Ecological building design measures as a powerful leverage for social sustainability and vice versa
A ‘real-life’ perspective from grouped housing projects

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ABSTRACT: A growing awareness regarding the integration of ecologically sustainable principles in the fields of construction and housing has been observed. Although these sustainability measures have been applied occasionally, the background and the real implications are not integrated in the general architectural and urban thinking yet. In promoting sustainability measures it is noticed that the social dimension of sustainability is often neglected. This paper emphasizes the social aspects of ecological building design principles. For this the theoretical concept of ‘Beneficial Pattern Measures’ is introduced as a strategy towards an integral approach and implementation of sustainability. The verification and illustration of the defined concept adopts a ‘real-life’ perspective. A multiple case study method is applied on demonstration projects for sustainable grouped housing. It is concluded that ecological design measures not only meet long-term, environmental objectives, but that they also can be seen as important drivers in achieving short-term, social aspects. This leverage for social sustainability, and ultimately for a sustainable development, is promising when building design measures are in compliance with the concept of ‘Beneficial Pattern Measures’. The recognition, development and implementation of this concept creates a new impulse in achieving a broader base for the needed integral approach and implementation of sustainable transition of the built environment.

Keywords: sustainable development, ecological and social dimension, building sector, strategy, design measures

INTRODUCTION
Buildings meet basic needs of humans in order to survive on this planet. On the other hand, buildings need to be sustainable so that planet Earth would survive, and thus its users. Sustainable building receives much attention in contemporary discussions. Unfortunately the majority of new construction projects lack sustainability. The implementation deficit is inter alia caused by singular approaches of a sustainable development. Driven by political and financial motives, project teams tend to focus on ‘here and now’ issues, instead of taking into account ‘elsewhere and later’ matters, as the description of sustainable development necessitates. Once aware of the needed integral approach, architects/designers face a complex task. Despite multi-disciplinary actors in the construction industry undertake frantic efforts to facilitate this task, adequate tools are nonexistent. Most current tools focus unilaterally on the display of checklists and/or performance criteria, not on generic, specific or practical sustainability measures, which are more appropriate for architects/designers. Sustainable building springs from engagement and the awareness of the complexity, not from checklists. Another limitation is the lack of an underlying theoretical framework to stimulate new measures, so that architects/designers still can indulge their creativity. As a result, new constructions do not endorse sustainability issues, neither the ecological nor the social dimension. A dragging legacy is created for the future.

To counter the implementation deficit of sustainable building, Van Hal [1] promotes searching and highlighting ‘multiple benefits’ of sustainable buildings. This approach has to a large extent influenced the development of a new principle. This paper introduces the theoretical concept of ‘Beneficial Pattern Measures’ as a strategy towards the integral approach and implementation of sustainability. It seeks to counteract the prevailing one sided or even mostly disregarding approach of sustainable development in the building sector, and the single oriented view of most tools.

The objective is to underline the social benefits of ecological building design measures. The newly introduced concept enables to uncover corresponding illustrative building design measures. This way, the research chooses the perspective of the architect designer, who often serves as the centre of contemporary project teams. This framework creates a starting point for a comprehensive research on these ‘Beneficial Patterns’
conducted by the authors of which the outcome will mean a new impulse in achieving a broader base for the needed integral approach of sustainable transition of the built and yet to be built environment (partly presented in the oral presentation).

**METHODOLOGY**

This paper is partially derived from the fundamental research part of an ongoing doctorate dissertation on sustainability issues in grouped housing projects.

The background of the newly introduced concept is based on a literature review and focuses on the justification and conceptualisation of the newly developed theoretical framework of ‘Beneficial Pattern Measures’. First, an overview clarifies the widely accepted meaning of ‘sustainable development’. Second, different approaches of this concept relevant to the stated implementation deficit are put in a historical perspective. Complementary, to fulfill the objective of this paper, a real-life perspective is adopted to illustrate the theoretical concept on ecological and social issues of sustainability. Empirical findings of a multiple case study on demonstration projects for sustainable grouped housing are being used.

The complex and contextual nature of an architectural project can be understood through the study of actual cases. According to Yin [2], case study methodology can be used when a contemporary phenomenon, like e.g. sustainable building, should be investigated. In order to increase the reliability of case study research, multiple cases are considered.

Buijs & Silvester [3] define a demonstration project as: ‘a project in which innovative technologies are being used in more or less normal situations to foster the development and diffusion in the regular market of these technologies’. This view is endorsed by the United Nations Human Settlement Programme and the European Working Group Sustainable Methods and Technique. Research shows that demonstration projects have an important role in the process towards more sustainable building [4, 5]. By making the complexity of sustainable building tangible and visible, demonstration projects provide realistic data both on the product, the sustainable building, and on the design and construction process.

To act and serve as a demonstration project, literature urges that certain conditions are being met: Keating & Peach [6], Buijs & Silvester [3], UN Habitat and Van Hal [4] promote repeated evaluations; Keating & Peach [6] and The United Nations Habitat Programme mention the open and public character; The United Nations Habitat Programme puts forward the intention of acting as a demonstration project from the beginning, and highlights its special character.

Demonstration projects were selected within the field of grouped housing. It is seen that there is a growing interest towards sustainable housing, although this is still a very small percentage of the total housing stock. In order to meet demographic changes, social needs and expectations, minimizing construction and operating costs, and obeying urban planning regulations, the housing market rediscovers and re-appreciates the idea of grouped forms of housing. This trend is even noticeable in certain regions of the western world where housing was reduced to an individualistic affair during the 20th century. Due to specific features of this sector like e.g. density, size and overlapping scales, social interactions, mixed use, multidisciplinarity, collectivity, etc. these projects contain both opportunities and barriers for sustainable building. All aspects of sustainable development need to be fulfilled in a reasonable limited time span and scope. Such projects are therefore particularly suitable to study the sustainability quest.

Grouped housing projects can thus be seen as practical laboratories for an integrated approach of sustainable development. The practical experience performed in the demonstration projects area for sustainable grouped housing can be observed by actors in other building sectors.

Projects were selected from The Netherlands, United Kingdom, Germany, Finland and Sweden. All cases are connected as one of the main driving factors was based on achieving a ‘full sustainable development project’. Information on the presentation of the district was rich and available, both descriptions and illustrations. Other neighbourhoods, a priori interesting to analyze, were identified but were not selected for the research because their information proved to be incomplete. Table 1 lists the cases and provides a brief project description. This overview shows that projects were selected regardless of their urban context (urban – suburban – rural) and that they overlap different scale levels (block – neighbourhood – district). This grants the aim to collect a representative set of building design measures in context and scale level in order to verify the newly stated concept.

To uncover illustrative building design measures that meet the concept of ‘Beneficial Patterns Measures’ on ecological and social issues, the case study methodology consists of compiling a synoptic table. The basis of this table exists of the identification of individual ecological building design measures. In a next step each of the individual measures are screened regarding their impact on social issues of sustainability design measures and social impacts are both split up by scale level. By analysing their specific ecological and social impact, it is possible to put them in an overall ‘Beneficial Pattern’.
Completing the aimed synoptic table necessitates meeting the proposed model by Feminias [5] for presenting, learning and investigating demonstration projects: the tangible, non-tangible and the image.

Table 1: Selected demonstration projects

<table>
<thead>
<tr>
<th>Name – region - country</th>
<th>Nature of the site</th>
<th>Context</th>
<th>Scale level</th>
<th>Size</th>
<th>Brief description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eva-Lanxmeer Culemborg The Netherlands</td>
<td>water extraction area</td>
<td>rural</td>
<td>block neighbourhood</td>
<td>24 ha</td>
<td>EVA-Lanxmeer is an initiative aimed at developing sustainable and environmentally conscious living environments in a populated green zone.</td>
</tr>
<tr>
<td>GWL-terrein Amsterdam The Netherlands</td>
<td>former municipal water facility</td>
<td>urban</td>
<td>block neighbourhood</td>
<td>6 ha</td>
<td>The development’s master plan focused on providing housing for families with children, compact living in the city combined with calm, greenery and open space, while addressing environmental concerns.</td>
</tr>
<tr>
<td>Bedzed Sutton United Kingdom</td>
<td>former coal site</td>
<td>suburban</td>
<td>block neighbourhood</td>
<td>1.7 ha</td>
<td>The project is the first residential block to be built on a large scale in the UK, which corresponds the principle of a carbon neutral development.</td>
</tr>
<tr>
<td>Millennium Greenwich London United Kingdom</td>
<td>brown field site of former gas works</td>
<td>suburban</td>
<td>block neighbourhood</td>
<td>29 ha</td>
<td>Built as part of the largest regeneration project of its kind undertaken in London, Greenwich Millennium Village is a residential development of the future that promotes and supports sustainable living.</td>
</tr>
<tr>
<td>Vauban Freiburg-im Breisgau Germany</td>
<td>former military site</td>
<td>suburban</td>
<td>block neighbourhood district</td>
<td>38 ha</td>
<td>The primary objective of the project was to create a new ‘garden-city’ district in a cooperative and participatory manner that met ecological, social, economic and cultural needs.</td>
</tr>
<tr>
<td>Eco-Vilikki Helsinki Finland</td>
<td>open farmland</td>
<td>suburban</td>
<td>block neighbourhood</td>
<td>0.64 ha</td>
<td>Situated on 8 kilometers of Helsinki, the housing area consists of a mix of housing types, designed and constructed according to strict ecological criteria set by the city of Helsinki.</td>
</tr>
<tr>
<td>Västra Hamnen – BO01 Malmö Sweden</td>
<td>polder, former industrial wasteland</td>
<td>rural</td>
<td>block neighbourhood</td>
<td>12 ha</td>
<td>On the occasion of the European Exhibition of Habitat, the polder Västra Hamnen was chosen for a new densely built urban area arranged according to the principles of sustainable development.</td>
</tr>
<tr>
<td>Hammarby Sjöstad Stockholm Sweden</td>
<td>former harbor area and industrial site</td>
<td>suburban</td>
<td>block neighbourhood district</td>
<td>200 ha</td>
<td>The mixed use project seeks specifically to expand the inner city across the water, with a strong emphasis on ecology and environmental sustainability.</td>
</tr>
</tbody>
</table>

THE THEORETICAL APPROACH OF ‘BENEFICIAL PATTERN MEASURES’

The motive for a ‘beneficial pattern’ approach
Sustainability is the common ground in a multi-actor process, but at the end of the day it is not perceived as urgent [7]. Our society is not sustainable and there is a long way to go. Sustainable development is a ‘wicked concept’ with a multi-dimensional complexity that cannot be explained unambiguously [8]. So the definition leads to the badly needed common ground in a multi-actor process, but interpretations are diverse and are simplifications of reality. There are many relevant disciplines - for this paper we will name the two most important ones.

The Environmental approach
Climate change due to human activity is a discovery from the 19th century as Svante Arrhenius discovered in 1896 the relation between carbon dioxide emissions and global warming [9]. Resource depletion has been a constraint for every city development in history. However the total impact of the (mis)behaviour of humankind became world news with the Club of Rome report The Limits to Growth [10]. The focus here is on the process (or flow) components of urbanisation such as energy, water, traffic, materials, and food (this goes back to Patrick Geddes, 19th century, and Abel Wolman, 1965). By taking climate change and one flow at a time, sustainable development becomes measurable and explainable (the Al Gore view). Clear goals make this a well-used philosophy for engineers and designers. Here, climate change is the biggest threat.

Anthropocentric discipline
Within sustainable development the UN conference in Rio de Janeiro 1992 [11] shifted attention from
technological issues to the well-being of people: ‘Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.’ This concept made man both a means and an end, since his commitment is crucial for achieving sustainable development. This approach is more subjective and qualitative than its predecessors. It confronts us with problems that cannot be solved using engineering alone, as appears to be the case with efforts to reduce CO₂ emissions by x per cent over y number of years. And only part of this idea is related to the built environment. The primary goal here is health. In recent years this goal has been modified into happiness (as was discussed in the UN conference of April 2012 Happiness and Well Being: Defining a New Economic Paradigm). This shift has a Dutch origin in the work of Veenhoven [12].

Each of these worldviews is a way of looking at reality and can help us on the path to a sustainable built environment. But if a researcher is trapped within one vision there may be a negative effect on others. An environmental approach starts with the global problems of the future, and gives context to the present-day by extrapolating backwards. Social sustainability (the anthropocentric approach) starts in the here and now and looks for durable needs in relation to elsewhere and the future. From our perspective sustainable building is a combination of disciplines - a necessary package deal to prevent us from trade off effects.

This complexity describes the problems of sustainable development and at the same time shows the daily practice of an urban designer or planner. The practice of finding ‘promising combinations’ [13] is the common ground for sustainable transition and design. In a designerly way of thinking one combines possible solutions from disciplines which are by nature different [14, 15]. Goal finding from a specific angle needs to incorporate methods from other perspectives and every assignment is context specific.

Ecological and social components/indicators of sustainable development

The two most tangible pillars of sustainable building are ecological and social aspects. This section identifies components and provides illustrative features/indicators. As in literature no consensus can be found about the content and naming, a self compiled set was made.

Buildings have adverse impacts on environment during their entire life spans, starting during construction works and going up to demolition until handling of the waste. In order to reduce these effects, the central principle of ecological sustainability within the building sector is flow management. This implies a diminishing of flows, the closing of loops, the prevention of negative flows and at best the creation of positive flows. Components of this management and some important issues are given in table 2.

Table 2: Ecological components of sustainable development.

<table>
<thead>
<tr>
<th>ECOLOGICAL COMPONENTS (PLANET)</th>
<th>ENE</th>
<th>ENERGY</th>
<th>heating, cooling, lighting,…</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAT</td>
<td></td>
<td>WATER</td>
<td>potable, rain, brown, black,…</td>
</tr>
<tr>
<td>MAT</td>
<td></td>
<td>MATERIAL</td>
<td>construction, techniques,</td>
</tr>
<tr>
<td>AIR</td>
<td></td>
<td>AIR</td>
<td>indoor, outdoor,…</td>
</tr>
<tr>
<td>WAS</td>
<td></td>
<td>WASTE</td>
<td>construction, domestic, demolition</td>
</tr>
<tr>
<td>TRA</td>
<td></td>
<td>TRANSPORT</td>
<td>motorized (carbon) vehicles</td>
</tr>
<tr>
<td>SOI</td>
<td></td>
<td>SOIL</td>
<td>displacement,…</td>
</tr>
<tr>
<td>ECO</td>
<td></td>
<td>ECOLOGY</td>
<td>wildlife, vegetation,…</td>
</tr>
</tbody>
</table>

Buildings meet demands. These are besides functional and physical also based on social matters. The social aspect of sustainable development cares about the welfare and well being of users and residents. Focus lies on the core concept of livability, introduced by Van Dorst [16], which concentrates on emotional and sensorial requirements. Components of this core concept are given in table 3.

Table 3: Social components of sustainable development.

<table>
<thead>
<tr>
<th>SOCIAL COMPONENTS (PEOPLE)</th>
<th>IDI</th>
<th>IDENTITY &amp; IDENTIFICATION</th>
<th>recognition, cultural embedding,…</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIA</td>
<td></td>
<td>SOCIAL INTERACTIONS</td>
<td>privacy, social contact, social control,…</td>
</tr>
<tr>
<td>SCO</td>
<td></td>
<td>SOCIAL COHESION</td>
<td>amenities, management, involvement,…</td>
</tr>
<tr>
<td>SEC</td>
<td></td>
<td>SECURITY</td>
<td>privacy, safety,…</td>
</tr>
<tr>
<td>HEC</td>
<td></td>
<td>HEALTH &amp; COMFORT</td>
<td>requirements, needs, quality of life,…</td>
</tr>
<tr>
<td>FLE</td>
<td></td>
<td>FLEXIBILITY</td>
<td>adaptability, expandability,…</td>
</tr>
<tr>
<td>AVA</td>
<td></td>
<td>AVAILABILITY &amp; ACCESSIBILITY</td>
<td>usability, functional differentiation,…</td>
</tr>
<tr>
<td>ATT</td>
<td></td>
<td>ATTRACTIVENESS</td>
<td>dearness, recreation,…</td>
</tr>
</tbody>
</table>

To favor the principles of flow management and livability, respectively central within ecological and social sustainability, architects must ensure specific features in their designs. Features that can be seen as indicators are: For ecological components e.g.: reduce consumption, (increase) efficiency, use local and renewable-reusable-recyclable resources, etc. For social components e.g.: recognition, adaptability, dearness, privacy, etc. Achieving these features / indicators implies implementing deliberate measures in building designs.
Description of ‘Beneficial Pattern Measures’
Measures are deliberate and distinct decisions in order to fulfill a certain requirement and achieve aimed features. Each measure implies an investment, and thus a weighing between costs and benefits. When a measure serves different requirements, efficiency increases and objections for implementation fade or even disappear. ‘Beneficial Pattern Measures’ are building design measures which positively affect multiple targets. This implies that the concept can mean a strategy to respond to multi-criteria issues. When applied on sustainability, ‘Beneficial Pattern Measures’ aim at satisfying both ecological (Planet) and social (People) components (see figure 1). Political and Prosperity components are in this regard seen as important preconditions.

In order to lower the possible resistance for application of a specific ‘Beneficial Pattern Measure’, indicators of listed parameters of success should be:
- low for: the risk of negative side-effects, associated costs and the number of conditions,
- high for: the number of benefits, the spreading of benefits and the ability to valorize.

VERIFICATION AND ILLUSTRATION
Illustrative building design measures
This section provides some building design measures which meet the concept of ‘Beneficial Pattern Measures’ derived from the synoptic table on displayed demonstration projects. Measures were selected either because their fully known benefits could be incomplete or even unknown by project teams, or because it is likely that their implementation encounters objections.

‘Colours’ - ‘Materials’
Planet: [thermal accumulation/control | light reflection | thermal control | light reflection]
People: [recognition | cultural embedding | dearness]

‘Sun protection’
Planet: [thermal control | lighting control | wind control]
People: [privacy regulation | recognition | dearness]

‘Large windows’ - ‘Glazed balconies’ – ‘Greenhouses’
Planet: [thermal accumulation | natural light]
People: [recognition | social contact/control | adaptability]

‘Courtyards’ - ‘Green fingers’ - ‘Ponds’
Planet: [heating/cooling | water control | wildlife | vegetation]
People: [social contact/control | recreation | needs | safety]

A ‘Beneficial Pattern Measure’ in the sustainability quest, should ensure a causal connection between ecological and social aspects, so that a single oriented view on sustainability is prevented. Factors for success of a ‘Beneficial Pattern Measure’ are:
- the number of benefits and their spreading among sustainability components and different scale levels,
- the nature and number of conditions in order to fulfill its target (be effective),
- the risk of potential (negative) side-effects (on e.g. other sustainability components, ...),
- the scale level of the measure (unit, block, neighbourhood, district),
- associated costs,
- the ability to valorize, quantify the pattern benefits.

Within the scope of this article, displayed building design measures and related ‘patterns’, conform the theoretical concept of ‘Beneficial Pattern Measures’, are illustrative and thus seek by no means to be exhaustive. Listed examples will, amongst others, be discussed and documented in depth during the oral presentation.

Preliminary findings of the ongoing research
Pending the outcome of the full research of ‘Beneficial Pattern Measures’ in selected demonstration projects, preliminary findings can be displayed.
1. In order to meet the ‘Beneficial Pattern’ aspect, building design measures should apparently be tangible, be physically present (the Thomas Herzog view: visualization of sustainability measures).
2. Measures may be of such a nature that they intrinsically are ‘Beneficial Pattern Measures’. Others have great potential, and thus are promising when certain adjustments are done or terms are met.

Figure 1: Figurative representation of ‘Beneficial Pattern Measures’.
3. ‘Beneficial Pattern Measures’ which need to be considered/implemented in early stages of the design process, seem to be more successful, and are more likely to be intrinsic.
4. ‘Beneficial Pattern Measures’ cover both common or general applicable measures, as well as bespoke/tailored or more specific ones.
5. The key for ‘Beneficial Pattern Measures’, especially within grouped housing projects, lies in commonalities or interfaces between private, semi private and public (visible, functional, territorial, …).

CONCLUSION
This paper verified that ecological building design measures can be a powerful leverage for social sustainability and vice versa, especially when measures comply the introduced concept of ‘Beneficial Pattern Measures’. The recognition, development and implementation of ‘Beneficial Pattern Measures’ can mean a promising strategy to counter the implementation deficit stated in the introduction. For builders it becomes clear that efficiency of sustainable investments increase. The design process of architects/designers is facilitated because the strategy focuses on actual ‘building design measures’ which can immediately be implemented, or can serve as the starting point for the development of new or modified creative measures/solutions.

The introduction of ‘Beneficial Pattern Measures’ is only a first step in the development of a new strategy to achieve/aid a broader base for, and ultimately the implementation of, full sustainability in building projects. Further research (see figure 2) is required on:
1. the applicability of individual ‘Beneficial Pattern Measures’ (BPM): Within different building types, and in a variety of different contexts (environmental, social, cultural, urban, political) research should be conducted on ‘promising combinations’.
2. the determination of ‘Beneficial Pattern Concepts’ or ‘BM(ulitiple)PM’ or ‘BM(atrix)M’: One single measure cannot meet the sustainability quest. Several ‘BPM’ need to be combined. Measures must be complementary, mutually reinforcing and/or eliminate barriers or disadvantages of other measures (search for synergies).

The methodology for aimed researches consist of research by design.

Following remarks and questions require attention or can be discussed:
1. the possibility to find/develop ‘pattern benefits’ for all ecological and social components,
2. the assessment (intermediate) of the results derived from the process of research by design, especially social aspects of sustainability (in view of the valorization of pattern benefits),
3. the presentation of the outcome of the research in such a way that it complies the specificities of architects/designers.

REFERENCES
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