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RE-VISITING PERFORMANCE-BASED DESIGN IN PURSUANCE OF PASSIVE TECHNIQUES MANIFESTED IN THOMAS HERZOG'S ARCHITECTURE

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Abstract

The first buildings designed by Thomas Herzog reflect solar design techniques. Overarching geometric forms as well as efficient structures complimented long, slanted, south-facing walls incorporated in the meticulously-crafted structures. These design strategies created much more approval of solar buildings in the eyes of the mass consumer. Inspired by the early modern movement, his buildings are characterized by treating structure and function both ecologically and typologically while at the same time stressing the formal organization of the floor plan and façade in tandem. In line with first followers of this movement, Herzog, also resorted to stretching the limits of tradition (including the modern movement) by taking on a leadership role to broaden the view of present and future practitioners.

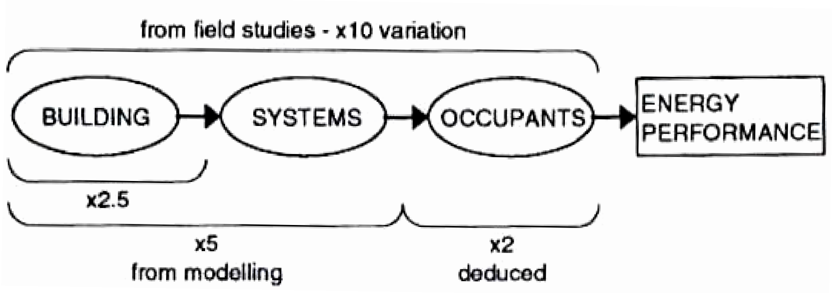
By means of the analysis of a series of Thomas Herzog´s works, four cases of study, in which their design approach is based on Performance Form, have been selected for further discussion both on their techniques and processes. There is a considerable integration between architecture and engineering throughout these projects.

This paper seeks to outline the prominence of performance-based design in which building performances are translated into guiding design principles which are considered either equal or more important than designing the forms. Furthermore, it attempts to depict the performative aspects of Herzog's works and suggests that the objectives sought by performance-based design can introduce an opportunity to accomplish a more efficient architecture.

1. Introduction

Case studies, energy audits and studies using mathematical models contribute to the formation of a picture in which significance and necessity of building performances are emphasized. As demonstrated in the following chart, building design and systems can jointly promote energy performance by up to five times (Baker et al, 2000) and therefore deserve attention when dealing with the design paradigm of building performance, although occupants can negatively affect it by as much as twice (Figure 1).

Figure 1. **Contributors to Energy Performance**



1- Building design
2- Services design and performance (systems)
3- Occupant behaviour

Source: Baker et al (2000).

In the domain of performance based design, the simplest, most useful and clearest definition is contained in the CIB Report # 64 *Working with the Performance Approach in Building*: “The Performance Approach is the practice of thinking and working in terms of *ends* rather than *means*. It is concerned with what a building or a building product is required to do, and not with prescribing how it is to be constructed.” (Gibson, 1982: 17).

Performance Based Building focuses on the target performance required for the business processes and the needs of the users. It is about the defining of the requirements and fitness for purpose of a building, constructed asset or facility, or a building product, or a service, right from the outset (Szigeti and Gerald, 2005). This is as opposed to the more traditional, prescriptive approach, which is concerned with describing type and quality of materials, method of construction, workmanship, etc. (Spekkink, 2005).

A performance-based design (PBD) is a building design that is based on a set of dedicated performance requirements which can be evaluated on the basis of a solution that is independent of the performance indicators. The performance-based design approach is a means to enhance the professionalism and the client’s orientation of the building design sector. It is aimed at satisfying the client’s real needs (*answering the question behind the question*) and leaves the design process open for creative and innovative solutions. The performance-based approach makes *integral design*, with parallel, interrelated contributions from all design disciplines imperative. PBD offers architects the opportunity to be the integrator in total building design again; PBD is like bringing Vitruvius up to date again in a modern setting (Spekkink, 2005).

Viewing it from another angle, the current interest in building performance as a design paradigm is largely due to the emergence of sustainability as a defining socio-economic issue and to the recent developments in technology and cultural theory. Within such an expansive context, building performance can be defined very broadly, across multiple spheres, from financial, spatial, social and cultural to purely technical (structural, thermal, acoustical, etc.) (Kolarevic and Malkawi, 2005). However, performance-based design should not be seen as simply a way of devising a set of practical solutions for a set of largely practical problems, i.e. it should not be reduced to some kind of neo-functionalist approach to architecture. The emphasis shifts to the processes of form generation based on performative strategies of design that are founded, at one end, in intangibilities such as cultural performance and, at the other, in quantifiable and qualifiable performative aspects of building design, such as structure, acoustics or environmental design (Kolarevic and Malkawi, 2005).

According to Herzog in the domain of performance form, "urban planning pilot projects, pioneering buildings, prototypes of building systems and components are created as a result of knowledge-based design tasks which are always carried out with a special demand on aesthetic quality. And goes on to state that the form is not predetermined, but is created depending on the task as a result of the design process as the case may be. It is called *performance form*" (Herzog and Partner, 2012: 1). Consequently this characterizes the working method of the architectural practice, the problem definition and the specific marginal conditions are examined and interpreted systematically (Herzog and Partner, 2012).

Change is inevitable as a part of fundamental human development. It is a simple fact that the building engineering solutions of today will become outdated over time. As engineers, we can contribute significantly to the effort for change but often we do not. Engineers are more typically reliant on *rule of thumb* design or processes that are familiar and proven - an understandable pattern, especially as an engineer's view must be conservative at times. What about intellectual curiosity and the creativity of engineering design? What about using *what if* more often? A stubborn attitude to change is the engineering profession's heaviest burden, and yet, at its most fundamental practice, engineering design, or the application of science, has potentially the most to offer in the evolution of the built form (Kolarevic and Malkawi, 2005).

1.1 Prescriptive Design versus performance-based design

A prescriptive approach is the most commonly adopted approach in engineering design. Prescription implies that there is a set of rules that need to be followed, rules normally outlined by a code or a design guide that is based on previously developed empirical and scientific knowledge. A simple example is the design of a beam from reinforced concrete (Kolarevic and Malkawi, 2005).

Prescriptive design takes on larger importance when one views it with respect to the larger scale design of systems, such as structural or mechanical systems for buildings. Often due to economic and time pressures, building form is limited in its complexity in order to simplify large-scale inputs for engineers, simplifications that manifest themselves in ensuring that the design and the spatial configuration have been seen before and that the design process is predictable. A prescriptive approach may provide reduced risk, but it can also lead to reduced gains. A performance-based approach may be more tailored to use in a particular project, one where the design problem cannot be simply categorized, or a solution from the past be readily adopted.

Performance-based design offers a process that relies more fully on an engineer's training in creative problem-solving and applying first principles for design. It does not preclude the use of prescriptive areas of design where they may be applicable, either at a component or systems level. But in a performance-based design process, the design inputs have to be carefully developed and meticulously understood. Their effect on the design is critical to the development of an innovative product. The process of design feedback is also critical to the success in performance design. Finally, a design output cannot be prejudged or biased. The process must be relied upon to properly assess inputs to develop and shape an unknown outcome (Kolarevic and Malkawi, 2005).

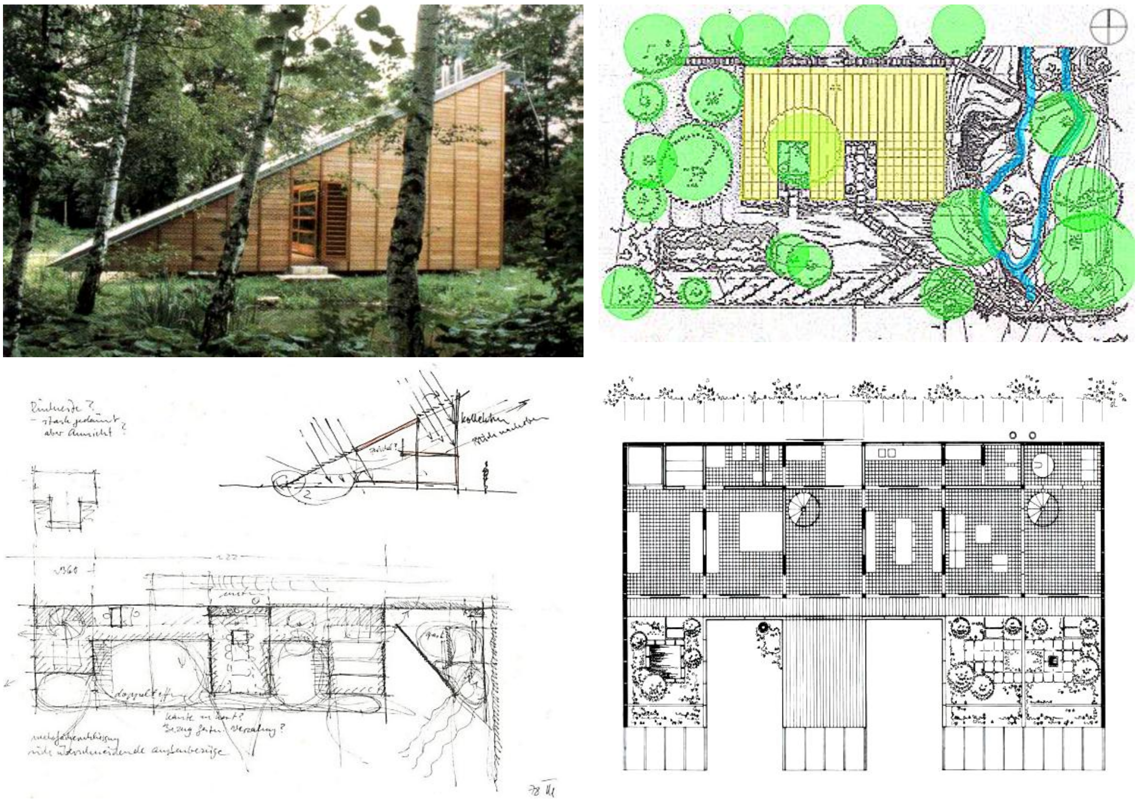
It is a fact that prescriptive processes are utilized constantly in building engineering, as our processes for performance-based design are in their infancy. This is for a good reason, as performance-based design eliminates several hurdles, the greatest of which is the requirement for integrated design thinking for all the members of a design team. For performance-based design to work effectively, it relies on well-communicated feedback loops between different members of a design team. This, in turn, creates a process that is more non-linear than a standard prescriptive approach, a design hysteresis loop that can often be frustrating and time consuming. An integrated approach to engineering design -one that adapts quickly to other disciplines and is rooted in a fundamental understanding of a variety of building systems- is essential to the success of a performance-based approach (Kolarevic and Malkawi, 2005).

2. Performance form oriented design – a multidisciplinary approach

2.1 House Regensburg 1977-79

Thomas Herzog's House in Regensburg (1977-79) is a simple diamond-shaped structure with a sloping glass roof that allows extra light to penetrate the interior (Figure 2). Indicative of the designer's view that environmental architecture should *make necessary technical features visible ... detailing them in an aesthetically effective form*, he created a passive solar dwelling using a layered house-within-a-house integration of an intermediate temperature zone (Wines and Jodidio, 2000).

Figure 2. **House in Regensburg, Conceptual sketches, site plan and ground floor plan**



Source: Hezog (1993).

The visual appearance of the house viewed from different directions is that of a greenhouse facing south, locked into its own cluster of beech trees. The image is not only that of a high-tech structure, but one which is also comfortably integrated into its location as a result of the use of lean-to timber beams and the feeling that it grows (plant-like) out of its surroundings. The technology applied is visible. It has a glazed southern face (Figure 3), a sloping roof for passive solar heat gains, natural limestone floor tiles for radiant heating, stilts to raise the edifice above the high ground water level and protect the beech trees, and the general light-weight construction materials that blend with nature, rather than assert the building's importance (Wines and Jodidio, 2000).

Figure 3. **House in Regensburg, glazed southern face**

Source: Hezog (1993).

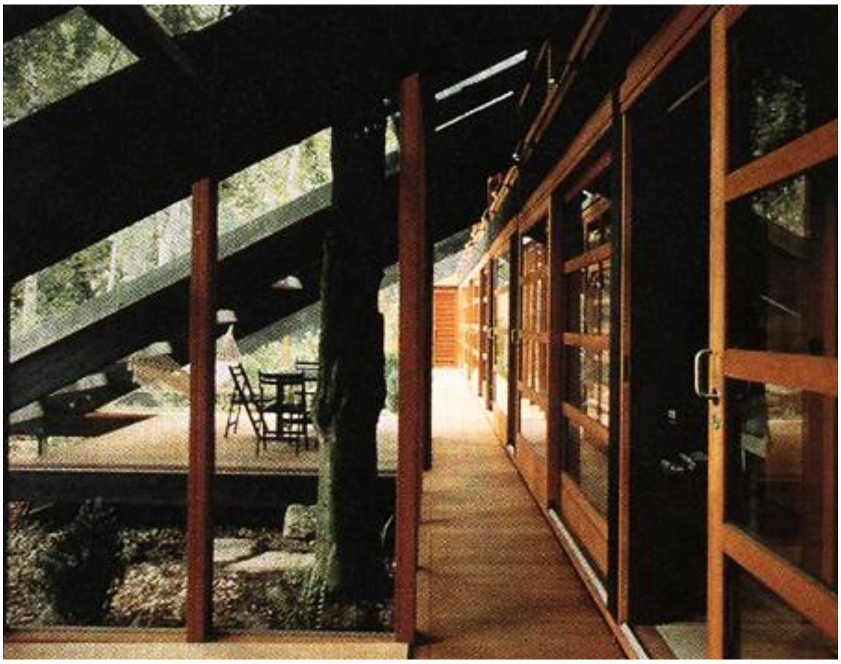
Herzog shows a merging of science and environment as he is guided by both, the laws of physics and the conditions of nature. He believes that progressive architecture *must possess a neutrality that will allow life to develop* and he does not feel *obligated to conform* to the current standard of exhibitionism but instead is content at the cutting edge of *new minimalism*. His technological advances focus more on natural aspects such as infrastructure, site restraints, solar energy and the properties of materials. Such research has led him to unusual yet effective concepts including the house in Regensburg, which is a building within another building. As the outer structure is built like a green house, it creates a temperate zone, with temperature rising the further you go inside the second building. Herzog has also designed the interior floor plan using this method of insulating the house, with rooms wanting to retain heat towards the centre. Along with cheaper heating bills, having a greenhouse outer shell also provides the house with free lighting all day and an area between the two structures for temperate plants to grow. However, the house isn't reliant on the sun due to the fact that heat released from underneath the floor is absorbed by the wooden framework and kept in by the temperate zone.

In an overall view, technical and constructive details were deliberately exposed and integrated into the geometric order of the building, giving it an aesthetic effect of its own.

Thomas Herzog's house is elegant in its simplicity, with a form that enables one of the most fundamental principles of sustainable design: passive temperature control through the thoughtful use of material and geometry, coupled with an understanding of how to manage thermal gains from solar energy.

The *sunspace* concept has been in practice since the Victorian era, when conservatories were added to the exterior of buildings to control heat transfer, by providing a space between the exterior and interior to moderate daytime and evening temperatures. Herzog employs this concept in the House at Regensburg, but within a distinctly modern and rational form. The sunspaces (also serving as greenhouses) face south, and the structure is divided into zones along the north-south axis. The main enclosed living space is connected to the sunspaces with an intermediate hallway, as seen below in the image of this transitional space (Figure 4) (Moss, 2010).

Figure 4. **House in Regensburg, intermediate hallway**

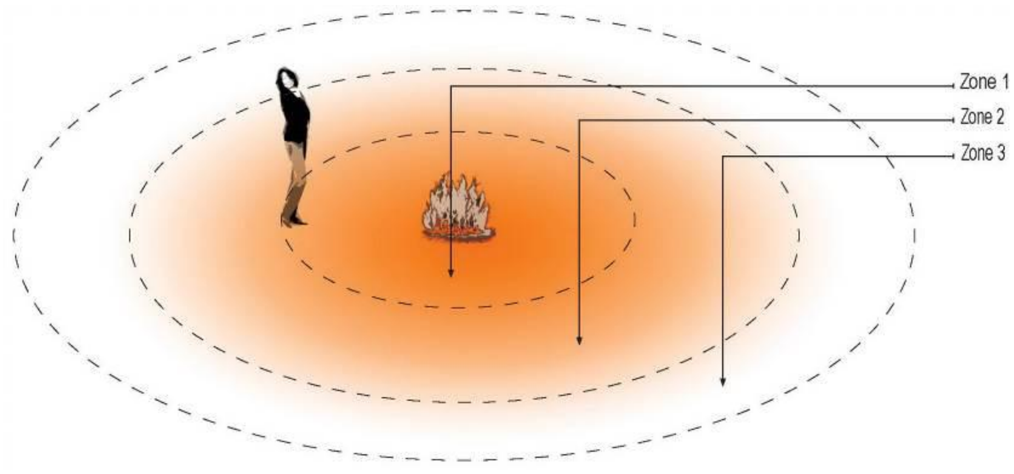


Source: Moss (2010).

The entire system of spatial areas is enclosed by a double glazing angled plane above the sunspace zone that turns into a titanium-zinc roof structure on top of the living spaces. This spatial integration of solar gain, formed by transitional and occupied zones, allows it to be designed with a simple triangular form. The visual strength of this form is apparent viewed from the side, cladded in locally sourced wood, which softens the minimalist form with contextual, sustainable materials (Moss, 2010).

In fact, fire has traditionally been the centre point of social life, creating a focus point. Starting with the inner social gathering point and from there on by means of the fire's heating and lighting gradient it defines more private zones for people to use, as described by Banham. This can also be seen in the traditional use of the hearth in our houses, which used to be the social gathering point. This is illustrated in Herschings anecdote about the American family moving from their air-conditioned house to a small village in France and the fireplace becoming the centre for them in the winter time, whereas in the summertime the entire house and the streets are a part of their home and life. Here, illustrated with the zones around the fire (Figure 5), the first circles being the social ones and the third being the more private ones (Peterson, 2011).

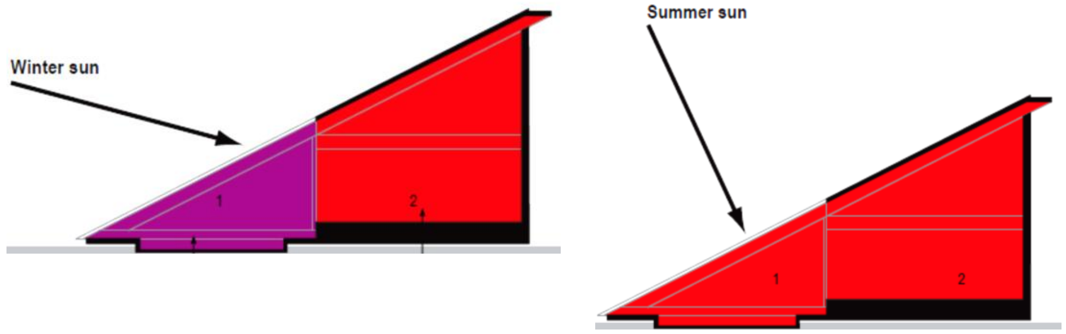
Figure 5. **Onion principle, different zones from the fire**



Source: Peterson (2011).

Thomas Herzog's solar house in Regensburg from 1979 shows an example of an onion principle similar to that of the different zones radiating out from the fire. However, here they are strictly defined zones where the outer zone is a buffer between the outside environments whereas the interior is the warm core of the house, which defines the environment for daily life and central social functions. Here the thermal spaces play a more active role in the design of the building. The buffer creates a zone that during the warm summers functions as a part of the living area whereas during the cold winters it works as a conservatory by preheating the air (Figure 6). Nevertheless, it requires the user to be aware of these functions and not to see them as an essential part of the living space throughout the year (Peterson, 2011).

Figure 6. **House in Regensburg, different zones**



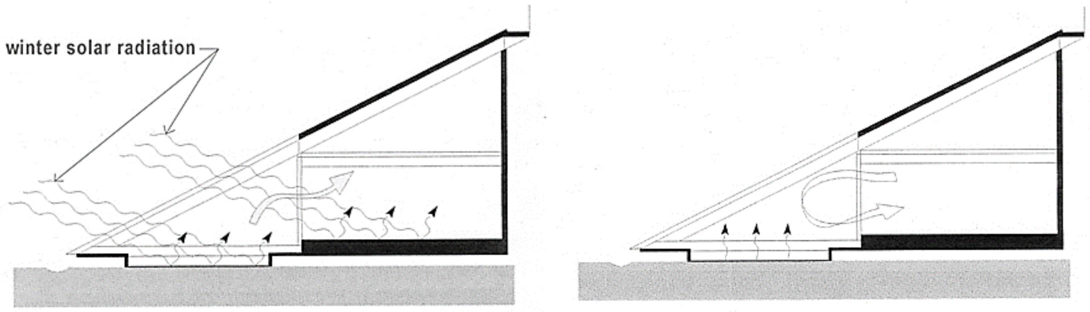
1: Zone one as a buffer between the core and heart of the building, is a space that can be used and is warmer than the outside but not as a place that is as warm and comfortable as the core of the building.

2: The core of the house is comfortable throughout the year and naturally ventilated.

Source: Peterson (2011).

A quick analysis of how solar energy is captured, stored, and re-radiated to maintain a comfortable temperature during the winter months is indicated in the section diagrams below (Figure 7).

Figure 7. House in Regensburg, winter solar radiation and heat releasing in the evening



Source: Moss (2010).

During the winter months daytime, solar radiation penetrates into the sunspace, as well as the main living spaces at a low angle, allowing light and heat to enter the home. In order to maintain the right temperature at night, the concept of thermal mass is incorporated into the design and this affects material selection. Heat is gained and stored in the stone floors throughout the day and released slowly in the evenings to warm the occupied spaces (Figures 6 and 7). Meanwhile, double glazing windows serve to further insulate the space. (This is a strategy used in countless projects, both old and new. Today, we often see concrete utilized to serve this purpose) Herzog designed the House at Regensburg to sit lightly on the earth, with a raised floor system which minimizes any potential environmental disturbance and protects existing drainage patterns, as well as the numerous beech trees on the site. In fact, the design responds to its immediate context by removing the sunspace element at a location where an existing beech tree remains (Moss, 2010).

Maintaining the natural tree (Figure 8) canopy not only is inherently ecologically responsible, but this practice also provides for shade and natural cooling in the summer months by moderating the microclimate at the site. Lifting the structure off the ground also aids in passive cooling by allowing airflow beneath the building and enabling natural ventilation.

Figure 8. **Regensburg House, minimizing potential environmental disturbances**

Source: Herzog (1993).

The House at Regensburg has helped us to expand our understanding of sustainable design and to underscore the truth that creativity is not compromised by sustainability. Creativity is, in fact, enhanced by this type of contextual and innovative thinking, and makes a project, as we like to call it, sustainable by design (Herzog, Kaiser and Volz, 1996).

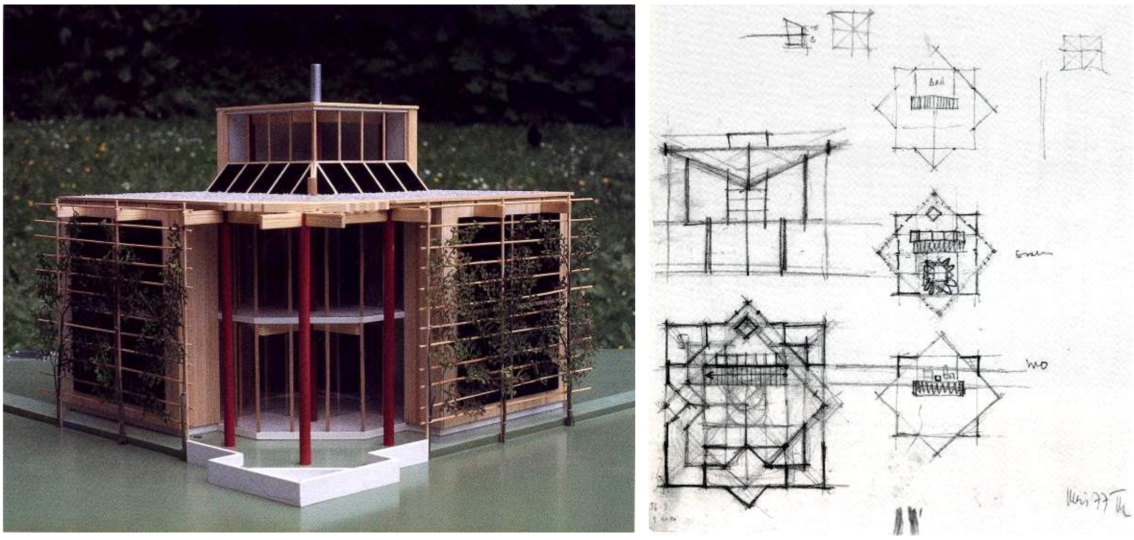
Discussion 1

Taking into account the characteristics of this building, we realize that there is an emphasis on the fact that environmentally-responsive design does not entail that a building has to look a certain way. Actually, Herzog rejected the widely-held belief during the early 1970′s that *energy efficient design had to adhere to a specific aesthetic*. In contrast to many designers of the era, who turned to an anti-industrial ideology in order to help them define an ecologically responsive form, he celebrated the convergence of modernism, science, and innovation to create a unique solution.

2.2 House in Waldmohr 1982-84

The second example of Herzog's architecture is a House in Waldmohr (1982-84). For the plan, Herzog used the *thermal onion* plan, involving another interpretation of the building within a building (Figure 9).

Figure 9. **Model of House in Waldmohr, South view and conceptual sketches**



Source: Herzog (1993).

Herzog placed a cube in a square on the diagonal of a south-facing site to create both an external and internal glass facade. A conservatory between these membrane walls (Figure 10) functions as a temperature control buffer zone, as a solar collector and as a draught-excluding lobby, and heating comes from under floor hot water central heating. For much of the year, this space can be used as an additional living area. Each of the environmentally favourable features of the house is clearly visible and part of its aesthetic statement, inclusive of the surrounding trees, laminated timber construction, Mylar foil sun screens on the interior, planted roof, and verdant trellis structure shading the east and west elevations (Moss, 2010). The planted roof and the climbing plants (verdant trellis structure) along the east and west faces prevent the overheating of the house in summer (Herzog et al, 2001).

The building is based on a comprehensive modular order. A skeleton framework of laminated timber elements is set on a peripheral, adjustable steel frame on top of the basement.

A layer of diagonal timber boarding, visible from underneath, provides horizontal stiffening for the load-bearing structure. Plywood sheets serve as a vertical bracing on the outer walls.

On top of the timber boarding at the uppermost level is a non-ventilated flat roof construction with a foil insulation layer (U = 0.24). The ground floor slab is insulated with rigid foam plastic.

The outer walls are cladded on both faces with timber boards, and with internal thermal insulation and an air cavity, which have a *U* value of 0.3. The timber casements, with insulated double glazing, have mylar foil blinds on the inside face that act as heat and sun screens. The green roof and the climbing plants that provide shading to the east and west façades prevent the building from overheating in the summer (Herzog, 1993).

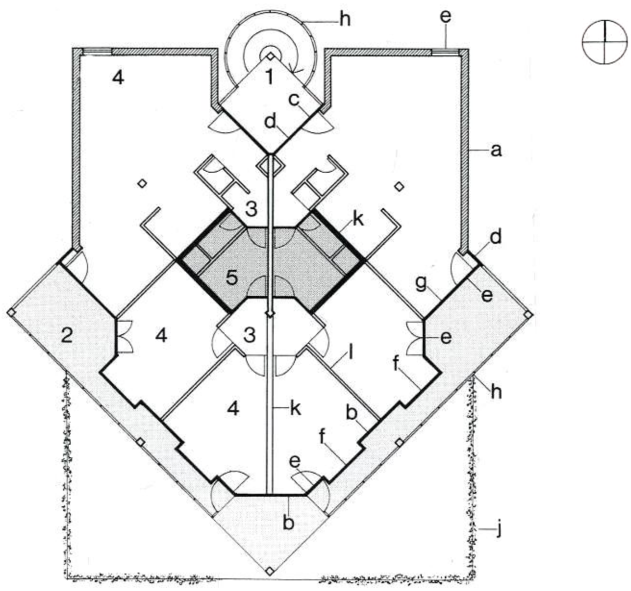
Figure 10. **House in Waldmohr, the layering glass membrane walls**

Source: Herzog (1993).

His house in Waldmohr is significant in its passive heating technique. Here, the design strategy for the capturing of light finds its spatial configuration; rather than the façade arrangement. He located spaces, which required more heat towards the centre of the building. He surrounded these spaces with the ones that need less heat (surrounded by rooms where the temperatures decrease proportionally as they get closer to the exterior) so that they are situated near to the façade (Yazgan, 2006).

In fact, the warmest spaces, such as bathrooms, occupy the centre, with the temperature decreasing gradually towards the perimeter, a *thermal onion* (Figure 11). Conservation and comfort both come from protecting the core first, like the human body, or a tree losing its leaves in the winter. Floor planning typically follows space programming, driven by functional and organizational needs (Hosey, 2007).

Figure 11. **House in Waldmohr, ground floor plan**



Temperature zones during heating period
1 wind lobby
2 conservatory, suntrap 16-28°C
3 store, areas of brief use 12-t6° C
4 living, sleeping, cooking, working areas 18-2o° C
5 bathroom 20-22° C

Elements of passive systems
a closed solid wall- heavily insulated
b closed lightweight wall- heavily insulated
c entrance door
d triple glazing, fixed
e triple glazing, movable
f double glazing, with insulating shutters
g double glazing, movable, with insulating shutters
h single glazing
i vegetation as shade-giving skin
k solid internal wall
l lightweight internal wall

Source: Herzog (1993).

The ratio of surface area to volume of a cube means that this form has certain advantages in respect to thermal losses through transmission. With one corner of the house facing south, the south-east and southwest facades allow an optimum direct exploitation of solar energy, while no side has a purely northern aspect (Figure 12) (Herzog et al, 2001).

Figure 12. **House in Waldmohr, north view**

Source: Herzog (1993).

Discussion 2

Thomas Herzog has continued his research throughout the entire spectrum of climate control within a single building, including air circulation, air quality, lighting, and temperature control. He fundamentally believes that a truly ecological building also has a corresponding resolution in an aesthetic form.

Considering the design process of the Waldmohr house, it would be worth asking ‘how does the process of design change when we fully address the needs through strategic connections to the exterior?’ Is it especially related to solar orientation?

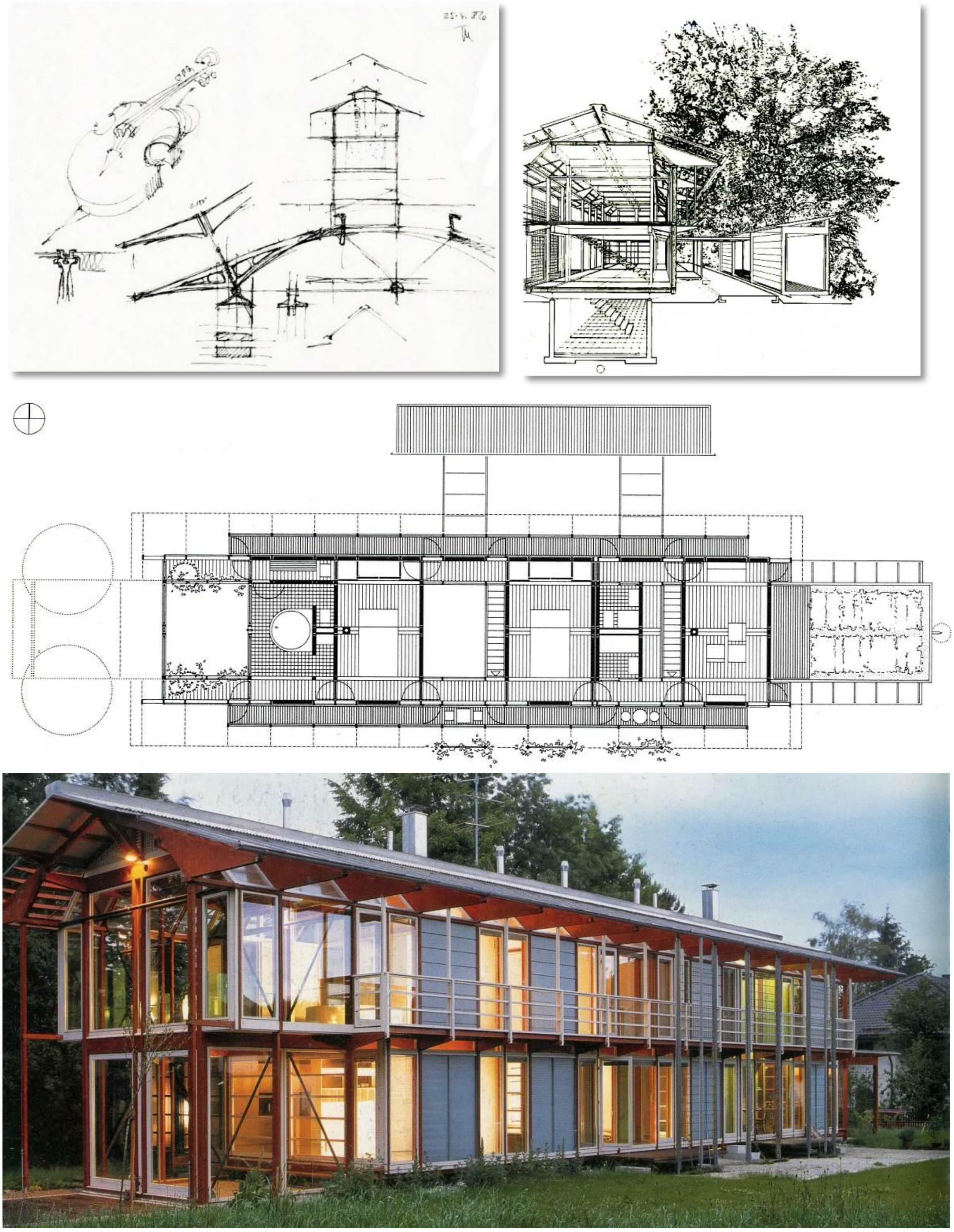
In fact, The Waldmohr house demonstrates how the building is shaped as the process of design is significantly affected by experiencing the environment.

2.3 Two-family House, Pullach (1986-89)

The third example of Herzog's architecture to be studied is the house in Pullach (1986-89). Despite its High-Tech image, glass on a laminated wood frame with steel cross tie bracing, this house has its origins in the traditional Alpine timber frame barn. Like its vernacular precedent, the Pullach house starts off with an elegantly small substructure and outward cantilevers, like the Eames House, at each successive upper level. The roof becomes a huge overhanging form in comparison to the thin proportions of its base. A relatively small and well-protected structure rests beneath the sheltering eaves.

The vernacular barn uses this outwardly cascading form defensively to keep its wooden frame and rough board cladding dry and covered, structurally. The scheme provides an economy of support and cantilevered spans. Thomas Herzog acknowledges this as a formally appropriate starting point and then opens up a series of complex interactions with the climate via technical components and Modernist ambitions. Glass is used wherever possible (Figure 13), then solar collector panels are strategically integrated as insulated walls wherever privacy dictates an opaque barrier. There is an exposed industrial wood structure, a galvanized metal screen where climbing summer vines grow facing the south, and a corrugated metal roof that turns into glass beyond the exterior wall line to become a broad and transparent rain canopy (Bachman, 2003).

Figure 13. **Two-family House, Pullach, conceptual sketches, cross section, first floor plan and south face overview**



Source: Herzog et al (2001).

In fact, the architectural consequences resulted in all the spaces being south-facing. Admittedly, this action would eliminate the problem to transfer solar heat to the rooms which are placed on the north side in the winter. Therefore, in the Pullach house the concept of the design resulted in an elegant cross-section which is extremely refined (Figure 13). Additionally, different rooms around the building were meant to be used in certain hours of the day (some of them for 2 hours a day and others for 12 hours a day) in the cold season. As a consequence it was decided to completely define different kinds of space as well as mechanical service systems and building materials. The greatest application of glazing is focused on the long pavilion plan of the building in which each square foot of floor counts for 0.5 ft^2 glass (fifty percent). This area was designed in such a way as to absorb heat directly. There were many aspects to be considered, not only heating, cooling and ventilation, but also an optimized use of daylight to be exploited for the generation of electricity.

Additionally, their aim was not only to incorporate the contextual considerations throughout the design process (the surroundings, their scale and the kind of material used) but also to build a house which would cater for the clients' needs and meet their demands, which, besides exploiting environmentally-friendly forms of energy could have an aesthetically pleasant appearance.

In fact, the building applied cutting-edge technology. The outcome of this climate-appropriate house obviously illustrates Herzog´s philosophical attitudes towards technology stressing how the integration of functional and traditional aspects can immerge into a practical application in which the materials and resources are minimized.

In an overall view, the emphasis on research and development in Herzog's academic pursuits find Modern expression in his professional practice. He constantly experiments and seeks to apply the best and most advanced technologies to the service of his buildings. For him, Modern architecture is still involved in the transition from the 1970s attitude whereby energy efficiency was sacrificed to achieve visual statements of material minimalism. Herzog sees the emerging role of Modern architecture as just the opposite-using new materials and configurations to exploit a building's functional relationship with the environment. This evolution is evident in his own career as well (Bachman, 2003).

Discussion 3

The inventiveness of the solar design of this project is more successful in integration, which is mostly strategic, than physical. The performative characteristics of this project are mostly achieved by design logic. As a result, a simple plan exposes an integration of complex thoughts about solar penetration, interior planning, summer shading, structural spans, privacy, circulation and view, the outcome of which has been successful in reconciling different aspects of design. Furthermore its aesthetic quality of form is remarkable which is configured by timber framing with a significant transparency by infilling with glazing.

2.4 Guest Building for the Youth Educational Centre, Windberg 1987-91

The next example of Herzog's architecture is the guest building for the youth educational centre (1987-91) in Windberg (Figure 14).

The long walls of the south tract of the building are of 30 cm limestone blocks with a light coating of lime-wash. The walls support reinforced concrete floors spanned in a north-south direction. Lateral bracing is provided by four cross-walls. The roof structure consists of plywood box beams, visible from the inside. Laminated timber plates on top of the walls in the longitudinal direction function as peripheral tie beams. These beams are cantilevered out at the ends over the corner rooms, where they are supported by isolated columns. The wall slabs are centrally supported in the basement by pairs of reinforced concrete columns. In the northern tract the walls of the plinth zone built into the slope of the site are in concrete and contain an insulation core.

The narrow northern tract is of a timber skeleton frame construction with lightweight infill panels. Bracing in the longitudinal direction is provided by the wall slabs alongside the staircases. Lateral bracing is in the form of vertical trussed frames, visible on the inside.

The continuous, horizontal strips of fenestration are glazed with fixed panes of double glazing. Elsewhere, the north-facing wall surfaces are insulated with a 14 cm thick layer of mineral wool. The 45 cm vertical module underlying the construction is indicated by the narrow aluminium drip beads in the facade. Entrances in steel and glass are clearly differentiated from the large areas of timber cladding. Movable elements (doors, ventilation flaps) consist of dark plywood-faced construction board.

The southern tract has a standing-seam metal roof covering of prefabricated elements. The roof of the northern section is covered with small-corrugation aluminium sheeting. On the upper storey the floors are carpeted.(Herzog, 1993)

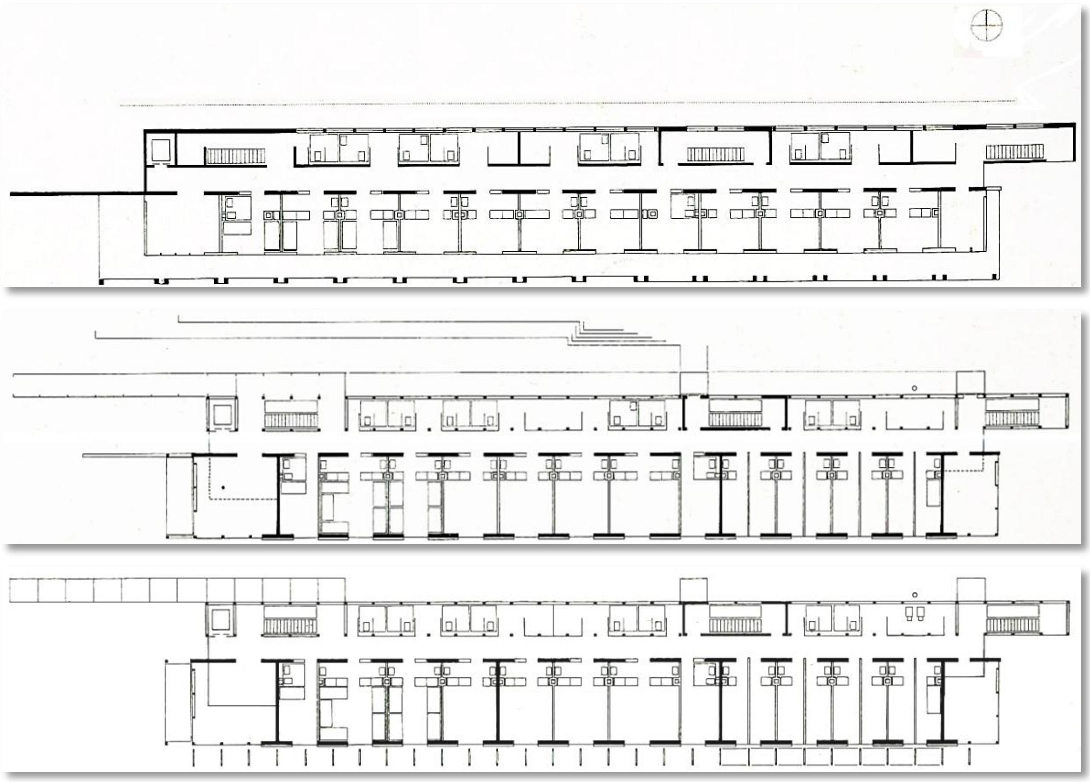
Figure 14. **Guest Building, Windberg, view of the timber-boarded front facing the village**

Source: Herzog et al (2001).

The main advantage of the system is its potential energy saving and also its low cost. In fact, with regard to conserving energy, the two main factors which were taken into account were the time-usage and temperature requirements for certain spaces. In this manner those spaces which were supposed to be for several hours use were separated from those which were supposed to be used for just a short period of time. Furthermore, different materials were employed to build them.

In other words, considerations of energy consumption affected the design development. The main strategy was based on prioritizing the rooms in accordance with the length of time they were meant to be occupied (Figure 15). The larger living spaces were located on the south side where solar heating was gained during the day-time with the enclosing walls and windows as thermal preservation elements. The smaller rooms which were on the northern side and served for shorter intervals required little heating and were fitted with insulation and an external wall with a high thermal performance (Herzog, Kaiser and Volz, 1996).

Figure 15. **Guest Building, Windberg, from top to bottom: Lower Ground floor plan, Ground floor plan and Upper floor plan**



Source: Herzog et al (2001).

In fact, elements of the flatter surfaces were generated from Herzog's ecological design strategy and this was based on a modular structure in order to carry out the passive heating systems. In order to expand daylight usage, translucent insulation panels were erected. In other words, the spaces which were planned to be used for long periods were lit and heated with daylight and solar energy by means of using translucent thermal insulation, among other materials.

The south facade of the building was divided into vertical segments of opaque walls and windows which were used alternatively (Figure 16).

Figure 16. **Guest Building, Windberg, from left to right: northern and southern facade**

Source: Herzog et al (2001).

In order to prevent the wall from overheating, during the summer months, the exterior louvers can be lowered for shading the walls. This situation actually creates an interesting shift in perception, because one would not expect to see these shading devices in front of opaque wall elements in a conventional wall (Figure 16).

Moreover, an optimum form of wall construction was developed and tested which was based on the climatic and regional context. In this way, the statistical pattern of local weather conditions was simulated in computer trials.

Thermal energy distributed throughout the building was based on orientation, temporal and programmatic calculations.

In addition to the main and primary function of the building, it also demonstrates the principles of the bioclimatic architectural design by making the students aware of the passive and active energy systems as well as the environmental performances of this building by means of presentations and by facilitating a digital information board placed in the entrance area showing energy performance, visible service runs, storage elements and solar collectors (Herzog, 2001).

Discussion 4

The aim of Thomas Herzog's architecture is to reach ecological self-sufficiency by benefiting from technology, which is applied throughout his works, while making his main focus on enhancing passive technologies.

Evidently, there is a real harmony between form, material and colours in this building. He has also taken care of the existing exterior scales and their influence on the organization of the site. In fact, he made a coordinative approach between *modern architecture* and *historical and cultural references*.

Herzog not only provided the spaces that really work well for the clients and others who experience the buildings, but also one of his aims was to design the buildings in order to educate the habitants or users on solar technologies and energy conservation throughout their lives which, above all, offers educational and cultural values.

Another point worthy of attention is that while the building organizes a residence hall, at the same time passive and active design are incorporated in the building's system and these are visible in the interiors, enclosure and also in the structure of the building.

3. Conclusion

From a holistic standpoint, analysis of Herzog´s works and drawings highlight the following posit: Performance-based approach to design will be a prescriptive recipe for our tomorrow's architectural solutions which is a vital point for improving our built environment ensuring quality designs and results for our clients.

Rather than a way of devising a set of practical solutions to a set of largely practical problems, performative architecture can be characterized as a *meta-narrative* with universal aims that are dependent on particular performance-related aspects of each project. To overcome the key challenges of this approach and consistent with this conceptualization, each project has to be considered per se with the aim of determining different performative aspects and often reconciling conflictive performance goals in a creative and effective way.

Parallel with the guidelines of performative architecture, instead of the building's appearances and forms, more emphasis is placed on processes of formation founded on imagined performances, indeterminate patterns and dynamics of use, poetics of spatial and temporal change. Regarding this, the architect's role is more focused on diversifying, multiplying, embedding and instigating their effects *in the material* and *in the time.* Put another way, architects should develop their performative techniques, of design, by changing their mentality from scenographic appearance to the pragmatic imaginations of how a building works, what it does, and what action, event or effect it might engender in time.

Perfromative architecture enjoys the synchronization between technical processes, the harmony of nature and a sense of social responsibility. It aims to demonstrate that a long-term, mutual responsibility for the public welfare plays a greater role in life. In order for a society to develop along humane lines it must be more than the sum of its individuals pursuing their own interests.

As architecture is one of the few professions with a truly comprehensive character it is imperative that architects take a holistic approach to complex systems. practicing *performance-based design* calls for architects to take on a *holistic approach* towards the problems which can be resolved by the increasing of interdisciplinary considerations to an interaction among engineering and economics, natural and social sciences, arts and environmental design, providing that the latter be understood as a central discipline.

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