CREATIVITY AND MODULARITY IN ARCHITECTURE

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ABSTRACT

The Modern Movement in Architecture put forward industrialization, mass production and standardization among its most important banners. At the end of the century those principles are partially applied. However, the overwhelming growing of exchanges and the purchase of artifacts coming form all over the world to be assembled in order to create new artifacts, determines that in the short span, a world wide standardization becomes unavoidable. Designers should be aware about this imminent issue. Working with standard objects means modular thinking. If modules are conceived as sort of constraining entities framing the mind, creative thinking is facing a gloomy prospect. Creativity and freedom seem to be jeopardized by ready made objects. In fact, from the beginning of design as a form-giving activity it exists a dialectic between creativity and feasibility. It is not surprising since designing is essentially the transformation of ideas into real world objects. Nonetheless, the increasing standardization and the indispensable use of computers are exasperating that dialectics. In this paper is argued that if the characteristics of modular procedures are used in the early stage of the design process to prompt the form for further adjustment, creative thinking is released from excessive awareness about dimensional constraints. The first part of the paper is devoted to the description of the contextual trends that make modular thinking relevant. In the second part some propositions about the use of computer systems to generate “modular freedom” are exposed together with examples illustrating the proposed process.

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A word on the globalized world

Globalization trends go in the sense of inclusion embracing every object and every action performed in the world. In son doing, particular things are confused with the general case. Details are ignored or chopped out in order to easily packing together objects and procedures. This generalization trend has its counterpart in an equally strong specialization trend. Both trends grow symmetrically feeding each other in a recurrent manner. The urgent need to generalize is a consequence of the fantastic development of the multiple ways the world is explored. Every discipline has exploded into different branches each one going to its own. This exuberant growing make the ones overlap on the others. Where is nowadays the frontier between Medicine and Engineering? Biology has become a sort of mechanics of compounds and surgery is a machine dependent activity. At its turn Engineering dissolves itself in number of particular technologies being strongly computer dependent.

At this point the branches prevent to see the forest and the forest is taken for the branches. It is a somewhat tropical forest where interwoven branches have taken the place of trees; stems are ignored not to speak about roots. In the global mood, generalization is in fact a kind of simplification because the loss of referential points conceals the path from the particular to the general and viceversa. In order to cope with the bulk of particular objects, which have lost their original stem, parcels of adjacent objects are cut out from the whole following rather practical purposes. Thus “new” disciplines are created. These are composite bodies of knowledge owing their existence to the clustering of particular procedures coming from the “old” disciplines. Clearly, every new parcel is a package of knowledge having no other structure than just occasional connections. So what appears to be a generalization process is a cutting down operation to ease the packing operation.

This state of affairs leads to standardize objects (ideal or material). A standard object is one whose particular characteristics have been reduced as much as possible aiming to make it compatible with other objects. This means that every part of standardized system although sharply specialized, must resign its profile surrending to the rule of coexistence. This is true for objects as well as for activities, procedures and even persons. As things and persons are cut down to fit into the general cut down parcels they are separated from their stems and roots: they are just leaves of the global foliage. People inhabiting globalized areas accomplish the same ritual activities moving through standardized environments. Office buildings, high rise buildings, factories, hotels, shopping centres, stations and airports, etc, are altogether the same, no matter which country they could be. These are what the French anthropologist Marc Auge (1998) calls the “no-place” buildings because they have no signs of appertainance but just symbols of a common global trunk. Images, procedures, instructions and recipes travel easily trough the world ruling clothes and food (Christian Dior, Mc Donald´s, Domino´s Pizza…) as well as prescribed rituals.

Let us finish the present section with a good example of the way things are going at the moment. Consider this paper itself. It has been written following precise prescriptions; it has been sent to participate in an academic/professional ritual; it deals with “old/new” subjects contained in a quite new created parcel whose label is “Architectural Design/Computers/Creativity”; it has the usual “conference standard” format so as to be packed together with other standardized papers; probably the resulting proceedings will be identified by an ISBN number, finally, authors and organizers will be happy if a Library Congress Catalog Number is obtained.

A word on standardization

Of course the idea of standardization is a quite old one. The Industrial Revolution of the nineteenth century accelerated the movement towards unification of systems of weights and measures. However, standards were the matter of the separate industrial or administrative fields each one obeying to the particularities of the objects they dealt with. It was only around the second war period that in many countries studies aiming to establish general standards started through the creation of national agencies. The result was a constellation of overlapping norms. Being firmly anchored on national industries they have an inertial weight making difficult the integration process. Despite this, the needs of a globalized market lead fatefully to generalized systems. Therefore design tasks will be increasingly devoted to the combination of standard objects following precise prescriptions.

In which concerns architectural design the Modern Movement promises a fantastic development of professional activity through industrialization and mass production, standarization was the axial force organizing design and production. Some more recent movements have taken the same banners insisting on industrial assembled components. Although it seemed to go in the right direction results have been deceivingly restricted to some local cases. Probably the rationale for this can be found in the very nature of Architecture which is reluctant to accept exogenous compromises.
Meanwhile the building industry has been going ahead riding on new technologies, just in the same way as during the second half of the nineteenth century when architects were surpassed by the evolution of the surrounding world.

A word on modules and modularity

In regard to Architecture, even if a reduced standard system is attempted, number of entities ought to be combined taking into account their respective nature in connection with the function they accomplish into the whole. From design tasks to construction tasks interlocked aspects need to be considered. All these are ultimately contained by spatial forms. When spatial forms are integrated in a standardized system they become modules. These result from related geometrical characteristics (shapes) and co-ordinated dimensions (measures).

It is worth noting that in architecture the concept of module has many meanings depending on the context it is used. The word **module** can be used to signify some abstract numerical entity as well as some material object. At its origin module was the size of the diameter or the semidiameter of the base of a column, taken as a unit of measure by which the proportions of the others parts of classical buildings were regulated. In this sense a module is referred to as a particular measure governing the composition of a particular building. It does not express precise dimensional data, even though that kind of module became a sort of universal ratio (institutionalized by Vitruvius). When a module is defined by a size (or sizes) intended to be repeated in some co-ordinated manner it represents a unit of a particular modular system. Moreover, if the module has a shape determined by relations between parts and its corresponding sizes it becomes an element, which under certain rules can tesselate the plane or the tridimensional space. Finally, when shapes and sizes have their origin in some building component (as tiles or iron sheets to cover roofs) it conveys the idea of materiality of the thing even if the module itself remains an abstract entity.

This is not the place to go into detail about modules and their co-ordination which is a subject well developed elsewhere (see for instance, B. Martin (1965), L.March y P. Steadman (1971), Caporioni et al. (1971)). For the present purpose it is sufficient to remark that from old ages the idea of modularity has been at the core of architectural thinking. It has evolved becoming nowadays an indispensable help when mass production is envisaged. As it has been argued in the foregoing discussion, standardization and its corresponding modular counterpart will take an increasing protagonism in the globalized scene. It concerns not only industrial production but also corresponds with the need of hasty multiplication. Standard objects can be reproduced individually far from industrial chains. At present number of commercial firms spread all over the world their standard buildings composed of modular pieces to be adapted to the particularities of local sites. Taxes and transportation costs are saved because once the modular layout is ready local contractors can materialize it. Thus the image of standard buildings and hence their implied modularity is rather a common stuff in the urban scene. We will come back on this point later. Now it may be sufficient to stress the fact that a worldwide organized manner of designing is taking the pass of the up to now usual design techniques. To be efficient it needs standard forms, fixed sizes and quick communication. Modular design and Internet are there to provide with.

A word on creativity in architectural design

For a start it is convenient to define which kind of creativity we are referring to. In our Communication Era the meaning of many words has been fading away. They are employed for too much purpose and in too much occasions. Among them the concept of “creativity” has become particularly ubiquitous. It covers a large range from the creativeness shown by children drawings to the inventiveness of scientific research findings. Nowadays a creative person is someone whose ideas are little more than trivial. On the other hand, in terms of Arthur Koestler definition (1964), creation is to join systems, which were formerly separated. If this sense is retained only Isaac Newton´s or Vicent Van Gogh´s can be defined as creative work.

It is not our purpose to go into the semantics of the word “creativity” but to establish a reasonably accurate meaning to be applied to architectural design tasks. For instance the Information Theory says that a message conveys information only when something of new is communicated. The more unexpected is that information the more information the message conveys. If something is awaited it means that its existence is already know. In the same way the creative act has the property of being surprising. Known facts are waited to come or to occur in determined contexts. Creative propositions modify the expectancy about what might come up. In these terms only unexpected artistic or scientific work is truly creative. A creation gives new insights and new definitions.
Once a new definition is built up, number of different descriptions around the defined characteristics can be done. Descriptions depend on and proceed from previously stated definitions. As the core of a creation is a new definition, new descriptions are only variations on the same theme.

With all this said it is time to come to creativity in the special case of architectural design. But before go further we must consider, to some small extend at least, the relations between architecture and design. Let us propose that designing is to describe previously defined ideas. The act of creation is achieved with the definition of an idea. At its turn, the definition is the delimitation of a part of the world where the defined idea is isolated to stand up in front of the rest of the ideas. That delimitation is done within the limits of the idea of architecture that the architect has in mind. Therefore defining an architectural object is an act of pure conception, which proceeds any description. Only when the definition is given the design tasks can start (i.e. the description of the defined idea).

As a description proceeds in terms of some understandable combination of signs, the role of design is to make feasible in architectural terms the things that an idea proposes in more or less general terms. Notionally speaking, a description is a sort of conventional representation. So as numbers represents mathematical entities, so architectural ideas are represented by material objects put together during the process which begin with the designing description and ends with the building materialization.

If the foregoing argument is accepted it should be clear already that the design tasks themselves are not creative because they are subaltern to architectural ideas. Moreover, if that notion is applied in watching the nowadays architectural scene, it may be readily visualized that new architectural definitions are rare, whereas designing descriptions spinning around the same theme make a bulk. In terms of Information Theory these descriptions are a lot of messages referring to the same information. Often some of them are surprising messages. In that respect it is important to realize that a message may be surprising owing to the unexpected form of the message. Thus new descriptions can appear as new definitions. It is a usual advertising technique to draw attention on old known items by suddenly changing the manner they are presented. In this case the novelty comes from the manipulation of the form of the message. They can be looked at as decorative descriptions of known definitions. These might be creative in the way that they manage to represent the signs of architecture, often abusing these signs, either

exaggerating some features (bunches of pipes and gigantic trusses) or reducing at its minimum all features or labouring ad infinitum geometrical arrangements.

We are not going to say which kind of creativeness fits architectural design. However, we suggest that there is a mayor difference between those that give definitions and those who describe them. The former are the big architects, the late the vast host of designers. In view of this, we should be on our guard and consider more critically the demand of creativity in almost every designing act. Creativity is a burden put on the architect's shoulders from the beginning of their education. After all, the compulsive search of creativity and uniqueness, together with sheer competition are shadows projected on the profession from the times of the "Grand Prix de Rome".

About modular thinking

In the preceding sections we have touched to various themes. All of them are concerned with the use of modular systems to design. As already said, we are not introducing something of new neither some special way to prompt creativity. The above arguments were directed to pay more attention to what it might be called "modular thinking". Following the globalization wave we are accustomed to think in terms of combining miscellaneous pieces. Of course, Architecture is not spared from this growing trend. Some architects speak on their work as "assembled fragments" reflecting a somewhat nostalgic resignation about a lost order. On the other way round, working with modules is not intended as a gathering fragments operation. There is an established order into which every piece (modular) is inserted following established rules. It hardly needs saying that, in creative grounds, that order makes its strength but also its weakness.

Now let us examine the consequences on the everyday design tasks. First of all we assume that professional work can be divided barely in two classes. The one is constituted by the work directed to very special issues. It needs of outstanding features, as is the case for institutional edifices, large splendid houses and so on (some authors have called that kind of work "The architecture for the Princeps"). Obviously the number of designers in charge is very small and their aim is precisely to avoid modules and standardization. The other kind of works makes almost the whole of the buildings constructed in the world. As it is well known, architects design a reduced part of them. This special part of the general designing work is going to be the more and more modular since it is constituted by a good deal of massive building.

When in the 1930's A. F. Bemis proposed the adoption of modules to be applied to prefabricated houses he was thinking mainly about the industrial process. Bemis wrote his "The Evolving house" (1936) about modular co–ordination. He said almost nothing about modular design itself. A short time after Bukminster Fuller proposed his Dimaxion House, but although he actually designed a dwelling system his chief purpose was to convert the, at that time idle war industry into a peaceful domestic industry (see R. W. Marks (1960) and S. Rosen (1969)). At the beginning modular thinking referred mainly to sizes and the way as these can be co–ordinate. More often than not it was a matter of numbers and design issues were seen as an aside result.

Meanwhile Le Corbusier proposed the Modulor as an attempt to convert into numbers his humanistic view of architecture. He started from human needs to go to measures. According him human measures were the vehicle to draw organic life into the inorganic fabric of buildings. Probably he was feeling that the opposition to standardization could be overcome introducing an aesthetic order in the somewhat uncompromised modular objects.

Frequently objects made up of modules are considered of minor value because their forms betray a mass production origin. Repeated parts proclaim that the resulting arrangement can be repeated again and again. Repetitions are seen as tedious and lifeless. Curiously enough, organic life is highly modular. Life is in fact a repetition system made up of surprisingly few basic elements. The method of combination is the key to understand its enormous diversity. Consider a mass of living beings: a forest or a herd of cattle. They are monotonous as tiles or bricks if observed in isolated patterns. But if some distance is taken so as to look at the outline surrounding the mass of undifferentiated things, it can be seen that it performs an ever-changing profile.

A final example

In the above discussion we have suggested that design tasks must be preceded by actually new definitions to produce creative work. Fresh information makes genuine messages. But the same information can be presented in different ways. Lest us end this paper proposing that modular thinking offers the possibility of organizing messages far from fastidious repetitions. Beside this it should be remembered that computer systems are also modular systems. Furthermore, computer processes are mainly combinatorial operations. At its turn architectural design operations proceed combining and selecting the pieces of information supplied by the architect's definitions. From that we conclude that Computer Aided Design is a convenience marriage. In spite of this CAD systems remain mostly drawing aids rather than properly speaking design aids. The following example is intended just to hint at some possibilities in developing computer systems that could help the designer in his design operations.

Figures 1 to 8 illustrate the work of a computer program conceived to design modular forms. Is helps the designer to trace shapes whose outline (closed or open) is always modulated by one or many determined measures. It draws straight or curved lines. The late are actually polygonal lines whose segments correspond to the given module. It is also possible to choose among different types of polygonals (armonic, precise, centered and so on). This procedure liberates the designer from excessive awareness about geometrical conditions and dimensional constraints because these are calculated by built in routines of the program. The Figure 1 shows a modular layout and the Figure 2 shows the boundaries of a set of buildings inscribed on the modular basis. If the pattern shown by the example were traced by hand it could be a quite complicated operation. Using the computer program the designer avoids to be involved in a painstaking modular co–ordination. Beside this he or she can examine each step and come back if necessary.

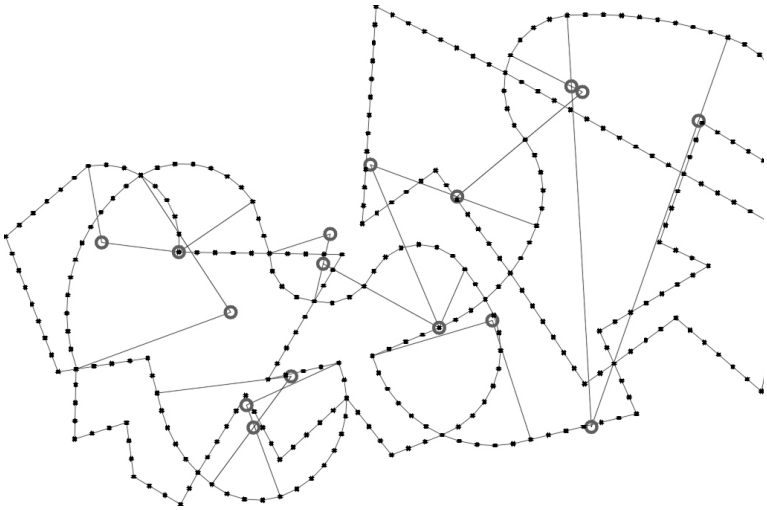

Figure 1.

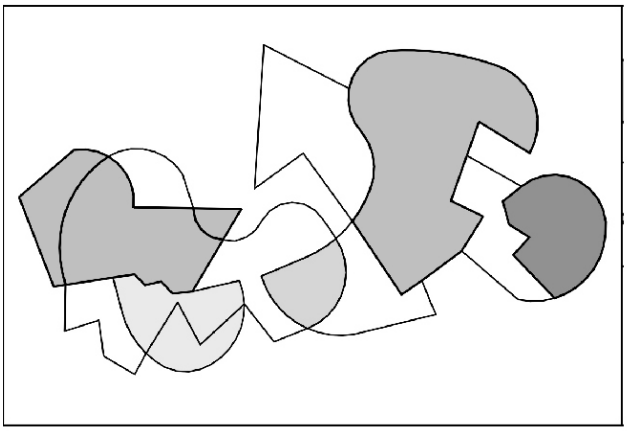

Figure 2.

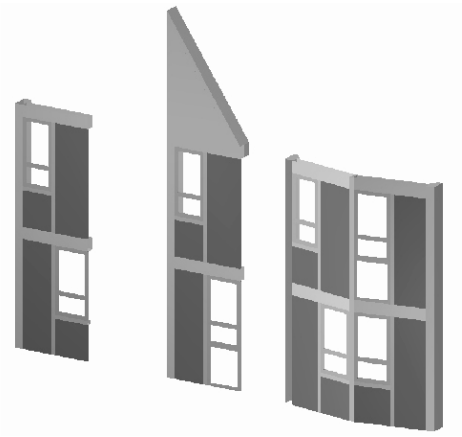

Figure 3.

The design of modular tridimensional components can be done through the same program. Figure 4 shows some of the pieces used in the composition of the set of buildings illustrated in remaining Figures. The procedure of insertion of components is straightforward and can be performed in 3D (see Figure 3). Figures 5 to 8 show some views of the different possibilities of assemblage.

Figure 4.

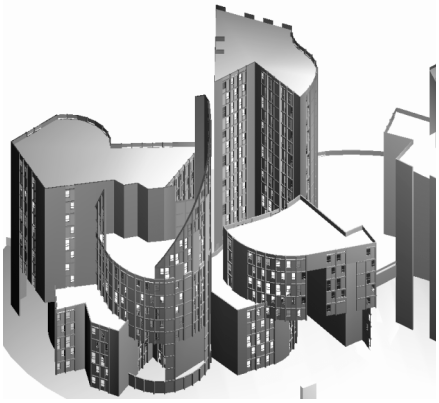

Figure 5.

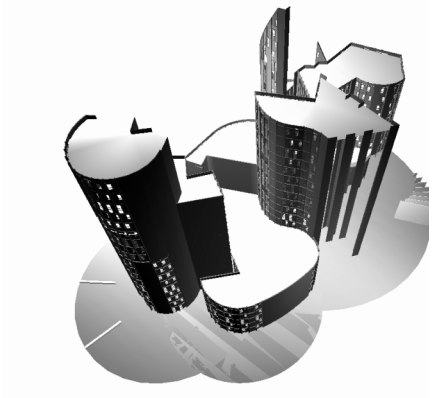

Figure 6.

Figure 7.

Figure 8.

To conclude this paper let us summarize the main arguments:

- Architectural design is not being spared from the standardization wave.
- Standard objects can be combined if they have suitable modular forms. The success of modular arrangements depends on the modular system rather than on the particularities of the components. In the same manner the beauty and fitness of modular objects depends on the way the modules are combined.
- Computers are powerful devises able to perform complex combinations. However CAD systems pay few attention to modular problems and their management.
- Modular thinking prompts the mind to deal with standard objects. It does not guarantee creativity but helps to adapt the design procedures to the piecemeal events that characterize the global scene.

Acknowledgements
We would like to thank K. Saito and L. F. Barrionuevo for their help in editing this paper.

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