sb13 munich

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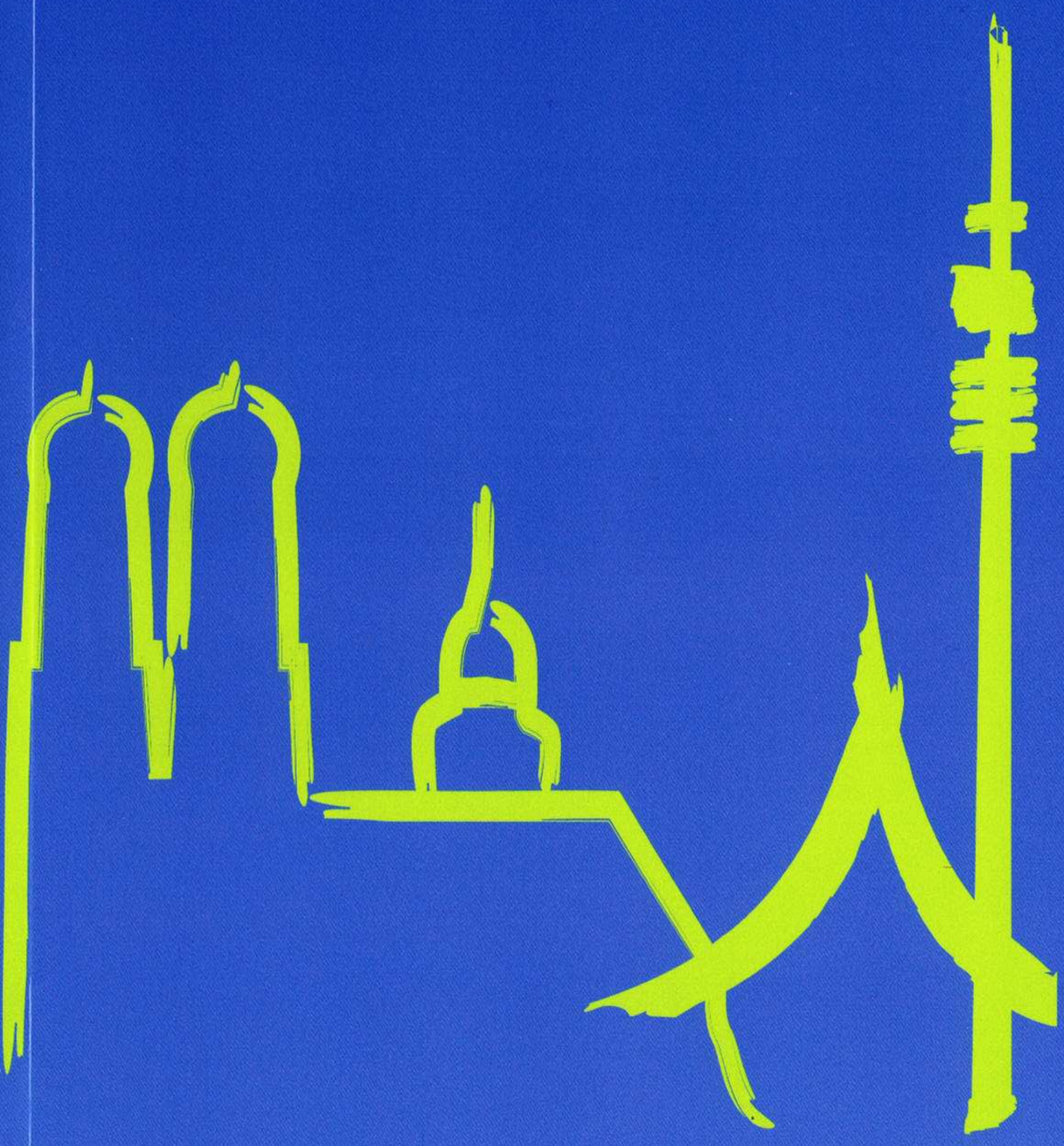
Implementing Sustainability – Barriers and Chances

Sustainable Building Conference
April 24-26, 2013

Conference Guide



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Wednesday 24.4.

14:00 - 15:30

Session 3.1
Chair: Prof. Dr. Thomas Hamacher
Design, Architecture and Education

Three Strategies for Holistic Housing

User-Centered Design in Certified Office Buildings

Influence of Sustainable Building Attributes on Customer Satisfaction

Evaluation of Criteria for Sustainable Housing Development: Results from a preference analysis among different stakeholders in housing development and occupancy

Block of Flats from 1958, Rejuvenated with Wood

Energy Postive Buildings – Impact of the Building Envelope

15:30 - 16:00

Coffee Break

Hall A

Design Strategies

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Imprint

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Edited by: Hauser, G.; Lützkendorf, T.; Essig, N.;

Printed on acid-free and chlorine-free bleached paper.

THREE STRATEGIES FOR HOLISTIC HOUSING

HANS DREXLER AND SEBASTIAN EL KHOULI

ABSTRACT
The abstract of your paper should be included here. All abstracts, papers and posters need to be presented in English. The maximum length of abstracts is 300 words. The submission can be done via the conference website (www.sb13-munich.com). Authors whose full abstract has been accepted will be asked to deliver a full paper.

KEYWORDS:
Three, to a maximum of five, keywords; separated by semicolons; like this.

CONFERENCE TOPIC:

Please specify which topic (topic 1 -5) your abstract is addressing. Detailed information on each topic can be found on the conference website (www.sb13-munich.com). **Please tick relevant topic in table below:**

Topic 1: Political Frameworks for a Sustainable Built Environment	
Topic 2: Sustainable Urban and Regional Planning	
Topic 3: Design, Architecture and Education	
Topic 4: Methodologies and Tools for Planning, Operation & Deconstruction Processes of Buildings	**X**
Topic 5: Technologies, Material and Product innovations	

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Three Strategies for Holistic Housing

In a two year research project the authors have analysed concepts, strategies and methods for designing sustainable residential buildings. Sustainable design is not a merely technical problem. Sustainable design can be most successful if it accomplishes to bridge the gap between the cultural role of architecture and its technical requirements. To the SB13 Munich conference three of those strategies for design 'holistic housing' would be presented:

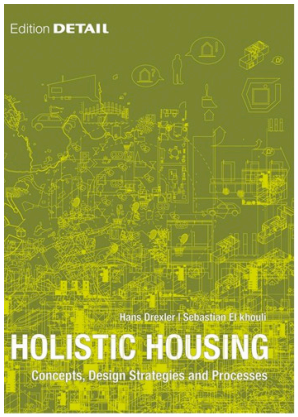
- Minimum impact: Reduce the impact on the build an natural environment
- "Less bad is not good"[1]: Building as a complex cradle-to-cradle design approach
- Built utopia: Planning as a systemic and process oriented approach with the aim of contextualizing our build environment

With the help of a number of international examples, it will be demonstrated how essential aspects of sustainability can be integrated at different design stage. Each project represents a specific response to a given context, the local climate and the user requirements. A central part of the research was the development of a rating system which could be used for evaluating sustainability criteria in the wide range of contexts and climates. The developed building rating system is based on earlier research and existing rating system.

The research focus lies on the methods and processes employed during the planning phase: In opposite to most of the existing rating systems, the developed system can be used during the whole design process due to the efficient and phase adapted rating methodology – beginning with the establishment of an objective agreement, followed by the analysis of different plots and urban design layouts until the rating of variation studies for different floor plan layouts.

Sustainable architecture translates into an experiential value for the locale, the environment and the people who live there – thus the central idea that has informed this project.

The research has been published with Detail in 2012:
Holistic Housing. Concepts, Design Strategies and Processes
Hans Drexler und Sebastian El khouli, 288 pages with many illustrations, graphics and photos
Format 24 x 33 cm
http://shop.detail.de/uk_e/landingpages/startkategorie/holistic-housing.html



[1] McDonough, William/Braungart, Michael: *Cradle to Cradle*. San Francisco 2002

Paper Number:
Date received:

THREE STRATEGIES FOR HOLISTIC HOUSING

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The paper will be presented by both authors.

Abstract

Vast achievements in the field of sustainable building have been made: A variety of targets, aspects and criteria have been identified that constitute important building blocks of a comprehensive understanding of sustainability in the field of architecture. Assessments and evaluation systems have been developed that help to analyse designs and buildings. Still missing are strategies that could be used to integrate the targets in the design process.

In a two year empirical research project concepts, strategies and methods for designing sustainable residential buildings have been gathered and analysed. Sustainable design is not - merely a technical problem, rather it can be most successful if it accomplishes to bridge the gap between the cultural role of architecture and its technical side. For this reason, the study focused on the design potential that could be derived from the following questions:

- What are approaches and strategies to meet the diverse and sometimes divergent requirements of sustainability in architecture?
- What methods and tools can be applied in the early stages of the design and planning process for new and existing buildings to be planned holistically in order to optimize the design in terms of sustainable construction?
- What is the role the context (in the broadest possible sense of climatic, structural, cultural and social context) plays in respect to the design?
- What are the advantages and disadvantages arising from their implementation?

The study was conducted for a book project that was published with 'Edition Detail' in July 2012 under the title 'Holistic Housing. Concepts, Design Strategies and Processes' [1]. In the book 15 buildings are documented and analysed with special focus on the design process. With the international examples, the study demonstrates how essential aspects of sustainability can be integrated at different design stages. Each project represents a specific response to a given context, the local climate and the user requirements. /
Based on the analysis of the built examples and design processes three strategies were identified, that have been found in the built examples.
The strategies are to be understood as mutually complementary or sequential. None of the investigated buildings can clearly be assigned to one of the strategies exclusively, but in almost all projects a clear focus can be found:

- **Strategy 1: Minimum impact:** Minimize the negative impact of the building for environment and society through more efficiency in combination with the reduction of consumption.
- **Strategy 2: 'Less bad is not good' strategy** [2]**:** Building as a comprehensive design approach which focuses on maximizing positive effect to maximize tangible added value and experience for users and planners
- **Strategy 3: Built utopia:** Planning as a systemicand process oriented approach with the aim of contextualizing our build environment

A central part of the research was the development of an analytical method (building assessment system) that can be used for evaluating sustainability criteria in the wide range of contexts and

system) that can be used for evaluating sustainability criteria in the wide range of contexts and projects. The applied method in this research project is based on the valuation method developed by the Department of Design and Energy Efficient Building of the TU Darmstadt in 2009 called ‘Housing Quality Barometer’ (Wohnwertbarometer [WWB]) [3]. Whereas most rating systems, this system can be used during the design process due to the efficient and phase adapted rating method – beginning with the definition of targets, followed by the analysis of different plots and urban design layouts until the rating of variation studies for different floor plan layouts.

The study has demonstrated that most existing systems are not reflecting the real impact of a building if only approximately. The focus on specific aims and methods often leads to serious limitations in the range of possible approaches in the design processs. A large part of the strategies analyzed in the study would not be covered by conventional assesment. Therefore a re-evaluation of these methods as tools for the design and planning process is based on the following criteria:

- Evaluation of all sustainability-related criteria, to enable a comprehensive reflexion of the qualities and requirements
- Simplified data collection and evaluation to limit time and effort, especially in the important early stages of the planning process does not increase disproportionately.

Fig. 1: Studied buildings (from left upper to right lower): Loblolly House, Taylor Island, Kieran Timberlake Architects, 2008; 20K Houses X, V, VII, VIII, Rural Studios Auburn University, 2008-2011; Quinta Monroy, Iquique, Chile, Elemental, 2007-2009, Lakeside House, Saimaa lake, Finland, NOW Architects 2007; Townhouse, Landskrona, Sweden, Elding Oscarsson Architects, 2009; Wall House, Name: Wall House, Lampa, Santiago, Chile, FAR frohn&rojas, 2007.

Keywords: Strategies, methods and design processes, rating systems, residential buildings, systemic and process oriented, minimum impact, life-cycle-engineering, cradle-to-cradle

1. Planning strategies between technology, design and culture

Although sustainable building is argueably most important and most present discourse in the discipline of architecture, the achievments on closer inspection are modest. At the level of the individual building, savings in energy and resource consumption can be significant. Potential savings achievable in the creation of zero-energy buildings might be as high as 90% but for a variety of reasons potential savings don't translate into an overall reduction of ressources. Existing strategies can mostly be applied for new buildings. But with the replacement rate of existing buildings it is only one percent; it would take a hundred years to reach necessary efficiency levels. Also they are mainly restricted to the energy consumption during operation neglecting the construction and building material of the building. What is still missing are strategies that adress a comprehensive range of sustainability issues.

On the building level energy consumption per square meter is in the period between 1995 and 2006 but decreased by 14.4% on average. In the same period per capita living space increased by 13.8% offsetting all potential saving effects. The electricity consumption of households in the same period increased by 11.5%. [4] This can be deduced to rising standards: Demographic and social change leads to more and smaller households and rising living standards, which in effect offsets the increasing demand for living space per capita. The challenges therefore can't be met with increasing efficiency alone but has to offer alternative 'live styles'.

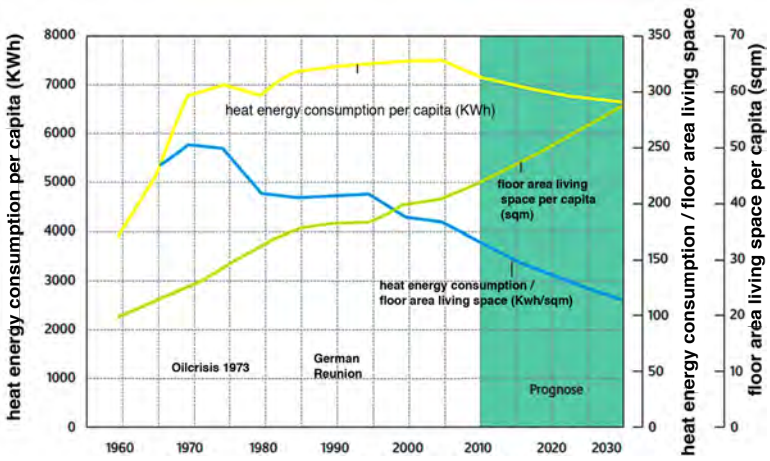

Fig. 2 Living area in Germany [4]. The upper yellow line indicates the energy consumption for heating per capita. The green line the per capita consumption of living space area and the blue line the energy consumptions per sqm.

Architects and planners, despite years of efforts by policy and organizations, do not have the willingness to react to social and political goals and objectives. Issues of sustainability and energy efficiency are still met with ignorance at best and resistance at worst. They are not perceived as an inspiration or design challenge but as a limitation or impediment, restricting the-- assumed freedom in the creative process. Energy parameters, window area ratio on facades, benchmarks, life cycle costs and certifications seem like a tangle of strings that hinder architects in their creative development. This perception is - in our opinion - closely related to the lack of comprehensive strategies, methods and tools to integrate the issues of sustainable design in the planning process and in design strategies. For this reason, we focused in the study on the design potential that can be derived from the following questions:

- What -- different approaches and strategies exist to meet the diverse and sometimes divergent requirements of sustainability in architecture?
- What methods and tools can be used in the early stages of the design and planning process for new and existing buildings to be planed holistically in order to optimize the design in terms of sustainable construction?
- What is the role the context (in broadest possible sense of climatic, structural, cultural and social context) plays in respect to the design?
- What are the advantages and disadvantages arising from their implementation?

The study aspects of which are summarized here was conducted for a book project that is published with 'Edition Detail' in July 2012 under the title 'Holistic Housing: Concepts, Design Strategies and Processes' [1]. This study analysed 15 international projects. At the same time a catalogue of sustainability criteria has been developed to benchmark and compare these different projects. This includes not only the parameters identified for assising and comparing the buildings, but also the strategies used to achieve the goals.

The basic assumption of the study is that sustainable architecture is contextual on the one hand, and process-oriented on the other. To analyse and understand these relationships of the building and the context all the projects were studied on site and individually documented. To understand the design, planning and construction processes, that lead to sustainable architecture, it was necessary, to consider the buildings not in a static state, but to take into account the whole life cycle of the building: From the first idea, through design and construction to the usage by the inhabitants. To this end the architects, engineers and contractors have been interviewed as well as users and owners. All buildings have been visited and documented while being inhabited.

2. Three Strategies of Sustainable by Design

Based on the empirical study three strategies were identified, that have been applied in the design of examples and can be seen as a departure point for more detailed studies of design strategies. The three strategies are to be understood as mutually complementary or sequential. None of the investigated 15 buildings can clearly be assigned to only one of the strategies, but in almost all projects a clear focus can be found.

2.1 Minimum Impact Strategy

The current ecological, economic and social problems are created because of our excessive consumption and the resources being overused. Renewable resources are being consumed faster than they can be regenerated by natural or anthropogenic processes. Non-renewable resources are consumed so quickly that they will be available only for a comparatively short period of time. The scarcity of resources leads to higher prices, supply shortages and social injustice. The excessive consumption is associated with unacceptable emissions of pollutants and waste. The obvious solution of the problems is to reduce consumption and emissions to an acceptable level. [5][6]

Fig. 3: Minimum Impact House, DGJ Architects, Foto: Daniel Jauslin.

In the field of architecture, this strategy has been discussed for a long time. The sharpest controversy in the recent past triggered the ‘Passive-House’ concept, which aims at limiting the heat demand and the primary energy consumption of buildings during operation. A more comprehensive approach offers the concept of the ‘2000-Watt-Society’. [7] Here energy consumption and greenhouse gas emissions are to be reduced to a globally uniform and acceptable level: 2000 Watts per capita energy consumption (continuously), and 1 ton of CO_2 - emissions per capita per year. From this overarching goal then requirements for the individual sectors i.e. housing are derived. Both concepts require -- a drastic reduction in consumption and emissions by a factor of five to ten. These reductions can be achieved firstly by significant gains in efficiency in combination with the reduction of consumption. In our study, several projects have been analysed whose primary objective was the reduction of the negative impact on the environment (‘Isar Palais’ Isar city residence in Munich, ‘Lakeside House’ in Finland, youth and ‘Holzbox’ recreational camps in Styria).

In the research project ‚Minimum Impact House' conducted by Drexler Guinand Jauslin architects --- with the Department of Design and Energy Efficient Building of the TU Darmstadt, is an overall assessment of the environmental impacts of a building including building construction, operation, land use and mobility. [5]

The ‘Minimum Impact House’-study has shown that for energy-efficient buildings (‘Passiv-House’-standard or better), the energy consumption during operation is significantly lower than the embodied energy necessary for production, maintenance and disposal. Therefore the construction and the materials used play a crucial role. In addition to operation and construction of the building

and site-related factors such as land use and mobility were evaluated. For the assessment of environmental impacts of building construction in the planning process requires new planning instruments. In an iterative process, the results of a life cycle assessment has been used to optimize the projects in terms of its overall effect. In the study a prototype building ‘Minimum Impact House’ has been analysed and optimized in respect to the overall impact.

In a comparative study and life cycle assessment the prototype was compared with a conventional building. Here, the environmental impact of the prototype on a small left over site in the city centre was compared with those of a typical building in a conventional construction in a newly developed residential area in the north of Frankfurt. The result of the study is that the prototype produces only about one-third of the emissions of which the mobility is the biggest share of the emmissions.
One factor that is often neglected in the evaluation of buildings is the impact of the location: The better infrastructure and the shorter journeys within the city centre lead-- to significant less traffic than the suburban setting. Additionally most of those journeys can be done environmentally friendly by walking, cycling or public transport. The biggest advantage of the use of left over spaces is the lower land consumption. One result of the research project was that for new settlement areas of the lion's share of the land use does not come from the actual buildings but from the construction of infrastructure such as streets, sidewalks and public buildings.

Fig. 5: Research project Minimum Impact House: Primary Energy Consumption in comparison to a conventional building construction

At the same time, it was also important to develop new building typologies, which offer high quality spaces for narrow urban left over spaces. The prototype building is designed for a site of just 29sqm and has a living area of 150sqm. Accordingly, the spaces are arranged vertically. The spatial relationships in a conventional flat occur on one level through horizontal movements and visual connections between the rooms. In the prototype building (‘Minihouse’) they are based on vertical relations. Visual connections between the floors create a continuous spatial experience. Outlooks into the surrounding city allow for the exterior spaces to become part of the spatial experience. A generosity was achieved that made the space seem-- much larger than their floor area might suggest.

2.2 Less bad is not good [2]

To reduce of negative consequences for their own sake or to save the planet is not a motivation that has noticeable effects on people's behaviour. Behavioural changes generally arise only by political, economic or other constraints or through positive motivation. Herein lies the weakness of the minimum impact approach: Even if the efficiency gains are perceived very positively - on an abstract level - it offers very little in way of a tangible added value and experience. A even bigger danger can be seen in the so called rebound effect. [8] Many achivements in efficiency are over compensated by higher levels of consumption due to lower prices, higher availability or perceived lesser harmfull impact of goods and services. For example all significant fuel saving efforts of new engines or other technologies are rendered meaningless in the face of ever increasing dimensions and weights of newer cars and the even more significant increase of the number of cars in use.

The issues of sustainability are to prevail in the architects, planners and users only if a gain in improvement of housing is related to it and can be experienced on a dayly basis. An example of this concept is the ‘Sunlighthouse’ in Pressbaum near Vienna by Hein-Troy Architekten, which reverses the argument of the ‘Passive House’ concept, without dogmatically contradicting it. The ‘Passive House’ concept primarily limits the energy consumption of the building. Windows are as a consequence restricted in size and orientation. A greater separation of interiror and exterior spaces can be a result, which often contradicts the prevailing ideas of modern housing.

In contrast the idea of the ‘Active Houses’ is to balance energy gains and losses, or to outweigh consumption by gains. Therefore it is not necessary to define a specific method by which such a balance is reached or to specify target values for characteristics of the building. Important is the balance between losses and gains. In this concept windows are not seen as energy loss factors but rather are a central architectural element - supply the interior with natural light to optimally in order to create specific visual references as well as a passive solar collector. The increase in spatial qualities is an equally important target to the reduction of the negative impacts. Not only is building is CO_2-neutral throughout the life cycle, but also a spatially complex and multifaceted structure that successfully resisted the prevailing doctrine compactness.

Fig. 6: Energy and ventilation concept of the Sunlight House

The volumetry of the building is designed in response to the geographic and climatic context. The combination of material homogeneity and spatial complexity leads to a design whose energy strategy is manifested in space itself. Through the architectural integration of the PV-system and solar panels in the roof are part of building envelope. In the annual primary energy balance produces ‘Sunlighthouse’ surpluses that lead to the building after about 30 years of operation can submit a positive energy balance taking into account the total power consumption and the need for the construction of the building and embodied energy.

2.3 Built utopia

In the past architectural and urban movements and developments have had the aim of improving the living conditions and social grievances. Sustainable architecture requires to deal with the great challenges of our time: The environmental, the economic and the social. In this framework architecture would have a greater social responsibility continuing the most influential discourse in architecture of the last century.

The current discussion on the reorganization and renovation cities falls short of the mark. It is decoupled from the social dimension, which would include creating affordable housing, a representative mix of social groups within the city and a clear agenda for avoiding gentrification that often appears to be an unavoidable consequence modernization of buildings and city quarters. The ever-increasing gentrification in urban areas leads to a displacement of whole populations from near city centre and attractive neighbourhoods. The increasing segregation takes place along subtle social boundaries - between the neighbourhoods of the wealthy and those in the financially and socially disadvantaged, which simply cannot afford rising rents. A socially mixed urban realm is still the core of a democratic society and state. As Thomas Sieverts has pointed out a democratically and socially evolved consciousness can only be developed based on real day-to-day experience of the society as a whole. [9] How is a citizen to develop empathy and solidarity with fellow citizen he never see and who's fate he only can guess from over-excited and distorted media coverage?

The project ‚Dreieck' (German for triangle) shows a different approach within the housing market of one of the most expensive cities in the world. The project began with a design competition in 1987 held by the planning department – the result of which was never realized. The proposal was to demolish the existing buildings, which sparked a wave of resistance of the residents against the urban plans and the results of the competition. Instead of the demolition of the existing buildings they campaigned for a large-scale urban renewal and a gentle renovation of the buildings. In two cases existing buildings were replaced to increase the available floor area. At the beginning of this process were several protests initiated by the inhabitants. Those developed into a constructive campaign, which included the support of several architects in order to design an alternative scheme. It proved that the renovation not only causes significantly lower costs, but It would also allow the former residents to continue living in familiar surroundings. After the surprising acceptance of the project by the city council, the residents established their vision in the shape of a cooperative ‚Dreieck'. They founded two building workshop under the leadership of two craftsmen from 1997 to 2000 which employed 15 formerly unemployed residents and refurbished the existing buildings in that period. From 2000 to 2003 then the two new buildings were created so that the entire project could be completed in 2003, 16 years after the first discussions.

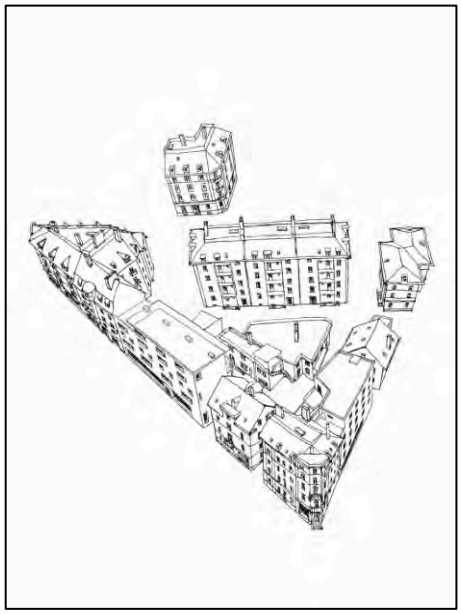

Fig. 7: ‚Dreieck', isometric after renovation

The result is a spatially and functionally open city block, which offers cafés, shops and public spaces for the residents and the surrounding neighborhood. In the building complex a mix of uses includes shops, restaurants, bars, a district library, a guest room as well as offices and commercial spaces to a variety of social and economic groups.

To reduce energy and resource consumption the energy needs of existing and new buildings were minimized. The triangle were uses renewable energy a combination of heat pump, solar energy and plus a combined heat and power plant. Another often neglected resource saving strategy is implemented: The intelligent and thoughtful approach to the available standing in the living area of this triangle only 36sqm per inhabitant and is thus 30% lower than the average housing area per capita in Zurich.

Despite the extensive renovation and addition measures, the objectives were achieved: The rent in the ‚Dreieck' are still about 20% lower that comparative local rent. Even after more than a decade of planning and construction today still more than half of the original tenants in their old quarters. The triangle is the catalyst for the development of an entire neighbourhood, it offers new ways of seeing and creating new spaces and opportunities.

3. Building rating system: ‚Housing Quality Barometer' (WWB)

Rating systems and evaluation methods can be applied at all levels of the design and planning process. An iterative and recursive procedure is one of the basic principles of a holistic design methodology. A repeated review of the results in relation to objectives and requirements requires powerful and practical tools. Also needed is reliable information for the evaluation of options in early project phases. At this stage design and evaluation methods are closely linked. A goal-oriented assessment and strategic planning is not possible without appropriate tools for qualification of results.

The applied method in this research project is based on the valuation methodology developed by the Department of Design and Energy Efficient Building of the TU Darmstadt in 2009 called ‚Housing Quality Barometer' (Wohnwertbarometer, WWB). It has been developed for the assessment of sustainability of residential buildings. The study was carried out in cooperation with the department of computer science at TU Darmstadt and the developer Pirelli RE Germany. Funding came in parts from the Federal Minestry for Building and Regional Planning (BMVBS). [10]

Location quality and available facilities

City centre
Regional centre
Childcare and elementary schools
Secondary schools
Colleges and adult education

Social services facilities
Hospitals and medical centres
Doctors and pharmacies
Playgrounds and play areas

Parks and open spaces
Recreational areas
Public transport availability
Alternative transport concepts

Car accessibility

Footpaths and bicycle paths

Accessibility

Public accessibility and thoroughfares

Integration of transport routes and roads
Car parking availability and accessibility
Quality of stationary traffic
Wheelchair accessibility and age-appropriate facilities

Process quality

Systematic planning and user participation
Assessment in the planning process
Self-administration
Personalisation
Appropriateness and building tradition
Addressing the user

Quality of space and design

Integration into the urban or landscape environment
Communal facilities
Communal outdoor spaces
Different degrees of publicness
Design of the building's entrance areas

Zoning within the apartment
Privacy protection
Visual references in outdoor spaces
Private open space
Relationship between indoor and outdoor areas
Entrance and hallways in the apartment

Functional Quality

Media connections
Equipment and service quality of building systems
Equipment quality of sanitary facilities
Private storage rooms
Utility space

Communal storage spaces

Flexibility and variety

Choice of apartments
Variety of use
Conversion capacity
Spatial flexibility of the apartment
Spatial flexibility of the building
Furnishability

Building-related costs in the life cycle

External costs
Cost of mobility
Building and property costs
Maintenance and upkeep costs
Energy costs

Comfort

Natural light in the apartment
Lighting of access areas
Thermal comfort in summer
Thermal comfort in winter
Internal sound insulation and acoustic zoning
Requirements for insulation from outside noise
Healthy materials
Controlled fresh air supply
Security of the outdoor areas

Security of the building

Resource demands of the building

Utilisation
Spatial efficiency of residential estate and building

Revitalisation and redevelopment area
Sustainable use of building materials
Durability and dismantling
Primary energy demands for mobility
Energy demands for room temperature control
Energy demands for electricity
Proportion of renewable energy

Generating water circulation
Reducing water consumption

Overall impact of buildings

Environmental hazards of technology
Environmental hazards building materials
Waste sorting and composting
Primary energy content of the construction

The system is particularly useful for analysing the potential of existing buildings. Through the evaluation of the building to be renovated at an early stage potential and weaknesses can be identified as well as possible strategies and targets are defined. In the further stages of the planning achievement can be tested and verified. Due to the ease of handling and the comparatively small time required for the analysis, the system could be adapted for use for the assessment of design options for new buildings.

The ‚Housing Quality Barometer' (WWB) has been developed specifically for the evaluation of the rental properties in the German Market. Therefore a direct transfer to the buildings studied in the book project was difficult. In the study a broad range of housing types, with different regional and national characteristics were analysed. Moreover, the aim was not a comparison of the projects, but the transparent and comprehensive picture of sustainability-related topics and strategies applied. For this reason, relative weighting of criteria and aggregation of assessments to an overall result has been avoided. The multi-dimensional representation corresponds to the complexity of the tasks and reveals strengths and weaknesses. The evaluation of the criteria is primarily goal-oriented without prescribing specific measures in order to allow for a wider range of strategies.

The projects analysed in the study have very different objectives, frameworks and standards. A direct comparison would therefore not be meaningful. The ‚Housing Quality Barometer' (WWB) shows strengths and weaknesses of the projects. The integration of non-building-related but user-related parameters (floor area per capita; land-use per capita) allows for a assessment of the building's impact than the commonly used systems, which focus on building-related characteristics. A holistic assessment of the environmental impact of residential buildings can not be made on the basis of assumptions that exclude one of the most important potential for saving resources: Sufficiency – i.e. the use of land per capita. [11]

4. Discussion and Conclusion

4.1 Discussion

Through the introduction of additional parameters that set the project in relation to a realistic number of users a comprehensive assessment of a building's environmental effects can be achieved. The commonly used parameters set resource consumption in relation to floor area - regardless of how many residents inhabit the respective areas. For example a single family house of 200sqm, which is inhabited by two people, has often greater environmental impact than two 100sqm apartments shared by four people. Also in regard to the use of land and necessary infrastructure required, the number of residents is a more comprehensive criterion for the environmental impact than square footage. This approach based on goal and benchmarks is reflected in assessment systems such as the '2'000W-Society' [7] or the ecological footprint measure [12]. Such a resource use per capita analysis focuses on the performance (like 'providing shelter') of the project instead of the usual building or area based statements. It considers the building not for its own sake, but puts to the user in the centre. In combination with the transparent presentation of criteria and evaluations in the matrix a more precise image of the relationship of building impact and its performance is possible.

When comparing the results of the assessment it is particularly striking that the differences in the evaluation per person are much higher than the rating in respect to floor area. That encountered in the projects range in the field of land use is between 11.5sqm per capita (for 'Quinta Monroy') and 2879 sqm per capita (for 'Wall House'), and even for projects that demonstrate a comparable floor area per person, the land use differs more than 600 percent (in 'Isar Stadtpalais': 15 sqm per capita; in 'Fehlmann's' area: 99sqm per capita). Similar differences can be found in the building footprint area per capita: Here differences were noted between 7sqm (for 'Quinta Monroy') and 13sqm per capita (for 'Dreieck'), and 62.5sqm (for 'Townhouse') and 74sqm per capita (for 'Wall House'). Not analysed in this publication is the over all land use, which would need to include the construction of infrastructure. Here project within existing urban structures (Town House, Mini House, The Triangle) have an advantage of projects that afford the creation of miles of paved roads was necessary to make a few cottages accessible (i.e. 'Loblolly House'). If the targets of national politics in Germany for the reduction in the annual increase in housing and transport area of currently nationwide 113 ha per day (in 2006) to a mere 30 hectares per day by the year 2020, are to achieved, concepts and future strategies need to look at the land use more comprehensively. [13]

4.2 Conclusion

At the centre of our interest in architecture is the relationship between architecture and context and as well as the interaction between mankind and environment that follows from it. Mankind, society and the environment are one system and can only be conceived and understood as a whole. This is why context and the temporality of the architecture of such central importance to sustainable design.

The study demonstrates that the existing design strategies and most of the rating systems are not reflecting the building impact comprehensively. The three strategies presented in this essay show that a much broader range of approaches is necessary to reach a more sustainable development in the building sector. At the same time it would redefine the role of architects and planners which pressupose a much more integral planning process from the beginning. Their consultation must not be limited to the mere solution of given technical problems but include a constructive dialogue about the appropiateness of program and suitability to site and users. From the point of view of the architects it might help to overcome the frustation they feel in face of new challenges to their discipline. Rather than a limitation of design options as a result of over-ambitious technical requirements they might find there possibilities extended by the integration of the new strategies.

These strategies should be supported by assesment tools that produced a higher level of transparancies especially in the early stages of the planning process and comparability of options to support decision-making processes and the discussion between client and architect. But the research must be continued in order to develop easy appliciable tools for the design process.

Sustainability is no additive that can be attached to a conventional building. Neither it is a mere technical requirement for buildings. It is integral to the design, building construction and architecture. Therefore it is important, above all, to develop methods and strategies that allow for the right questions to be asked and sub sequentially be answered in the design process.

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