Analyse that!

understanding sustainable design

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ABSTRACT:
This paper describes a method for the analysis of sustainable building projects. Sustainable technology measures can easily be misinterpreted, consequently leading to unsustainable building solutions. Our research and educations aims at discovering new approaches for sustainable design. For building analysis no principal method exists. Our method for the analysis of sustainable buildings encourages future designers to produce a complete picture of a building. It results in a short description and picture, which is an effective way to communicate the sustainable qualities of a building. In sustainable building design research 'tools' to inspire architects in a conceptual stage deserve more attention.

Conference Topic: 2 Design strategies and tools
Keywords: sustainability, design, analysis, building technology

INTRODUCTION

In 2004 the Dutch government has stopped active involvement in sustainable construction, claiming the architecture and building sector has to take its own responsibility. This paper describes a method for the analysis of sustainable building projects. This method is developed for building designers. It aims at creating a quick overview of good examples of sustainable design in order to increase the understanding of sustainability issues for architectural design. A good analysis will unravel the heart of the sustainable design concept. This will inspire (young) architects to aim for a higher level of sustainability. Current design tools have an effect but something is lacking. Most of the time they ask for too much in detail information (LCA based tools) or they relapse into prescriptive listings, regretfully blocking all creativity.

2. HISTORY AND PROBLEM STATEMENT

During the past decades the concept of sustainable building has been widely adopted by all building partners: building clients, architects, contractors and suppliers. A short overview of developments in the Netherlands is presented, at the same time introducing our problem statement.

2.1 history 1970-2001

In the period of 1970-1985 the Brundtland report – Limits to Growth- general public awareness of ecological problems was developing. Global and local organisations for environmental protection became publicly present and active. At the same time an energy crisis gave raise to large energy-saving programs. This had a direct impact on the use and design of buildings: for example increased addition of insulation materials to new and existing buildings and the development of new efficient building heating equipment.

From 1985-2000 Dutch environmental policy has been developed. From 1990-2001 the Dutch government issued four national environmental policy plans (Nationaal Milieubeleidsplan - NMP). The first NMP-plus in 1990 contained a plan of action for sustainable construction, defining clear goals for construction industry. An intensive program of research and experiments started. This program has resulted in building design support tools, varying from environmental impact assessment tools (Eco-Quantum-LCA), financial support and legislation (energy performance standard – EPN) to lists of prescriptive measures, 'national packages for sustainable building' (in Dutch: ‘Nationale pakketten Duurzaam Bouwen’) [1].

2.2 problem statement

These ‘national packages’ consist of practical measures (prescriptive solutions) to be applied in building designs in order to attain a desired level of sustainability. Several Dutch local authorities and building clients have used these packages to formulate their building requirements regarding sustainability. This brings us to our problem statement: The uncritical application of these 'national packages'' measures frustrates the integral quality of buildings and the built environment.
Our analyses of Dutch example projects for sustainable building brought forward the question of integral quality of some of these projects. Cox and Janssen, in their search for ‘extreme sustainable’ (autarchic) buildings, have analyzed several of these project examples. They’ve discovered that some projects only score on very specific sustainability issues, which have the Dutch national policy program for sustainable building [2] did stimulate. The application of a single measure may have outshone other – less tangible- issues, such as aesthetical quality and individual perceptions of comfort and well-being. Prescriptive measures –well mentioned prescribed by building clients- can easily be misinterpreted, consequently leading to unsustainable building solutions. In order to prevent this, sustainability must be dealt with from the conceptual design stage. Our research and educations aims at discovering and developing new approaches for sustainable design taking this into account.

2.3 recent developments
In the Netherlands the period until 2001 has delivered many results: new legislation on energy performance, new products and techniques, tools for design and evaluation, etcetera. For example, in 2001 40% of all new dwellings were built sustainable, according to Dutch government standards [3]. In 2001 the Dutch government issued their final environmental policy plan (NMP-4). As from now, 2004, sustainability is a responsibility of the building sector, without government interference. An essential shift for sustainability will take place: will the building sector adopt sustainability principles or will sustainability disappear? Some recent private initiatives picture an optimistic future: on the national day of sustainable construction (‘nationale dubo-dag’) in 2003 the Royal Institute of Dutch Architects (BNA) launched their vision on sustainable design, called ‘Vitale architectuur’ [4]. The Dutch magazine ‘Duurzaam Bouwen’ (sustainable building) pleads for a more appealing approach of sustainability and rename their magazine Puur Bouwen (‘Pure Building’) [5]. Both initiatives are signs for a new spirit for sustainable architecture and building.

3. SUSTAINABILITY AT TU/e

3.1 Technology for Sustainable Development
At Eindhoven University sustainability is a prime issue for our academic work in both research and education. We choose a two-way path to develop sustainability. The introductory course ‘Technology and Sustainability’ reaches students of the most faculties. It addresses general environmental issues, some faculty specific cases are included. Students who want to specialize in sustainability can obtain the TDO-certificate (Technology for Sustainable Development). Both the certificate programme and the introductory course are organised by the centre ‘Technology for Sustainable Development’ (TDO). For a more detailed description is referred to ‘Curriculum greening at Eindhoven University of Technology’ [6].

3.2 Sustainable building design
Within the faculty of Architecture sustainability issues are being addressed in several academic courses and research programs. One course of the group of Building Technology focuses on sustainable design. The sustainable building design course contains:
- A historical overview of sustainable construction policy and practice;
- Examples and approaches for sustainability, focussing on material and energy;
- Architects presenting their view and approach;
- Design tools for check and evaluation;
- New building technology concepts.

This course deals with all key elements, brought together in a framework for sustainable design (fig. 1). First of all we deal with design on three levels: area, building and component. As a designer it is essential to be aware of the interrelation between these three levels and the specific issues per level. The level of performance on five key issues determines sustainability of a building: material, energy, water, indoor and outdoor environment. For these key issues building clients and design teams can define goals and measure their actual performance. The need for sustainability will result into new building concepts, for example design for lifespan, zero-energy, or autarchic design. Finally we aim for an ‘broad’ approach, in which ecology, economy and sociology are addressed equally (Atkinson’s triple-P). From our Dutch experience we emphasize the institutional role of the government in policy-making, legislation and stimulation, but also as a large principal of building works.

![Figure 1: BTO framework for sustainable design [v.d. Brand 2003]](image)

Students are assessed by performing an analysis on two sustainable building projects. We chose this approach because a critical analysis will help them increase understanding of sustainable building design. Students can directly apply the theory of the lectures.
4. BUILDING ANALYSIS

For building analysis no principal method exists. Several approaches for integral building analysis have been developed. The following --no doubt incomplete- references have inspired us in drafting our method:

Databases by universities and ‘labelling’ organisations:
- Hongkong University research group ‘BEER’, http://www.arch.hku.hk/research/BEER/sustain.htm
- Canada, Terri Meyer Boake at University of Waterloo, Canada http://www.fes.uwaterloo.ca/architecture/faculty_projects/terri/684_sust.html
- LEED: https://www.usgbc.org/LEED/LEED_main.asp
- PROBE http://www.esd.co.uk/portfolio/PROBE.htm~tmain

A methods for analysis combining architecture and management is presented by Peter Camp’s, Matrix-methode [7]. Furtheron we’ve been inspired by descriptive books on sustainable architecture by critics and professors, such as Brian Edwards, Ed Melet and David Jones [8], and individual architects and consultants such as Ken Yeang, Nikken Sekkei, Jon Kristinnson, Anke van Hal [9]. In addition RIBA rapport Report of the Sustainability Special Interest Group (Architectural Education) by Bob Fowles (Cardiff) e.a. gives a rich overview of ongoing efforts in this field.

All databases and methods define different qualities of sustainable buildings. Some even try to deduct general principles for sustainable design. The problem with that is different approaches in sustainability - bio-ecological, high-tech ‘intelligent’, autarchic- lead to different principles. We advocate an open-minded approach towards multiple visions, challenging students to anticipate on their responsibility as future architects. They must investigate the full potential of sustainable design and from there explore their personal preferences and vision.

Many databases describing sustainable building cases focus on quantifiable performances, such as energy-use and waste production. Restricting to these issues gives a limited view on the ‘real sustainability’. Our analysis of sustainable buildings encourages future designers to first grasp a complete picture of a building, based on 9 questions around VISION, DESIGN and RESULT. Answering these questions you will ask ‘What is sustainable design’. In some cases sustainability is really outspoken by architect and/or client. In other cases it is hidden behind other arguments.

4.2 BTO analysis approach
In order to study the concept of sustainability in building design we defined a 9 steps analysis method: a.1 vision client; a.2 vision architect; a.3 brief; b.1 design concept; b.2 integration of sustainable solutions; b.3 special details; c.1 building; c.2 user response; c.3 building performance. The analysis forces to focus on sustainability aspects from concept to detail. It gives an emphasis on the phase before (a1, a2, a3) and after (c1, c2, c3) the actual building design process.

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Figure 2: BTO analysis of sustainable design [v.d. Brand 2003]

4.3. demonstration, XX office

To show how this method works we demonstrate the steps, using the XX office of XX architecten as an example [10]. This is a building reflecting the vision and research approach of the Building Technology group, called ‘design for lifespan’ [11].

VISION
a.1 client;
Wereldhave –a Dutch-origin real estate developing and management firm- develops and exploits real estate, aiming for high user value at low user costs with a minimum environmental impact.
a.2 architect
XX architects’ view is sustainability does not naturally imply that buildings are meant to last for eternity.
a.3 brief
Design a functional office, fit to market needs, for a restricted period of use. In the case of this specific function and location –Delftechpark- this would be 20 years.

DESIGN
b.1 concept;
A regular office consists of 150 different materials and components, each with their specific lifetime. The aim was to synchronize all to 20 years.
b.2 integration (of sustainable solutions);
The design team was challenged to persevere the concept, but safety and usability were not to suffer from this. This resulted in a step-by-step approach for materials choice: decay, re-use, recycle.
b.3 special details;
The concept stimulated to choose new techniques, such as Swedlam wood for the
loadbearing structure, cardboard climate ducts and sand-filled floors.

RESULT
c.1 building;
XX office shows that a new design concept for sustainability can result into a building that is fit for normal use, within architectural and built environment conditions.
c.2 user response
The users –XX architectural office and a commercial technology company- appreciate the transparent and responsive working environment.
c.3 building performance.
In advance the environmental performance of the office was calculated, using the LCA based tool Eco-Quantum, showing good results for prevention of material use and waste production. Energy use is monitored on a continuous base.

CONCLUSION
Many design tools for sustainable building have been developed. These tools not necessarily lead to sustainable solutions. Some tools focus primarily on quantifiable issues, such as energy use and waste production. Other tools are too much based on a specific sustainability philosophy. In both cases they have a risk of overshadowing the context of a certain design question. Aiming for sustainable building means defining your goals regarding sustainability and integrating them from the first conceptual sketches. In our opinion sustainability is a challenge and responsibility for all designers. It cannot be seen as a separate design issue, but it will play a role in every design question. In research for sustainable construction ‘tools’ to inspire architects in a conceptual stage deserve more attention.

Our research aims to increase awareness for sustainability issues in our research and educational program. First of all we need a sound method for the analysis of sustainable buildings. For building design analysis no principal method exists. We have drafted and tested a simple matrix to support this analysis. Several sustainable building projects are described in a structured and easily understandable structure.

At the same time our research will focus on a critical evaluation of existing design tools for sustainability, and –in the longer term– lead to the development of supporting ‘tools’ for designers and building clients in the process of briefing, designing and evaluating more sustainable buildings.

REFERENCES
[1] more information about ‘Nationale pakketten duurzaam bouwen’ is available at www.dubocentrum.nl and www.sbr.nl
[3] VROM, Cijfers over Wonen, February 2003, also available at www.vrom.nl
[7] Camp, Peter; Gebouwen met een ziel, Amsterdam 2003