

# AN INTEGRATED BUILDING DESIGN APPROACH

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## ABSTRACT

Architectural design is becoming each day a more complex process while it seeks to embrace the various aspects of sustainability. The way how the buildings are affected by their own shape and materials, how the urban environment is affected by it and how this will affect the building, becomes a critical issue of the design process for sustainable architecture. The architectural design process should be dynamic and look holistically at all building technologies and systems, including the urban dimension. Designing towards sustainability is designing with an integrated approach.

This paper discusses the subject of integrated approach to building design. It addresses in particular the integration of sustainable aspects in the architectural design process. The paper is structured in six parts. The first part introduces the topic, the second defines integrated design, the third discusses the role of the architect in the design team, the fourth illustrates some barriers to the integration of the various environmental aspects into the design process, the fifth develops the topic indicating possible directions to overcome existing barriers and, finally, the sixth part summarizes the main conclusions.

## KEYWORDS

Sustainable architecture, integrated design approach, holistic vision

## INTRODUCTION

I have a friend who lives just across the street in front of the Justus Lipsius Building in Brussels. Her living room balcony faces the reflective glazed façade of the office building housing the European Council of Ministers. Sometimes she benefits from a welcomed reflected sun (which she would otherwise never have), other times the glare and reflected radiation from the Justus surface is so intense that the resulting indoor heat forces her to blind the view by rolling down the shutters and move elsewhere to a cooler place. Buildings are still very often assumed or conceived as isolated islands in the middle of an open space or in the country side, neglecting that in a city our concerns are essentially urban. Thus, when buildings are built, the way how they are affected by their own shape and materials, how the urban environment is affected and how this will affect the building, becomes a critical issue of the design process for sustainable architecture. We are also looking for a more sustainable city, and each intervention, should bring to the city buildings which are helping the environments and the rest of the city. Architectural and urban systems cannot be looked at in isolation. For example, the selection of glazing and shading devices must be examined along with lighting solutions and the mechanical system design, which in turn affects structure, interior design and also the surroundings of the building. The optimisation of one aspect means very often to compromise another. Designing for daylight, for instance, immediately comes into conflict with designing to minimise heat loss and gain, and moreover the human events that are to happen inside the building and how these might change with time will also determine how much daylight is required. This then interacts with the materials selected and the form and structure of the building and with its expected duration.

Sustainable design aims at producing places, products and services in a way that reduces the use of non-renewable resources, minimizes environmental impact, and relates people with the natural

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environment. Architectural design is becoming every day a more holistic vision, while it seeks to embrace the various aspects dealing with depletion of non-renewable sources, energy-efficiency, interior air quality, environmental impact of the building and materials, quality and durability, integration of renewable energy sources, design for re-use and recycling and life cycle analysis of the building. Architecture is not the sum of its parts and sustainable design is not an attachment or supplement of architectural design, but an integrated dynamic design process.

## **WHAT IS INTEGRATED DESIGN**

Architectural design, and in particular sustainable architectural design, is a conceptual process in continuous transformation and includes several dimensions, such as social, economical, environmental, cultural and historical, among others. It is a complex process which requires a holistic and interdisciplinary approach. In order to inform (and to transform) the environmental design process, specialists such as architects, engineers, environmental scientists, acoustical scientists, landscape architects, urban planners, interior designers, lighting designers, specialists in historic preservation and disability access, may be needed. In a larger scope, environmental design has implications from wind-electricity generators and solar-electric equipment, such as integrated PV cells, to other kinds of equipment. Nowadays, energy efficiency, appropriate technology, organic agriculture, land restoration, community design and ecologically sustainable energy and waste systems are recognized considerations or options and may each find application in the whole process as well.

The complexity of buildings and of urban environments is constantly increasing in terms of its technologies, services and infra-structural systems, making architecture and urban design become more multi-disciplinary than ever. Collaboration and communication are imperative to sustainable design. An integrated design approach requires the will and ability of each team member, including architects, engineers, urban planners and contractors, to work together in producing collaborative and better solutions. The design process should thus be participatory and inclusive of the various design disciplines. It should be a dynamic process that looks holistically at all building systems and dimensions, including the urban dimension; this is "Integrated Design".

Today architecture usually requires a team of specialist professionals, with the architect being one of many, although usually the team leader.

## **THE ROLE OF THE ARCHITECT**

In the first century B.C. Vitruvius wrote that "Architecture is a science, arising out of many other sciences, and adorned with much and varied learning: by the help of which a judgement is formed of those works which are the result of other arts." [1]. He added that an architect should be well versed in other fields of learning such as music and astronomy. Later, Alberti believed that the role of the architect is to be concerned firstly with the construction, which includes all practical matters of site, materials, of their limitations and human capabilities; secondly, it should consist in articulation, in the sense that the building must work and must please and suit the needs of those who use it; and thirdly, it should be concerned with aesthetics both of proportion and of ornament [2]. The work of an architect has always been an interdisciplinary field, drawing upon mathematics, science, art, technology, social sciences, politics and history, and often governed by the architect's personal approach or philosophy. The practice of architecture includes the planning, designing and oversight of a building's construction by an architect. It addresses both feasibility and cost for the builder, and quality space for the user.

After Modernism and Postmodernism, part of the architectural profession felt that architecture was not a personal philosophical or aesthetic pursuit of individualists; rather it had to consider everyday needs of people and use technology to give a liveable environment, and search for more people oriented

designs. Extensive studies on areas such as behavioural, environmental, and social sciences were undertaken and started informing the design process. During the last two decades of the twentieth century and into the new millennium, the field of architecture saw the rise of specializations within the profession itself by project type, technological expertise and project delivery methods. Today the most significant development in the profession is the mainstreaming of sustainability. The acceleration in numbers of buildings which seek to meet sustainable design principles is in line with a growing world-wide awareness of the risks of climate change. It is now widely expected that architects will integrate sustainable principles into their projects.

In comparison to the project team leader role of an architect, the broad discipline of engineering encompasses a range of specialized sub-disciplines that focus on the issues associated with developing a specific kind of product, or using a specific type of technology. Structural engineering, electrical systems, construction estimation, fire safety and protection, HVAC systems control, plumbing, acoustics, noise and vibration control, building power systems, lighting, building transportation systems and air quality control are some examples of such sub-disciplines. With the technological development in the construction industry new ones are constantly emerging.

Today the term architectural engineer is also used and it applies the skills of many engineering disciplines to the design, construction, operation, maintenance, and renovation of buildings while playing attention to their impacts on the surrounding environment. In some languages, "architect" is literally translated as "architectural engineer". The separation between engineering, architecture and the art should disappear to allow the development and the evolution of a new architectural knowledge and of new expressions.

In order to coordinate the integration of all aspects into the design process the architect, or the architectural engineer, should be able to communicate and use the same vocabulary of the various design team members.

Nevertheless, barriers to the integration of all aspects in the design process still exist and need to be overcome.

## **EXISTING BARRIERS TO INTEGRATED DESIGN**

Some architectural and urban aspects are most of the times not really integrated into the design practice. Environmental issues, for instance, are usually not part of the overall design concept and philosophy. In general, these issues are simply additional systems for energy savings or production or options which are there just to conform the regulations requirements, often introduced at a final stage during the detailing design phase.

Why do most of the architects, despite all the developing knowledge and availability of technologies and tools, still not incorporate an integrated approach in their design process?

The problem of integration of sustainable concepts into design depends mainly from the architect's background, approach and practice, but it is also a cultural problem, in particular regarding the lack of awareness on the demand side.

The architect's background is related to his or hers professional education and level of knowledge on building physics and environmental sciences. There is a gap between the academic knowledge and the practice. In general, environmental issues are associated to technical issues. Some architects believe that technical issues are specialised technical knowledge which they don't dominate. And when technical issues are servant to the project, they are usually developed in a second stage of the design,

and therefore their potential and integration are not fully exploited. Unfortunately, there are still many architects for whom technical issues are seen as a limitation to creativity and freedom rather than a challenge in the design process. The main reason for this attitude is a consequence of their academic education. Many schools of architecture still contribute to the dissociation between technical issues and design, where most of the subjects, including environmental issues, are taught separately from studio work and design studies and are left as an option to the design process. Those schools following the academic architectural Beaux-Arts model, with studies mainly based on drawing, aesthetics and philosophy rather than physics of the building and its environment, do not consider integrated studies nor help the development of a holistic design approach. If the technical issues are servant to the project and developed only at a second stage of the design concept, the potential for its integration is not fully explored. In the other hand, teaching systems focusing only on quantitative aspects of environmental integration do not contribute to explore the creative architectural potential neither.

Today there are many climatic databases and websites as well as a series of design tools available in the market which can help designers with the integration of environmental aspects into their design solutions. Ranging from data provided in spreadsheets and manual calculation methods to sophisticated programs on computational analysis, most of these tools require, however, some basic knowledge in building physics. Design tools can be grouped in generative tools and performance analysis tools. The former helps mainly in the definition of the geometry, including orientation and shape of the building as well as of openings and solar control elements in regard to solar access. This type of tools requires usually few data and thus can help on the decision making during the initial stage of design. The more sophisticated analytic tools provide quantitative data and information on the buildings thermal and visual performance for particular solutions. These require, however, most of the times, a complete and detailed description of the building and are thus more suitable for an advanced stage of the design. They usually lack on graphical visualisation and demand special skills to their use and knowledge on the interpretation of results. In addition, most of this complex software is usually oriented to analyse only one or a few, but not all, environmental aspects. Therefore, there is a need for the use of additional programs to complement the analysis of other relevant aspects. In this case, know-how and knowledge on how to integrate and balance the various environmental aspects in an optimised final design solution is needed. In the lack of such a specialised knowledge and skills, most of the architects prefer to follow their intuition based on their own experience. Without a specialised knowledge (which can take some time to be acquired and assimilated) architects will have little to help them visualise the dynamics of an integrated approach and can easily fall in a wrong intuition. The architectural education has not contributed much to overcome this problem.

The lack of awareness on the demand side is another barrier to the integration of the various sustainable aspects into the design process. The client is many often afraid of new technologies and techniques. Sometimes the need for consultancy to thermal analysis or environmental systems requires additional budget. However, the perception and believe that passive technologies and environmental strategies are still expensive measures is also a cultural problem.

Building regulations may also gain a negative influence if associated to the notion that these consist basically on requirements for energy efficiency and thermal comfort, based only on limits to specific parameters of building components and systems. This main focus on quantitative criteria can also limit the development of innovative solutions, research and qualitative issues.

## **POSSIBLE DIRECTIONS TO OVERCOME EXISTING BARRIERS**

First, architectural teaching programmes and methods should be aiming at providing students a basis for the development of a holistic approach for an integrated design process. Therefore, all separated

subjects should be put together, tested and developed into design studio work and the student should learn and be given the grounds for communicating with the various specialists. When there is more knowledge of building physics and the understanding of the dynamics between the building and its external environmental conditions, material's properties, solar geometry, etc., the design solution can develop logically to promote its best use and find the optimised balance between aesthetic issues, architectural expression and sustainable design strategies.

The use of new technologies should be seen as an opportunity to explore the aesthetic potential to control environmental conditions. The client always seeks for quality of space, so does the architect. Sometimes it is necessary to raise awareness to the client, establishing a relation between cost-benefits and design solutions. It is important to show a vocabulary of good examples through a set of solutions which show a balance between aesthetic issues and environmental solutions, where comfort and energy efficiency are natural consequences of the search for this balance.

In addition, the opportunity to experience a pleasant integrated design solution encourages and may contribute to cultural change.

We have to acquire new knowledge: the principles which characterize the relation between architecture and nature as well as the skills to translate these principles into architectural knowledge so that these become part of the building. Moreover, our choices need to be rechecked, identifying what is relevant or what is part of a particular context and predicting the environmental performance of the building before it is built. This is why we use computers and analytic tools or even environmental design support tools. We also need to know how this happens in practice through empirical knowledge, either through our own building experience, before it is used by the occupants, or through a different complementary knowledge. All these aspects are necessary to create the so called environmental sustainable design as a process which can lead us to products which can be evaluated.

Finally, although adopted legislation sometimes renders difficult the integration of the different requirements of various aspects, regulations and financial incentives can help raising awareness and promote the adoption of a green agenda, acting as useful instruments to stimulate an integrated design approach. Green labelling and certification schemes can also be an important tool to promote integration and could be also used to decrease taxes and attract the market.

## **CONCLUSIONS**

Architecture is still the art and science of designing buildings and structures; it is the design of the built environment, from urban design to construction details. Architectural design involves the manipulation of mass, space, volume, texture, light, shadow, materials, program and other elements in order to achieve an end which is functional, aesthetic and of high quality.

To consider environmental issues optional or an addition to the architectural project is a poor approach and will not lead to an integrated design solution. Designing with an integrated approach means to exchange knowledge and work in collaboration with a multi-disciplinary team, from the consultant or specialist to the client or final occupant, working together aiming at developing a design that reaches mutual goals. The architect plays usually the role of the coordinator and should therefore have a holistic and integrated approach. He is expected to dominate the appropriate basic language of each specialist in the design team in order to communicate and perform well his role as leader.

Integrated building design is a dynamic process which looks holistically at all architectural dimensions. Existing barriers to an integrated approach in the design process are primarily related to the architect's education and level of knowledge in particular regarding the fundamental understanding of the relations

and dynamics between the building and the local environmental conditions. This should be encouraged already by teachers and architectural course programmes and methods during the professional education. The consideration of environmental issues in the early design decisions is not necessarily directly related to the use or improvement of design tools or software. However, the knowledge of some tools can help understanding the dynamics and synergies among design choices

The scientific and technical aspects of this area are not just by themselves procreative and generative of architecture. They do not determine but maybe they suggest a certain direction allowing the creative side to open up for this magical process which is the creation of any form of art.

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