of one-storey high pre-cast and pre-stressed concrete columns that are differentiated only by the numbers of nibs, from 2 to 4, projecting just below the top of the column (fig. 140). The shape of the columns is dictated by balance principles. Their specific use will correspond to the continuous, T, or cross-type of jointing necessary for the development of the facade. This building system was developed by Hertzberger for an earlier project and improved since so as to resolve, by the addition of the projecting nibs, the problem of turning the corner and allowing identical facade patterns on the elevations (fig. 141).

The columns are placed on top of each other and are braced horizontally on the nibs by one of the three sizes of concrete beams that determine the spacing between them. This arrangement creates a rigid and tri-dimensional structural frame that will support slabs and infill components (fig. 140-142).

Like some flat slabs, the longitudinal double-T section slabs of various modular lengths are installed perpendicular to the structural frame (fig. 140-142). The joint between slabs and beams is covered along its full width by an additional finishing parapet component that lies on top of the bracing beam (fig. 143-144).

The 5 cm thick infill wooden frame facade panels are divided into two parts. The bottom part is fixed and made of wood and supports the lighter top part. This upper part is in turn divided into three horizontal zones: the upper, the middle, and the lower zone. The positions of the horizontal zones are established according to the ergonomics required by the users' physical condition and the activities they are performing, and also by the functional requirements of the room (fig. 139).
There are three different types of facade components based on modular dimensional sizes. The subcomponents assembled into a facade component are classified into three groups, also according to their horizontal positions in the facade. There are four different types: fixed and open, clear or frosted window panels and eblind panels for each of the horizontal zones (fig. 145). The composition of a single facade component may require up to 12 of these subcomponents.

There is, however, one aspect of Hertzberger's building system that is difficult to understand and that might appear redundant. The post and beam slab system is strong enough to carry the weight of each floor and to maintain the rigidity of the entire building. However, party walls between single units are made of solid concrete blocks. The use of this heavy material, in addition to making both the room unit and the building less flexible and tractable, it is not necessary, structurally speaking. There seems to be no explanation except for Hertzberger's preference of concrete blocks as opposed to traditional materials, to understand his use of such an unmanageable material.

"The reasons for using concrete blocks may be the following: it is part of a strategy to have the same material inside and outside in order to be able to overstate or understate their nature, their relativity and interpenetration. To use, for instance, bricks would in this context be too sombre in the interior. (Besides, brickwork for me is too connected with traditional Dutch regionalism.)"

Herman Hertzberger

MODULAR COORDINATION

The success of this project is based on many factors among which modular coordination played a determining role in the design of the building, and in the production and the erection of the building system components. The Old People's Center design is based on a structural grid, as were many modern projects in which the span was the guiding criterion for defining space. Here, Hertzberger utilized an initial module of 920 mm that he developed into 2M, 3M, and 4M. The 2M loggia component is the only one of its type, while the 3M and 4M types are rather limitless in terms of variations (fig. 146). The structural grid is, therefore, either 1840 mm, 2760 mm, or 3680 mm wide. On each side of the 300 mm thick columns, he placed either one of the three types of infill facade components that are either 1540 mm, 2460 mm, or 3380 mm wide. (fig. 139).

Modular coordination is extended further in some areas of the building. Hertzberger has developed it up to 8M in section, by using combinations of the three first modules. For example, the 8M may be equal to 2M + 2M + 2M + 2M or 3M + 3M + 2M. The same combinations are also applicable to the 7M and 6M (fig. 147).

"For me it comes down to making form as "competence", appropriate to generate "performances" or as I used to formulate it: make form as an instrument rather than an apparatus".

Herman Hertzberger

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STANDARDIZATION

Aside from dimensional standardization applied to structural grid and room size, there is also the standardization of joints which enables the numerous subcomponents to be interchangeable. The use of the same material for the facade components allows the standardization of joints more easily. The uniformity of material serves one main purpose: to avoid the problem of material compatibility and jointing details, as appear in Kroll’s la Meme. In that sense, Hertzberger’s work is closer to Bofill’s in St-Quentin-en-Yvelines where rationalization of materials, concrete in that case, enabled more elaborate detailing. Hertzberger maintains that, in spite of uniformity of shapes, the unity of materials and building elements and the way in which these elements are assembled bring clarity and become an architectural language (fig. 148).

..."these principles lead to a building periphery composed of a multitude of facets. And because these facets are all constructed of the same material they are in fact many views of the same thing. In other words, the emphasis is more on making the parts interpenetrable than on the whole, yet the whole is represented in the parts". ¹

Herman Hertzberger

Hertzberger limited the form of the subcomponents to a rectangular shape. Within the middle zone, the combination of B + C will give E; C + D = B, and consequently, E may also be equal to C + C + D. Between zones, similar relations apply: F + F = E, for instance. Component sizes are not arbitrarily determined: for example, component D is the remaining part of component E, when a perfect square, based on E’s smaller side, is removed (fig. 149).

¹ ibidem.
It is the standardization of dimensions that most evidently allows the possibility of exchanging subcomponents for one another, but it is the standardization of shapes or forms that bring them together and that creates unity. With Hertzberger's rational style of design unity of the facade unity appears not only within the horizontal zoning, but also in the vertical one. By means of this two-way formal coordination, Hertzberger avoided chaos and unaesthetic facade composition, but maintained variability, choice, and order, either one of which both Bofill and Kroll have missed in their own projects (fig. 146).

LIMITATION OF COMPONENTS

In the field of prefabricated housing, Hertzberger's Old People's Center is an outstanding example of the advantages of limitation of components. Not only did Hertzberger restrict the structural elements to three types of columns, three lengths of beams and two types of floor slabs, he also limited the number of facade components without encountering the usual dullness of many modern prefabricated buildings (fig. 150). In addition, he introduced variations in a rational way such as few contemporary architects had done before him, and his project may be considered as a model for designing future prefabricated projects using an industrialized process.

He certainly agrees with Lucien Kroll in that the tools must be limited, not the product. His main achievement is the development of only three types of facade components differing only in their size, that may be composed of some of the 12 subcomponents available. He, therefore, limited the diversifiability of components, but increased their variability. The variations are, to some extent, limitless, since hundreds of combinations within a facade component are possible.
From a really basic, almost too modest, catalog of facade components and a more elaborate catalog of subcomponents. Hertzberger created an unusual facade which constantly evolves according to users' needs (fig. 147). This idea of using more subcomponents than components is consistent with his concept of change, or perpetual transformation and allows for the design possibilities that he and his team could not have thought of during the design process.

To ensure the equilibrium of the system as a whole in each new situation, i.e., that it continues to function, the components must be capable of serving different purposes".1
Herman Hertzberger

PREFABRICATION

Hertzberger obviously has a sense of what prefabrication should be like. Even though his writings are not loquacious about it, it is clear through his work, that prefabricated open systems have, especially with Hertzberger's development of them, a very promising future. His facade components are a paradigm of what prefabrication should achieve: variability. With his project, Hertzberger has proven that being rational does not mean being inflexible and boring.

Whether the building components were prefabricated off-site or not is not really important. They were produced for this project in sufficient quantity eto be really a means of cost saving. One of the great finest achievements of this project is, of course, its small number of components; but another is the use of most components a purpose other than the one for which they have been created.

But most objects and forms have, besides that single purpose for which they are designed and to which they generally owe their name, an added value and dignity, and hence potentially a far greater efficacy. Thus greater efficacy, which we call polyvalence and which comes closest to 'competence', is the characteristic we now wish to emphasize as a criterion of design.¹

Herman Hertzberger

This extensive use of the same components enhances the role of each component and shows how deeply Hertzberger went in his research to reduce the number of components and how far he wanted to go in their use, and consequently how important the cost saving aspect was for him. As a means of cost saving, this multi-use of components will, therefore, enable both the users and the architect to redistribute any cost surplus to other parts of the building so as to stimulate people's involvement into it, for instance. To many people, this is an attitude at which prefabrication should aim.

PERFORMANCE CRITERIA

The criterion of adaptability is highly applicable to this project. Because Hertzberger's design of the facade components uses many subcomponents, adaptability, understood as a minor change in the component, is simple to be performed. Using a diversified catalog of subcomponents, adaptability represents any kind of modification within the facade component that will not destroy the components' integrity, the building system or the adjacent subcomponents. These changes within the components are made possible because of Hertzberger's previous selection of subcomponents and because of the well elaborated modular coordination used by him for both the infill and support systems (fig. 151).

As opposed to Bofill's St-Quentin-en-Yvelines which has been judged to be very poor according to the criterion of additivity, the Old People's Center encourages people to add various kinds of elements on to the facade to respond to climatic requirements or users' preferences. In the summer, for instance, red and orange sun blinds sprout all over the building, as they are easily attached to the wooden frame of the components (fig. 152). Moreover, Hertzberger has provided, inside and outside, many beams without assigning to them any specific function: they rapidly became support for all sorts of curtains, flags, and mobiles. (95) (fig. 153).

Changeability, defined as the replacement of one component by an identical one, is not a very important criterion in this project. In fact, it was not really important since many solutions were good for one function. The facade components are broken down into many subcomponents, so that, before changing an entire component, there are several possibilities to adapt it, with little effort, by replacing some of the subcomponents. This open possibility is due to the impressive variability that occurs within one type of component. However, if necessary, it is just as easy to replace the entire facade component.

The concept of permanence does not dominate at 'De Drie Hoven' because of the nature of its residents. By using a wooden frame infill system, Hertzberger left the building open to any transformation or repair, and thus accentuated his concept of changeability. Like Kroll's project and unlike Bofill's, in this project the process of change does not require skilled workers or special equipment and may be performed by maintenance people at any time after the completion of the building.
In principle, at least, the subcomponents could all be interchanged with technical assistance if the function of the room were altered or if users' requirements were modified due to the development of their physical or mental condition. Even though the principle of variability is quite mechanical, and follows a predetermined set of rules, order, and sequence, it presents an impressive degree of variation in both column spacing and arrangement, and in the subcomponents within the panels. The whole facade is then put somewhat more elegant and less boring.

At 'De Drie Hoven' the almost permanently unfinished setting, as described by Hertzberger, is in constant evolution and that is in many ways Hertzberger's reply to users' participation and to flexibility (fig. 154). It is consistent with his concept of changeability. Due to minimum square footage, rearrangement of the living units is practically impossible (98) (fig. 155).

..."Constant changes occur within the organization, thereby requiring frequent adjustments to the size of the different departments. The building must be capable of accommodating the internal forces, while the building as a whole must continue to function in every respect at all times. This means that permanent adaptability [flexibility and tractability] is a precondition of the design". 1
Herman Hertzberger

"From the very beginning the plan was developed to a programme which enabled it to fulfill a large variety of requirements and regulations. Blocks of different dimensions can be added as desired, so that the structure was created which was then filled in, as it were, in moment. This structural language is assumed to be strong enough to incorporate subsequent additions, however, chaotic, without disturbing the sense of unity". 2

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1 "Questionnaire to Hertzberger", in Architecture + Urbanism (A+U)., No 159, December 1983, pp. 40-43.

"From the very beginning the plan was programmed to enable it to fulfill the large variety of requirements and regulations which had to be met, and blocks of different dimensions can be added to it as desired. So a structure comes into being in which many things can be altered while in use, and where the occupants, improvising if need be can find answers to needs which could not be anticipated during its completion".  

The criterion of permutability is not really applicable to this project. Following a major change of function, there is, in fact, no need to substitute one component for another, since it is so easy to modify the existing facade by using the extensive and diversified catalog of subcomponents.

The projects exhibits a high degree of tractability, and not only on the facade. The nibs on the columns appear throughout the project and are a sign that the floor plan may be extended (fig. 156-157). These structural signs are also noticeable in the solid vertical circulation shaft, and reinforce the possibility of the extension of the whole complex. Tractability is more difficult to achieve on the inside of the project than on the inside. The concrete-block party walls and the sanitation units prevent easy extension of the exterior, such as the combination of two apartments into one larger unit. As explained by Rijk Rietveld, flexibility and tractability represent the building potential for changes. Up to now, nothing occurred at the Old People's Center.

"The complex is, then, essentially unfinished, much as a town centre is constantly being revised within its basic street system, according to changing requirements".

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"The structure can be regarded as incomplete in another aspect as well, namely in the colourless, grey, unfinished appearance of the materials used. It is hoped that this will stimulate the residents into exerting their influence in shaping their environment to their liking. The building is like an instrument in that only by investing their manipulation of it with love and care, are its users truly able to appropriate it and become its occupants".\(^1\)

Fig. 126: General View.
Fig. 127: Floor Plan.
Fig. 128: Meeting Place.
Fig. 129: Rooms for Married Couple.
Fig. 130: Rooms.
Fig. 131: Apartments.
Fig. 132: Interior Street.
Fig. 133: Corridors and Meeting Places.
Fig. 134: Vertical Zoning
Fig. 135: Old People's Home, Germany, 1931.

PART THREE/CHAPTER TEN: HERTZBERGER'S OLD PEOPLE CENTER
Fig. 136: Users' Interventions.
Fig. 137: Users' Interventions.
Fig. 138: View of the Facade.
Fig. 139: Structural and Infill Systems.
Fig. 140: Structural Elements.
Fig. 141: Columns. Fig. 142: Structural Assembly.
Fig. 143: Jointing.
Fig. 144: Section.
Fig. 145: Catalog of Components. Fig. 146: Variations within Components. Fig. 147: Modular Development.
Fig. 148: Assembly.
Fig. 149: Components.
Fig. 150: Structural Composition.
Fig. 151: Infill and Support.
Fig. 152: Elements Added.
Fig. 153: Structural Elements.
Fig. 154: Users' Participation.
Fig. 155: Users' Participation.
Fig. 156: Potential Structure for Extensions.
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