Diagrammatic Approaches in Architectural Design

Addressing architectural and urban design through the use of diagrams

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Diagrams have an extraordinary potential as a tool for the analysis of architectural and urban problems. They can also be considered a design strategy in themselves according to Eisenman’s understanding of this graphic notation system. Diagrams have proved to be a valid design tool for architecture beyond the professional practice within the design studio. Students were given a design tool which was alien to their previous practices and it worked well as a propositional graphic device for the design of an architectural artefact. As a graphic tool that may be embodied in grids the possibility to enrich the design by superimposition techniques may well serve as a trigger for collaborative work, embedding in the design different layers of meaning and design solutions proposed by various students enhancing a level of complexity which the proposal of a single student may not achieve. From a didactic point of view, the use of these design strategy among the class, enabled to tackle different problems so that the work in the urban scale was also successfully addressed as part of the course aims.

Keywords: diagrams, architectural design, urban design, collaborative work

INTRODUCTION

Diagrams are present throughout the history of architecture. From the Hippodamus of Miletus’ urban grid organising the Piraeus, or the Etruscan urban planning based on cardo and decumanus to the focalized urban grids characteristic of baroque planning; from the classical compositional systems to Durand’s design method or Le Corbusier’s regulatory traces. They are no modern invention.

In the last two decades diagrams have become a common place in architectural design among some conspicuous architectural practices. It is worth mentioning that in recent decades there have been architects like Peter Eisenman who have exploited their use, generated an architectural theory and worked in an innovative way with them. Grids -which could be regarded as schematic order systems- as well as diagrams -essentially defined by grids- make possible architectural shorthands (Eisenman 1999, p.27), true graphic notations which have the capability to define the basic hierarchy and scale of the different parts in relation to the whole, as well as the topological connectivity relationships within the morphological structure. Moreover, grids set main directions, align-
ments and, above all, axial character; that is to say: orientation in architectural space. Not to mention the advantages of their use from a structural point of view in classical and ancient architecture before the development of a precise calculus apparatus to ensure structural stability and even load bearing distribution. No wonder why grids have been present and still are in most built architecture and urbanism; and amongst all of them, the orthogonal grid as one of the greatest inventions of rationality.

Probably, the first architect aware of the synthetic attributes of diagrams was J.L. Durand. He developed this graphic notation to liberate his design method from any particularisation of stylistic nature (Madrazo, 1994). Thus, he tried to step over the limitations of style and of the architectural language of his time allowing for further reach in their use. He should be certainly regarded as the inventor of such graphic devices and their generative possibilities even if he started to work with them for analytical purposes like others have done in the past decades.

In his *Précis des leçons d'architecture* Durand (1981) proposed a diagrammatic syntax for architecture based on his graphic analysis, proposing a compositional system as a design method. The intention being that its principles must transcend styles; therefore, the elements of architecture “must be freed from the tyranny of the orders, the classical orders should be seen as mere decoration” (cit. Monéo, 1978, p. 29). To deprive his syntax of any traces of stylistic influences and raise it to a more abstract level, Durand simplified the representation of architecture abstracting the geometry to the limit, thus radically removing any level of detail. His diagrams are so restrained that have been reduced to a schematic set of lines; lines which, nevertheless, maintain the dimensional value of the spans of the basic geometry of the architecture they embed, thus keeping the proportions controlled.

### ANALYTICAL AND GENERATIVE DIAGRAMS. EISENMAN AND THE DIAGRAMMATIC BASIS OF HIS ARCHITECTURE

True architectural diagrams must retain measurable relationships inherent to scale drawing in order to depict the very geometrical essence in a work of architecture; in this sense, we may regard them as synthetic representations of architectural order rather than of architecture itself. The use of diagrams, as a conceptual tool equipped with metrics, can be used both in the analysis of the existing, as well as in the generation of the project.

On their analytical side, diagrams have the capacity to represent a certain conceptual hierarchy of the object to study. Analysis may entail both: the choice of content and in its valorisation and representation. Eisenman started this diagrammatic approach as early as in his PhD defended in 1963 and supervised by Colin Rowe. Both of them employed the diagrammatic representation after their use in Wittkower’s analysis of Palladian villas. Eisenman, however, as a practitioner has made an extensive use of them. In his 70’s houses he made a considerable number of diagrams analysing his own work and illustrating the process of design followed in these early projects. As Somol has rightly pointed out, the idea of repetition and differentiation is present in the diagrammatic analysis of Rowe and Eisenman (Somol 1999).

The diagrams in their most productive aspect constitute themselves as a generative or ideation tool. In the late 90’s, Eisenman’s use of diagrams is based on this approach. Diagrams are then to be considered graphic constructions that prefigure what the design may be. However, they are not the design itself, not even the inception drawings. To a certain extent, they are similar to conceptual schemes, yet there is a significant difference: they have metric attributes -a geometric quality-. From a conceptual point of view, they vividly recall the description of space as a nurse of matter found in the passage from Plato’s *Timaeus* where a third genre is established somewhere in between being and becoming,
that is, between the idea or form and matter, literally “This, more than anything else: that it is the Receptacle -as it were, the nurse- of all Becoming.” (MacDonald Cornford 1997, p.177). Maybe the notion of potential being coined by Aristotle's *Metaphysics* is an even more suitable conceptual base for their understanding (Aristotle, 1991).

**DIAGRAMMATIZATION AS A TOOL FOR A PROJECT. TWO DESIGN STUDIO EXAMPLES**

It is this generative dimension of diagrams that is basically reflected on in this paper. Works done by students using these design strategies are commented here. Diagrams may be understood as a tool to represent and objectify a certain concept, but it is the choice of variables and the way of diagramming them that makes of it a singular design. Diagrams can be based on spatial traces \((x, y, z)\), time \((t)\) or any other variable \((v)\). The development of information mapping techniques is an immense diagrammatic source for the generation of architectures. This alone may serve as a trigger to develop an architectural form that may relate to site, embody relationships with the past of the *locus*, involve scale decisions, incorporate connectivity issues between the parts and the whole as well as include programmatic or functional variables. It is the idea of process which we find most interesting from a didactical point of view as diagrams may easily entail this kind of approaches and guide the process within the design. The final outcome of the design may be easily traced and developed thanks to the capacity of diagrams to embody several design issues simultaneously.

Students of the Master course *Graphic Tools for Architecture* at the University of Alicante were asked to produce a design following this diagrammatic approaches to tackle the design problems. In one case, the students were asked to produce a small pavilion -a building- taking this diagrammatic approach as a conscious design strategy. In the other case, students were asked to work on an urban project to redesign a public square; they were also asked to work on it on a collaborative basis.

Students had a couple of lectures on generative diagrams as part of the course content and were given bibliographical references to become aware of this design strategy. According to what was addressed from a conceptual point of view, students were asked to work on a project using diagrammatic strategies of the generative type. The purpose was to develop their own creative diagrammatic approach to gain this design skill applying this tool or strategy in a practical case of intervention within the architectural field.

**DESIGNING A PAVILION.**

On the site of the Mies’ Barcelona pavilion, built in 1929 on the occasion of the Universal Exhibition held in the city of Barcelona and briefly dismantled short after its construction, some sixty years later, it was literally reconstructed by Ignasi de Solà-Morales, Cristian Cirici, Fernando Ramos and Ana Vila in the most faithful possible way as an authentic architectural facsimile of the original between 1983 and 1986. In the academic course 2015-2016 the students were proposed to imagine themselves placed in the hypothetical situation of this group of architects with the task of create an exhibition pavilion with a programme similar to that of the Miesian pavilion and on its same location, supposing that the replication criticised by Koolhaas as a certain kind of Disney kitsch (1995, p.49) had not been really rebuilt and that, accordingly, the site was empty to hold an expo in 2016. Special attention to Eisenman’s externality diagrams with references to the traces absent in projects such as the Wexner Center for the Arts, or the Cannaregio town square; to topographies as in Banyoles, or Santiago, etc. and his more clearly generative proposals regarding the diagrammatic approach such as the Church for the year 2000, the Huei library, the contest for the IIT Student Center or the Tours Conservatory should be considered.

The example shown in Fig. 1 shows the diagrammatic design process of one of the pavilions designed by one of the students. As it can be seen, many of
the aspects that can be dealt with in a diagrammatic approach of the design can be traced in the different design steps illustrated in the mentioned figure. As diagrams have both topological as well as geometric qualities, the metric of the site and the possibility of scaling strategies are pursued. In step four one of the key issues regarding this design strategy used by Eisenman, the superimposition of an alien order grid to favour the generation of alternative geometries, precede the ‘extraction’ process of the final shaping of the pavilion. In his own words: “It is the idea of the trace that is important for any concept of the diagram, because unlike a plan, traces are neither fully structural presences nor motivated signs. Rather, traces suggest potential relationships, which may both generate and emerge from previously repressed or unarticulated figures.” (Eisenman 2000). Based on the same assignment and during the same academic course as the design in Fig. 1 another student worked over the plan of the original Mies pavilion to obtain a complete different outcome (Fig. 2). In this case, the starting point of the process commenced with the simplification of the Miesian plan to the bone -just the vertical enclosures that define the functional space-. Although in the original design the implicit limits defined by the overhangs and roof decisively contribute to configure the overall architectural space it was this specificity of Mies’s project the spark that triggered this other design. A virtual topography was created around the heads of the ori-
original walls for the roof generating a fluid shaped cover for the building. The new walls, were extruded to accommodate to their geometry to this new geometry and do it in accordance with a principle of geometric continuity. Thus, one of Mies strongest points in the original design—the fluidity of space—was critically read and anew design proposed to embody in a contemporary language this idea of spatial fluidity in spite of the fact that the footprints of the original walls remained.

**URBAN PROPOSAL FOR A PLAZA**

The diagrammatic approach allows to step beyond the scale limitations characteristic of the architectural discipline and enter into the realm of the urban space. As Hall has written, “In the last decade, architecture has embraced diagramming as a means to negotiate the complex phenomena of urban design” (Hall 2011, p. 164). Accordingly, students on the following year in the same course were proposed to work in an existing square with total freedom to reorder it, solve conflicts between the traffic and pedestrian circulations and contribute to enhance a quality urban public space in a contemporary language, making use of diagrammatic approaches.

The chosen square is an urban space connected by two adjoining squares to one of the most important boulevards of a Mediterranean middle sized city, Alicante (Spain) lacking significant large public spaces. Located in the heart of a group of blocks, surrounded by 4 important roads of traffic and transit, it is a quiet place with virtually little traffic circulation. The Plaza has four significant public buildings that were designed in the 50’s: A church, the Public Finance offices, the Government’s Delegation and offices of the Telefonica—then in hands of the government. Even though the quality of their design is certainly questionable, they belong to the period known as Autarquia—Autarchy—(during Franco’s dictatorship). It was intended then to develop a large public space to solve the lack of a central plaza in the city and, although it was never finished, these four buildings remain as a unitary design embodying the local zeitgeist of the epoch while the rest of the plaza’s building elevations are a considerable pastiche of the following decades with little relation amongst each other or with the rest of the plaza. That is the reason for the students to choose to redesign the plaza to solve these conflicts as well as the functional ones.
A city analysis was firstly done by the students and several individual designs were developed for the plaza (Figure 3). Once these two stages were completed the class, guided by the professor, chose on of the students’ best designs. In this case, it was Pedro Pignatelli’s the chosen scheme as it addressed and conveniently solved most of the issues and conflicts at stake. Once agreed, all the students worked collaboratively in the redesigning of the plaza following the initial concept after Pedro Pignatelli’s initial scheme; they enriched the original proposal and everyone of them had to develop in detail an element of urban furniture that should be integrated in the master plan.

Due to the aforementioned characteristics, it is contradictory that the plaza in its current state is constantly traversed by traffic lanes and its central space is even invaded by a car access to an underground parking that completely destroys the urban space (Figure 4 A). In addition, the mentioned public buildings do not have an open space preceding them of the size, scale and importance according to their activity. For these reasons, a unification of the three squares is proposed as a large space for pedestrian connection to different consolidated areas of intense shopping and leisure activity in the city such as Avenida Maisonave, calle San Francisco and calle Felipe Bergé (Figure 4B).

A diagrammatic strategy was carried out adapting the new design to these communications and taking into account various factors such as the existing network of trees, the architectural elements present in the square, the generation of spaces prior to public buildings, combined with other occasional temporal traces such as the preparation for popular celebrations (Hogueras similar to Valencian Fallas, huge cardboard and wooden sculptures several stories high which are burnt on the night of Saint John -the patron of city- coinciding with the summer solstice), or even past traces such as the former topography of the square. As Vidler has pointed out, some of the qualities of diagrams rely on their capacity to
foster abstraction, reduction and geometrical simplicity (Vidler 2011, p. 54). This is quite obvious for any designer who is willing to delve into this design strategy and develop his project design in accordance to such qualities.

The most important features of the new design are that, to begin with, the plaza is now perceived and inhabited as a single magnificent urban space of which the city is lacking. In addition, the existing conflicts of pedestrian traffic and car traffic are now solved in a smart design considering the fact that the car traffic is, in the actual state, basically related to the parking which now is being accessed in the perimeter instead of occupying the centre of the urban space. Moreover, the plaza is now a truly public space for the citizen to be there enjoying the public space and remain, not just a transit space connecting parts of the city with major commercial or leisure activities.

**DIAGRAMATIC DESIGN STRATEGIES FROM THE POINT OF VIEW OF THE STUDENT**

At the University of Alicante’s School of Fundamentals in Architecture and Master in Architecture the students are asked to make a design statement proposing their own architectural themes to develop their projects trying not to condition the student in the way to address them. This involves an investigation and original experimentation on the part of each student regarding how to approach the project on every occasion. But this systematic absence of method or conditioners may produce a certain disorientation or blockage at the beginning and/or during the project process as it has already been discussed in length (Marcos 2012).

In the academic course of 2017-2018 within the course *Graphic Tools for Architecture* led by Professor Carlos L. Marcos the condition of the use of diagrams in the design work of the square has brought the students closer to the diagrammatic theory in architecture and has allowed to work more efficiently and intensively. This is not only because the students have known from the beginning the project tools to use, but also because the use of diagrams constitutes a very dynamic way of designing and experimenting, both in the analysis of situations and in the creative proposal of solutions. In our particular case it has been of special convenience considering the short duration of the course.

In greater detail, two exercises have been proposed: firstly, the urban reorganization of the square to be carried out collectively by all students; secondly, an individual assignment in which each student had to project in detail one of the architectural or urban furniture elements of the square.

One of the most common operations in the use of diagrams as a design tool is the superposition and combination of them. This aspect has been key in cooperative work among students. The use of dia-
Figure 6
Final design of the plaza including redesigned filters, parterres and pedestrian paths. Implicit pedestrian circulations are solved, traffic circulation and new access to underground parking are provided; a unitary image of the plaza joining the two previous ones (Plaza de la Montañeta -originally divided into two parts by parking access and traffic ane- and Plaza Calvo Sotelo). Render: student Luca Pereiro.
Figure 7
Photomontage of the new design of the Plaza in which several of the urban furniture designed individually by each student are perceived as part of the same intervention and integrated in the global design. Photomontage by Pedro Pignatelli.

grams by all the students of the course has allowed a greater ease in the development of a joint proposal where the diagrams made by the students are combined collecting all their contributions and enriching the final proposal.

For the analysis of the square diagrams of the circulations of cars and people, sunlight, focus of activity, topography, etc. have been made. The superposition of these diagrams, of great formal richness due to the complexity of the urban space in question, have shaped the proposal for the reordering of the square. In this way the traffic has been repelled from the pedestrian area and the elements of shade, street furniture, lighting and trees have been adapted to pedestrian routes and activity centres.

The individual part allows each student to experiment freely through the use of diagrams to obtain in this case the design of a specific element contained in the square. In this part the elaboration of the objects has been required by means of some digital manufacturing technique. The new techniques of production through computers have revolutionised modern architecture, exponentially increasing its formal possibilities. By combining the use of diagrams with digital manufacturing techniques students have been able to verify the proximity between them and their connection with parametric programming. Each student has designed each element with a different digital fabrication technique of their choice. The projected elements have been: benches (folding), street lamps (sectioning), pergola (tessellating) and filter (adding-subtracting). Subsequently all the elements have been gathered together in a common file and represented together.
CONCLUSIONS

It can be stated that the diagrammatic theory is both, a tool and a design strategy that may be naturally associated with parametric or digital architecture and has proven fruitful as a design aid for students.

One of the greatest advantages experienced to this regard is that operating through additive or subtractive procedures allows easy interaction and cooperation between different subjects in both analytical and creative processes. Moreover, the possibility to superimpose several grids that address different problems by different members in the team may add up a compromise solution that can benefit from the team work and the different individual’s insights.

In addition, diagrammatic approaches allow either the design process of an architectural artefact as well as urban design strategies. The fact that the traces of these graphic devices embody metric relationships help students to step over the problem of scale, be it on the architectural or on the urban scale.

Diagrams not only serve as a tool for analysis but also allow stemming shapes out of them as they are “the spatialisation of a selective abstraction and/or reduction of a concept or phenomenon” (García 2011, p.18). In a certain sense, diagrams could therefore be regarded as a form finding design strategy. If the students had been skillful in programming with Grasshopper or Rhinoscript, these design form finding strategies could have taken advantage of computation potentials. This remains as a possibility to be explored in future courses.

REFERENCES

MacDonald Cornford, F 1997, PLATO, Hackett Publishing Company, Indianapolis
Durand, JL 1981, Compendio de lecciones de arquitectura (Orig. Title Précis des leçons d’architecture,[1805]), NAOS, Madrid
Eisenman, P 1999, Diagram Diaries, Ed. Universe (Rizzoli), New York