Immaterial design:
Mapping flows to communicate and inform

JORGE RODRÍGUEZ ÁLVAREZ[1], MANIA ABATZI[1], LEONIDAS BEIS[1], MARÍA MENA DEFERME[1], MICHAEL SMITH MASIS[1], JUAN CARLOS SANABRIA[1], RAYMOND LEI[1], EKACHAI SHOPHONODOUPORN[1]

[1]SAAI, Sustainable Architecture Advisors Int., London, United Kingdom

ABSTRACT: One of the main barriers that prevent the implementation of successful environmental strategies in architectural design lays in the disengagement caused by abstract data and the difficulties to translate immaterial processes into physical designs. The motivation of this paper is to explain some of the main communication strategies that this environmental consultancy team has developed in the last few years to facilitate the comprehension of complex information by designers from diverse backgrounds. Environmental software tools are valuable instruments for quantitative analysis and, in some cases, also have great visualization potential. However, much of the work comes after simulations. This paper focuses on that stage of environmental analysis, when the outputs from calculations and models are rationalized, interpreted and converted into potential design alternatives. Diagrams, schemes, axonometric views or physical models are combined in innovative ways in order to get across the message. Several case studies in Europe and America are used to exemplify the argument. These cases include a diverse range of building types, from office buildings to public facilities, as well as urban projects. In each project, particular issues and processes were addressed: daylighting, ventilation, microclimate analysis or thermal performance were analyzed and converted into design opportunities by means of a combination of meaningful visuals and articulated stories.
Keywords: Environmental design; visualization techniques; design applications

INTRODUCTION

It is undeniable that architectural and urban design are collective processes. The idea of the architect as a lonely and isolated genius is outdated and unpractical. Recent examples about the retrospective recognition of creative partnerships confirm this trend [1]. The increasing complexity of buildings, technological profusion, economy of scale and dreadful bureaucracy are some of the reasons that moved architects to engage collaborative partnerships. The advantages are numerous but they can be summarized as the greater quality that is possible thanks to the coordinated action of multiple minds. However, there are boulders in the trail that may prevent effective collaboration, especially when the actors have a different notion and level of expertise on a specific matter. This is the case of environmental design. Environmental consultants need to transmit a message that is meaningful and legible for the whole design team. One of the best ways to do this effectively is by the graphic display of data and information. Architects are used to read, produce and scrutinize the environment by means of drawings, sketches, renders and conceptual diagrams. Using a similar toolbox will enable fluent and unambiguous communication. This paper is based on the authors' experience in establishing collaborative partnerships to produce environmentally responsive architectural designs. It reports about the difficulties and opportunities to transmit clear concepts so they can be integrated in the creative process.

PRELIMINARY ARRANGEMENTS

Communication starts even before the collaboration has been formalized. At this stage it is fundamental to define a clear framework for the partnership. This step becomes simpler when the teams have worked together in the past as they had the opportunity of knowing each other's abilities and needs. However, the nature of the collaboration may evolve, always aiming for better results. If the teams have not worked together in the past, the framework is absolutely essential. Much of the project's success depends on the correct understanding of the parts at this stage. On the one hand, the environmental consultant needs a clear description of the architect's needs. Sometimes these are vaguely stated and are open to multiple interpretations (e.g. "just wanted to know how sustainable it is" or" make it sustainable"). In those cases, the architect should be advised about the different ways they can be supported so that they can decide accordingly. On the other hand, architects often demand information on the type of work that environmental consultancy will deliver. The reasons why a firm requires external environmental advice are diverse (regulations, client requirement, genuine interest...) and the scope of the consultancy work varies greatly according to the nature of the project. As a result of experience the authors have created a detailed brochure to describe possible modes of collaboration. This brochure is adapted and presented

to the architects in order to facilitate the cooperation framework (fig.1).

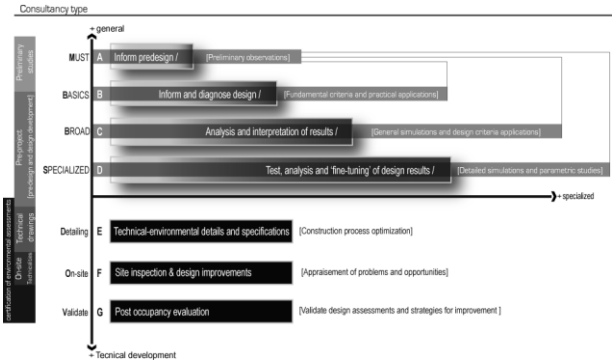

Figure 1: Consultancy stages and cooperation modes [6]

The brochure includes different categories, according to work complexity, coverage and level of detail, as well as illustrative examples. It also includes the fees, which are calculated based on the scope and the stages of engagement (preliminary project, detailed project, construction site...). The basic case would consist of site and climatic analysis to deliver some simple guidelines whereas an advanced consultancy would cover parametric, typological analysis and project evaluation. Bespoke collaborations could be formed in special cases, such as research projects or competitions. This distinction reduces ambiguity and helps to clarify the scope of the work. The brochure has proved useful as it establishes a first communication channel to build a sound collaboration. The architect can discern the convenience and nature of the consultancy and his expectations are levelled with examples and references.

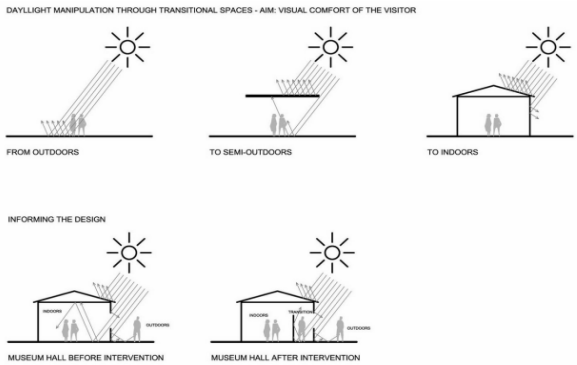

Figure 2: Examples of basic guidelines [6]

ENVIRONMENTAL DESIGN AND STANDARDS

Risk aversion may have led to overregulation in many countries, especially in advanced societies where deterministic codes have connected quality assurance to standardization and checkbox ticking. The combination of complex requirements and simplistic checklists that declare their observation has derived in a total detachment from original design solutions. For instance, in the case of thermal performance, maximum values are prescribed regarding the conductivity of building elements. They are summarized in sheets and the design team only needs to introduce the right values for their region and building type. In our recent experience some mistakes have been consistently detected. These may not compromise the buildings' performance, but denote a lack of understanding of basic thermal principles as well as the uselessness of the method (e.g. it is common to find ridiculously low U-values in windows or rooflights because designers introduced a solar transmission instead). Environmental consultancy has also a pedagogic component. The analyst needs to instruct and make sure that the design team understands the key aspects of the message.

On the other hand, environmental certificates have achieved a substantial recognition by the market. In the last twenty years a number of schemes (BREEAM, LEED, CASBEE...) have reached international projection and are used as the primary demonstration of the sustainable character of buildings and urban developments. It has a notable influence in consultancy projects as developers are willing to use these labels as a marketing strategy. The additional work required to obtain the certification is important and may force the design team to concentrate only on the fulfilment of its parameters. Ideally, certification and environmental advice should work in parallel, so that wise solutions would end up in a high level of certification. It is important to point out that most labels require licensed assessors who have received specific training to assess projects under the schemes' criteria but they have not necessarily been educated on environmental principles. In countries where certificates are widely used (e.g. UK, USA, Germany or, more recently, Spain) it may be a good alternative to include the certification as part of the consultancy, to minimize potential discrepancies during the design process.

ENVIRONMENTAL GUIDELINES: CONCEPT FORM, NOT A DESIGN

Louis Kahn stated the difference between conceptual form and design [2]. The former is the representation of an idea, the fundamental intentions of the project, whereas the latter can be defined as the process by which the idea is materialized in a physical construction. The concept is tested against the programmatic needs and may be adapted in order to meet them. However, he argued that in architecture the concept has to be retained in the final solution.

This notion can be applied to environmental analysis as to define environmental guidelines for a particular project. These guidelines should not be interpreted as design solutions but as concept forms that can be

adapted according to the design intentions, as long as the fundamental idea is retained.

The use of graphic guidelines is one of the most effective ways of communication during the early stages of a project. The aim is to illustrate basic bioclimatic design criteria that can be interpreted and developed in different ways. Recommendations are organized according to levels of priority so that the eventual influence of each decision can be interiorized by the design team. The balance of the final result depends on the integration of fundamental principles from the outset. It has been noticed that too much technical data at this stage can overwhelm designers so this is reduced to an absolute minimum. The effort is devoted to concentrate all the information in a number of simple architectural diagrams. It ensures maximum returns and acceptance. Sometimes, the diagrams are so simple that architects may feel they did not need them at all as all those principles were being considered anyway. Even if that was the case, this is preferred to over-complexity, which could quickly lead to confusion, as new layers and variables will inevitably amount during the design process.

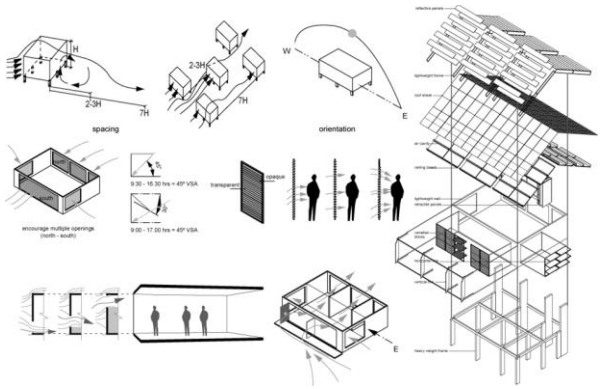

Figure 3: Examples of guidelines for social housing in warm humid climate [4]

Schematic pre-design guidelines are elaborated after a thorough diagnose. They are based on knowledge on climatic issues, microclimatic variations and the functional needs described in the brief. Potential environmental strategies are portrayed in a sequence of illustrative sketches that inform about the connections between form and performance. Ventilation and thermal flows or solar gains are typically reflected in these first diagrams to inform design decisions such as orientation, permeability or compactness. The target is that at the end of this stage, the architects can discern the potential consequences of the main design lines they have chosen.

When the nature of the consultancy is, by definition, complex, alternative modes of representations should be explored. In the case of urban studies, portraying variables such as form or density in a graphic way can result either ambiguous or over deterministic. Figure 4 shows an example where a summary matrix was elaborated to illustrate connections between urban form and mobility. Over one hundred previous studies were analyzed to produce this matrix but it was kept as simple as possible. Light grey boxes represent a direct correlation between pairs of variables. This is when one increases so does the other. Conversely, darker boxes represent an inverse correlation, when one variable decreases the other increases. The level of influence is depicted by the size of the box. When bespoke diagrams are created either as design tools or to communicate information they must be easy to read and interpret. The degree of abstraction should be considered carefully as the recipient of the message may need a considerable effort to decipher the logic behind an intricate graph.

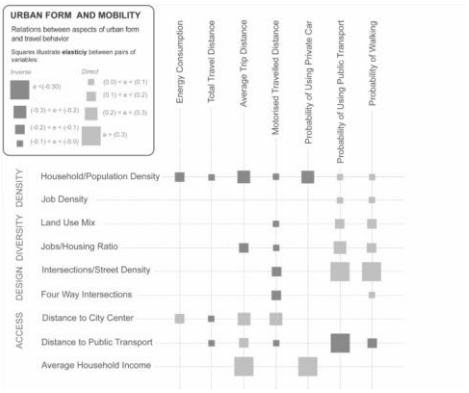

Figure 4: Diagram showing correlations between urban form and transport patterns [5]

Another option of communicating complex correlations between form and performance is by combining parametric and typological analysis. As this refers to numerical values it may result too abstract and distant from associated forms. The addition of representative typologies that are typically connected to a range of parametric values conveys the message to designers more effectively as they are more familiarized with spatial representation than with mathematical abstraction.

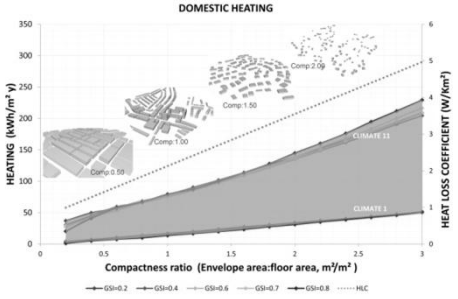

Figure 5: Combination of typological and morphological analysis for urban fabric [5]

DESIGN DEVELOPMENT

The initial simplicity gets diffused during the design development. Once the solutions become more specific, they need to be tested and integrated within the overall concept. Advanced assessment tools offer predictive capacity to evaluate the potential effect of alternative design solutions. However, the outputs from these tools can be either too dry or too colourful, causing contradictory stimuli. For instance thermal graphs showing overheating are not, on their own, illustrative on how excess heat could be diffused. They need to be complemented with drawings that indicate the origin of the problem and possible suggestions to counteract that effect (fig.6).

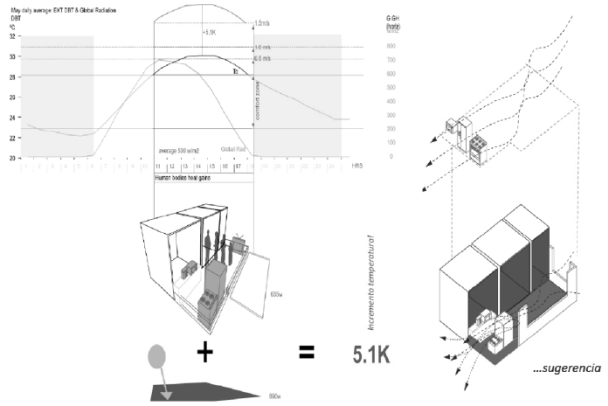

Figure 6: Example of illustration of overheating in a domestic environment and possible design solutions to counteract it [7]

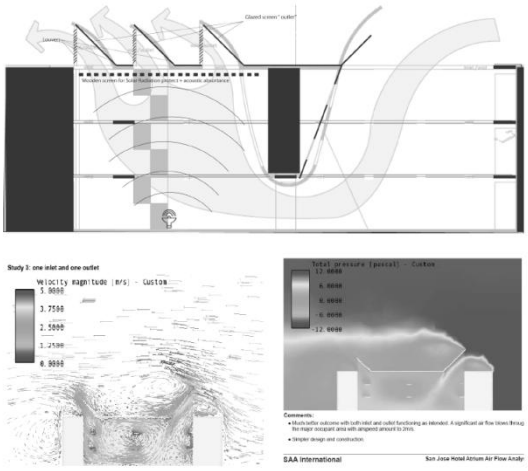

Figure 7: Example of illustration of overheating in a domestic environment and possible design solutions to counteract it [8]

On the opposite extreme, it has been detected how designers are sometimes distracted by appealing representations. This has been particularly noticed with CFD outputs. The relevancy and accuracy of the information takes, in those cases, a secondary interest as architects may want to use those images to demonstrate the thorough environmental analysis that has been performed, regardless of the content. Although this may seem exaggerated, it was a common situation at some point of the environmental consultancy. To counteract that, synthetic schemes were created in order to pass the information in a more concise way. Then, the explanatory diagrams could be complemented with the outputs from simulations, but the attention was already on the environmental process and not so much on the representation (fig.7)

The environmental approach to design starts from climate analysis and programme, which define the initial needs that shape building form. As the process advances, materialization becomes more concise and practical issues have to be integrated without distorting the original architectural concept. One of the critical stages comes when services have to be integrated after building design has reached a high level of detail. The development of the design of the various elements that compose the project should be coordinated. Negligence of the spatial needs of structural and environmental systems ends up in disappointing results, expensive solutions or poor performance. The design of building services cannot be approached as an isolated piece of engineering that is plugged-in afterwards but has to be fully integrated with the structure and the architectural conception. This is now easier with BIM systems [9] but cross sections and three-dimensional drawings are a simpler alternative to discuss alternatives.

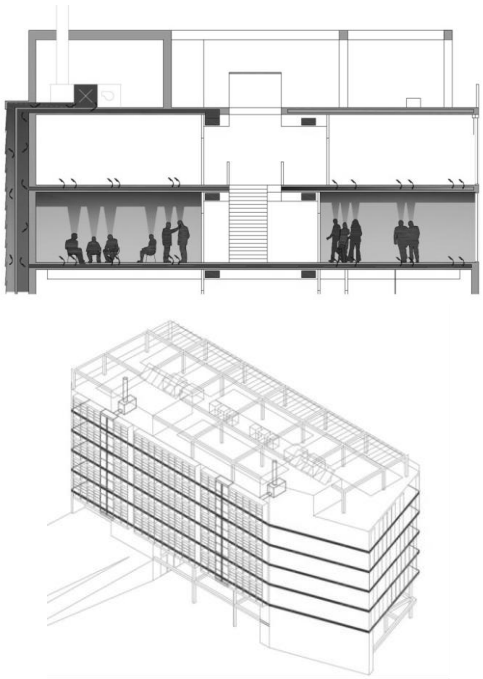

Figure 8: Example of a proposal for ventilation system with hollow decks and solar chimneys [10]

FINAL ASSESSMENT

The criteria to evaluate projects are based not only on final performance but also on the successful coordination of all building's elements and strategies with the architectural intentions. The first part of the assessment consists of the comparison of key performance indicators against benchmarks for similar building types and climatic conditions. In addition, the environmental strategies that deliver that performance are represented and highlighted in construction perspectives (fig.9) and realistic renders (fig. 10). The aim is twofold, on the one hand to clarify the arrangement of the systems at construction stage and, on the other hand, to confirm the coalescence of environmental and architectural design in the final product (fig. 11).

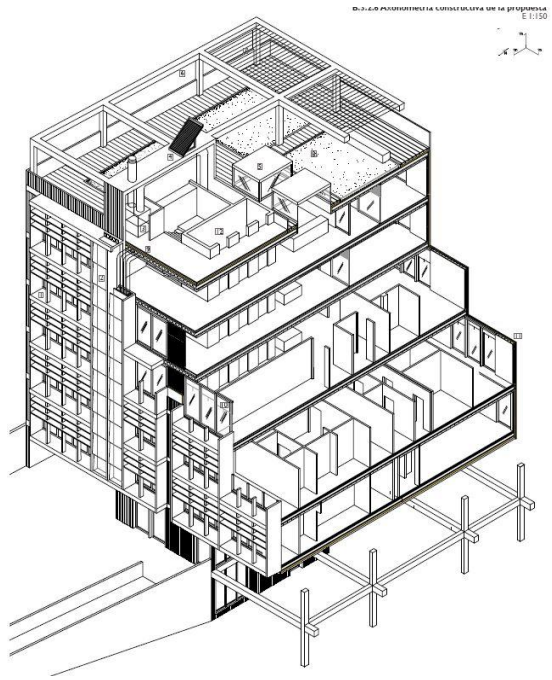

Figure 9: Construction axonometric view with environmental systems [10]

Figure 10: Realistic perspective to assess the final design [7]

CONCLUSIONS

This paper reflected on the communication strategies followed by environmental specialists to convey the outcomes from analysis within design teams. The importance of adapting the content and visualization techniques to each stage of the design process and architectural jargon has been highlighted. Examples have been showed to illustrate how this concept has been followed in consultancy projects around the world. Every graph or numerical output from environmental assessment tools was processed in order to open new opportunities for design creativity.

Figure 11: This museum in Pylos is an example of successful collaborative work. The light was filtered to recreate an underwater environment [11]

REFERENCES

1. Nazareth. I. (2013) Pritzker Challenge: Recognition in the Age of Creative Partnerships [Online], Available: www.archdaily.com/365674/pritzker-s-challenge-recognition-in-the-age-of-creative-partnerships/ [8 May 2013]
2. Christian Norberg-Schulz y J.G. Digerud (1981) Louis I. Kahn, idea e imagen. Xarait Ediciones
3. Serrats, M.ed (2012) 1000 Tips by 100 Eco Architects. Firefly Books
4. Smith Masis, M. (2010) Social Housing in Costa Rica's Warm Humid Climate. Strategies and Considerations for Passive Design. Lambert Academic Publishing
5. Rodriguez Alvarez, J. (2013) Cities Beyond Entropy. Urban Form and Enviornmental Performance in Post-Industrial Cities. PhD Thesis. University of A Coruña
6. SAAI (2009) Sustainable Architectural Advise. Brochure
7.SAAI-Cr (2012) Bioclimatic Consulting on Amaranto Holcim House.Costa Rica
8.SAAI-Cr (2012) Bioclimatic Consulting on City-Mall Alajuela Project.Costa Rica
9.Building Design Magazine (2012) BIM White Paper. Online], Available: www.bdonline.co.uk/home/the-bim-white-paper/5034325.article [8 May 2013]
10.SAAI-Sp (2010) Bioclimatic Consulting on Agra Office Building Project.Spain
11. SAAI-H (2012) Bioclimatic Consulting on Museum of Underwater Antiquities of Pylos.Greece