# Synthesis through Trans-disciplinarity

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# Synthesis through trans-disciplinarity

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When looking up the word 'synthesis' in a dictionary, one comes across the following definition: "The combining of separate elements or substances to form a coherent whole."[1] Based on this definition one could argue that all great architecture is achieved through synthesis in one way or another, and that architects are general regarded as the person responsible for synthesising the different architectural elements that influence spatial and haptic perception.

An exemplar of this is Peter Zumthor's thermal baths in Vals, Switzerland, where synthesis between spatiality and tactility, materials and colours, architecture and landscape provides a great architectural experience. Another is Jörn Utzon's church in Bagsvaerd, Denmark, where the treatment of construction, acoustics and daylight ingeniously fuses with the church's function and architectural expression, once again offering a unique architectural experience.

In relation to 'environmentally sustainable' architecture the importance of synthesis becomes even more apparent, however, as the success of the design depends on how, and if, a synthesis is achieved between technology and architectural design.[2] This understanding has led me to consider how synthesis is a requirement for creating successful 'environmentally sustainable' architecture through the application of trans-disciplinarity, which leads to an increased awareness of the differences in decision-making as well as that of communication barriers between the different professions. These parameters play a fundamental role in relation to the achievement of synthesis in a world where professions merge and new hybrid professions and educations emerge.


a

a. Thermal baths in Vals, Switzerland, by Peter Zumthor. Image courtesy of Marcus Trimble.

Environmentally sustainable architecture

Sustainability is an ambiguous term whose definition changes according to the persons applying it and the context in which it is applied. For instance, sustainability in relation to construction or economics has a completely different meaning than the definition expressed in the proceedings of the Bundtland Commission, 1987. Entitled *Our Common Future*, the commission provided 'a global agenda for change'[3] outlining strategic improvements on environmental conditions worldwide. As defined in the report, "sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future."[4]

The term 'environmental sustainability' as applied here relates to environmental design, where 'environmental' means the relationship between the indoor and the outdoor environments. Thus the term 'environmentally sustainable' architecture can then be used to describe designs that meet the needs of today without sacrificing the ability of future generations, whilst considering the relationship between indoors and outdoors. These parameters include visual, psychological and physiological comfort, energy consumption, life-cycle profile and human toxicity of the construction materials utilised, the building's impact on nature and so on.

The understanding is that environmentally sustainable architecture need not necessarily have a specific architectural expression, but that environmentally sustainable considerations should, ideally, be a natural part of all architecture. It is, however, open to debate whether or not these considerations will put limitations on the artistic freedom, leading to a specific kind of architectural expression.

b

b. Church in Bagsvaerd, Denmark by Jörn Utzon. Image courtesy of Peter Guthrie.

## The Design Process

Most construction projects are conventionally divided into these sequential phases:

Briefing → Concept → Detailing → Contracting/Tenure → Construction → Maintenance and Refurbishment

Traditionally the architect, acting as designer, is the client's adviser throughout the project, and the engineers or the various technically responsible consultants, come in very late in the process in the detailing phase, when the majority of the design decisions have already been made. This means that the chances of applying calculations as a decision-making tool are few and a design synthesis becomes harder to attain. When the project reaches the contracting/tenure and the succeeding phases the main responsibility for realising the project is taken over by a contractor, but the designer remains the client's adviser.

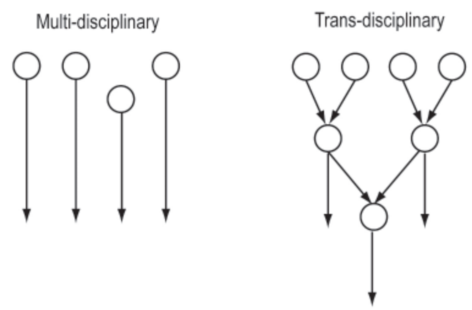
Research in the fields of sustainable (also labelled environmental, green, ecological, low-energy etc.) architecture indicates that the success of an environmental project relies on how early environmental considerations are implemented in the decision-making process.[5] This procures a need for a new way of viewing the architectural design process, whereby environmental considerations and the requisite technical tools are applied earlier in the decision-making process.

## A Trans-disciplinary Approach

Many successful companies in the field of environmentally sustainable construction have what they call a multi-disciplinary approach, but if we are to achieve architectural synthesis and innovation we should go a step further and apply what is termed a trans-disciplinary approach.

The difference between multi-disciplinarity and trans-disciplinarity can be explained in the following way:

In a *multi-disciplinary* process the people involved in the process work side by side on different areas of expertise from early on in the design process, thus ensuring the involvement of the necessary competencies in all stages of the process. In a *trans-disciplinary* design process the parties are also involved early on, but in this case they work together on the different aspects of the process, enabling new 'hybrid' competencies and innovation in the design process.




A simple example will suffice. The architect's view that conventional types of natural ventilation would compromise the design's aesthetic expression might lead to a novel way of solving the ventilation which the engineer did not think of. This development will benefit both parties; the resultant design will correspond with the architect's vision and the engineer develops an alternative way of ventilating a building that he might use in future. As a result, the process becomes more inter-disciplinary; it is no longer possible to differentiate the engineering requirements from the architectural expression of the building and the two aspects become fused in the design process.

The outset of a trans-disciplinary approach is involvement of all parties of the design team from the briefing stage onwards in order to reach consensus about the goals and solutions in the project with respect to differing scientific approaches and concerns. For this to work, it is important to acknowledge differences in the way the various professions approach the assignment of designing architecture and that those differences call for alternative types of decision-making.

As lead designer, architects frequently make qualitative judgments combined with quantitative values. Architects thus rely on a lot of non-measurable and often unverifiable data when making design decisions. In contrast, engineers primarily base decisions on quantitative data obtained in calculations, it can therefore be hard for an engineer to accept arguments based solely on qualitative values when trying to reach consensus with the architect. Engineers are, however, not necessarily novices to qualitative decision-making themselves. They too, often have to apply qualitative values when setting up an experiment or calculation and when assessing the resulting data.

It is therefore essential that all parties, who subscribe to dissimilar value systems, recognise and respect these differences, as they often form potential barriers of communication. In spite of this, these very differences also contain the possible generator of innovation.

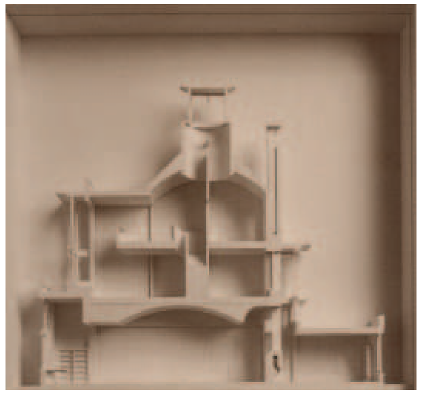
The basic setup of a trans-disciplinary approach has now been established: all parties collaborating in an integrated manner throughout the entire project. It is also agreed that consensus and mutual respect is essential to the success of this cooperation. Given this, we can now consider how to structure the design process so as to enable early implementation of environmental considerations, as well as employing rough, sketch-like calculations as a decision-making tool that encourages innovation. Although research and practice over the last decades have resulted in a number of publications and exemplary projects, we still have a long way to go before reaching a stage where environmental considerations and solutions become a natural part of the design process. There is nevertheless evidence pointing towards the positive effects of a trans-disciplinary approach.

## Integrated Design

Associate Professor Mary-Ann Knudstrup from the Department of Architecture and Design at Aalborg University, Denmark developed a methodical trans-disciplinary approach entitled 'The Integrated Design Process' in connection with the development of a new type of engineering education specialised in architecture.[6] Initiated in 1997, the education mixes the skills of building engineering and architecture, specifically emphasising the synthetic integration between the different disciplines. This methodical approach focuses on the phases leading up to the detail design of the project, considered to be the crucial phases of an environmental design approach.

The various phases highlighted in the Integrated Design Process and possible iterations between them are:


Besides integrating engineering and architectural tools early on in the process, the approach focuses on the fundamental importance of analyses for the sketching and achievement of architectural synthesis. The approach also elaborates on the briefing and conceptual stages, where tools which belonged to the detailing phase of are brought into the analysis, sketching and synthesis phases and considered as supplements for decision-making and idea generation.



c

## Selective Design

Another reflection on the requirements for a rethinking of the design process for sustainable architecture can be found in *The Selective Environment – An approach to environmentally responsive architecture* by Hawkes, McDonald and Steemers. Here, the authors present the idea of a selective approach as well as a design checklist of things to consider from early on in the design process.

Selective design is defined in the following way: "Selective design, as opposed to exclusive design, aims to exploit the climatic conditions to maintain comfort, minimising the need for artificial control reliant on the consumption of energy. This manipulation of climate, to filter selectively positive characteristics of the environment, is achieved through architecture."[7]

Besides delineating in detail the design process for a 'selective' building,[8] the publication also provides a design checklist contains the following parameters: site analysis, building form, courts and atria, site planning, building use, building fabric, daylighting, passive solar gains, natural ventilation, overheating and comfort, artificial lighting, heating and services.[9] These guidelines indicate that this approach again bring forward considerations traditionally belonging to the latter phases of a project to be integrated with a design philosophy that emphasises environmental sustainability.

## Towards Trans-disciplinarity: the tools for synthesis

This discussion clarifies the importance of an integrated, process-oriented approach to the design of 'environmentally sustainable' architecture that incorporates considerations traditionally belonging to the engineering fields early on in the design process. By providing examples of how tools such as calculations, visualisations or simulations from the related engineering fields can be integrated in an innovative way, both approaches discussed can serve as an inspiration for people working in fields beyond that of environmentally sustainable architecture.

c. Cover image from *The Selective Environment*. Image courtesy of Dean Hawkes.

The order in which the tools are applied can however, only partially help the integration. Another crucial element is the capabilities of the chosen digital and analogue tools themselves. These tools should enable the integration of the engineering considerations early on in the project. The key is that they can be applied in a sketchy manner to provide some insights into which architectural elements have the biggest influence on for instance the energy consumption, thermal comfort or other important criteria specific to the project. The success of the tools rests on their capacity to incorporate engineering considerations and calculations in a sketchy way, guiding the project in the right direction without restricting the potential for architectural expression. Together with the continual advancement and technical improvements of these tools, applying the notion of trans-disciplinarity as explored by the integrated and selective design processes will arguably lead to projects that both technically respond to environmental issues in a sustainable way as well as allowing a naturally evolving design aesthetic, and thereby enabling genuine architectural synthesis.

## Notes

1. dictionary.reference.com 2006: http://dictionary.reference.com/search?q=synthesis (accessed April 1st 2006)
2. If synthesis is not successful the result will often be either a piece of 'environmentally un-sustainable' *architecture* or an 'environmentally sustainable' *building*. A *building* is taken to be an envelope which merely provides shelter, whereas *architecture* includes appreciation of experiential qualities such as the spatiality of the room, colour, tactility and smell of materials, and lighting.
3. Gro Harlem Bundtland et al.: *Our Common Future*, Oxford University Press 1987, p.11.
4. Bundtland et al.: op.cit. p. 51.
5. For instance, see Nick Baker and Koen Steemers: *Energy and Environment in Architecture: A technical design guide*, E&FB Spon 2000; Klaus Daniels: *The technology of ecological building: basic principles and measures, examples and ideas*, Birchhäuser Verlag 1997; Victor Olgyay: *Design with Climate: bioclimatic approach to architectural regionalism*, Princeton University Press 1964.
6. Mary-Ann Knudstrup: *Integrated Design Process In Problem-Based Learning, The Aalborg PBL model - Progress, Diversity and Challenges* (ed.s): Kolmoes A., Fink K. F, Krogh L., Aalborg University Press 2004.
7. Dean Hawkes, Jane McDonald and Koen Steemers: *The Selective Environment - An approach to environmentally responsive architecture*, Spon press 2002, p.123.
8. Op. cit. p.13.
9. Op. cit. pp.122-150.