

'Ventilation and Building Envelopes in a Holistic Perspective : A plea for Fit For Purpose approach and Activating Design.

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ABSTRACT

A questionnaire presented to designers demonstrates the difficulty to explain the specific status, the stratification and the correlation of parameters, features, concepts, principles and requirements. These aspects are essential for, but simultaneously hindering the interdisciplinarity when confusion occurs in use of words or obscurity occurs in the design process.

When designing a high performance building envelope, an essential condition to optimize the integration of the complex quantity of mentioned aspects is to bring together different design views. This arrangement originates in an interdisciplinary team on the moment that bilateral interfaces are developed, by exceeding the establishment, what creates interesting correlations as a guarantee for architectural integration. The stratification, feeded by the input of different design views, enriches the choices, put them in a holistic perspective and makes them more indispensable.

The management of formulated objectives can be situated in a 'Fit For Purpose' approach generating concepts to test the accomplishment of the requirements and guiding towards a 'Fit To Communicate' phase.

'Activating Design' can be used as a graphic translation of the bilateral interface which improves the communication and which demonstrates the intentions of the interdisciplinary team...

KEYWORDS

Building envelope, Activating Design, Holistic, Integration, Concept, Performance, Stratification.

CONTEXT

Analysing the design development of existing building envelopes lead often to the conclusion that the roof and the ground slab have been almost exclusively designed from the functional viewpoint while the façade has been designed taking into account architectural aspects. In this context, it was primarily the development in glass technology that was important. Due to the desire for maximized glass surface, the advanced development of the glass technology on the one hand and due to the search for more adequate insulated opaque external components on the other hand (both feeded by the need for a better comfort) caused a complex quantity of parameters, features, properties, concepts and principles. The emergency grows for

verifiable criteria which take all these aspects into account. In this context, Sint Lucas School of Architecture created a research environment called IVOTO¹.

In order to optimize the processing of all these verifiable criteria (in the case of designing a building envelope), it can be essential to join different design aspects (expression on the one hand and building technologies on the other hand) through amplifying the position of the building envelope as being not just the outer shell defining the boundary between inside and outside, but as being a selective filter² which enters into dialogue with its surroundings³ to exclude aggression or hostility and/or to admit supply from the environment. This definition makes the building envelope attractive and accessible for different design viewpoints in an interdisciplinary team. For example, physical parameters can be considered as an expression of dialogue with its physical environment.

As an exercise, students architecture were asked to evaluate or to compare given building envelopes only by means of illustrations and they were asked to list the parameters, features, concepts, properties they used (see Table 1).

TABLE 1: Student list of parameters, features, concepts, properties to evaluate building envelopes
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Materialisation / Transparency / Sunshade / Airtightness/ Wind load / Fire safety / Fire resistance / Orientation / Accoustic insulation / Thermal insulation / U-value / E-level / Energy Performance Regulation / Comfort / Temperature / Thermal mass / Modulus of elongation / View / Texture / Shaping / Day Night situation / Vandalism / Maintenance / Cost / Burglary / Ecology / Structure / Gravity / Sustainability / Water discharge / Flexibility / Technology / Ventilation / Perforations / Assembly / Roof as fifth façade / Workability / Completion deadline / Transport / Energy / Color / Lighting / Calamity / Buckling lenght / Slenderness / Climate / Accoustics / Watertightness / Vapourtightness / Availability of materials / Function / Programme / Fragileness / Absorption / Reflection / Temporary skin / Advanced skin / Interactivity / Double skin / Renewability / Replaceability / Prefab / Multifunctionality / Density / Movability / Thickness / Maximum span / Odour / Chemical resistance / Bending Moment / Compression strenght / Tensile strenght

It is interesting to understand how students or more experienced designers deal with that complexity on the one hand and to find the moment of appearance in the design process to guarantee the satisfactory objectives on the other hand. These questions are a basic search for management. Classifying them in them in subaspects (expression, structure, comfort and energy, construction, prevention, organisation) can be a primary management approach.

This classification demonstrates that many belong in several subaspects. A lot of cross links can be discovered between the subaspects (see Figure 2):

¹ IVOTO, Instituut Voor Ontwerpmatig Technologisch Onderzoek, Intitute For Design Aimed Technological Research.

² Steven V Szokolay (2008), *Introduction to Architectural Science, The Basis of Sustainable Design*, Elsevier, Oxford, U.K.

³ Hegger, Fuchs, Stark, Zeumer (2008), *Energy Manual, Sustainable Architecture*, Institut für Architektur-Dokumentation GmbH & Co KG, Munich, Germany.

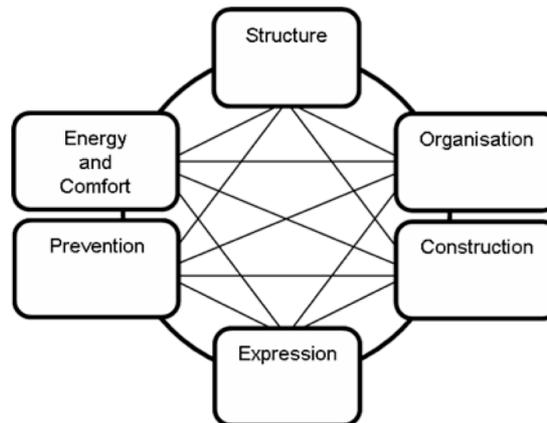


Figure 2 : Cross links between the subaspects, S. De Bruycker.

These cross links gives aspects as sunshade a plural purpose or surplus value and contributes the accessibility for the different partners in the interdisciplinary team : the designer can implement sunshade into the design of the building envelope, the structural engineer can anticipate by means of a search for structural integration (load bearing), and the engineer techniques searches to satisfy the comfort inside the building. In this context, a kind of common platform is caused in the interdisciplinary team where the building envelope will obtain a plural purpose as a guarantee for a better architectural integration on the one hand and it contributes to the fit to communicate approach to convince the client on the other hand.

The uplisted aspects are a cocktail of concepts, parameters, features, requirements and properties : essential and simultaneously hindering the interdisciplinarity. Sharp differences between these aspects could bring some intelligibility. Next questions should be answered :

- What are the differences between parameters, features, concepts, requirements and properties?
- Does clearing these differences tell us something about the implantation in the design process?
- Are there different implantations?
- Do different implantations cause different architecture?
- Is there a relation between implantation and architectural integration?

HOLISTIC PERSPECTIVE

Searching for answers can be done in an holistic perspective, the idea that all the properties of a building envelope cannot be explained by its components alone but instead, the building envelope as a whole determines in an important way how the parts behave. Designing a good building envelope is a difficult exercise because of its demanded complex versatility and, in addition to, its variable behaviour.

In the previously definition of a building envelope it became clear that the envelope has as a communicating and filtering task. If the common platform in the interdisciplinary team presumes the filtering requirement as communication with its environment, a potential rises to design a rich building envelope : the envelope can admit supply or stop aggression through which it is automatically communicating with its environment. So from that viewpoint there is no difference between the

filtering and the communication requirement. The appearance of the filtering can originate from the demands and wishes of the different stakeholders : the person, the organisation and the society. These demands vary mutual : an employee in a landscape office will perform more successful if his environment satisfies personal conditions as visual comfort, thermal comfort, acoustic comfort and indoor air quality. A colleague, working in other circumstances can have opposite expectations. The office in general (the organisation) has its conditions in terms of presentation towards their clients resulting in more or opposite or several conditions. Finally, the neighbours or the public space (the society) requires more or opposite conditions. This way of thinking strenght the idea of previously definition of the building envelope as being not just the outer shell defining the boundary between inside and outside but on the contrary, on the contrary, areas in terms of the street, the public space, the neighbour and perhaps the complete city are involved when thinking about or designing a building envelope. A building envelope does not exist or does not perform without the inside and outside. Trying to quantify an envelope in terms of a limit, a line as a barrier, is not global and will hinder its objectives.

THE DESIGN PROCESS

In order to exceed the chaos of parameters, features, concepts, requirements and properties it is desirable to formulate as soon as possible the wanted objectives in the interdisciplinary team. The management of these objectives can be situated in a 'Fit For Purpose' approach before starting any sketch or drawing. First questions as 'what is expected from the building envelopes' are important. These expectations are given in by the needs of the different stakeholders (the person, the organisation and society) and will be influenced by economic criteria as capital cost and futur cost. There is an increasing interest in methods expressing sustainable development in economic variables regarding building stock or portfolio management. This research will focus on requirements related to energy and comfort but these should be considered in the idea that they represent only a part of the whole.

A search for objectives related to the building envelope will lead towards requirements. To fulfil the requirements, performance should to be introduced. A matching mechanism⁴ will occur in the design process to match the posed requirements and the related performance. The interdisciplinary base will promote that occurrence and is, simultaneously, conditional due to the complex multi stratified input of aspects.

Being aware of the fact that the complexity is not disappeared but reduced after determination of the requirements, the management of these requirements is nested in the idea of a target strategy⁵ : the main target is the optimisation of the envelope by implementing subtargets related to the filtering and communicating definition :

- Maintaining and gaining heat.
- Avoiding overheating.
- Decentralised ventilation.
- Using daylight.
- Generating energy.

⁴ Leo Hendriks and Hugo Hens (2000), *Building Envelopes in a Holistic Perspective, Methodology*, IEA, K.U.Leuven, Belgium.

⁵ Hegger, Fuchs, Stark, Zeumer (2008), *Energy Manual, Sustainable Architecture*, Institut für Architektur-Dokumentation GmbH & Co KG, Munich, Germany.

Again, granting the main target does not reduce the complexity but at least it stimulates the very start of the management system, the realization must be located in the subtargets. It is important to adapt these subtargets regarding to the context of the environment. In a more moderate climate it is useful to organise a lot of glass surface pointed to the south west, but in some conditions (sunny winterdays and full sunny summer) the great surface grows the overheating issue.

Concepts should be introduced to accomplish the subtargets as a cognitive unit of meaning, a unit of knowledge. These concepts should be controlled by all partners of the interdisciplinary team to guarantee the implementation in the design process. In opposite of this common knowledge, not all the partners should control the features necessary to define the building envelope properties to generate performance which will be matched with the requirements (see figure 3).

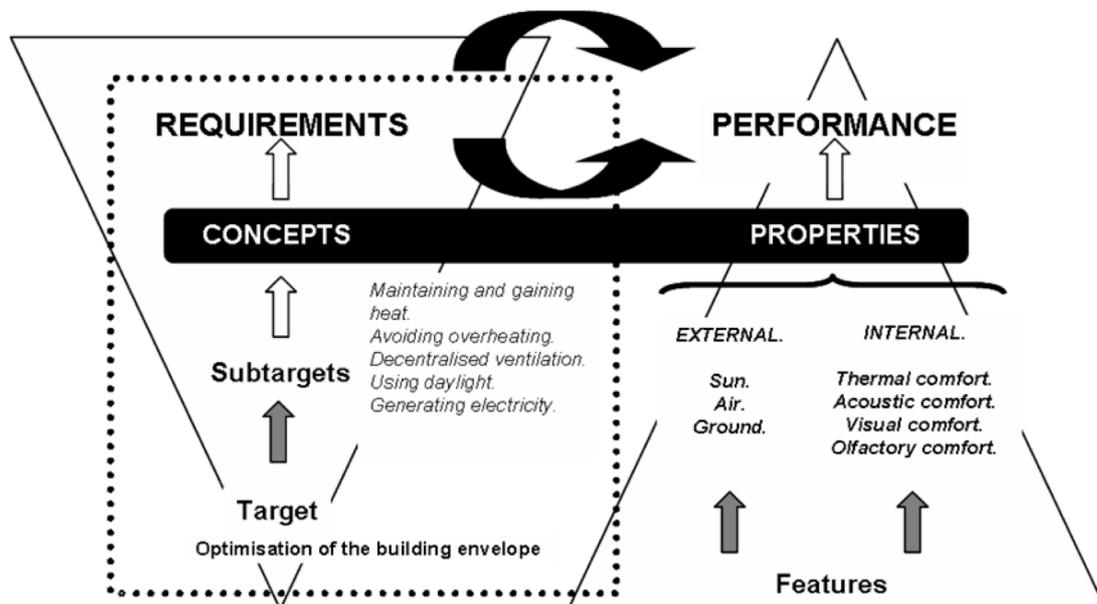


Figure 3 : The body of knowledge in the interdisciplinary team, S. De Bruycker.

There can be different concepts to accomplish the subtargets. For example related to subtarget 'Maintaining and gaining heat': surface optimisation and envelope geometry (concept 1), thermal insulation of transparent components (concept 2), thermal insulation of opaque components (concept 3), passive use of solar radiation (concept 4), minimising ventilation heat losses (concept 5), active solar thermal energy gains (concept 6).

Properties will be allocated (designed) to the building envelope to realize to match the concepts. These properties are a well considered combined action of external and internal features to generate a performance as an answer to the requirements and they are often the result of experts in the interdisciplinary team (see figure 4).

The tool and the language the designer is mainly graphic. Activating Design (see figure 5) can demonstrate the selected concepts as a preparation for the moment in the design process where the matching point occurs between the concepts and

properties. What's more, this activating design can be useful in the 'fit to communicate' phase to convince the client or stakeholder.

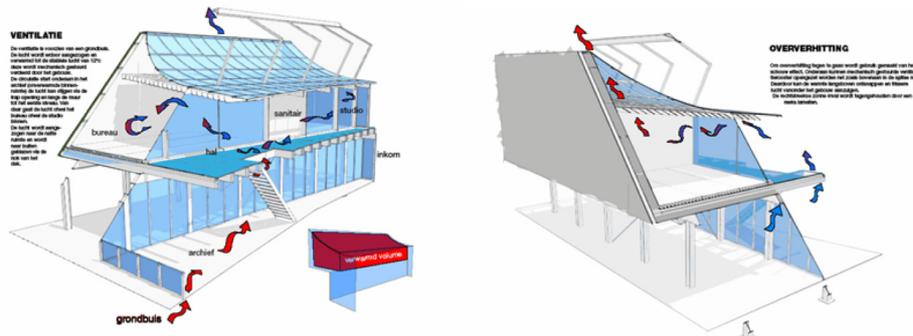


Figure 5 : Activating Design, result of the Research Seminar Construction and Structure, Sint Lucas School of Architecture, 1030 Brussels, Belgium.

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