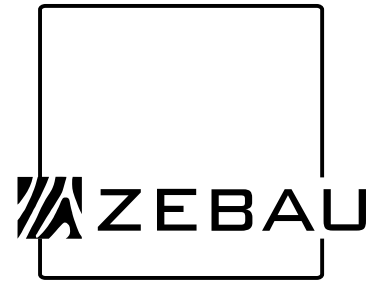


SBF16
HAMBURG



STRATEGIES
STAKEHOLDERS
SUCCESS FACTORS



Book of extended abstracts

Sustainable Built
Environment
Conference 2016
in Hamburg

Strategies, Stakeholders,
Success factors

7th - 11th March 2016

Program Overview

	Monday 7.3.2016	Tuesday 8.3.2016	Wednesday 9.3.2016	Thursday 10.3.2016	Friday 11.3.2016
8:00-9:00 a.m.		Registration	Registration	Registration	
9:00-10:30 a.m.		Opening Keynotes	Scientific sessions	Scientific sessions	PhD Session
		Coffee	Coffee	Coffee	
10:30-11:00 a.m.		Scientific sessions	Keynote Session COP21 and the consequences	Scientific sessions	PhD Session
11:00 a.m.-12:30 p.m.		Day of Municipalities		Day of Architecture, Planning & Engineering	
		Lunch	Lunch	Lunch	
12:30-2:00 p.m.		Scientific and special sessions	Scientific and special sessions	Closing Ceremony	PhD Session
2:00-3:30 p.m.	Excursions	Day of Municipalities	Housing Industry Day	Excursions	
		Coffee	Coffee	Coffee	
3:30-4:00 p.m.		Scientific and special sessions	Scientific and special sessions		
4:00-5:30 p.m.		Day of Municipalities	Housing Industry Day		
		Coffee	Coffee		
5:30-7:00 p.m.	Warm-up and exhibition opening	Welcome and Networking-Reception for all participants (Handelskammer)	Get Together and Award Ceremony (Holcim Study Award)		Scientific Session Session in German language PhD Session

SBE16 Hamburg

International Conference on Sustainable Built Environment Strategies – Stakeholders – Success factors

7th - 11th March 2016

Book of Extended Abstracts

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SBE16 Hamburg – a brief introduction

„SBE16 Hamburg“ is an international scientific conference on sustainable building that is part of the Sustainable Built Environment Conferences series 2016/2017. The series is run by the International Council for Research and Innovation in Building and Construction (CIB), the International Initiative for a Sustainable Built Environment (iiSBE), the Sustainable Building and Climate Initiative (SBCI) of the United Nations Environment Programme (UNEP), and the International Federation of Consulting Engineers (FIDIC).

The conference series follows of a ten-year tradition. Held in three-year intervals in different cities around the world, the conference series has established itself as one of the major events in this area. Following the World Conference in Barcelona in 2014, 20 regional conferences will take place in 2016 to prepare for the next World Conference in Hong Kong in 2017 and bring together thousands of players in the field of sustainable construction.

The title of SBE16 Hamburg, the regional conference in Germany, is „**Strategies, Stakeholders, Success factors – Strategien, Akteure, Erfolgsfaktoren.**“ With this title SBE16 Hamburg exemplifies what the general framework for sustainable construction must consist of and which procedures, influences, interactions and stakeholders, in fact, need to be part of a successful implementation. It focuses geographically on Germany, Scandinavia, Poland, the Baltic States and Russia, and is aimed at scientists, architects, city planners and engineers, politicians, stakeholders, the real estate industry, and municipalities.

The **Scientific Advisory Board** of SBE16 Hamburg is composed of more than 80 international and recognized scientists and experts who evaluate independently and anonymously all submissions to the conference and thus ensure the scientific quality of the event. Presiding over the Scientific Advisory Board are Professor Thomas Lützkendorf (Karlsruhe Institute of Technology), Professor Peter O. Brown (HafenCity University Hamburg), and Professor Natalie Eßig (University of Applied Sciences Munich).

The **multi-faceted program** provides congress participants with the opportunity for intensive exchanges and knowledge gain and thereby also foster experiences. The aim is to bring together scientists, planners and representatives from politics and business to discuss science, policy and practice with one another, thus contributing to a targeted and effective exchange of knowledge.

SBE16 Hamburg consists of various components: a combination of scientific knowledge, research results, and examples of practical implementation and innovation. The conference planners have made this possible by building into the agenda a diverse lecture program, ample opportunities for communication and networking, and a varied menu of excursions.

The lecture program consists of plenary, scientific contributions, and, for German-speaking participants, **subject-specific theme days**.

In the **plenary** opening by the event organizers, speeches and greetings will be given by representatives of the main sponsors of SBE16 Hamburg as well as German and international representatives of the political and scientific arenas. The national political representatives include Federal Minister for the Environment, Nature Conservation and Nuclear Safety, Dr. Barbara Hendricks and the Second Mayor of the Free and Hanseatic City of Hamburg, Katharina Fegebank. Nils Larsson (iiSBE) and Prof. Dr. Lützkendorf (KIT) will cover the significance of this conference series. Keynotes will be delivered by Professor Mojib Latif of GEOMAR Kiel and Hans-Dieter

Hegner from the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety.

A program of outstanding speakers will accentuate once again the results of the **UN Climate Change Conference in Paris COP 21** and highlight key issues and challenges during the second plenary session on Wednesday morning. Nils Larsson (iisBE) will convey his impressions of his participation at the Paris conference. He will be followed by Stefan Schurig (WFC) on the impact on future cities and Dr. Harry Lehmann (UBA) on the consequences of the UN climate summit for the construction and property industry.

The **scientific sessions** will take place over the three main days of the event (Tuesday to Thursday) with parallel sessions consisting of 10-minute presentations by national and international researchers, whose submissions were reviewed and selected by the SBE15 Hamburg Scientific Advisory Board. Around 150 papers from 34 countries will be presented, and each presentation will be followed by a brief discussion. In addition, contributions in the form of posters will be introduced in short talks at the end of some sessions.

The opportunity to **network and talk** with others is an essential part of SBE16 Hamburg. An accompanying exhibition of industrial partners, 'chat breaks,' and various evening events and excursions offer participants the chance to discuss scientific findings and link them with practice.

The **exhibition** takes place in the foyer of the HafenCity University, which forms the spatial intersection of all other activities of SBE16 Hamburg. Designed as a communication area, the space allows visitors to learn about the innovations of the supporting partners.

Within the program framework, on Monday, Wednesday and Friday the interplay of lectures and discussions will be rounded by several **excursions**. Through these conference participants will be able to witness examples of sustainable building in practice. The program includes excursions to a variety of interesting locations and construction projects, such as the urban development project HafenCity Hamburg, where the event venue - HafenCity University (HCU) - is located.

SBE16 Hamburg thematic focuses:

- Strategies and frameworks for sustainable construction and sustainable urban development
- Innovative concepts and case studies in sustainable neighborhood and urban development
- Project development and sustainability
- Application of sustainability tools and methods in the construction and property industry
- Research on innovative materials and products
- Expression of sustainability in education and training

The management group of the SBE16 Scientific Committee welcomes you in Hamburg!



Prof. Dr.-Ing. habil. Thomas Lützkendorf,
Karlsruhe Institute of Technology (KIT), Head of the Scientific Committee

Prof. Dr. Natalie Eßig, Munich University of Applied Sciences
Prof. Peter O. Braun, HafenCity University Hamburg

Both the planning, construction and operation of buildings in accordance with the principles of sustainable development, and the further development of the building stock and infrastructures to improve the quality of the built environment require the active involvement of all relevant stakeholders. Being dedicated to these topics, SBE16 Hamburg has a scientific program that is specifically addressed, among others, to representatives from research and education and to the staff of municipal administration, housing companies, and real estate and portfolio management companies. The discussions of how aspects of sustainability can be integrated in the processes of planning and decision making, of which strategies and solutions are available, and of how success can be measured are the thematic continuation of the SB 13 Munich Conference. It is not only the provision of calculation and evaluation methods, of design principles and design tools or of new structural and technical solutions that decides on the success of sustainable construction. As a matter of fact, the respective approaches need to be in demand, to be applied successfully, and to offer clear advantages to the environment, society, and industry. SBE16 Hamburg tries to overcome the traditional separation between science and practice. Contributions on the further development of methodical approaches are complemented by presentations of practical examples and analyses of experiences.

The international sustainable building conference series, within which Hamburg is the host city, has developed its range of subjects and has clearly expanded its focus to comprise all aspects of the design of a sustainable built environment. SBE16 Hamburg caters to this development by offering a program emphasizing a sustainable development in neighborhoods and urban districts. This focus is supported by discussions of issues related to the interaction between buildings and the grid. In addition, SBE16 Hamburg deals with the further development of national and company-owned building stock to achieve the objectives of climate protection and with the sustainable planning, construction and operation of civil engineering structures and constructed assets.

We are pleased that we will be able to benefit from many contributions by young researchers and PhD students. Whereas it becomes clear that the issue of sustainability is rather widespread in research and practice, future generations of specialist and executive staff may profit from some sessions dedicated to the integration of aspects of sustainability into the further education of planners, real estate agents, and specialists for property evaluation.

The conference is the perfect platform for scientific exchange between national and international participants. The results of inter- and transdisciplinary research projects with partners from several countries are presented in various contributions, and international experience is communicated.

We are very grateful to the members of the International Scientific Committee who have ensured the scientific quality of the conference by participating in the preparation and holding of SBE16 through reviewing papers and taking over organizational tasks.

We wish all guests and participants successful days and interesting encounters while being in Hamburg.

Thomas Lützkendorf, Natalie Eßig, Peter Braun

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GPEE –

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funded by Germany Federal Ministry of Education and Research and Ministry of Science and Higher Education, Republic of Poland

HEE – Horst Erichsen Energy

www.hee-energy.de

iiSBE – International Initiative for a Sustainable Built Environment

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Program Overview

Tuesday, 8th March 2016								
Location:	HOLCIM Forum	Lecture room 200	Lecture room 150	Room 2.102	Room 2.103	Room 2.104	Room 2.105	Room 2.015
9.00-10.30 a.m.	Opening Keynotes							
11.00 a.m.-12.30 p.m.		2A: BMUB – Nachhaltige Kommunen	Ses 1.2: Energy supply for urban areas		2B: Lösungen der Energieversorgung Ansätze für Kommunen	Ses 1.1: International experience		Ses 1.3: Valuation and selection of construction products
14.00-15.30 p.m.		3A: Projekte der Klimafolgenanpassung	Ses 2.1: Net zero and plus energy buildings	Ses 2.2: Education I	3B: Mittel und Wege zum Erreichen kommunaler Klimaschutzziele	Sp 01: PLEEC – Planning for Energy Efficient Cities I	3G: Sportstätten - Förderer des nachhaltigen Bauens?	Sp 03: Open international data network for LCA at building level I
16.00-17.30 p.m.		4A: Regenwassermanagement	Ses 3.1: Building integrated solutions and new technologies	Ses 3.2: Education II	4B: Aktuelle Herausforderungen – Potenziale und Lösungswege	Sp 02: PLEEC – Planning for Energy Efficient Cities II	Ses 3.3: Infrastructures and constructed assets	Sp 04: Open international data network for LCA at building level II

Wednesday, 9th March 2016								
Location:	HOLCIM Forum	Lecture room 200	Lecture room 150	Room 2.102	Room 2.103	Room 2.104	Room 2.105	Room 2.015
9.00-10.30 a.m.		1C: GdW – Nachhaltigkeitskodex der Wohnungswirtschaft	Ses 4.1: Urban design and mobility	Ses 4.2: Timber structures and biobased products	1D: Hamburger Stadtentwicklung	Ses 4.3: Standardisation, regulation, innovation		
11.00 a.m.-12.30 p.m.	5.1 Keynote Session: COP21 and the consequences	2C: Nachgefragt – die drei Säulen nachhaltiger Wohnungswirtschaft						
14.00-15.30 p.m.		3C: Wohnraum für Flüchtlinge I	Ses 6.1: Development of urban districts I	Ses 6.2: Sustainable assessment systems – further development and application	3D: Zukunftsorientiert und nachhaltig: Energie für heute und morgen	Ses 6.3: Portfoliomanagement & improvement of building stock	Sp 05: Energy efficient facades – technologies and measurement I	Ses 6.4: Stakeholder perspectives and actions I
16.00-17.30 p.m.		4C: Wohnraum für Flüchtlinge II	Ses 7.1: Development of urban districts II	Ses 7.2: LCA-application and further development	4D: Nachhaltige Quartiersentwicklung	Ses 7.3: Public Sector – activities and experiences	Sp 06: Energy efficient facades – technologies and measurement II	Ses 7.4: Stakeholder perspectives and actions II

Thursday, 10th March 2016								
Location:	HOLCIM Forum	Lecture room 200	Lecture room 150	Room 2.102	Room 2.103	Room 2.104	Room 2.105	Room 2.015
9.00-10.30 a.m.		1F: Nichtwohngebäude – Finanzierung und Qualitätssicherung	Ses 8.1: Urban development under specific conditions	Ses 8.2: Construction products and processes	1E: dena – Turbo für die energetische Sanierung	Ses 8.3: Design stages – importance and contribution		Ses 8.4: Cooling, ventilation and air conditioning
11.00 a.m.-12.30 p.m.		2F: Nichtwohngebäude – Energieeffizienz in der Praxis	Ses 9.1: Urban planning and energy	Ses 9.2: Cost and value – the economic point of view	2E: DBU – Klimafolgenanpassung und Regenwassermanagement	Ses 9.3: Collaboration and user involvement		Ses 9.4: Resource efficiency and recycling
13.00-14.00 p.m.	Closing Ceremony	3F: Nachhaltig und effizient – Bauen und Heizen mit Holz			3E: DBU – Klimafolgenanpassung und Regenwassermanagement			

SBE16 Hamburg

Extended Abstracts

in alphabetical order

30 years after – case study of ‘Ökologische Gemeinschaftswohnanlage Nofels’ (ecological housing cooperative Nofels)

Extended Abstract

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Summary

The study investigates an autonomous housing project for eleven families in Feldkirch/Austria. This project combines a radical mix of societal alternative, typological innovation and tectonic efforts. The project addressed four key design objectives: ‘radically cost efficiency’, ‘ecological approach’, ‘individual homes in a communal frame’ and the possibility of developing an adaptive ‘self-build’ system. All four objectives required a strong tectonic strategy.

After the experience of almost 30 years, the comparison between the initial ideas and design of the housing project ‘Ökologische Gemeinschaftswohnanlage Nofels’ with the status of 2015 seems to be very fruitful for ongoing discourses on adaptability, life cycle design and new self-determined and self-organized housing forms, which are developing in many places.

Given the low fluctuation of inhabitants over the period, examining the pre-designed adaptations and upgrading of individual dwellings and considering the low cost and low maintenance of the building, Ökologische Gemeinschaftswohnanlage Nofels’ can be considered a success. Still it is useful to look at the the obstacles, contradictions to original goals and the conflicts in the process, but in summary they turn out to be secondary.

Keywords: communal housing, ecological building, low-cost, adaptive, self-building

1. Introduction

‘Ökologische Gemeinschaftswohnanlage Nofels’ is a housing project with eleven individual units plus a collective house and an office in Feldkirch/Austria. The project was started in 1986 by five young families. Their goals from start were:

- living individually in a communal frame
- living self-determined and self-organized in respect to the formation of their home
- living ‘ecological’
- building as economic as possible

For a design strategy it became clear from start that only a very flexible, resilient and adaptive tectonic strategy following the concept of ‘growing and shrinking house’ could merge the individual and individualistic desires (in size as well as in standard of the homes) with the needed radical low-cost approach and the ‘ecological program’.

The smallest ‘standard house’ (including land) should not cost more than 50% of the regional market price for a conventional home with the same size and it should be habitable also in case of a power cut or of energy shortage. A primary obstacle was to find a quality site of the needed size, which was inexpensive because investors had no interest for reasons of site layout or topography. After a long decision-making process with design participation, the building process started in 1987.

2. Methodology

This paper is a case study and a reflection with special focus on the tectonic aspects of the dwelling over time. It documents the project’s history, based on parameters decided by the group, on architectural drawings and facts of the building process, on comparative photos and interviews with six inhabitants in April 2015. It illustrates problems and contradictions during the process of design, building and habitation. It presents and discusses the transformations that happened over time and thereby it focuses on the tectonic solutions which supported these intentional changes.

3. Results and Conclusion

‘Ökologische Gemeinschaftswohnanlage Nofels’ has many layers to learn from: new homes in Austria became less affordable since 1986, and their environmental impact has not significantly improved apart from marketing propaganda. Adaptability is still an alien concept for most of the housing market. These are the reasons for new self-organized housing initiatives in Austria and other countries. The building in Feldkirch is a valuable object lesson on the field of group dynamics as well as on the emergence of a performative architecture for dwellings, which rather fulfils individual desires than predefined aesthetic clichés.

The project includes several ‘controlled experimental’ solutions like an economically optimized and unusual hybrid primary structure, Trombé walls to the south in massive wood, self-made straw-earth boards to mention only a few. Eleven individual hypocaust heatings including a cooking part, both working also in case of power cuts using collected fire wood from nearby forest, still provide comfort and the spatial experience of a warm core in each house.

Despite different life situations, higher incomes and new family situations, the minor fluctuation of the inhabitants is a clear indicator of high user satisfaction, which was also expressed in interviews with six owners: Out of eleven families, eight are still the original owners. One family sold the house and moved to another place, two couples have divorced and sold the house. One buyer was the son of an original group member, who together with his wife has four young children. Therefore already the third generation lives in the housing estate and after a period of grown up children leaving their parents homes, again small children inhabit and enjoy the place.

The collective design-, decision- and building processes certainly have been exhausting over some periods and provoked conflicts. But over time, the housing group was rewarded with high living quality at extremely low costs for a life time. And that puts it straight at the heart of departure of this group: What’s the point to live in a city or town if you don’t interact with your neighbours?

Space for notes

A Case Study of Rainfall Water Harvesting Effects on Runoff for Guzelyurt, Northern Cyprus



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Summary

Development of the cities and growing population significantly change the natural water cycle in urban districts and consequently increase the amount of runoff water which results in higher flood risks. For mitigating the negative impacts of urbanization on runoff, rainfall water harvesting (RWH) is proposed and applied in several regions for reducing the amount of runoff. In this study, the RWH by installing storage tanks and the methodology for studying its effects on runoff are introduced. The methodology is applied on a small catchment in East Guzelyurt, Northern Cyprus as a case study, in order to investigate the effectiveness of RWH for this region. The results show that considering a 6 hour rainfall with a critical intensity of 30 mm/hr, for the selected catchment the runoff can be reduced up to ~15% in first 2 hours; however before the peak rainfall, the storage tanks get full and the runoff is not significantly reduced for the next 4 hours. The results show that RWH by installing storage tank in residential buildings for this catchment is not sufficient for reducing the amount of runoff and other harvesting methods should also be considered.

Keywords: Rainwater harvesting, Sustainable development, Source control, Peak discharge.

1. Introduction

The changes in natural water cycle not only adversely affect the quality and quantity of water, but also increases the flood risk in the cities by introducing higher runoff water. In order to make this defected cycle more close to its natural conditions rainfall water harvesting (RWH) seems to be a promising approach. Applying this method can supplement water scarcity in the areas that suffering from insufficient water resources. Moreover, reducing service water demand by supplying a part of the water consumption with rain water, the costs would be reduced throughout the time by saving resources and energies. The objective of current study is to introduce a general methodology for studying the effects of RWH from rooftops of the residential buildings of a small catchment on the runoff water during a critical rainfall period. The method is applied on a small catchment at East Guzelyurt, Northern Cyprus.

2. Methodology

To investigate the effects of RWH by installing water storage tanks for residential buildings on runoff water, it is necessary to analyze the surface characteristics of the catchment. The orthophoto map is used for this purpose and different surface types are categorized in three different batches which are namely rooftops, streets and pavements, and neighborhood area. The runoff water from these areas are calculated using the rational method. The methodology is applied on a catchment at East part of Guzelyurt, N. Cyprus. The road map for this area and the pictures provided by Google Earth are used for generating the orthophoto map. Based on the available measured data, it is assumed that the critical rainfall has an intensity of 30 mm/hr and the hyetograph which follows 6 hour rainfall SCS type II pattern is generated. Moreover, for simplicity of the study, the water consumption of each dwelling is calculated by assuming a constant consumption rate per capita. Considering specific tank sizes, cumulative amount of the stored water is calculated for 6 minute time steps. This calculations are continued till the tanks get full and then the runoff from the rooftops are considered to be disposed to the sewerage system. The volume saved by the tanks is calculated and the equivalent rainfall is obtained by dividing the total harvested water volume by the total area of the catchment to find the hyetograph after RWH.

3. Results and Conclusion

Comparing the resulting hyetographs before and after utilizing RWH shows that RWH from the rooftops would reduce the rainfall intensity by 2% during six hours of rainfall. Since the rooftop area found to be only 17% of the whole catchment and the region is not densely populated the reduction in runoff is not impressive, especially for a rainfall event with high intensity. After about 2 hours of rainfall the tanks get full and since the consumption is not considerably reducing the stored water, the reduction in runoff drops significantly. After 2.7 hours the tanks are completely full and there is no reduction in runoff. The results show that for the studied catchment RWH from rooftops is not sufficient for reducing the amount of runoff water and other techniques should also be studied and used.

4. Acknowledgment

This research is supported by the Research Fund (FEN 13-YG-5) of the Middle East Technical University, Northern Cyprus Campus. This support is gratefully acknowledged.

Space for notes

A Comparison of How Sustainability and Green Building Standards are being adopted into Building Construction Codes within the United States and the EU



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Summary

Sustainability is being adopted into building codes at different levels of government and with varying motivation. This paper provides a brief synopsis of the process that has occurred in this development and a description of the state-of-the-art in the industry, particularly focusing on the United States and Europe and comparing the approach in these two regions.

Keywords: High performance buildings, ASHRAE 189.1, LEED, EPBD, EPC

In the U.S., there has been a combination of methods and programs that have gradually led to an increasing focus on sustainability concerns in new commercial and residential construction. The methods range from voluntary programs that include rating systems and guidelines up to standards and mandatory enforceable codes. The rating method primarily used in the United States is the Leadership in Energy and Environmental Design (LEED) program, created by the U.S. Green Building Council (USGBC) in 1998 as a voluntary, consensus-based, market-driven green-building certification system. Soon after the LEED program was initiated in the U.S., some jurisdictions began to include achieving LEED certification (of a specific level) as part of their building permitting and code process. This was never how LEED was structured, and thus in 2006, ASHRAE (in conjunction with the USGBC and the Illuminating Engineering Society (IES) began a process to create a standard that would address a growing need within the industry for a code-language document for green buildings suitable for adoption as part of building codes. The ASHRAE 189.1 Standard for the Design of High-Performance Green Buildings was developed during a more than three-year process with extensive public review and was initially published in early 2010. This Standard includes mandatory criteria in all topical areas (e.g. site, construction, materials, energy, IEQ, water,) and provides for two compliance paths. In 2010, the state of California adopted its own state-wide green buildings code, termed CALGreen, and an updated version issued in 2013 became in effect in January 2014. California for a long time has had a series of fairly progressive regulations related to energy efficiency. One unique item of the CALGreen program is that there are criteria for both residential and non-residential buildings in the same program. In most other situations in the U.S., residential and non-residential building codes are based on separate documents and standards.

Various voluntary schemes have been introduced in the Europe over the years. Amongst them, the most notable effort has been the BREEAM method, a voluntary program first introduced in the

U.K. Parallel efforts by the European Commission over the past decade have also introduced several mandatory directives to increase efficiency at all stages of the energy chain, targeting final consumption and the building sector, where the potential for savings is greatest. Over the past 20 years, numerous European directives have been issued to address different aspects of energy use in buildings, starting with hot water boilers and household appliances, until, in the early 2002, the first comprehensive policy addressing building energy performance (EPBD) was enacted. The European Directive 2002/91/EC on the energy performance of buildings (EPBD) and its recast (Directive 2010/31/EC) are driving the efforts for improving the energy efficiency of the European building stock. Accordingly, European Union Member States (EU MS) are strengthening the energy performance requirements and set more stringent goals for reducing the energy performance of buildings. By the start of 2021, all new buildings shall be “nearly zero-energy buildings” (NZEBS), while new buildings occupied / owned by public authorities should comply by 2019. The Energy Efficiency Directive (EED 2012/27/EU) establishes a common framework of measures for the promotion of energy efficiency at all stages of the full energy chain (i.e. transformation, distribution, consumption), by setting specific obligations schemes and policies to improve energy efficiency in all end-uses, ensuring a 3% renovation rate of public buildings and a long-term national strategy for building renovation, informing and empowering consumers.

Due to these varied differences in goals and societal concerns in the various countries on both sides of the Atlantic, making broad generalizations about the future as just guesses. In the U.S., there will be a consolidation of the green building codes as the merger of ASHRAE Standard 189.1 and the International Green Construction Code is on track to occur in 2018. The energy efficiency levels with the U.S. codes will continue to decrease, with the green building codes evolving toward a net energy intensity level that will be 20-25% of the code minimums that existed at the turn of this century by the year 2025. In Europe, the energy goals for 2020 will not be fully met, although the end result will be close to the original targets. The next major push will be to develop and set in motion the targets for 2030.

Space for notes

A Design for Improved Natural Ventilation in Housing Development in Thailand



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Summary

Natural ventilation provides free cooling. However, the use of natural ventilation in a housing development is challenging due to the grid alignment of land lot with the result that the wind is blocked by the houses upstream. This study improved the potential use of natural ventilation in the housing development in Thailand with the following 2 steps: housing setback arrangement and function adjustment. After the housing setback was adjusted into staggered grid alignment, the average air velocity measured in the tested house was increased by approximately 61.7%. However, when looking into the house interior on the level of room function, the air velocity in living and dining rooms were typically low with approximately 0.3 m/s since toilet, kitchen, and stair blocked the wind. To encourage more natural ventilation in those spaces, toilet, kitchen and stair were flipped into another side of the house. The air velocity in living and dining rooms were improved significantly by 33% and 42%, respectively and increase to more than 0.4 m/s which prove to be thermally comfort for Thai people. With the limited design in land lot alignment, the natural ventilation in housing developments can be improved by housing setback arrangement and function adjustment.

Keywords: Natural ventilation, Computational Fluid Dynamics, Housing setback, Air velocity

1. Introduction

Natural ventilation (NV) strategy can offer free and effective passive cooling, reduce the use of air-conditionings systems, an active cooling approach, and improve indoor environmental quality. For tropical country likes Thailand, about 90% of urban indoor environment are air-conditioned due to air and noise pollution. However, in the suburban area, especially around Bangkok the metropolitan, the micro environment around the house is still less polluted. People choose to open air-conditioning only during hot hours of the days. Hence, providing more natural ventilation for the house would help reduce the use of electricity for air conditioning. In Thailand, air-conditioning system has been used in almost 50% of municipal households and contribute for over 70% of total electricity load in a small household. Most of the houses in suburban area are housing

development project. It is with challenge to use natural ventilation due to the grid alignment of land lot which normally arrange so that the wind is blocked by the houses upstream. This study describes a computational fluid dynamics (CFD) analysis to improve the potential use of natural ventilation in the housing development in Thailand. And to support the careful considerations of natural ventilation during the design process for urban designer, landscape architects and architects who involve in the design process of land lot alignment.

2. Methodology

There are two steps for the improved potential use of natural ventilation in this study; i) the simulation model of housing development of 2 types of housing setback arrangement are studied, the base case with the linear grid alignment and the design case of the staggered grid alignment. This step offers the result to quantify the higher air velocity to the downstream houses, ii) after the housing setback was adjusted, the wind velocity inlet are measured inside the tested house with to see the improvement of wind velocity within the house. Computational Fluid Dynamic (CFD) simulation program is used to simulate the direction and wind velocity.

3. Results and Conclusion

The results discussed in previous section give the insight as to which grid alignment and room function position should be in the housing development project to improve natural ventilation for thermal comfort.

By realigning the land lot into the staggered grid alignment, the wind velocity at the reference house improve from 0.18 m/s to 0.47 m/s. The results also show that when located on the same size of land lot, the different alignment can gives the house a higher wind velocity by 61.7% and suggesting that the staggered grid alignment of land lot is more appropriate for natural ventilation.

When considered the wind velocity within the room of the 2 storey house, the simulation results show that the average wind velocity in Living room and Dining room are reduced to 0.3 m/s due to toilet, kitchen, and stair blocked the wind. To encourage more natural ventilation in those spaces, toilet, kitchen and stair were flipped into another side of the house. The air velocity in living and dining rooms were improved significantly by 33% and 42%, respectively and increase to more than 0.4 m/s which prove to be thermally comfort for Thai people.

Space for notes

A holistic Methodology for District Retrofitting projects management through an Integrated Decision Support Tool



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Keywords: Urban District Retrofitting, Sustainability, Energy, Decision-Support, Software Tool, Neighborhood

1. Introduction

The main objective of the FASDUIR Methodology development was to establish the conceptualisation and strategies to develop a holistic methodological framework for the assessment of energy and sustainability retrofitting interventions at building and district level. The energy retrofitting of districts is a complex and work intensive task. In order to achieve the most effective results all involved stakeholders have to cooperate in a well-coordinated and structured way. The high complexity of retrofitting projects on district scale requires a thoughtful methodology which guides the urban planners and all involved stakeholders through the different phases of the district retrofitting project. To improve the effectiveness of the planning and implementation process of energy retrofitting measures and to reduce the needed time the use of an advanced and integrated planning and decision-support tool (IDST) is indispensable.

2. Methodology

FASUDIR provides an Integrated Decision Support Tool (IDST) based on a new methodology supported by a web-based software tool that helps decision makers to select the most suitable energy retrofitting strategy to increase the sustainability (economic, social and environmental) of a whole urban district [2]. The Decision Support Methodology developed in FASUDIR guides planners of neighborhood retrofitting projects in a structured way through several phases of the project. The Methodology starts with the preparation phase comprised of data collection and data entry. The diagnosis phase demonstrates planners and stakeholders the current state of the neighborhood in terms of sustainability and overall energy efficiency. The decision-making phase helps planners to create optimized energy retrofitting variants for the neighborhood. It allows considering the neighborhood as a global energy system by assessing heat and electricity related synergies and interactions between buildings. Based on the results the planners are able to design heat

networks and to plan the inclusion of renewable energy sources taking into account smart grids and energy storages. The created energy variants can be assessed and ranked with regard to their sustainability by a MCDA approach and the use of several simulated Key Performance Indicators (LCA, life cycle cost, cost, ROI, energy, social aspects e.g. gentrification, etc). Moreover the Methodology defines the requirement of different IDST software modules to support planners in the complex planning process of neighborhood retrofitting projects. The defined software modules are used in the process of the methodology for building simulations, 3D-visualization in a virtual Citymodel, e-collaboration platform for stakeholders, KPI evaluation and further functions. The Citymodels and the modules have been developed in the FASUDIR project and incorporated in the Integrated Decision Support Tool (IDST).

3. Results and Conclusion

A validation of the final prototype of the IDST on three real case study neighborhoods (Frankfurt, Germany; Santiago de Compostela, Spain; Budapest, Hungary) has been conducted in order to fine-tune the methodology and simulations. The results showed that the high flexibility and usability of the FASUDIR approach facilitates a broad application in Europe and beyond. The data collection phase for the creation of the Citymodels in the case study sites has been identified as the main bottleneck of the FASUDIR approach. Especially the quality and availability of GIS data, which is needed as basic input for the FASUDIR Citymodel, is not for in all cases available. Furthermore if the data is available the quality in many cases is not sufficient and an intensive data reprocessing is necessary. Another limiting factor is the high price for buying the underlying GIS data from land surveying offices. However, as the distribution of high quality GIS data in Europe will improve in the near future the usability of the FASUDIR approach will become even easier and cheaper. The exploitation of the FASUDIR Methodology and IDST Tool are in progress now. Several cities, urban planners and professionals have tested the first version of the IDST in special local project committee meetings. The feedback of these meetings has shown a strong demand of advanced decision-support tools for district retrofitting all over Europe.

Space for notes

Application of a parametric LCA tool in students' design projects



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Summary

In winter semester 2014/15 students at the Bauhaus University of Weimar and students of the University of Mersin employed a self-developed parametric tool for life cycle assessment (LCA) during design. Throughout the semester the students presented the LCA results of their current design every week. The final results showed that the students were able to save an average of 16% of Global Warming Potential (GWP), compared to a default variant. In comparison to a reference group who did not apply this tool they achieved designs with only half the GWP. The project demonstrates that, if they have the right tools at their disposal, even non-experts can apply LCA during the design phase without much additional effort. Furthermore, the GWP reduction clearly proves the application to be worthwhile.

Keywords: Student design project, architecture, LCA, parametric model, building simulation

1. Introduction

Life Cycle Assessment (LCA) is becoming more and more important for building evaluation. In general, the optimization of the design in view of a low environmental impact can best be achieved in early design stages. In order to allow architects to analyse the environmental impact of their building while designing it, two major developments are necessary: First, appropriate tools – simplified and adapted to meet the architect's requirements – have to be developed. Second, the architects need to acquire some expertise in building physics and LCA to be able to interpret the obtained results. Ideally, this know-how should be taught at the beginning of the architectural education at the universities. This paper responds to both points and discusses the results of applying a self-developed parametric LCA tool in a student design project.

2. Methodology

The design task of this project consisted in developing a use scenario and in designing a building in the historic city of Tarsus, in the south of Turkey. The students were asked to analyse the life-cycle environmental impact of their designs every week, from the first sketches at the beginning of the semester to the final design. Any decision, from the urban setting to the size of the windows, should be made on the basis of design variants and the corresponding environmental impact. The idea was not to hinder solutions with a higher environmental impact, but to improve the understanding of the relation between design and environmental impact as well as to provide a quantitative basis for decisions.

The students employed a parametric tool to carry out the LCA. The tool was developed for “Grasshopper3D”, a parametric plug-in for the CAD software “Rhinoceros”. The method is based on parametrisation of all influencing factors, such as geometry, material, service life, etc. The core of the method is a parametric LCA model with three main parts:

1. Input of geometry, materials and surrounding conditions, such as climate data, user profiles, etc.
2. Automatic calculation of the building’s energy demand and the resulting operational impact as well as the simultaneous calculation of the embodied environmental impact, which is based on the automatically generated bill of quantities
3. Visualization of the results, which serves as a feedback for the architect

The architect can then make an informed decision to change the design stepwise towards less environmental impact or to employ computational optimizers to find an optimum solution.

3. Results and Conclusion

The semester was divided into two parts. The first part focussed on the optimization of the geometry, the second one on the choice of material. Due to the difficulties some students initially had in modelling the geometry correctly on the one side and minor adaptations of the tool on the other, the influence of changes in the geometry could not be assessed correctly. In the second part of the semester all students were familiar with the tool and able to insert their individual materials. On average, the students were able to save 8.2% of primary non-renewable energy (PENRT) and 16.2% of global warming potential (GWP) by choosing another material than the default materials of the tool. The designs of a reference group of 17 students, who did not apply the tool, were analysed afterwards with the same tool. The materials they chose caused an average of 30.7% more PENRT and 16.9% more GWP than the default materials.

The results indicate the potential of applying LCA in early design stages. The student project demonstrates that also non-experts can make use of LCA with the aid of the adequate tools.

Two requirements for the future improvement of the tool became clear: First, a very simple, intuitive input of the 3D geometry is necessary. Second, the computation time for the simulation is too long and real-time approaches are necessary. In order to solve this problem, a quasi-steady state method for energy demand calculation will be integrated. In general, the students were highly interested in the LCA tool and we will employ an improved version in future classes again.

Space for notes

Asphalt Solar Collectors contribution to the Urban Heat Island Effect under Hot Arid Climate Conditions



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Summary

Asphalt solar collector (ASC) is a novel technology that is used to capture the solar energy from paved roads for low to medium temperature solar thermal applications. However, asphalt paved roads are also one of the main contributors to the urban heat island effect which causes an increase in the urban temperature. This study assesses the impact of the ASC technology on the thermal behaviour of the asphalt roads and consequently on the urban heat island effect. In the research an ASC system is developed and its performance under the load of an absorption cooling cycle, an atmospheric water generator and domestic hot water demand is analyzed and evaluated along with each load impact of the on the asphalt surface temperature under the typical hot arid climate conditions.

Keywords: Asphalt solar collector, solar energy, urban heat island, Jeddah

1. Introduction

Asphalt Solar Collectors (ASC), is a comparatively 'young' technology that started to capture the interest of researchers in the past few years for two reasons: The thermal properties of asphalt, and the abundance of the asphalt infrastructure in modern cities. However, Apart from some simple lab tests the contribution of a functioning ASC on the urban heat island as well as its possible applications are to date not well documented. The use of ASC for solar thermal applications and as urban heat island (UHI) mitigation in the same time represents a paradox by itself. On the one hand, the design of the ASC is optimized in order for the asphalt to reach high temperature in order to for the system to be able to collect more energy, resulting in the delivery of higher exergy content for the solar thermal application. On the other hand, when the ASC is used as an UHI mitigation measure, the system needs to maintain the asphalt surface temperature at low temperatures, which, in turn, would render the collected energy not useable for solar thermal applications. Therefore, this paper will assess the performance of an optimized ASC for three solar thermal applications and the contribution of the ASC for each application to the urban heat island measure in by means of exploring the resulting of surface temperature.

2. Methodology

The research is conducted with the help of the numerical simulation software TRNSYS16 under typical hot arid climate conditions. The hot arid climate is chosen, as under this climate conditions, the ASC potential can be fully exploited. The typical meteorological year (TYR) weather data of the city of Jeddah, Saudi Arabia is chosen for this research. A simulated asphalt model is built in the software using the thermal and physical properties of real sample from the case study site and its performance is validated by comparing the thermal behaviour of the modelled sample with the real one. An optimized configuration of the ASC components is developed as result of subjecting the ASC components to a sensitivity analysis. The performance of the developed system under the load of an absorption cooling cycle, an atmospheric water generator and domestic hot water demand is analyzed and evaluated along with each load impact on the asphalt surface temperature to assess the ASC impact to the urban heat island effect.

3. Results and Conclusion

The research results showed that, the heat exchanger part of the ASC (pipes and fluid) has greater influence on the performance of the ASC over the thermal properties of the asphalt. The results of investigating the ASC performance under the loads reveal good potentials for the use of the ASC technology for covering the domestic hot water demand and for atmospheric water generation. The system efficiency reached 22% with the system working under the domestic hot water demand mode. As an atmospheric water generator; the investigated 20m² ASC system was able to extract a total of 1160 liters of water from air for the month of May.

The contribution of the ASC to the urban heat island is assessed basing on the surface temperature of asphalt pavement with and without the ASC. The results showed that the ASC functioning to meet the load of the atmospheric water generator and the domestic hot water demand had neither a decisive positive nor negative impact on surface temperature and consequently the UHI, as the maximum surface temperatures in both cases was slightly below or above the surface temperature of a normal paved asphalt surface. However, this was not the case when the ASC is working to meet the load of an absorption cooling cycle, but due to the weak performance of the ASC meeting that load, such an application can be considered as not suitable for the ASC and is thus, not recommended use of the ASC.

Space for notes

Assessing the Sustainability Performance of Sports Facilities – Methodology and Case Studies



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Summary

Up to now, a holistic assessment methodology for the sustainability performance of sports facilities is not available. Therefore, this paper presents a methodology developed specifically for sports facilities and shows the results of a case study. On the basis of selected examples it is demonstrated how the developed 36 criteria address the specific characteristics of sustainable sport halls by their subindicators. The presented methodology, so far developed for stadiums and sports halls, may be a driver of sustainable building regarding sports facilities in the future.

Keywords: Sports Facilities, Sustainability Assessment, Pilot Cases, Sports Halls, Stadiums

1. Introduction

In recent years, assessing the sustainability performance of buildings became a common practice in today's construction industry. Labels like LEED, BREEAM or DGNB are widely used to assess the performance of an even wider range of building types such as offices, hotels, residential and educational buildings. However, up to now a holistic assessment methodology for the sustainability performance of sports facilities is not available, although the organisers of mega sport events are under constant pressure to report on the sustainable performance of their venues. Previous methods like the 'BREEAM for Olympic Park and Venues' developed by BRE for the Olympic Games in London did not offer a holistic methodology and a comparison of the sustainability performance for sport facilities is not yet possible [1].

Therefore the objective of the present study was to develop a set of criteria and indicators designed specifically to assess the sustainability performance of sports facilities for different applications: stadiums and sports halls. To demonstrate its suitability for the application, several case studies have been conducted.

2. Methodology

First step of the study was to determine the main criteria for the sustainability assessment for sports facilities. A working group was established to investigate all different approaches for building sustainable sports facilities. Property owners, architects and planners, representatives of associations and federations, political and economic representatives, researchers as well as mem-

bers from the DGNB and ÖGNI took part in defining the set of criteria. Furthermore, subindicators were designed for the application to stadiums (type I) and sports halls up to 200 spectators (type II). The subindicators were developed by the experts from the specific sectors of the working group as well as the planners of the case studies to ensure the direct application.

3. Results

In summary, 36 criteria were defined. The specific characteristics of sustainable sport halls are addressed by subindicators. Therefore, the full paper demonstrates the criteria for sustainable sports halls on the basis of selected examples such as accessibility, commercial viability, safety and comfort.

Additionally, the results were successfully applied on a real case ('Am Sportpark', Zorneding). Not only because of the innovative design and energy concept, but also by the integrated planning process which involved the later users as well as environmental friendly material selection and many more, the sports hall constitutes a flagship project on sustainable building.

4. Conclusion

The developed methodology closes the gap of a holistic assessment methodology for the sustainability performance of sports facilities. An application of the developed method in practice is no more obstacles. So far, the methodology can be applied for stadiums and sports halls, but additional developments e.g. for swimming pools are conceivable. Further assessments in the way of case studies are recommended to proof the benchmarks.

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Space for notes



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Assessment of Land Use/Cover Change and Urban Expansion in Tehran, Iran, by using GIS and remote sensing

Summary

Tehran as a mega city has been challenged by numerous difficulties like unplanned urbanization, traffic congestion, water logging etc. Geographic Information Systems and remote sensing are powerful and cost-effective tools for assessing the spatial and temporal dynamics of land use/cover changes (LULC). This study evaluates land use/cover changes and urban expansion in Tehran, Iran, between 1984 and 2014 using satellite images and socio-physical data. The result shows that important growth of built-up areas in Tehran over the study period resulted significant decrease in the area of barren lands, cultivated land, and vegetation. The land use maps produced in this study will contribute to both for forecasting possible future changes in growth patterns and also the development of sustainable urban land use planning decisions.

Keywords: LCLU Land cover / Land use; urban growth; Tehran; Iran;

1. Introduction

Tehran is Iran's largest city and urban area, the largest city in Western Asia and one of the largest three cities in the Middle East (along with Istanbul and Cairo). According to DWUA [1], Tehran, the capital of Iran, is the twenty-second most populous city in the world with a population over 13.5 million people. Land cover and land use change (LCLUC) caused by urban growth is a global issue [2, 3]. Rapid changes in land cover / land use (LCLU) and increased environmental degradation in developing cities caused by population growth and human activities have enormous negative consequences. The aim of this study is to explore the patterns of LCLU changes in Tehran. This will be done by integrating remote sensing-derived LCLU data and PCC algorithm.

2. Methodology

The study area is located in Tehran province (north of Iran), between 35°26'30"N / 51°43'39"E and 35°51'52"N / 50°58'36"E. Landsat TM (1984, 1994) and ETM+ (2004, 2014) satellite multi-spectral data were acquired and used to generate LCLU maps of study area for four separate dates. LCLU classes were typically mapped from digital remotely sensed data through the process of a supervised digital image classification. The Maximum Likelihood classifier (MLC) quantitatively evaluates both the variance and covariance of the category spectral response patterns when classifying an unknown pixel. In this study, four LCLU classes ('Built-up area', 'Water Bodies',

'Greenland, and 'Barrenland) were established. PCC is one of the most popular methods for change detection assessment. Post-classification comparison proved to be an effective technique, because data from two dates are separately classified, thereby minimizing the problem of normalizing for atmospheric and sensor differences between two dates. Cross-tabulation analysis was carried out to analyze the spatial distribution of different LCLU classes and changes.

3. Results and Conclusion

Table below shows a summary of the major LCLU conversions which occurred during the 1984-2014 period. According to this table, the majority of built-up area was acquired by converting areas that were previously 'Barrenlands', 'and 'Greenland' (about 48531.15ha and 31812.3ha respectively).

Table1 LCLU conversions from 1984 to 2014

"From Class"	"To class"	1984-2014 Area (Hectare)
Built-up Area	Waterbody	50.22
	Greenland	7781.22
	Barrenland	7380.54
Barrenland	Built-up area	48531.15
	Greenland	21014.46
	Waterbody	118.53
Greenland	Built-up Area	31812.3
	Barrenland	13499.64
	Waterbody	89.37
Waterbody	Built-up area	58.23
	Barrenland	92.07
	Greenland	54.9

This study evaluating LCLU changes of Tehran by these steps .: (1) LCLU mapping through multispectral imagery supervised classification for 1984, 1994, 2004 and 2014; (2) change detection of LCLU from 1984 to 2014; The first procedure allowed mapping LCLU in the study area for 1984, 1994, 2004 and 2014. It has also enabled us to quantitatively assess the LCLU spatial distribution in each one of these years. Second procedure has allowed identifying and assessing LCLU changes during this 30 years period. This way, the magnitude, location and nature of the changes is able to be studied and assessed.

Space for notes

Assessment of sensing performance of wireless illuminance sensors in built environment



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Summary

To attain intelligent control, the control algorithm needs to be fed with real time environmental data. Real time data, which comes from various sensors that act like “eyes and ears” of the system, directly impact the performance of the control system. This real time data, if not accurate enough, will cause a “garbage-in, garbage-out effect” that can negatively impact any control system. In this paper, a series of different combinations of natural (emulated) and artificial lighting conditions in the tropics are set up and measured. Data from the proposed high performance sensing platform is compared with GOSSEN professional handheld lux meter to show good agreement. In addition, 3D illuminance profiling of a space is displayed to show how reliable illuminance representation can allow occupants to efficiently appreciate and control the lighting conditions of their space.

Keywords: Wireless sensor network, illuminance sensor.

1. Introduction

Intelligent lighting control algorithm needs to be fed with highly accurate information from the sensors in order to realise its full potential. In the context of a building, multiple sensors are needed to provide this feedback. In many situations, to reduce cost, low cost sensors that have high errors are used. In this paper, simulations are done to show that sensors with high errors detrimental to the control algorithm, and also increase discomfort to the occupants. A method of integrating high performance illuminance sensors with wireless sensor nodes to work under difference lighting conditions is presented. Test results with a network of these wireless sensors are compared with professional GOSSEN handheld lux meter to show good agreement.

2. Methodology

Simulations of different off-the-shelf low cost illuminance sensors are compared with high accuracy sensor. It is shown using the same algorithm, it takes a longer time for the luminaires to reach the recommended illuminance level on the work plane when fed with sensor data with high errors. At the same time, when fed with low accuracy information, the luminaires step through more iterations, which results in more flickers that can cause visual discomfort to the occupants.

A method of integrating high accuracy illuminance sensor with high resolution Analog to Digital Converter (ADC) and wireless sensor node is presented. Nine of such sensors are deployed in a test bed to provide high accuracy and resolution illuminance information fed wirelessly to a central server. Different lighting conditions are emulated using a 10 m by 3 m daylight emulator to test the performance of the sensor network. A measurement using a professional handheld lux meter from GOSSEN is done to compare the data.

3. Results and Conclusion

Under different lighting conditions emulated by the daylight emulator, a 3D plot is generated using spline interpolation. Measurements done using the GOSSEN handheld lux meter are recorded to compare with the wirelessly gathered data. The comparisons of both results show good agreement with less than 3% errors.

In conclusion, the proposed method of wireless sensor node with high resolution ADC integration with high accuracy illuminance sensor is verified. This method of integration allows easy deployment of high accuracy illuminance sensors in a space. Although having wireless capabilities and running on batteries, the accuracy of the data is within an acceptable range for the intelligent lighting control system.

Space for notes

Assessment of Walking Experience in Kitakyushu, Japan



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Summary

Various attributes addressing the issues on walking environment and walking condition possibly has distracted the efforts of creating better planning and development to promote walking to the citizen. It will take an enormous effort and time for them to consider all the attributes that are available. Therefore authors assess the possibilities of the utilization of the Pedestrian PL.AC.E. (Profile, Activity, and Environment) and its key-attributes using a survey questionnaire in order to confirm that it can serve as a framework for urban planning or assessment in promoting a walking-friendly environment. The questionnaire was distributed to the case study area which is the city of Kitakyushu, Japan. After collecting and documenting all responses, the results were analyzed using descriptive type of statistical analysis with SPSS software.

Keywords: walking, pedestrian profile, walking environment, assessment, walkable city

1. Introduction

If walking condition and environment could be improved, traffic congestion could be avoided, nature could be conserved, and public health and living quality could also be improved (Blanco et al., 2009). Walking environment is a very important subject because of the fact that pedestrian moves slower than motorized vehicle thus it interacts more with the surrounding environment (Sauter et al., 2010). Furthermore authors acknowledge that the developments toward the promotion of walking in urban area that focused only on improving the walking environment often fail to encourage people to walk. Thus one needs also to elaborate and address the factors of walking condition. Many studies from various disciplines were already conducted to define the attributes of walking condition that could be improved. So then the main question for this research is how to create a cross-field framework consisting common key-attributes of walking to serve as a measure for urban planning or assessment. Authors acknowledge that the attributes were the outcomes of multi-disciplinary researches, thus authors focus on subjects that are related to urban planning.

2. Methodology

For this study authors distributed the questionnaire by collaborating with the first year students of the Department of Architecture, the University of Kitakyushu, Japan. The questions were based on the key-elements of Pedestrian PL.A.C.E. (**ProfiLe**, **ACTivity**, **Environment**). Authors collected responses about **the Pedestrian Profile** with key-attributes of: age; financial income; physical condition; gender; mobility choice; employment and education back-ground; social cultural capital; pedestrian type; and public transportation usage, **the Pedestrian Activity** with key-attributes of: walking-related purposes; social interaction; walking intensity; walking habits; and transport modes interaction, and **the Pedestrian Environment** with key-attributes as follow: spatial planning; walk-ability; neighborhood livability; traffic safety; pedestrian facilities (hard elements); pedestrian facilities (soft elements); and environmental quality. Then the results were analyzed using descriptive types of statistical analysis with SPSS software.

3. Results and Conclusion

By descriptive analysis, authors managed to conclude the profile of the pedestrian of which represented partly of the people who experience walking in Yahatanishi area. As for the pedestrian activity, author concluded that walking activity was conducted by the respondents in accordance with their daily activities in a form of short distance journeys. The walking activity was still influenced by concerns regarding safety from traffic (cyclist) and crime especially during night time. Authors noticed also that the use of smartphone could be utilized to improve walking experience in the future. In regard to the Pedestrian Environment, there were positive evaluations of the physical condition of the pedestrian facilities. However in relation to the quality, the positive responses were decreased. These results confirmed that assessment method using questionnaire and statistical analysis could utilize key-elements and key-attributes to plan or evaluate, and regenerate a sustainable and local-based model of walking environment.

Space for notes

benefit E, Strategies for building integrated solaractive systems



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Summary

Funded by the ZukunftBau research initiative the research project examines existing barriers to building integrated applications of solar-active systems. In addition to identified barriers, strategies to expand the margin of composed usage of solar active systems in the building shell are pointed out. The research project benefit E shows the possibilities of using solar active systems as architectural element in the building envelope in context of existing legal, technical and economic conditions. The practically orientated final report provides suggestions for planners, builders and companies equally to minimize costs, early detecting possible risks in implementing active systems in the building shell and further technologies developments.

Keywords: building integration, solaractive systems, building-related energy production, designing building shell

1. Introduction

In the past 15 years, the solar energy production on buildings has made an enormous development. Electrical and thermal systems have, since the year 2000, systematically expanded. In the year 2013, a total of 3.8 million solar systems (solar thermal and photovoltaic systems) have been built in Germany. This has however been increasingly seen as critical. The main criticisms are the inadequate optical integration of active solar systems into the building envelope, the high energy and technical requirements of the construction of solar systems and the associated high costs. Solar active use should therefore be integrated into the architecture and not only be a technical additive element. There have already been very successful examples of this that are however not in the everyday building processes. It is a major challenge to develop the active use of solar energy as an integral part of the architecture. To this end, it is essential to integrate active systems into the building envelope.

2. Methodology

As described, the building-integrated solar application of active systems has so far not yet become a natural part of architecture. Systems are primarily added to a building and is not designed as an integrated component (roof, facade, parapet, etc.). This has lead to many reservations and further obstacles - resentments towards areas in artistic expression or design, technical integration or simply the necessary additional costs. The mentioned active systems are generally not rejected. Reasons for this are manifold and are from person to person quite different.

The presented work is devoted to the identification of barriers to the dissemination and integration of solar active systems. The aim is to create a comprehensive barrier catalog which categorizes, priorities and evaluates the found barriers and will then be used to find a strategy to overcome them.

3. Results and Conclusion

What is meant by integration in the context of building-related applications? The importance of integration in dealing with buildings is difficult to fully delineate. The type of solutions range from design principles to technical integration and provides many creative implementation possibilities.

The integration of solar active materials in the building envelope will confront planners, producers and executers with various kinds of barriers through out the building process.

The research project „benefit E, building integrated solar-active systems“ dealt with this topic and tried to find out which kind of barriers exist in specific. In an grafical and textual way the barriers had been described for the different fields of „design“, „planning“, „construction and techniques“, „society and law“ and „economy“.

Space for notes

Biocomposites for architectural applications based on the second generation of natural annual renewable resources



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Summary

Within this paper, the main concept and the development state of the research-industrial project, named “PLUS” are shortly discussed. The research is applied to find further sustainable solutions for contemporary buildings, through the development of new green building materials that are based on natural annual resources, replacing fossil-based conventional ones. The green materials are developed to be applied through innovative architectural designs in interior spaces, offering optimum thermal and acoustic insulation properties in the form of sandwich panels. These newly developed materials are dependent on the second generation of renewable bio-resources, represented in recycled agro-fibres derived from agricultural resources that do not interfere with food-supply chain. The developed materials should have a planned closed cycle loop, to maximize their sustainable benefits.

Keywords: Green building materials, Biocomposites, Life-Cycle, renewable resources, agro-fibres

1. Introduction

Biocomposites, is a term to describe a composition of a fibre and a matrix, in which at least one component is a bio-based one. In this research *agro-fibres* are applied with bio-plastics to reach pure *green biocomposites*.

Agro-fibres is a term to describe agricultural plant residue fibres, which is considered a second generation of renewable resources, after food-supply resources. Cereal straw is the highest available agro-fibre worldwide. Germany ranks the seventh among the world top ten wheat producers, representing almost 3.7% of the annual wheat production worldwide. In parallel, the annual Construction and Demolition wastes (C&D) amounts arises dramatically in Germany reaching up to 260,7 million tons in 2012, according to the German Federal Statistical Office in 2012, providing about 64% of the total annual waste amounts annually generated. That reflects the importance of considering the end-of-life options of the applied building materials in our built environment. This strategy is applied through these types of biocomposites handled, as it is generated from upcycled agro-fibres and should at the end be completely recycled and/or composted. In this case, waste

generation is prohibited, once within production and forever after applying the materials in building industry.

2. Methodology

This second generation resource, agro-fibres, can be practically a main source for huge chemical industries, regarding bio-polymers synthesis and development, in addition to the extraction of fibrils and fibres from these resources for reinforcement applications. When these available agro-resources are applied in the form of recyclable and compostable building materials in combination with those extracted bio-polymers from the same source, high sustainable levels within the built environment can be reached. This is in addition to the improvement of agricultural resources management system, directing agro-fibres towards more industrial applications.

Accordingly, it was planned to apply research work based on these concepts, to supply a new chain of bio-based materials for building and architectural applications, with high technical performance in addition to the high environmental foot-print. This is possible through plastic processing technologies' applications to compound bio-plastics with agro-fibres. In this reaserch project, aesthetic concepts are also considered. Accordingly, different product designs for the newly developed materials are offered to suit different attractive architectural applications.

3. Results and Conclusion

Within this research project, sandwich elements of agricultural fibres and bioplastics are being developed. One of the materials is in the form of bio-based foam, in which agro-fibres are combined with bioplastics and foamed with an environmentally friendly foaming agent. Different economic and ecologic concepts are reached through these applications. The first developments were in the form of extruded roller shutters and extruded plates. One of the suggested products offer an environmentally friendly alternative to the classic MDF plates that are widely available in the interior architectural markets for partitions and furniture applications, accompanied by the known VOC emission problems, including formaldehyde and isocyanate ones in specific, which are carcinogenic as settled by the European Union. The other development should replace the classic fossil-oil based extruded polystyrene and polyurethane foams that are classically applied for thermal insulations, that have high drawbacks regarding the high carbon dioxide footprint and the dependence on expensive non-renewable fossil-based resources, in addition to the limited end-of-life options, especially regarding polyurethane foams.

Space for notes

Building for the Gap. Innovative engineering for housing applications in Africa.



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Summary

The enormous pressure of urbanisation calls for delicate solutions; a culturally manifested family and social cohesion inside existing neighbourhoods is being torn apart by the destruction of established city fabric (slums) and the insertion of new, yet impersonal mass housing projects without any reflection to the way of living and social interaction. Different prototypical buildings with different underlying impact were planned, built and tested as a potential model for housing in Africa. The first project focused on a natural resource from the agricultural industry utilized as build material for the complete house. The second prototype (re)introduce the potential of robust and tolerant prefabricated systems. The third prototype comes along with a parameterized numeric modelling and production technology to fabricate building parts, which allow self-made constructions in a high quality. All solutions are based on culturally and socially motivated design investigation and can respond to highly flexible occupation scenarios. The proposed building systems and adequate designs promotes economic, cultural and social sustainability by respecting existing ways of living while introducing improved contemporary housing standards.

Keywords: prototype, architecture, prefabrication, material, building modelling, Africa, participation

1. Innovative engineering

Between 2012 and 2015, we planned, built and tested different prototypical buildings as a potential model for housing in Africa. The three housing solutions are the product of a culturally and socially motivated design investigation and can respond to highly flexible occupation scenarios. (Fig. 1) There was always a very specific interest and focus on each of those projects. SECU, the first project, invent a natural material from the agricultural business as a building material and is built out of it completely. SICU, the second prototype (re)introduce the potential of robust and tolerant prefabricated systems. MACU, the third prototype comes along with a parameterized modelling and numeric controlled production technology to fabricate building parts, which allow self-made constructions in a high quality. The proposed systems of building and these simple designs

promotes economic, cultural and social sustainability by respecting existing ways of living while introducing improved contemporary housing standards.



Fig. 1 Introduction of different engineering innovations – three prototypes built in Africa

2. Results and Conclusion

Based on our experiences, we can proceed to more complex and cost-effective even multi-story housing that can adapt to individual needs and conditions. We recognized that it is less the technology itself, it is more the involvement of the people and the shared effort to provide identification, motivation for the inhabitants. The project is more successful if you just provide a “framework” as a starting point for the target group from the beginning. It is more flexible and open if the design is not ready to give space for further extensions and additions. After almost two years further dissemination are currently ongoing and accompanied with the introduction of combinations and improvements. All those new implementations, which are based on those initial ideas, will give a wider proof and evidence of the initial concepts. Private companies as well as governmental institutions are looking for a wider involvement, which could not be realized by this time and budget limited project.

Space for notes

Building life cycle assessment: investigation of influential parameters in a helpful decision tool



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Summary

A building life cycle assessment tool was developed and linked with an energy simulation tool, allowing to take into account the strong interactions between the energy and the environmental performance of buildings. This life cycle assessment tool was then extended at the urban level to evaluate the environmental impacts of a district including many buildings, streets, public spaces and technical network. Building and neighbourhood design alternatives can thus be compared, providing assistance in the decision process. However, the reliability of LCA tool is essential to guide the decision maker towards sustainability. A methodology is presented here to investigate the most uncertain inputs. Parameters affecting the building energy performance and the choice of the electricity mix were identified as the most influential factors which could alter the results' robustness.

Keywords: Life Cycle Assessment of buildings, Life cycle assessment of districts, Energy simulation, Robustness, Sensitivity study

1. Introduction

Because of its high environmental impact (energy and water consumption, waste production, greenhouse gases emissions...), the built environment has been identified as a key sector to face today's energy and environmental challenges. Life cycle assessment (LCA) is particularly adapted to study these impacts in order to make the building sector more sustainable. However, to orient the decision toward sustainability, robust building and district LCA tool are necessary.

2. Methodology

To take the building sector specificities into account, like the large influence of energy on the environmental performances, a dedicated building LCA tool novaEQUER was linked to a thermal dynamical simulation tool, COMFIE. It was then extended to the district level by including public space and network in the studied system. These tools enable eco-design at the neighbourhood scale by providing a design aid.

If buildings and districts LCA tools are used in the environmental decision-making process, they have to give reliable results. But during an LCA study, practitioners are facing many choices and the uncertainty on input parameters can affect the results robustness. Uncertainty and sensitivity analysis methods aim at investigating and better understand the effect of uncertainty and drivers potentially changing the results can be indentify. The influence of uncertain input parameters on the output uncertainty was identified using the Morris screening method.

3. Results and Conclusion

The Morris method was applied in the case of a single family house in order to investigate the influence of 22 uncertain parameters concerning mostly the building thermal envelope, lifetime and context. It turns out that parameters having a large influence on the energy performance also influence the environmental performance strongly for most of the environmental indicators calculated in novaEQUER. The choice of the electricity mix also has a large influence.

In this first study, a limited set of uncertain parameters was considered. Furthermore, some types of uncertainty met in the building sector were poorly or even not taken into account: among them, the influence of the building lifetime, methodological choices or uncertainties occurring during the life cycle inventory or the life cycle impact assessment. This work will therefore be extended to a larger set of parameters in order to identify drivers among uncertain inputs at the building and district scale. Then uncertainty analyses will be carried out on comparative LCA to investigate the results' robustness, i.e. the ranking of different alternatives of a project accounting for uncertainties.

Space for notes

Buildings as active components in smart grids



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Summary

In the EUREF research campus "Mobility2Grid", research is carried out on the implementation of a sustainable energy and mobility development in urban areas through the utilization of renewable energy sources.

During the first phase of the project Mobility2Grid different scenarios for the EUREF district with electricity generation from renewable energy sources and optimisation approaches for stationary batteries and electric vehicles were evaluated by using a simulation framework with regard to the degree of self supply and CO₂ emissions. Selected results are presented.

In this context, buildings will be classified as components of an overall energetic system, and can actively contribute to control the energy consumption in dependance of energy production and thus smooth load fluctuations. The integration of a thermal model into the energy optimisation and simulation environment associates especially storage, energy conversion, the heating network and the heat load displacement potential.

Building Information Modeling (BIM) supports different analyses to improve the overall energetic system. It links the building characteristics with the data of utilization and provides information for building energy simulations. The aim is to determine the building loads and the storage capacity of one or more buildings, depending on building condition, operation and also considering alternatives.

Keywords: smart grid, thermal storage, BIM, electro-mobility

1. Results of the first project phase

In the EUREF research campus "Mobility2Grid", located in the center of Berlin, research is carried out on the implementation of a sustainable energy and mobility development in urban areas through the utilization of renewable energy sources. The coordinated interaction of electro-mobility, power and heat supply networks is tested directly and experimentally on the EUREF campus.

During the first phase of the project Mobility2Grid different scenarios for the EUREF district with electricity generation from renewable energy sources and optimisation approaches for stationary

batteries and electric vehicles were evaluated by using a simulation framework [1] with regard to the degree of self supply and CO2 emissions.

2. Buildings and BIM

In the future, buildings will be classified as components of an overall energetic system, and can actively contribute to control the energy consumption in dependence of energy production and thus smooth load fluctuations. CHP - and P2H technologies increase the flexibility. The integration of a thermal model into the energy optimisation and simulation environment associates especially storage, energy conversion, the heating network and the heat load displacement potential.

With the analysis of an optimized energy management, an economically feasible application of CHP - and P2H technologies will be examined. The integration of buildings and their load profiles into the overall energy system takes place within a building model (building information model, BIM), which maps all system interfaces.

In this project, in the context of EUREF Camus, BIM supports different analyses to improve the overall energetic system. It links the building characteristics with the data of utilization and provides information for building energy simulations. The aim is to determine the building loads and the storage capacity of one or more buildings, depending on building condition, operation and also considering alternatives. In terms of an overall improvement and based on a systematic implementation of the building structures in the load management of the campus, the results allow a positive effect on the control of the energy components, such as a combined heat and power unit (CHP). Regarding this the target is to operate the CHP in an efficient way, to bear in mind that there are not only technical requirements to fulfill but also economical requirements like fluctuation of price at the electricity stock exchange. In addition, also a significantly improved basis for the evaluation of energy indicators is caused during building operation phase. With regard to the respective use simultaneously increasing energy efficiency can be realized.

Space for notes

Buildings energy retrofit: dealing with uncertainty



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Summary

Over the span of the past decade, the interest in issues related to building energy efficiency has been ever growing. Consequently, an increasing amount of studies has focused on the economic viability of energy retrofit measures. Despite all these research efforts, the results are still uncertain and conflicting. Nonetheless, such studies have brought out the main variables affecting the economic feasibility of interventions improving building energy performance: savings-investment ratio, cost-effectiveness of energy supply, energy price trends.

The aim of this paper is to investigate the relevance of an often disregarded aspect: the rate of time preference as an expression of households' behaviours, that is to say, the discount rate adopted within several valuation approaches, which are based on discounted cash flow. A case study analysis is performed on a refurbishment project. It concerns a public housing estate, built during the seventies, located in the suburbs of Bologna. A number of retrofit alternatives are examined, by resorting to different judgement criteria, particularly the Net Present Value.

It is shown that uncertain results may occur repeatedly, more frequently than literature has evidenced. Moreover, unclear outcomes closely correlate to the discount rate level, which may lead to conflicting options; therefore, it is hard to unequivocally identify the alternative characterized by the highest NPV.

Keywords: Building energy efficiency; uncertainty; property investment valuation; Discounted Cash Flow; discount rate.

1. Introduction

Over the span of the past decade, the interest in issues related to building energy efficiency has been ever growing, and an increasing amount of studies has focused on the economic viability of energy retrofit measures. Despite the considerable efforts performed, the results are still uncertain and conflicting. Nonetheless, the main variables affecting the feasibility of interventions improving building energy performance are now known: savings-to-investment ratio, cost-effectiveness of energy supply, energy price trends.

The aim of this study is to investigate the relevance of an often disregarded aspect: the rate of time preference as an expression of households' behaviours, that is to say, the discount rate adopted within several valuation approaches, which are based on discounted cash flow.

2. Methodology

A case study analysis is performed. The reference building lies in the suburbs of Bologna, Northern Italy. It is a public housing estate - eight-storey, seven hundred meters long - which has been erected during the mid-seventies. To improve energy performance in comparison to the building as is, seven retrofit scenarios were defined, keeping the structure and arrangement of dwellings as constraints. The feasibility of the outlined scenarios is analysed by the Discounted Cash Flow approach.

3. Results and Conclusion

For each scenario, several NPVs have been calculated, by varying the discount rate within the range from zero to 15%. NPV curves of the seven scenarios show multiple intersections. A total of six reversal points are identified: the first two are recorded for a discount rate close to 1%, three other for a discount rate within the range from 2% to 5%, and the last one for a 10% discount rate. Accordingly, we observe that rankings highly vary across different discount rate levels, and a major change lies in the complete reversal of the two top alternatives. Moreover, the NPV curves are characterized by diverging slopes. The reason lies in the fact that the scenarios are at different scales, namely they imply hugely varying savings-to-investment ratios.

The analysis performed here suggests that methods such as Discounted Cash Flow and Life-Cycle Cost, which are usually resorted to in order to appraise the feasibility of energy-efficient solutions, should be employed carefully. Since the results are highly sensitive to the several essential variables, the feasibility and cost-effectiveness judgment may be biased by the assumptions and estimates upon a couple of key parameters.

Although, in valuation, the discount rate is considered a useful tool to manage uncertainty, we have shown that it may be a source of irresolute results. Aiming to perform a thorough and comprehensive study, the issue discussed so far leads to identify the sensitivity analysis as unavoidable. Further developments are identified in the opportunity to carry out extensive sensitivity analyses based on the Monte Carlo simulation method, so to treat simultaneously the variation ranges of energy price, energy inflation rate and discount rate.

Space for notes

BuildNow! – Research and Training



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Summary

At the Luebeck UAS, completely new forms of research in relation with teaching are being embarked on by the Department of Civil Engineering: Future teaching staff and students are to try out practical forms of studying so they are able to research innovative building technologies and procedures. The first project is a self-sufficient building which the students plan, design, calculate and build themselves. Renewable energies are used exclusively, therefore energy and water self-sufficiency have been amongst the most important criteria for designing.

Keywords: self-sufficient building, renewable energies, research in relation with teaching

1. Introduction

In construction areas, often there are two groups of people: Construction workers who have learnt their specific field. Construction managers, architects and structural engineers mostly have their theoretical ideas but often do not know how to practice them because they have learnt too little application. By reason of the missing communication and knowledge of both sides, new building ideas are blockaded.

The “BuildNow!”-Project wants to “return into the future” by referring on the culture of the stonemason’s workshop and the old master-builders. Precisely, students follow the principle of learning by doing.

2. Methodology

“BuildNow!” pursues a re-innovative or almost new educational approach both for teaching and research.

From the beginning, students learn that they have to plan, design and construct in a very responsible way by themselves, so they will have a greater motivation by knowing that their ideas will be built soon.

Academics are not only teachers but also adopt the role of lightly guiding mediators.

Furthermore teachers have got the possibility of communication towards the economy, so in conclusion “BuildNow!” can work in cooperation with economic enterprises.

“BuildNow!” does not end with the project because students and teachers can research and investigate the behaviour and life expectancy of the used techniques and materials. They will observe and advance.

3. Results and Conclusion

Students often like the easiest way. At the building industry, just the cheapest way counts.

At Luebeck UAS, students get to know the most sustainable way, so there awakes a new responsibility for sustainability for future’s engineers and architects, which generates a new consciousness in the general public.

With new methodologies we achieve a more appropriate and contemporary teaching and learning. A very desirable effect is that students will have more detailed background after graduating.

In the building sector, there are great gaps between different trades and subsections.

“BuildNow!” tries to reduce these gaps by involving everyone.

With tighter teamwork you can reach a better and faster success and – what is the most important fact – bring the researches of sustainable buildings to all participants of the building sector.

First results of the last years have shown that preparing students for their own healthy lasting future is more than successful: In cooperation with the teachers the students work out very interesting and vibrant new ideas for a sustainable world.

Nevertheless, there is a big step to do. After the first self-sufficient building will be finished, new projects have to be prepared and developed.

Recapitulatory, the “BuildNow!”-Team is willing to work and research and is full of expectation of next results.

Space for notes

Capturing sustainable housing characteristics through Electronic Building Files: The Australian Experience



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Summary

This paper presents an Australian Government pilot project in 2015 to develop and test a web-based Electronic Building Passport to capture energy efficiency and sustainability related information on residential buildings in the design to hand-over phases of their development and construction. The paper will discuss the key findings of this trial, in terms of (i) local government goals and responsibilities; (ii) available metadata compared with Code required data; (iii) technical benefits and limitations of the online data management system; (iv) data and information sharing, privacy and security; and (v) recommendations for future work.

Keywords: building passport, energy efficiency, information asymmetry, local government, mandatory disclosure

1. Introduction

In Europe, the introduction of building passports has been discussed for decades. The primary objective was and is to provide information to a potential purchaser, renter or user of the building. The type, scope and content of building passports or building files have evolved over time and continue to evolve. In response to a 2014 Australian study of residential buildings that alluded to key systemic, process and compliance weaknesses in the application of energy efficiency requirements of the National Construction Code, the state and territory governments funded a pilot project to develop and test a web-based Electronic Building Passport (EBP) to address information asymmetry, especially in relation to improving the process and quality control of documentation relating to the 'as designed' and 'as constructed' energy performance of buildings.

2. Methodology

The EBP trial design was approached from the knowledge that Local Government Authorities (LGAs) are the single largest repositories of individual building information due to their role in processing and approving building applications. The project sought to determine the extent to which an EBP could be founded on these large document stores and integrated into existing processes. Building documentation requirements were examined at a federal and state level, and

their application was evaluated at an LGA level. Eleven LGAs, from six Australian states, volunteered to participate in the tool development and testing activities which included telephone conversations, a one day workshop, phone based training and individual work on the EBP. An open-source data platform was chosen, with appropriate metadata fields being selected according to the energy efficiency requirements of the National Construction Code (NCC). The datasets created by the participating LGAs were then analysed and evaluated against the regulatory requirements, LGA documented practices and processes, and the stated preferences of participants.

3. Results and Conclusion

This analysis highlighted four main concerns: (i) a disconnect between the goals and responsibilities of local government and the NCC goals and expectations; (ii) lack of clarity as to what metadata and data sources are considered valuable; (iii) the technical benefits and limitations of an EBP; and (iv) issues of privacy and data security.

This discussion leads to the suggestion of areas for further research:

- Examination of the inverse of privacy i.e. the right to information / product disclosure
- The possibility of a hybrid mandatory / voluntary EBP
- Quantification of benefit:cost data from existing European EPC databases
- Clear identification of the tasks and functions of an EBP that can enable flexibility and continuing evolution

Overall this pilot suggests that the public good would be well served if the Australian, state and territory governments continued to develop and implement an EBP system in a cost-efficient and effective manner. This development should occur with detailed input from building regulators, the Australian Building Codes Board, LGAs and private certifiers in the first instance. A recommendation to this effect has been made to the relevant authorities.

Space for notes

Carbon storage and CO₂ substitution in new buildings



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Summary

Two aspects of wood and wood-based products in the construction sector should be taken into account in the life cycle assessment (LCA): The carbon storage during the lifecycle of the building and the substitution of non-renewable materials. 2012 the Federal Environment Agency of Germany (UBA) declared that more than 25 million tons of CO₂ are bound every year in the growing national forest stock. 2012 was decided in Durban to prolong the Kyoto-Protocol for the protection of the climate and were introduced rules for the methods and calculation of the national CO₂-Balance of the forests. Therefore, it will be important to calculate the exact carbon storage during the reference service life of the building. The research project „Active climate protection by resource efficiency of wooden buildings“ delivered data for different materialspecific solutions in the buildings sector. Different types of new built buildings and renovated buildings have been described, calculated and evaluated. The results of this research project are presented here.

Keywords: carbon storage, CO₂ substitution, wood, life cycle assessment

1. Introduction

2012 was decided in Durban to prolong the Kyoto-Protocol for the protection of the climate and introduced rules for the methods and calculation of the national CO₂-Balance of the forests. Also in this year the Federal Environment Agency of Germany (UBA) declared that more than 25 million tons of CO₂ are bound every year in the growing national forest stock. Therefore, it will be important to have exact figures about the content of wood and wood-based products in the existing building stock. Considering the changing methodologies in the construction sector, it will be important to calculate the influence of the future state-of-the-art on the national building stock. The Intergovernmental Panel on Climate Change (IPCC) has published a list with reference data of the carbon storage capacity in wood and wood based products. These data build the base for the carbon storage of the national building stock. The research project „Active climate protection by resource efficiency of wooden buildings“ delivered data for different materialspecific solutions in the buildings sector.

2. Methodology

Eight buildings, with many components containing renewable natural raw materials, have been chosen for the research project. A “standard version” building constructed using conventional construction products – largely created from non-renewable mineral, metallic or synthetic materi-

als – was also modelled for each building. The “standard version” building is identical to the real building in terms of space, floor area and shape, and therefore has the same energy requirements. The building’s energy demand is not taken into account, as the key energy demand performance indicators are constant for the assessed real building and the “standard version” building. The modelling of these “dizygotic twins” reveals the differences made by changing the construction type. The life cycle assessments shown here were compiled, using information taken from the Ökobau.dat 2011 database. The LEGEP tool was used to model and evaluate the objects.

3. Results and Conclusion

This study confined itself to buildings with a wooden main loadbearing construction. Only objects following this construction rule show significant differences to the “standard version”. For simplification of object comparison, one square metre of net floor area (NFA) per year is taken as the reference size. Life cycle assessment: The indicator “primary energy” is separated in non-renewable and renewable. All wooden buildings have lower non-renewable values than the “standard version” building by somewhere between 19 - 67 %. All buildings with a high renewable construction materials quotient also have a 5 to 8 times higher renewable primary energy quotient than that of conventionally constructed materials. The buildings with a high renewable construction materials quotient show reduction potentials of 31 -74 % compared with the “standard version” buildings. Carbon (C)-storage and substitution: The capacity of C-storage during the use phase of the building is important, because the carbon stays for a period of 50 or 100 years in the building. This will unburden the climate of CO₂-emissions. The carbon storage for the “standard version” reaches only 1 to 6 kilogramm per m² GFA. The buildings with a high quotient of renewable materials reach 45 to 87 kilogramm C per m² GFA. Additional to the C-storage capacity the use of renewable raw materials other materials from non renewable resources can be substituted. The comparison of the buildings shows an effect of the substitution between 0.9 to 1.9 tons per m³ of renewable materials built-in the buildings. Comparing conventional constructed buildings that contain numerous construction products derived from finite resources with buildings with a high proportion of building products derived from renewable raw materials, the results show a significant ecosystem load reduction potentials offered by the latter construction method.

Space for notes

Certification of Sustainability: Results from Practice



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Summary

In the last years the Assessment System for Sustainable Building (BNB) was established as one of the most important instruments for the implementation of higher quality requirements for federal buildings in Germany. Now the first results of complete certification processes according to BNB are available. As one of the first federal buildings the new Ministry of Education and Research in Berlin and the new Federal Environment Agency in Berlin were certified with the BNB Gold Certificate. These outstanding pilot projects are now the best federal buildings according to proven sustainability requirements and the experiences can be used for new recommendations or future requirements.

Keywords: assessment system for sustainable building (BNB); results of certification; best practice; new sustainability requirements of German government; federal project with highest sustainability standard

1. Introduction

Building in Germany is being geared towards sustainability. The federal government is the largest public client and owner in Germany and therefore has an exemplary role according to sustainable building. New sustainability requirements for federal buildings were defined by the Federal Building Ministry. As a result the BNB was established as one of the most important instruments for the implementation of higher quality requirements for federal buildings. Since 2015 the first results of complete certification processes according to BNB are available. As one of the first federal buildings the new Ministry of Education and Research in Berlin and the new Federal Environment Agency in Berlin were certified with the BNB Gold Certificate.

2. Implementing Sustainability Requirements for Federal Buildings

New sustainability requirements for federal buildings were defined by the Federal Building Ministry in the last years. For example, the higher quality standard "Silver acc. to the Assessment System for Sustainable Building (BNB)" was mandatory established for all new office buildings, new educational buildings and new laboratory buildings.

The planning-based Assessment System for Sustainable Building (BNB) is distinguished for its comprehensive consideration of the entire life cycle of buildings. The assessment of building qualities is accomplished in accordance with transparent rules and objective, essentially quantitative methods. No individual measures are evaluated in the results-oriented system, but rather their documentable effect on the overall concept of the building. Its application takes place throughout the planning stages, which means that it contributes not only to the optimization of the building but also and at the same time to quality assurance.

The BNB and additional planning tools are published via the Sustainable Building Information Portal of the Federal Building Ministry (www.nachhaltigesbauen.de). Some selected contents are available in English.

3. Certification of the Federal Ministry of Education and Research in Berlin

The new Federal Ministry of Education and Research (BMBF) in Berlin is the first civil federal building project that was realised by Public Private Partnership (PPP) and also the first building of that kind and size that received a certificate of BNB in gold. The project distinguishes itself by very high qualities and degrees of fulfilment in all main criteria groups of the assessment system BNB (81% - 99%).

This outstanding pilot project is now the best federal building according to proven sustainability requirements. Special and innovative features of the building include for example a reduced energy demand (optimized heat insulation, PV modules integrated in the façade, gas-powered fuel cell), optimized selection of materials, optimized flexibility and optimized accessibility. Beside these building aspects there were also implemented exemplary quality assurance systems during the whole planning and construction phase.

Beside the BMBF numerous other current federal building projects consider the requirements of the BNB. All these projects are a part of the sustainable strategy of the federal government and they demonstrate that higher standards according to the holistic approach of sustainability can be achieved in day-to-day-business. The experiences can be used for new recommendations or future requirements for sustainability projects in the public sector.

Space for notes

Characterization of Fly Ash/Metakaolin-based Geopolymer Lightweight Concrete Reinforced Wood Particles



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Summary

This paper reported on the properties of fly ash/metakaolin-based geopolymer lightweight foamed concrete with inclusion of wood particles. Class F fly ash and metakaolin was mixed with an alkaline activator solution (a mixture of sodium silicate; Na_2SiO_3 and sodium hydroxide; NaOH), and hydrogen peroxide; H_2O_2 was added to the geopolymeric mixture to produce lightweight foamed concrete. The NaOH solution was prepared by dilute NaOH pellets with distilled water. The ratio of fly ash/metakaolin and alkaline activator used was 2.5:1.0 with addition of 0%, 10%, 20% and 30% of wood particles by volume of the total mix. The reactive were mixed to produce a homogenous mixture sized 50mm and cured at two different curing temperatures (80°C for 24 hours and room temperature for seven days). In reference to the analysis and discussion, the integration of fly ash/metakaolin and wood particles enhanced the properties of the lightweight foamed concrete. The oven-dry density of samples cured at 80°C was greater than room temperature curing. The water absorption and porosity were reduced in parallel of increasing percentage of wood particles for both curing conditions samples. The results also indicate that there is a potential to use the geopolymer as a binder for novel lightweight wood concrete for non-loadbearing applications.

Keywords: geopolymer; lightweight, wood particles, metakaolin; fly ash

1. Introduction

Lightweight foamed concrete (LFC) becomes an innovative product for the construction industry nowadays. It has a number of attractive advantages such as good thermal and acoustic insulation, better fire protection and easy to fabricated. Although its mechanical properties are low compare to normal concrete, LFC may be used as partition or light load bearing walls in low-rise residential construction and as filler in civil engineering works. Recently, the potential for replacing Ordinary Portland Cement (OPC) and rapid-hardening Portland cement which were used in common foamed concrete has been explored extensively by researchers as its production creates environmental pollution due to release of CO_2 . 'Geopolymer', a term to describe inorganic polymers based aluminosilicate which rich in silicon (Si) and aluminum (Al), produced by reacting with

highly alkaline solutions was discovered to replace cement based binder. In this research, the main goal is to develop lightweight foamed inorganic construction material from fly ash, metakaolin and wood particles aggregates. Potential applications might include lightweight wood composite for non-load bearing walls. The evaluation criteria include compressive strength, oven-dry density water absorption and porosity. Preliminary findings are reported in this paper.

2. Methodology

In this study, four standard mix compositions; A, B, C and D were prepared. The ratio of $\text{Na}_2\text{SiO}_3/\text{NaOH}$ used in this research was fixed to 2.5. The solution is prepared by first dissolving NaOH in water and mixing with Na_2SiO_3 . The mix proportions of fly ash and metakaolin, as well as the alkaline solution and the constant percentages of H_2O_2 were mixed for 10-15 minutes until homogeneity was achieved. 0%, 10%, 20% and 30% of wood particles by volume of total mix was added. The resulting sludge was poured into the $50 \times 50 \times 50\text{mm}^3$ molds. The samples were cured at two different conditions: (a) at 80°C for 24 hours; (b) at room temperature ($\sim 22^\circ\text{C}$) for 7 days.

3. Results and Conclusion

The compressive strength, water absorption, porosity and oven-dry density of all the samples cured under two different conditions are listed in table below.

Conditions	Compressive Strength (MPa)		Oven dry Density (Kg/m^3)		Water Absorption (%)		Porosity (%)	
	80°C	RT	80°C	RT	80°C	RT	80°C	RT
A	5.71	5.20	524	456	17.5	11.11	73.68	71.43
B	10.2	6.35	887	750	8.57	11.38	52.17	45.16
C	7.62	5.85	725	665	6.67	7.14	22.22	26.67
D	6.30	5.58	535	514	6.61	5.17	23.53	20.69

Based on the obtain data in this study, incorporation of the wood particles and mixes of fly ash with metakaolin had comparable effects in the compressive strength, oven-dry density, water absorption and porosity. Lightweight concrete mixes with 10% wood particles with 70% fly ash and 30% metakaolin obtained higher compressive strength and acceptable value of water absorption rate, oven-dry density and porosity. These materials have relatively low density compared with normal concrete. Thus, it was suitable for either an insulating material, or a non-load bearing building material. However, extra research needs to be done in terms of enhancing the bonding between wood and geopolymer.

Space for notes

Climatic Zones in Poland and the Demand for Heating in a Typical Residential Building



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Summary

The paper deals with energy demand in a typical building, located in different climatic zones. Calculations were made using the BSim computer program, enabling the dynamic simulation of energy demand with the time step of one hour or less. Typical meteorological years were used as the source of climatic data needed in calculations. The thermal characteristics of the apartment's envelope fulfilled the requirements which have been binding in Poland for newly designed buildings since 2014. Two versions of building partitions were adopted: massive and lightweight, and the flat was rotated 45° to the cardinal points of the compass, in order to check how the results depend on various input parameters. The calculations showed diversification in energy demand resulting from external conditions, and revealed the factors which are most important for the energy characteristics of the building.

Keywords: Energy demand in buildings, Typical Meteorological Years, computer simulations.

Introduction

Energy performance of a building is influenced to a great extent by weather conditions connected with its location. In the territory of Poland there are distinguished five climatic zones, represented by differentiated design temperatures of external air, taken for the sake of the power adjustment of heating systems.

The aim of the paper was the analysis of energy demand in a typical apartment in a multi-family building, with regard to the factors influencing heat losses and gains in localities belonging to different climatic zones (namely Koszalin, Poznań, Lublin, Białystok and Zakopane). Typical meteorological years were used as the source of climatic data needed in calculations, providing information about external temperature, humidity, wind velocity and direction, and solar radiation.

Methodology

Calculations of heating demand were made using the BSim dynamic simulation program, based on the control volume method. The analysed apartment had a floor area of approximately 74 m² and

a net height amounting to 2.7 m. The flat was located in the middle section of the building's storey, and it had two opposite external walls with 1.5 m x 1.5 m windows. The heat transfer coefficients of the external partitions fulfilled the requirements obligatory in Poland since 2014. Two versions of building partitions were adopted: massive (masonry walls insulated with the ETICS system and reinforced concrete ceilings) and lightweight (wooden framework with mineral wool as thermal insulation). The flat was rotated 45° to the cardinal points of the compass, to take into account various solar irradiation.

Results and Conclusion

Among the analysed localities, the smallest heating demand was observed in Koszalin (belonging to the 1st zone, with relatively mild climate), and the biggest in Białystok (belonging to the 4th zone, with rather severe weather conditions). The increase of heating demand was strongly connected with the decrease of external air temperature during the heating season. The relationship between energy demand and solar irradiation was slightly weaker, which was reflected by correlation coefficients for the analysed datasets.

The choice of the climatic zone in which the building is to be constructed usually is dictated by the investor and does not depend on the designer's decision. Other parameters, such as the orientation of windows and thermal insulating or accumulative properties of the building's partitions, can be chosen consciously in order to diminish future energy use. In the presented case, the most favourable conditions were provided by windows facing south, giving the biggest solar gains during the heating period. Deviation from the south direction not exceeding 45° to the east did not produce the adverse effect on the energy balance, and in the localities with considerable amount of solar radiation intensity could even be more profitable. Orientation of the windows turned out to influence heating demand to a greater extent than the thermal capacity. Nevertheless, the implementation of the massive construction in order to exploit the additional heat gains in a better way, was still important for the reduction of energy use.

Space for notes

Commercial areas achieving the zero emission goal using the potentials of electric mobility: The eCar-Park Sindelfingen



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Summary

The eCar-Park Sindelfingen aims at delivering carbon neutral heat, electricity and mobility to its settling companies. To reach this aim, symbiotic relationships between electric mobility and renewable energies are identified and established: Electricity oversupplies will be buffered in battery electric vehicles (BEV) and fed back in times of undersupplies. If managed appropriately, the concept requires less installed capacities of renewable energies, which leads to decreased investment costs.

Keywords: eco-industrial area, electric mobility, energy management, fleet management, mobility demands

1. Introduction

Companies of most branches have increased their efforts to achieve ecological compliant goods and services. However, often transport and electricity requirements lead to fixed emissions beyond a company's area of direct influence. While several zero or low emission commercial areas have been developed so far, the concepts often suffer from high investment costs, low transferability and a still fossil-based mobility.

Transport demands usually entail fixed environmental impacts in companies and commercial areas, which are hardly manageable. So far, it lacks a concept that makes integrated, sustainable mobility economic feasible and transferable – independent from a park's location.

2. Methodology

A central aspect in implementing the concept is the required amount of BEV in dependence on the mix of branches. The park operator itself provides a significant BEV-pool to the companies. Furthermore, both companies and employees will hold own BEV and make them available to the energy

management of the park. Bi-directional micro cycles increase lithium batteries' life spans and a business case will be established: Since the park's electricity management system gets access to gratis storages, buffering can be priced. Technical, economic, and regulatory obstacles are objects of research.

Aiming at a high transferability, we develop the concept of eCar-Park for a wide variety of branches. To reach this aim, an energy simulation tool is programmed that includes heat and electricity flows as well as transport demands in dependence of a company's branch and size.

3. Results and Conclusion

In 2014, first renewable energy facilities (photovoltaics and small wind power) and the central charging station were installed. In the same year the park owned BEV fleet grew to four vehicles. Currently, the project consortium uses these BEV so that we can analyse their real life power performances (efficiencies, charging capacities, ranges during summer and winter).

The organizational framework had been created by establishing the Concept Centre Blue Business (COBIS), an institution managing relevant eCar-Park issues. At present, the main task is marketing the commercial and industrial areas.

With the development plan currently being finished, the construction phase starts in 2016 with the infrastructural development. Companies will start settling on-site in summer 2016. The park construction phase shall be finished in 2017.

Meanwhile, the fleet sizes and mobility demands of companies are analysed as described before and fed into the energy management tool. Accompanying research aims at further increasing transferability aspects of the project: By utilizing quantitative and qualitative methods of social sciences, the acceptance of the concept is evaluated and monitored as the park is being settled.

Technical, economical and legal barriers still impede the development of eco industrial parks as well as the vehicle2grid-approach. The concept of eCar-Park Sindelfingen will generate knowledge for crucial aspects to overcome those barriers.

Space for notes

Conceptual Design and Development of a Study Program in the Field of Climate Protection Management



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Summary

One of the key factors for sustainable built environments is not only a successful municipal or corporate climate protection strategy but also a well-trained team of professional climate protection managers (CPM) that operates as networkers and coordinators. Due to the enormous complexity of the field of work of climate protection managers, it is highly advisable to provide an educational branch, which is specialized on the different technical, social and methodical requirements in the field of climate protection management.

To meet the increasing demand of professional climate protection managers in town councils and companies the Institute NOWUM-Energy and the Solar-Institut Jülich of the FH Aachen University of Applied Sciences, Germany, developed the project "CPM@FH-Aachen".

Keywords: Climate Protection Management, education, teaching methods, university, sustainability

1. Introduction

The tasks of climate protection managers are versatile. They have to be all-rounders and well trained in many different fields of expertise. In addition to a fundamental knowledge of technical issues in the field of climate and environment protection, distinctive communicative and social skills are indispensable. Yet, an educational program for universities and colleges which is especially designed to train prospective climate protection managers is not available. Thus the Institut NOWUM-Energy and the Solar-Institut Jülich of the FH Aachen University Applied Sciences, Germany, are cooperating to develop Germany's first degree program in the field of climate protection management. During this program a two-semester specialization course for already existing bachelor programs as well as master program will be developed.

2. Methodology

As a first part of the project, the general tasks and necessary skills of German climate protection managers have been analysed in nationwide survey among more than 1,000 cities and municipalities. To generate as many access points for future climate protection managers as possible, these results have been used to develop curricula, teaching methods and materials for a two-semester specialization course in the field of climate protection management, which can be modularly implemented into miscellaneous bachelor programs of other universities. Furthermore, an autonomous master program has been developed, which has been inter-coordinated with the bachelor specialization course, regarding the contents and which can be offered either as an in-service part-time program or in full-time.

3. Results and Conclusion

As a result of the survey among town councils and professionally employed climate protection managers, the necessary main skills for the every-day work routine of a climate protection manager have been identified. Besides a general technical comprehension, especially communicative and mediative skills are necessary. Well-trained climate protection managers also have to know general legal boundary conditions as well as the municipal structures, they have to interact with. Furthermore, climate protection managers have to be able to assist and mediate communication processes according municipal climate protection sensitively.

Based on these results curricula, teaching modules and teaching materials for a two-semester bachelor specialization course, as well as master program in the field of climate protection management have been developed. In addition to classical lecture materials, one part of the teaching modules has been exemplary prepared as an e-learning module to make it easier accessible for students online. These materials will be available for all German universities and colleges to integrate into their present structures.

Space for notes

Constructions suitable for recycling



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Summary

Modern constructions are mainly characterized using a variety of complex construction materials that are inseparably merged together, or for which there are currently barely any recovery options. In pursuance of getting an effective use of secondary raw materials and to achieve higher resource efficiency, it is necessary to analyze the deconstruction processes when planning a building for a coming future. Moreover, to achieve a further application level, construction catalogs should be developed in order to have suitable criteria that can be useful for architects and engineers related to this area. In addition, a consideration of a dismantling plan should be considered as part of the planning and construction phases of the schedule of services and fees for architects and engineers (HOAI).

Keywords: Resource efficiency, Dismantling, Recycling, Urban Mining, Construction

1. Introduction

In Germany, approximately 550 million Mg of mineral resources are yearly being removed and used for the production of building materials [1]. Thus, construction and building material industries are responsible for 60% of the resources, and 35% of energy consumption in Germany [2]. Estimations regarding to the German residential inventory of the year 2010 show that, about 10 billion of Mg mineral building materials, such as brick and concrete, are being used as construction materials, as well as approx. 220 million Mg of woods and in particular, 100 million of metals. Furthermore, it is predicted that in the year 2025 this amount of material usage will increase by a further 20% of the actual amount [3]. There is a great potential of finding recyclable materials in those empty establishments (metals and minerals) which can be obtained through restoration measures, such as urban mining.

2. Materials and methods

The current situation of the resource streams in construction sites can be described as follows:

- There is a steadily grow of potential resources in buildings and diverse infrastructures.

- Getting high quality recycled material is difficult when there is an increment of complex building materials or inadequate constituents.
- There is not a nationwide uniform regulation concerning recycling yet.
- Although the material quality of mineral wastes does not meet the requirements needed for recycling, the disposal into landfills is not a future solution.
- The idea of recycling is currently not the main focus on the planning of construction projects due to the variety of participants and responsables involved.

3. Results and Conclusion

Buildings likely to be dismantle, provide a better reparability and demolition when there is a damage or remediation case, it grants a higher resource efficiency by reducing waste deposition into landfills or incineration plants. Planning tools are required to allow an appropriate evaluation. Constructions should take into account considering the material choice as well as dismantling costs; new alternatives should be set against evaluated and popular standard methods.

The new system version 2015 for Sustainable Building of the DGNB promises brand new indicators for **assessing the dismantling process**.

- Recycling-oriented building material selection
- Recyclable Construction

An additional approach is the introduction of a mandatory **dismantling concept** (including estimated costs). This could be created during the planning phase or at the end of the usage period. Accordingly, a better resource efficiency can be achieved through the establishment of an appropriate concept in the planning and construction phases (phases 2-8).

These considerations lead to necessary measures that need to be applied on various levels of actions to improve the utilization of resources in the construction field.

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Space for notes

Cooperative Housing Models in Zurich. Or: Can sustainable, affordable and socially-mixed housing be realised together?



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Summary

The example of the Hunzinger Area in the city of Zurich serves as case study to explore the question in how far cooperative housing can contribute to comprehensive urban development. The efforts of integrating the ambitious quality dimensions of affordable housing, social mixing and inclusion, and environmental sustainability illustrate success factors and restrictions. Furthermore, the question of the transferring the Swiss experiences to other planning cultures is treated.

Keywords: Cooperative housing, sustainability, affordability, social-mixed housing, new settlements in Zurich

1. Introduction

In consideration of the discussions about affordable housing and quality of life corporate living gains importance in particular in urban development and housing politics in growing city regions. In the Swiss metropolis Zurich housing associations are very active when it comes to the renewal of the housing stock and the construction of new settlements. Which specific features mark corporate living in Switzerland? Which innovations pursue the housing associations in Zurich concerning affordability, sustainability and social mixing? Can this "triad" be realized together? These questions are examined on the basis of a young housing project, the building cooperative „Baugenossenschaft mehr als wohnen" in the Hunziker Area.

2. Methodology

The paper is based on inquiries of the specific situation in Switzerland and Zurich (literature, internet and material research). Furthermore, guided interviews to the case study Hunziker Area with relevant actors of the cooperative „mehr als wohnen" in Zürich and external experts were important for getting additional information and assessments.

3. Case study cooperative housing project Hunziker Area in Zurich

The Hunziker Area serves as a case study for a comprehensive sustainability strategy. It integrates sustainable planning and building as well as an ambitious combination of environmental, social and economic objectives and requirements. Ecological and energy-efficient building constructions, social mixing, inclusion and affordable housing were strictly pursued in the course of the implementation and are lived continuously collectively with the residents. The construction phase of the quarter was finished in 2015.

4. Results and Conclusion

The case study Hunziker Area exemplarily illustrates that the simultaneous realization of different ambitious objectives appears feasible, although the evaluation of the initial research questions will only be possible after the completion of the project and the stabilization of the residents.

To implement the ambitious objectives in the Hunziker Area a mix of different strategies and instruments was used. From sides of the housing cooperative as well as of the municipality, it is not sufficient to merely act with single instruments. Rather it is the combination of instruments, which need to be coordinated even over the responsibilities of the various groups of actors such as the housing cooperatives and the public sector. One important conducive factor was that without urban default with regard to the rise of number of the non-profit dwellings in Zurich as well as the subsidiation of 20 % of the dwellings according to the Swiss Housing Act only a clearly lower number of dwellings for low-income households would have been provided.

Besides the Hunzinger Area, the city of Zurich offers a number of other good examples of housing cooperatives, both in new building or replacement building as well as in renovation, which are following this comprehensive approach. Although there exists a range of differences between Switzerland and Germany, just as to other countries, some mentioned concepts and experiences are worth discussing with regard to transferability.

Space for notes

Creating Awareness for Sustainable Construction through Practice-Oriented Teaching in Architectural Education in Eastern Africa



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Summary

Both the impact of the building sector on climate change and the impact of changing climates on the environment and subsistence of growing populations are especially precarious in developing countries. Rapid population growth rates and the rapid urbanisation of cities lead to enormous consumption of imported, industrially manufactured building materials. Nevertheless, the integration of sustainability of building materials and constructions into architectural education remains theoretical, a holistic approach to concepts of energy and resource efficiency in design studio courses is rare. In many countries, there is still a lack of locally trained experts who can link state of the art knowledge to regional building traditions.

With a focus on East African countries, the University cooperation project JENGA (funded by EU/ACP in the programme Edulink) described in this paper, aims at improving knowledge of and application of sustainable, low energy building materials, which are often wrongly associated with backwardness and lack of resources, through practical oriented, project based courses at East African Schools of Architecture. Prototypes designed and built by students from Universities in Kenya, Rwanda and Uganda will be used to illustrate challenges and potentials of sustainable construction materials and explain how the image of building materials can be improved by linking them to professional interest through good architectural design.

Keywords: practical education, problem-based learning, sustainable building, East Africa, capacity building

1. Introduction

The University cooperation project JENGA (Joint Development of Courses for Energy-Efficient Sustainable Housing in Eastern Africa) aims at academic capacity building and knowledge transfer for architectural education at three East African Universities. All three institutions hope to add a new way of studio teaching to their existing course curricula by introducing problem-oriented learning based on practical examples, model and prototype building and team work in studio.

2. Situation and Objectives

Architecture and construction are key fields to establish sustainable urban and rural dwellings for growing populations. In order to raise socio-economic, educational and health standards on the African continent, construction needs to break away both from inefficient technologies and from inadequate foreign strategies, including the dependence on expensive imported resources like cement or steel. Instead, adapted technologies, affordable construction and environment-friendly materials have to be further developed and implemented.

Practice-oriented education at higher education level for architects and engineers in Africa is currently not the rule. Practice orientation improves students' understanding of complex design processes, as well as their practical skills, creativity and problem-solving abilities. Training of young professional in these same skills will help to create the urgently needed local teaching staff.

The cooperation described in this paper aims at strengthening the practical orientation and interdisciplinary approach within architectural education. By creating a network of partner universities in East Africa and supporting it with expertise from Germany and South Africa, the goal is to develop curricula, which reflect the fast growing pace of countries in the global South.

3. Results and Conclusion

JENGA set out to explore the possibility to implement this kind of experimental approach into architectural education at three partner institutions in East Africa. The potential benefits are undisputed between those involved in the projects, even though the realisation has uncovered a number of challenges. It can be concluded that there should be two strategies to increase the significance of practical teaching in the context described above: One is to adjust the type, scope and investment of time and resources to the possibilities of faculties at the respective Universities.

The second, more intermediate-term strategy will be to discuss existing frameworks including course requirements, assessment criteria so external examinations or job profiles for graduates. The results of the cooperation will be published at the final conference in August 2016.

Space for notes

Decision Support Environment – assisting the transformation of built environment towards sustainability



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Summary

This contribution discusses the need for transformation of built environment in European cities and explores the potentials of new, innovative methods and instruments capable to support these processes. The core debate unfolds around the experience collected during the TRANSFORM project in the framework of which a new instrument – Decision Support Environment (DSE) - was developed. The paper shares the insights gained during this collaborative experience as well as provides detailed information on the potential steps in urban-energy planning which could benefit from DSE applications.

Keywords: Sustainability, built environment, transformation, instruments

1. Introduction

Looking at the European scale of urban development, the challenges we are facing are multifaceted and penetrate all dimensions. In particular increasing pressure on the urban ecosystems and climate change are topics that can not be overlooked. In the past decades cities have moved more and more into the forefront of the debates on urban transformation towards sustainability. Facing the fact that Europe is most urbanized continent in the world, we have to address the challenges accompanying the necessary interventions in existing urban context. Different layers of information need to be interconnected as well as made transparent and accessible in order to understand the behavioural patterns engrained in our existing built environment, before we can take effective measures that yield the promised impact. An interdisciplinary consortium of EU FP7 project TRANSFORM investigated the topic of transformation from a variety of perspectives, one of them being the development and modelling of the Decision Support Environment.

2. Methodology

A multi-method approach was used by the teams of AIT and Accenture in order to distill the information required from urban stakeholders and leading to a step by step development of the DSE.

The applied methods include in-take workshops, interviews, consultations with diverse urban stakeholders, such as utility companies, urban and energy planners, building owners, etc. Different layers of required information could also be extracted during interactive Intensive Lab Sessions, which took place in each of the six TRANSFORM cities. Developing the methodology and tooling to support decision making within the context of cities' energy transformation first of all required an in-depth understanding of which decisions need to be made by which stakeholders, based on which information, for what purpose, and for achieving which outcomes. Getting to this understanding within the TRANSFORM program, started by identifying key stakeholders from partnering cities and helping them to formulate their decision support needs in the specific context of each city.

3. Results and Conclusion

The consortium of TRANSFORM project has delivered a Generic Transformation Agenda as well as specific Transformation Agendas for each of the six TRANSFORM cities (Amsterdam, Copenhagen, Genova, Hamburg, Lyon and Vienna) as well as Implementation Plans for the Smart Urban Labs (SUL) in each city. The outcome highlighted in this contribution is the prototype Decision Support Environment, developed during cooperation in TRANSFORM project and capable to connect and process multi-layered urban data on energy related built environment characteristics coupled with the local geo-spatial information. The DSE provides the information and visualises the status quo situation of an urban district, city or an entire metropolitan area by using open and granular data. Multiple functionalities, such as definition of targets and scenarios, definition and allocation of measures, simulation of future scenarios and cost benefit analysis equip different urban stakeholders with an instrument, which enables an informed and collaborative negotiation and decision process. An application of the DSE in Amsterdam Zuidoost has clearly shown the advantages of a detailed bottom-up investigation and assessment concerning the specifics of the area and exposed the difference that such approach made in comparison to top-down studies based on theoretical assumptions.

However, the outcomes that TRANSFORM project generated go beyond Transformation Agendas, Implementation Plans and DSE. This experience made it very clear, that the complexity inherent to urban developments has to be matched by the methods and approaches that are able to grasp and, if necessary, intervene in an appropriate manner, avoiding isolated approaches. Transformation requires an intergration of all dimensions, including stakeholders, information, tools, methods, etc. In particular the example of Amsterdam Zuidoost has exposed the synergies that an open approach to urban-energy planning can spark. Integrative and interdisciplinary collaboration is probably the most challenging but also most rewarding experience we can make.

Space for notes

"degewo Zukunftshaus": Concepts for sustainable energetic rehabilitation of buildings



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Summary

An 8-storey apartment building with 64 apartments, erected in the 1950s, shall be refurbished to the so-called „Zukunftshaus“, or „house of the future“. Fundamental objectives are a high proportion of energetic self-sufficiency for the operation of the building, and a high portability of the conceptual and technical solutions to other buildings. A consistent low temperature concept is the key to success besides an optimized usage of available areas for solar energy technologies. In the end, the building will be completely self-sufficient w.r.t. it's own operation. A considerable part of the user's energy demand will be covered as well.

Keywords: energy concept, low temperature concept, building renovation, self-sufficiency

1. Motivation

Berlin's largest housing company, degewo, is in the process of rehabilitation of an 8-storey apartment building with 64 apartments, erected in the 1950s, to the so-called „Zukunftshaus“, or „house of the future“. Fundamental objectives are a high proportion of energetic self-sufficiency for the operation of the building, and a high portability of the conceptual and technical solutions to other buildings of the housing company. Start of construction is planned for the end of 2015, operational start and moving into the renovated building for early 2017. This paper describes the development of an energetically sustainable and lasting approach for the degewo project by the HTW Berlin – University of Applied Sciences.

2. Concept

The self-sufficiency goal essentially means two things: reduction of the energy demand to a minimum and providing a maximum of renewable energy generated on the building to meet the remaining needs. Minimizing the energy demand is crucial for buildings of this size. In a multi-stage process four concepts are developed, simulated energetically, roughly calculated economically and presented to the client. The result is based on a very good thermal insulation of the building envelope and a mechanical ventilation system with heat recovery. Other key elements of the concept are: maximum power generation on the building envelope, electricity storage and a consistent low temperature concept in combination with a ground heat store that allows for high efficiencies of the solar

technologies and best COP values of the heat pump. The heating distribution uses a radiant ceiling heating, which can be used also for cooling during summer. The use of combined PV-thermal (PVT) collectors leads to a better area efficiency for solar technologies. An implemented heat manager works on the principle of "consumption prior to storage".

The consistent low temperature concept in the degewo project is the key to success: a low-temperature store with temperatures slightly above its surroundings has little thermal losses and uses heat on a low-temperature level. Solar thermal energy may thus be used much more efficiently. Excess heat from the apartments during summer adds to the storage and offers free and unexpected summer comfort. A low temperature heating system is responsible for this. The combination of both low temperature technologies leads to unusually high COP figures of the heat pump and thus correspondingly low power requirements. Thus, the PV area necessary for HVAC is kept low so that still a large part of the user's electricity demand can also be covered.

As planned now, the primary energy (PE) demand is reduced from today's 1100 MWh/a to 470 MWh/a. It is striking that no district heat or fuels must be acquired any more, that the complete electricity for HVAC, lifts and general lighting in staircases etc. plus a noticeable proportion of the (estimated) user's electricity is also covered. The dependencies with respect to energy are a lot lower both in volume and in terms of the number of providers.

Space for notes

Design for minimum life cycle energy and emissions (minLCee) building



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Summary

This paper has IEA Annex57 as backdrop, which investigates embodied energy and CO_{2eq} in building construction. Calculations support design feasibility studies for a minimum life cycle embodied energy and emissions (minLCee) demo building in Brazil. A meaningful lifecycle perspective is based on the cumulative energy demand (CED) concept to explore energy neutralization scenarios beyond operation stage. Production cycle modeling used the authors' primary data as well as secondary data collected from national literature and manufacturers brochures or adapted data from SimaPro 7.3 built-in Ecoinvent v 2.2, ELCD v 2.0, US LCI v.1.6 and Industry Data v.2.0 datasets. Energy Plus e Homer Energy software simulations respectively supported calculations of operational energy consumption and sizing of the different PV system technologies studied. Raw material supply and product manufacturing (43%) and the use stage (52%) dominate lifecycle CED. Neutralization of the total operational electricity plus the non-renewable CED embodied in building products is understood as the highest achievable goal for the building's current design. Beyond this threshold, extra land use would be necessary for PV installation.

Keywords: net zero energy; life cycle assessment; building life cycle; NZEB, CED

1. Introduction and methodological approach

There is a consistent shortage of data across the construction sector on the energy used during all lifecycle stages. PV is considered one of the cleanest sources of energy available. However, its embodied impact fraction is seldom acknowledged in neutralization calculations. This paper presents the design feasibility studies for a minimum life cycle embodied energy and emissions (minLCee) demo building at the University of Campinas, Brazil. Renewable and non-renewable embodied energy components were calculated using the cumulative energy demand (CED) meth-

od. Production cycle modeling used the authors' primary data as well as secondary data collected from national literature and manufacturers brochures or adapted data from SimaPro 7.3 built-in Ecoinvent v 2.2, ELCD v 2.0, US LCI v.1.6 and Industry Data v.2.0 datasets. Energy Plus e Homer Energy software simulations respectively supported calculations of operational energy consumption and sizing of the different PV system technologies studied. Ten energy balance scenarios were simulated, ranging from net zero to complete building life cycle.

2. Results and discussion

Structure, partitions, PV system plus BOS and façade panels were the major contributors to CED embodied in building products. Raw material supply and manufacturing, and the use stage clearly dominate life cycle CED. Though EOL treatment scenarios simulated had negligible effect on life cycle CED, material replacement and transportation of the corresponding CDW mass between the project site and EOL treatment facility increased the CED during use stage by a factor of more than four. All net zero (NZ) energy and CED statuses would be easily reached through PV onsite generation. Optimized usage of envelope surface available for PV mounting, while keeping its architectural coherence, offset the total operational electricity *plus* the non-renewable CED embodied in Product stage's building items. This is understood as the practical feasibility threshold for the present design, beyond which all scenarios simulated would require extra land use.

3. Conclusions and final remarks

Onsite generation capacity was mostly limited by the available surface for traditional rooftop- and façade-mounted PV application. Ubiquitous use of PV panels sends a powerful message. This case does not represent the general practice in Brazil or even at the campus. The university's overall grid load is about 1000 times higher than the PV production. Furthermore, peak load hours in the country happen in the evening. No single building would be able by itself to significantly reduce the stress on the electricity grid and help the grid operator. However, this experience helps to ground concepts and shows that they are achievable in our context, as well as the major gaps and challenges to turn NZ goals into mainstream practice.

Space for notes

Design phase calculation of greenhouse gas emissions for a Zero emission residential pilot building



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Summary

In this paper we describe the design phase process and measures for a zero greenhouse gas emission residential building in Norway. The aim of the building is to go beyond a zero emission operational balance and include material emissions. With several design phase efforts to reduce and compensate emissions a zero emission balance was nearly met for our case building. In our design phase evaluations we see that our approach is sensitive to e.g. methodology for material emission accounting and the choice of electricity emission factor for the import and export of electricity. In general we show the need for a methodology for the design phase of ZEBs that includes simple and solid rules for allowed simplifications, service lifetimes and future scenarios.

Keywords: zero-emission buildings, design phase approach, embodied emissions, residential pilot, evaluation

1. Introduction

There is an increasing focus on life cycle incorporation zero emission buildings, as presented in [1]. Within the Research Centre on Zero Emission Buildings in Norway efforts have been made to define a zero-emission building that goes beyond the operational energy use [2] [3]. In this paper we describe and evaluate the design phase approach for a zero emission residential pilot building in Norway. The objective is to learn from our design phase experience for further improvements. We describe our design phase approach and evaluate it.

2. Methodology

The overall methodology is a simplified life cycle greenhouse gas emission accounting for a zero emission building inspired by [4]. The ambition level chosen for the building was ZEB-OM as defined by [2]. The design phase goal was to identify measures that could reduce GHG emissions (kg CO₂eq) and provide values for the ZEB balance calculations. We documented emissions from the production of the materials (initial and estimates for replacement), the energy use and energy production in the operational phase. We used the functional unit of 1 m² of heated floor area (~200 m²) over an estimated lifetime of 60 years. The building itself was the physical boundary for the analysis. The case is a two-storey single-family residential building, designed by Snøhetta architects. We identified emission reduction efforts through interdisciplinary group meetings and calculated different inputs until a satisfactory ZEB balance was achieved. The life cycle analysis tool SimaPro version 7.3

was used for the material emission calculations [5]. Material emission data used was from relevant Environmental Product Declarations (EPDs) and from the Ecoinvent database v2.2 [6], as well as the produced specific information. The space heating demand of the house was minimized by designing a well-insulated and air tight building envelope and a ventilation system with high efficiency heat recovery. Documentation of the energy use was done by performing simulations with the Norwegian simulation tool SIMIEN [7]. The energy production is based on roof mounted photovoltaic modules for electricity and solar thermal modules for thermal energy. The estimated energy output of the photovoltaic modules was simulated in PVsyst [8]. Emission payback calculations used a symmetric weighting approach for as described in [9].

3. Results and Conclusion

With design phase efforts to reduce and compensate emissions a zero emission balance was nearly met for our case building. Our approach is sensitive to e.g. methodology for material emission accounting and the choice of electricity emission factor. In general we show the need for a methodology for the design phase of ZEBs that includes simple and solid rules for allowed simplifications, service lifetimes and future scenarios. Interesting further work would be to perform an as-built analysis to verify the actual buildings performance.

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Space for notes

Designing and retrofitting the urban structure with daylight



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Summary

According to the UN report, the urban population will nearly double in 2050. The rapid demographic change and the increasing urbanization cause new spatial and social framework conditions for urban planning. Daylighting masterplans provide an opportunity to tackle the lack of urban space with sophisticated architectural concepts based on in-context and human-centered solutions. This method offers a large-scale approach to coordinate the design and/or retrofit of new and existing neighborhoods. In order to obtain human-centered solutions, biological, psychological and physiological needs of the citizens need to be considered in addition to the typical energy optimization. An analysis of performance criteria indicated that colorimetric characteristics play an essential role in this. The work presented in this paper aims at developing a computer-based parametric tool to optimize the daylight planning for multiple buildings based on spectral sky models. This tool allows a better impact assessment of designing urban spaces with daylight by outlining the dynamic range of daylight, specifically for non-visual effects of the light. The tool builds upon the spectral data measurements carried out by the Technische Universität Berlin (TUB). It enables to translate the spectral data into a spatial design software. The main emphasis thereby is the practical applicability of the sky models in an urban planning process. The outcomes of this work will support the design of sustainable built environments.

Keywords: daylight master plan, sustainable urban planning, daylight design, spectral sky models, smart cities

1. Introduction

Today's cities are subject to dynamic spatial and social change. According to the United Nation's estimates the urban population will increase dramatically in the next years and will nearly double in 2050. The rapid demographic change and the increasing global urbanization cause new framework conditions for urban planning. To minimize the environmental burden and to improve the quality of life in the more and more dense city texture we need to build in a sustainable, durable and reasonable way. Daylighting master plans provide an opportunity to tackle the lack of space with sophisticated architectural concepts and with in-context human-centered solutions. This urban design method offers a large-scale approach to coordinate the design and/or retrofit of new

and existing neighbourhoods based on natural light conditions. Up to date, in the consideration of daylighting master planning as a sustainable urban design strategy, energy optimization is typically the only guideline and main purpose. The analysis of additional performance criteria and related design parameters was carried out within this research project. Specifically considering biological, psychological and physiological needs of the citizens, the literature survey and case studies indicated that colorimetric characteristics play an essential role in the human centered performance criteria. Hence the need to factor in the spectral information of daylight, next to the illuminance level and the emphasis on the interdependence between the performance criteria, in order to realize healthy and sustainable urban environments.

2. Methodology

This research aims at developing a computer based parametric tool to optimize the daylight planning in urban structures for multiple buildings based on spectral sky models. The inclusion of the colorimetric information supports the consideration of non-visual aspects in daylighting design. The relevant performance criteria and design parameters for the program are determined based on literature survey and case studies. The implemented spectral sky models are based on the spatially resolved spectral power distribution measurements generated at the Technical University of Berlin. The main emphasis thereby is the practical applicability of the sky models in an urban planning process.

3. Results and Conclusion

Based on the spatially resolved spectral power distribution measurements the luminance, sky type, chromaticity coordinates and the CCT can be determined. To automate the analysis of the data a software has been developed. This tool enables the determination of the gradation and indicatrix group and this subsequently allows to define the sky type according to Kobav et al. (2013). Furthermore it allows the graphic representation of the colorimetric characteristics and the luminance distribution. Moreover additional software was developed to determine the dominant CIE sky type for Berlin.

This research will be concluded with the parametric tool to optimize the daylight planning in urban structures for multiple buildings. The implementation of the colorimetric information supports the inclusion of non-visual aspects in daylighting design. The tool will serve as decision aid for the authorities, as information platform for the citizens, as persuasion tool for investors and as planning device for the planners.

Space for notes

Determining Characteristics in Developing Economies that Influence Sustainable Construction



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Summary

Sustainability is an interdisciplinary topic with implications in a variety of areas such as manufacturing, automotive industry, politics, and the built environment. This research explores the degree sustainability has been implemented in the built environment of countries with developing economies and investigates potential factors that correlate with the level of implementation. For this research, authors focused on correlations among sustainability in the built environment in a developing economy and the percentage of labor, environmental health and GDP per capita. Results indicate moderate to strong correlations among the aforementioned factors and the level of sustainability integration in the built environment within developing economies.

Keywords: Sustainable Construction, Developing Economies, Labor, Environmental Health, GDP

1. Introduction

Organizations such as the United States Green Building Council (USGBC) have developed systems for assessment and certification of buildings in order to provide guidance and recognition in the sustainable building industry. The most widely used building assessment system around the world is the one developed by the USGBC called Leadership in Energy and Environmental Design (LEED) system. As of August 2015, based on the USGBC website, there are currently more than 72,500 LEED building projects located in over 150 countries and territories. Using assessment systems like LEED, researchers can explore correlations with various characteristics in an attempt to understand how sustainable construction grows within developing economies.

2. Methodology

Authors started the research with the CIA World Factbook to create a preliminary list of developing economies. Using LEED as a benchmark measure for sustainable construction, a number of de-

veloping economies worldwide were analyzed in which LEED is the predominant sustainable building rating system. Authors specifically focused on those countries in which a minimum of 75 percent of all sustainable building rating system activity involve LEED and with a minimum of three certified buildings. Once these criteria were taken into account, LEED certified square feet per capita (LEED SF/Capita) of 26 countries with developing economies were introduced into the analysis. This value is calculated by dividing the total square feet of certified LEED buildings in a country by the country's total population. Authors used LEED SF/Capita as the dependent variable to represent sustainability in the built environment against dynamic independent variables.

In order to determine the independent variables with potential impact, authors conducted an extensive literature review on sustainable construction and developing economies in three main areas: Social Structure, Economic Health and Environmental Status. Using specific country data extracted from the CIA Factbook and the Environmental Performance Index developed by Yale and Columbia Universities, authors created a spreadsheet database for organization and interpretation of trends within the selected countries. Authors ran pair-wise correlation analyses within Excel and SPSS to determine statistically significant relations.

3. Results and Conclusion

Results show three significant correlations with the LEED SF/Capita value: Percentage of Labor $r(73) = .326, p < .01$, Environmental Health $r(73) = .474, p < .01$, and GDP per capita $r(73) = .802, p < .01$. Percentage of Labor is a percentage of working population, and includes Agriculture, Industrial and Services. Environmental Health is a calculated value in the 2010 EPI Data Sheet measuring Environmental Burden of Disease, Air Pollution effects on humans and Water effects on humans. GDP per capita is a calculated value found by dividing a country's GDP by the total population.

Results of this study illustrate moderate to strong connections among sustainability in the built environment and the amount of labor available in a country, the environmental vitality, and the average wealth. These correlations do not necessarily prove causation, but simply prove there is a connection. Results of this research can be used to better understand sustainable construction trends in developing economies. Further research could include developing specific measures of sustainable construction, expanding the sample countries and utilizing other green building certification systems that are dominant in other countries. Authors are currently working on developing a comprehensive index called Green Building Accessibility Index to better assess sustainability in the built environment within various countries.

Space for notes

Developing Abu Dhabi's Sustainability Energy Index

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Summary

According to figures for the year 2011, Abu Dhabi's energy consumption was the highest globally. The consumption figure is expected to increase sharply. The two segments that increased this consumption are domestic power and transportation fuel. Fast population growth, unique weather, gross floor area and high energy subsidies are the main driver of high energy consumption. Abu Dhabi is committed to generate 7% of its total energy from renewable sources and 26% from nuclear energy by 2020. It is unlikely, with the current pattern of consumption, that Abu Dhabi will be able to achieve its target. This paper aims to develop a set of sustainability indicators for the unique and challenging Abu Dhabi environment. The anticipated framework has 21 indicators that have been categorised into 6 segments; namely, energy utilisation, energy effectiveness, environmental safeguards, monetary sustenance, policy making and administration. A consolidated cause-effect method, DSR, was used to interrelate the indicators. This index is structured around the DSR approach, where the driving force is related to energy consumption. The evidence of climate change as a result of CO₂ emissions represents the state of which a response from government policies is expected. The analysis of the proposed energy indicators intended to help decision makers in assessing the performance of the city, and the values of the indicators over time highlight the city trend towards sustainability.

Keywords: Sustainable development, indicators, Energy, DSR

1. Introduction

Energy is a key contributing theme in the city and an important issue in achieving a sustainable built environment. The world's energy demand has increased ; as a result, the CO₂ emissions and global warming have increased, and most of present patterns of energy supply and use are unsustainable.

2. Methodology

the Driving force- State- Response DSR framework has been selected because of the ability of this framework to define the case and response, which is very important for the decision maker. At the same time, it represents a simple approach to be understood by the decision makers and even the community. A DSR framework for energy in Abu Dhabi is where the driving force is related to energy consumption. The evidence of climate change as a result of CO₂ emissions represents the state, of which a response from government policies is expected. The analysis of the proposed energy indicators is intended to help decision makers and city stakeholders in assessing the per-

formance of the city and the values of the indicators over time highlight the city trend towards sustainability.

3. Results and Conclusion

The anticipated framework has 21 indicators that have been categorised into six segments; namely, energy utilisation, energy effectiveness, environmental safeguards, monetary sustenance, policy making and administration.

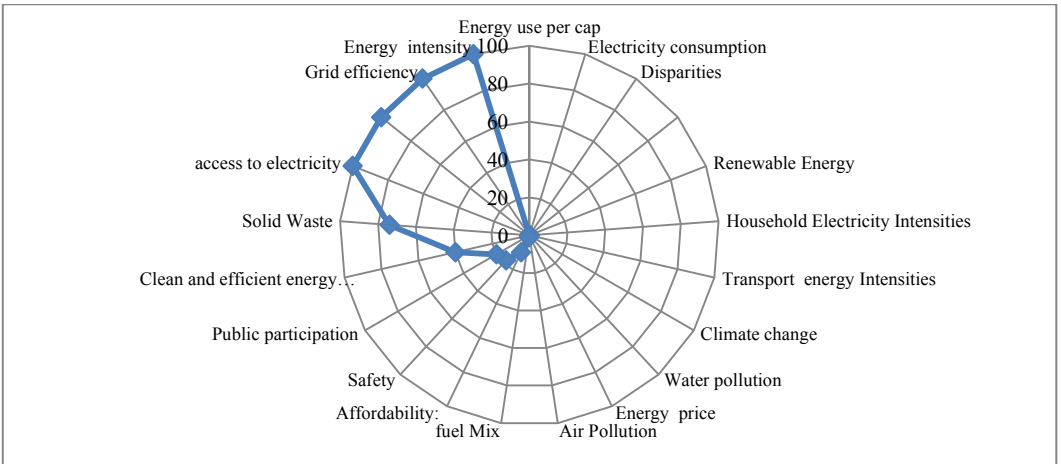


Fig. 1 Result for Abu Dhabi’s energy sustainability performance based on 21 indicators score

Figure 1, evaluates the poor performance and excellent performance in Abu Dhabi’s sustainability, based on 21 indicator scores. The ranges of the scores show a discrepancy from zero centres of the circles and the 100 edge of the circle.

Space for notes

Developing the Brighton Waste House: from zero waste on site to re-use of waste



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Summary

This paper considers two linked architectural projects designed and delivered by the author, Baker-Brown. The first considered the challenges associated with designing and building a energy efficient prefabricated dwelling in just six days, using predominately locally sourced, organic, 'compostable' materials whilst creating no waste on site. 5 million viewers a night on UK TV saw this program. However, frustrated by the lack of credible communication of the challenges associated with this project that the medium of TV provided, Baker-Brown was keen to re-build this project on campus at the University of Brighton where he taught, so that he could involve students in all aspects of the process, thus sharing the learning experience and proving that 'live' construction projects could be a useful pedagogic tool. This paper considers why the design emphasis of the second project went from 'locking carbon' and zero waste on site, to constructing with waste and proving "that there is no such thing as waste just stuff in the wrong place".

Keywords: Re-use, sustainable materials, collaborative learning

1. Introduction

Frustrated with the lack of knowledge, and indeed interest, around issues of sustainable design within the UK construction industry, Baker-Brown was keen to create a 'live' teaching project that included young learners, practitioners, educators, contractors and suppliers in the process of design and construction. The premise being that if the challenge was to deliver a truly innovative building, and that if the 'innovation' in question addressed on some of the many issues under the umbrella subject of 'Sustainable Design', then a greater understanding, of said issues, across practices within the design and construction industry, would perhaps be attained.

2. Methodology

This paper explains how over a period of six years, and via two construction projects, this ambition was eventually achieved via a 'live' research project known as 'The Brighton Waste House'.

The first project was a challenge presented to Baker-Brown in January 2008 by the TV production company 'Talkback Thames' who produced Channel 4's 'Grand Designs'. They asked Baker-Brown to design an energy efficient prefabricated house that could be assembled in only 6 days. It also had to be constructed from "sustainable materials", meaning in this case, locally sourced,

organic, non-toxic material, and to do this with zero waste during the construction process. This project was extremely innovative in 2008. However, despite significant 'air time', the TV format was not successful at explaining the reasons behind the challenge or why these innovations were indeed relevant. The project was dismantled after two days with materials returned to suppliers.

Baker-Brown was clear that there was merit in this project being re-built, but this time on campus where he taught architecture. This time it should a slower process that involved many more people, from across the design and construction industries, in the design and construction process, and that that experience would be a significant pedagogic experience.

Baker-Brown put together a design and development team with a national contractor (The Mears Group) running the construction site, providing the full-time 'site agent' who coordinate and controlled the site, but crucially they also supplied young construction apprentices. The Mears Group put Baker-Brown in touch with the Construction School at City College Brighton and Hove. They supplied the project with student constructors learning different construction skills. We also worked with undergraduate architecture students, as well as student environmental engineers. In addition we worked with Cat Fletcher a 'waste/ resource expert' who helped set up FREEGLE UK, which has over 2 million subscribers and serves as an online exchange of 'unwanted' stuff. We had our design and construction team. We also had a 'Governance Committee' that met every other month throughout the whole process. Members include the Dean of the Faculty, academics, constructors, designers, facilities managers and members of the design Team. We also had a PhD student install digital monitors in the external fabric of the building to monitor the in-use performance of the unusual construction materials.

3. Results and Conclusion

All students who worked on the project were able to use the process to help them gain their respective academic and vocational qualifications. Other design and production projects were created because of being associated with the 'live' research project that has been called 'The Brighton Waste House'. The whole process was written up, photographed and filmed by a student filmmaker, with edited information being downloaded to a live website, blog with supporting Facebook and Twitter feed, which we used to find material resource and labour. Over 750 primary and secondary school children visited the construction site and were given an introductory presentation by Baker-Brown. The project has inspired PhD, Masters and Undergraduate students from many different academic and vocational institutions. For more information see the Waste House Website: <http://arts.brighton.ac.uk/business-and-community/wastehouse>

Space for notes

Development of a cost-effective sustainability assessment method for small residential buildings in Germany: Results of pilot case studies



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Summary

Available systems to assess the sustainability performance of small residential buildings in Germany have so far not achieved widespread application due to a complex list of criteria and the costly implementation. Therefore, a new methodology adapted to the needs of detached and semi-detached houses was developed in the context of a research project. To ensure the suitability, the assessment system was tested in a pilot phase involving 18 real case buildings. From November 2015 on the new system will be available for general use.

Keywords: sustainability assessment methodology, sustainable certification, small residential buildings, pilot case study, Germany

1. Introduction

Outside Germany, small residential buildings have been assessed against sustainability criteria for many years. The numbers of certifications under the British BREEAM System, the American LEED system or the Swiss Label Minergie are increasing constantly. In Germany, however, available systems to certify the sustainability of this type of buildings have so far not achieved widespread application due to a complex list of criteria and the costly implementation. For this reason a new assessment method designed to the needs of detached and semi-detached houses was developed in the context of a research project on behalf of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

2. Methodology

At the beginning of the project existing assessment methods for residential buildings as well as current research projects and standards concerning the field of sustainable building were analysed. In a two-step procedure the transferability of existing criteria to detached and semi-

detached houses and the technical and economical practicability were reviewed. Based on the outcome existing criteria and indicators were adopted unchanged, modified or rejected.

In order to check the newly developed assessment method's suitability for detached and semi-detached houses in a second phase, a pilot case study involving 18 buildings was conducted. In this context, the system was applied to real detached and semi-detached houses. Finally the developed assessment system was adapted to the needs of the building practice.

3. Results and Conclusion

The first version of the assessment system for small residential buildings consisted of 18 criteria and 29 indicators in the categories of sociocultural and functional quality, environmental quality, economic quality and process quality. In contrast to existing assessment methods, the socio-cultural and functional quality comes first in the list of criteria as social factors play an important role within the field of housing. The categories technical characteristics and site are not rated [1].

After analysing the results of the pilot case study the assessment method was adapted. The practical test showed that the original assessment method was widely applicable in most instances. In some parts, however, the system had to be reduced and tightened due to costly implementation, time required for assessment and unavailability of products and certificates. The result was a list of 19 indicators – the current system for market introduction.

From November on the system will be available for general use and will be extended to cover residential buildings with up to five units. To ensure the quality of the certification process, assessments will be checked by an independent institution. From 2016 on the KfW Banking Group could possibly provide financial support, similar to the support for the Efficiency House standard, for building-owners seeking to achieve a sustainability certificate for a small residential building [2].

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Space for notes

Development of a Raw Material Model for Urban Systems – A Contribution to Support Material Flow Analysis and Resource Management



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Summary

The major aim of this project is to analyse the raw material flows over the whole life cycle of urban areas. The basis for this inventory sets the identification of what types of materials and how much are contained in different building types and selected infrastructure of the German building stock. Furthermore a developed life cycle model can give an indication at what times raw materials are required (e.g. insulation for retrofit measures), and when raw materials become available again, for recycling or disposal, after the end of life of individual components of the analysed area.

Keywords: Resource efficiency, material flow analysis, urban mining, raw material use, construction materials

1. Introduction

According to estimates of the German Federal Ministry for the Environment, the German building stock contains around 10.5 billion tonnes of mineral building materials, around 220 million tonnes of timber products and around 100 million tonnes of metals. Due to continuous building activities, especially renovation and retrofit measures, it is estimated that this raw material stock will grow by a further 20% until 2050 [1]. The building sector is one of the most resource intensive economic sectors in Germany. The German National Strategy for Sustainable Development sets targets of doubling the raw material productivity until 2020 based on 1994 levels [2]. The developed raw material flow model for the building industry that is described within this paper can aid in reaching these proposed targets.

2. Model Development

The major aim of this project is to analyse the construction related material flows over the whole life cycle of urban areas. The basis for this inventory sets the identification of what types of materials and how much are contained in different building types of the German building stock and selected infrastructure such as roads. Furthermore a developed life cycle model can give an indication at what times raw materials are required (e.g. insulation for retrofit, or new construction), and when raw materials and potential pollutants become available again, for recycling or disposal, after the end of life of individual components of the analysed area.

The developed raw material cadastre can then be integrated into geographic information systems (GIS), such as the CityGML standard as an additional layer and be linked to energy information for example (e.g. heating demand), to analyse the influence of raw material flows on the energy consumption of individual buildings and the analysed area as a whole. As the individual material flows (life cycle inventory) will be identified, it will also be possible to link this information to life cycle assessment (LCA) data to identify the environmental impacts (e.g. CO₂ emissions) the continuous changes of urban systems and the anthropogenic stock may have.

This integrated approach is not only examining the life cycle of material flows of urban systems over time, but it also tries to link and provide an interface to existing systems and calculation methods, to move towards rating the overall resource efficiency over time. As stated in VDI 4800, a conclusive rating of the overall resource efficiency of systems can only be achieved if the use of all natural resources is being quantified and then placed into relation with each other [3].

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Space for notes

Development of a simple approach for applying LCA analysis to compare decentralized energy supply options for urban areas



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Summary

Nowadays, various options for the urban energy supply of the future in a decentralized context are being discussed. Many of them claim to be the ideal solution regarding climate change. For measuring ecological quality the Life Cycle Assessment (LCA) approach has proved to be a reliable methodology in the past. This method is already common practice in Germany for comparing the ecological quality of single buildings, even of innovative concepts such as plus-energy buildings. However, the assessment of a total settlement seems to be rather complex, as energy flows between buildings as demanders, their suppliers and storages have to be determined at first. In this paper a simple approach for applying LCA on the urban energy infrastructure will be presented. The approach consists of an energy flow model to calculate the electricity flows between electricity producers, consumers and a battery on a 15-minutes base. For modelling the consumers, i.e. the buildings, templates for several building types have been created that can be collected in a database. The developed model can be easily attached to the existing LCA approach for buildings so that a holistic analysis of energy and buildings in the urban context will be possible. In a scenario analysis it is demonstrated that the model is applicable for assessing a decentralized electricity supply on the settlement level. However, the assessment of heat flows is still reduced to a single building approach without any interaction. Nevertheless, various options exist for further development of the approach.

Keywords: Renewable energy, Decentralized energy supply, Settlement areas, Building demand, Life Cycle Assessment

1. Introduction

Concerning the greater goal restricting climate change, it is not sufficient to focus only on energy flows for assessing the ecological quality of an energy system. Further system boundaries are necessary for analyzing the ecological impact of the energy production process and the ecological quality of the consumer i.e. the building. In this context the Life Cycle Assessment (LCA) metho-

dology defined by ISO 14040:2006 can be applied. An approach for performing LCA for single buildings has already been established in Germany within the DGNB certification system.

The aim of this paper is to show the results of a simple approach for performing LCA on energy infrastructure that could be combinable with the existing building LCA approach in order to allow a holistic analysis of energy and buildings in the urban context.

2. Methodology

To make the developed energy LCA combinable with the already existing building LCA approach, the same ecological database (OEKOBAUDAT) and the same assessment categories (Global Warming Potential, Acidification Potential and others) have been chosen. Before applying the LCA methodology the necessary energy flows have to be calculated. The approach consists of an energy flow model to calculate the electricity flows between electricity producers, consumers and a battery on a 15-minutes base. For modelling the consumers, i.e. the buildings, templates for several building types have been created that can be collected in a database. Heat demand and production is calculated on yearly base according to DIN V 18599. After that the calculated energy flows can be linked with the suitable ecological datasets. A scenario analysis has been conducted for a settlement with standard EnEV 2014 buildings and a settlement with plus-energy-buildings and a battery.

3. Conclusion and Further Outlook

The conducted scenario analysis showed that it is possible to analyze an electricity grid with decentralized electricity supply by photovoltaic systems and batteries at current state and to identify differences of the ecological impact of various supply options. The assessment of heat flows is still reduced to a single building approach without any interaction between buildings and suppliers via a heat network. Hence, an additional simple model for estimating flows, distribution losses and storages for district heating would be a valuable addition to the model. Likewise also the feed-in process of heat produced by the solar thermal collector into this grid could be assessed.

Space for notes

Development of the LCAByg tool: influence of user requirements and context



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Summary

A 2014 Danish governmental building strategy introduced sustainability of buildings as one of five focus areas for the future political work within the sector. Subsequently, a wide range of sector stakeholders were involved in developing a tool to assess the life cycle environmental impacts of buildings. Extensive participation from stakeholder generated a multitude of additional user related requirements for the tool to balance and prioritise within the restrictions of time and cost. The commissioning party and the politically related context of the tool development thus showed to greatly influence the process and the outcome.

Keywords: tool development, stakeholder participation, life cycle assessment, policy making, contextual influence

1. Introduction

The LCAByg tool was launched in spring 2015 as a new life cycle assessment (LCA) tool for quantifying environmental impacts from a building's life cycle under Danish conditions. Being a strategic political project, involvement of the many interests within the building sector was a key element during the development.

This paper presents how the work on a national building LCA tool for the construction sector has been balanced between practical prerequisites, user requirements and general LCA principles of transparency and comprehensiveness. The paper furthermore discusses the underlying contextual factors driving the development of this kind of tool.

2. Topics for prioritisation in the tool development

General LCA principles of transparency and comprehensiveness were key areas of concern in the LCAByg tool development process, for developers and stakeholders alike. More specifically, in the context of LCAByg, the terms refer to the following identified topics:

1. LCIA database incorporated in the tool; 2. Documentation format of the building assessments carried out with the tool; 3. Environmental impact categories assessed; 4. Life cycle stages included in the calculation; 5. Level of inventory detail for the building assessments carried out with the tool.

Moreover, a range of user specific requirements were introduced by the stakeholder monitoring group. These requirements reflected the breadth of the monitoring group; building product manufacturers, architects, consulting engineers, building contractors and developers as well as planning and/or regulatory bodies.

The following user requirement topics were a part of the tool development:

6. Predefined building elements to ensure speed of tool operation; 7. Evaluation of results (e.g. hotspot, alternatives); 8. Import of EPDs; 9. Provide access to calculation engine of tool; 10. Representative to Danish conditions; 11. Compliance with potential DK or EU regulatory requirements.

3. Results and Conclusion

Only in few cases do the implemented solutions in the LCAByg tool correspond to the ideal solutions for fully meeting general concerns of transparency and comprehensiveness as well as user requirements.

The LCAByg tool adds one to a seemingly growing number of digital tools aiming to assist in the evaluation of the potential environmental impacts from a building's life cycle. Thorough guiding principles for LCA tool development can be found within several existing standards (e.g. ISO 14040-14044, EN 15804-15978) and projects (e.g. EeBGuide). However, experience from the development of the LCAByg illustrates how the specific context and the participating stakeholders influence the outcome of a tool development project considerably.

The contextual outline of the LCAByg tool development was exactly to engage the national building sector as part of a political strategy towards increased use of LCA. Thus, the success of the project must not entirely be measured on the functionalities of the tool and the degree to which the tool complies with standards and guidelines. Bringing stakeholders together to discuss the way forward for a common national tool is in this regard seen as an imperative first step towards a robust tool solution for the entire sector.

Space for notes

Diversification of construction projects by implementing collaboration and information sharing tools



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Summary

In many of the construction projects, multicultural project teams have become a “common practice” and teams work together towards achieving the set goals. To coordinate the activities of the projects accordingly, all parties involved in the project have to work collaboratively and share information. The need for formalization in the form of computerized solutions for collaboration and sharing of this information has increased resulting in implementation of other Information Technology solutions that are stand-alone, meaning the systems are either installed on individual computers or a group of computers. Contrary to these systems, Web Integrated Information System promise to be less expensive, easier to implement, promote collaboration and capability to share information within construction projects. The purpose of the study is to investigate the effectiveness of Web Integrated Information System as a tool that improves collaboration and information sharing within construction projects in South Africa.

Keywords: Collaboration, Information Sharing, Construction Project, Web Integrated Information System.

1. Introduction

Construction projects are phased with the lack of information, and amongst the prevalent information there is a lack of quality, health and safety information. The absence of information results in construction projects re-inventing the wheel and repeating past mistakes (Taiwo, 2007). The situation is further complicated by the fact that there are few mechanisms for capturing and sharing the new knowledge gained through the duration of the projects (Latham, 1994). In crafting the culture of collaboration within construction projects, collaboration efforts have been addressed by the development of rapid global Information Technology (IT) solutions (Emmitt & Gorse, 2007).

Some construction projects in South Africa have developed these global IT solutions referred to as the Web integrated Information Systems, which are integrated Information Systems that are comprised of quality and health safety systems among others that are accessible through the internet. Web Integrated Information System also promises to promote collaboration and information sharing. However, regardless of the technological advancements collaboration and information sharing is about the people and the organisational culture (Turban, Aronson, Liang & Sharda, 2011). This has been evident in several IT solution implementation challenges reported, that key to solution success is people either rejecting the system or not using it effectively to help realization of the

system's intended benefits. Heeks (2003) further asserts that the majority of projects are failures. Hence the purpose of the study is to investigate the effectiveness of Web Integrated Information System as a tool that improves collaboration and information sharing within construction projects in South Africa.

2. Methodology

Surveys are easy to distribute, inexpensive and convenient for gathering data from large numbers of people spread over wide geographic area and reduces chances of evaluator bias because the same questions are asked of all participants many people are familiar with surveys (Leedy & Ormrod, 2005). Surveys were distributed to Web Integrated Information System users as a quantitative measure to investigate the effectiveness of Web Integrated Information System as a tool that improves collaboration and information sharing within construction projects in South Africa.

3. Results and Conclusion

The primary research question that the study sought to address was to investigate the effectiveness of Web Integrated Information System as a tool that improves collaboration and information sharing within construction projects in South Africa. Web Integrated Information System was critically analysed as a tool for collaboration and information sharing and the benefits and barriers of Web Integrated Information System were highlighted.

While IT is a solution within construction projects, the use of silo systems is producing isolation of information. The introduction of Web Integrated Information System has promised to eliminate challenges faced by the construction project. The findings of this study confirmed that Web Integrated Information System is indeed an effective platform for improved collaboration and information sharing efforts in construction projects. Therefore construction projects are recommended to implement Web Integrated Information System as an effective platform for improved collaboration and information sharing.

Space for notes

Documenting sustainable business practices of housing companies: Sector-specific supplement to the German Sustainability Code (Deutscher Nachhaltigkeitskodex, DNK)

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Summary

Because of the persistence of residential buildings, housing companies traditionally manage their housing stock in a sustainable way and take on social responsibility.

The housing sector was quick to identify the importance of sustainability reporting. Therefore, the *GdW Bundesverband deutscher Wohnungs- und Immobilienunternehmen* (Federal Association of German Housing and Real Estate Enterprises) developed a sector-specific concept and published corresponding guidelines for housing companies. This approach resulted in the initiative to also publish a sector-specific supplement to the German Sustainability Code (Deutscher Nachhaltigkeitskodex, DNK), which emphasizes the distinctive features of the housing industry concerning their strategies and goals. Their business processes (mainly housing stock management) are opposed to those of other sectors.

The paper covers the importance of sustainability reporting in the housing and real estate sectors. Because of this importance the process of establishing standards for the reporting of sustainable activities and strategies of housing companies is described.

Keywords: German Sustainability Code/ Deutscher Nachhaltigkeitskodex, housing industry, sustainability reporting

1. Introduction

Sustainability as a model for the housing and real estate industry is nothing new. Acting economically, ecologically and social responsibly has been characteristic of the housing companies' strategies for decades. Thus most of the companies now feel obligated towards the principle of sustainability. This is expressed in the way in which residential property is managed and residential and urban districts are further developed with perspective. It is an expression of the striving to maintain and further develop property values and equally to take into account the social needs of the residents.

2. Methodology

The future success of housing and real estate companies will greatly depend on a sustainable management strategy. The consistent implementation of sustainability goals along housing and

real estate economy added value processes, but also in particular the communication of sustainability goals and sustainability services for housing and real estate economy stakeholders, will increasingly influence the competitiveness of housing and real estate companies in the future. With this in mind, a stakeholder-orientated sustainability reporting becomes increasingly important also for companies of the housing and real estate sector.

3. Results and Conclusion

As, in principle, there are no requirements and there is no generally binding standard for sustainability reporting, the current initiatives were compared and inspected. The housing and real estate industry pursued the goal of setting its own standards with a guide and, ultimately, with a model for sustainability reporting. When it came to the question of the best-suited instrument the declaration of conformity in the German Sustainability Code (Deutscher Nachhaltigkeitskodex, DNK) was found to be particularly viable.

Space for notes

Drivers for change: Strengthening the role of valuation professionals in market transition – insights from the RenoValue research project



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Summary

Valuation professionals have a key role to play in being able to demonstrate the business case for a more sustainable built environment. This paper provides an overview of the EU funded research project RenoValue. The project's main goal is the development of a training tool kit for practising property valuation professionals on how to factor energy efficiency and other sustainability issues into valuation practices, to better understand the impact on building performance and property values and to advise their clients accordingly.

Keywords: property valuation, energy performance of buildings, education and training, sustainable development, data and information management

1. Introduction

RenoValue is a 2-year project funded by the Intelligent Energy Europe Programme of the European Union. The project's objective is to develop a training toolkit for property valuation professionals on how to consider energy efficiency, the use of renewable energy and other sustainability aspects in their daily valuation practice, and consequently help them to better understand the relationship between building performance and property value so that they may advise their clients accordingly in respective valuation reports.

The 2-year project was launched in February 2014 and is led by a consortium of leading construction and real estate sector stakeholder companies and organisations and has been rolled out in 7 geographically balanced EU member states at different levels of market maturity with regard to the issues mentioned above.

2. Methodology

The objective of the RenoValue project was to develop training material for valuation professionals. To capture the country-specific market and legislative context and the training needs of valuation professionals and those of valuation users, a specially designed survey and a series of national round tables were organised by the project consortium.

Findings from the survey and the round table workshops helped to assess the level of awareness and existing knowledge amongst the target group and consequently helped to develop the training content to match the target group's training needs.

3. Results and Conclusion

One important result was that most survey and round table participants agreed that the training material should be conceived in such a way that it would also cater for entry level participants, because the overall response from the valuation community was that current awareness with regard to energy performance and wider sustainability issues amongst professionals was rather low and that there were significant knowledge gaps to be addressed.

While responses from round table participants varied due to the respective characteristics of the market they were operating in, five common themes across all seven countries emerged during Phase 1 of the project:

1. Lack of publicly available central databases of Energy Performance Certificates (EPCs)
2. Lack of internationally recognised public building rating certificates
3. Lack of property operational cost data
4. Lack of adequate property transaction data
5. Inadequate data quality

While the training material developed as part of the RenoValue project will undoubtedly support market transformation towards a more sustainable and therefore more energy efficient building stock in Europe and help to increase the number of nearly Zero Energy Buildings (NZEBs), training will need to be supplemented by a legislative framework that addresses the lack of market transparency.

Once the training material has been piloted and reviewed by valuation professionals and revised on the basis of their market and professional expertise, a wide-labeled version of the training tool kit will be made freely available to all interested stakeholders for training and educational purposes.

Space for notes

Ecolabelling of Building materials in Russian Federation: condition and prospects



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Summary

Comparison of requirements of the Regulation (EU) No 305/2011 (Construction Products Regulation) of the European Parliament and of the European Council with provisions of technical regulations of EuroAsEC "About safety of buildings and constructions, construction materials and products" concerning ecological requirements to products presented in the market. A situation in the market of ecolabelling of construction materials in Russia. The application of the principles of the principal-agent theory to a situation in the market of construction materials in regions of the Russian Federation. Detection of a role of information resources about ecological properties of materials in market of construction products grouping. The accounting of information construction materials at an ecological assessment of real estate objects according to requirements of GOST P 54964-2012 "A compliance assessment. Ecological requirements to real estate objects". Ways of achievement of an indicator of 30-50% of ecologically certified (marked) construction materials for a concrete real estate object.

Keywords: construction materials, environmental labeling

1. Introduction

Environmental assessment of construction materials takes special place among ways and tools of securing sustainability in construction sector. Due to this, the Regulation of the European Parliament and of the Council № 305/2011 sets a demand for «disclosure of information on efficiency» as a prerequisite of labeling construction materials intended for sale on European construction materials market.

On the Eurasian Economic Community territory a regulation «On security of buildings and structures, construction materials and products» is in draft at the moment (prepared 02.11.11). It does not suggest stand-alone consideration of construction materials security, but adds requirements to them as a separate item 10. These requirements include mostly issues of sanitation and fire security of materials through their life cycle. Problems of resources consumption, air venting on different stages of life cycle are not considered in the paper.

2. Methodology

International practice suggests standards ISO 14025:2006 «Environmental labels and declarations. Type III environmental declarations. Principles and procedures» and ISO 21930:2007 «Sustainability in building construction. Environmental declaration of building products» as a base for environmental declarations composition. On the European level, one of the fundamental documents on environmental assessment of construction products is the EN 15804 standard « Sustainability of construction works. Core rules for the product category of construction products. Regulation». These documents include keystones of environmental declarations formulation, so we would like to make a brief analysis for each of them

3. Results and Conclusion

Environmental issues of construction materials production in Russia must be reviewed from two essential points: 1) maintaining production safety regarding its toxic impact on human and environment through its whole life cycle; 2) consideration of product power consumption factor and global environmental impact through life cycle stages.

Implementation of environmental declarations in Russia is advancing slowly due to the lack of manufacturing companies' interest.

Implementation and wide distribution of environmental impact declarations must become a factor of stimulating Russian construction materials manufacturing enterprises towards production modernization and improvement of ecological situation in enterprises location. Moreover, with the distribution of declarations improvement of materials environmental characteristics and easement of work with construction products for all participants of design and construction process must occur. One of the possible ways of implementing environmental declarations for construction products may be a way of developing national standards on construction materials environmental assessment.

Space for notes

Effects of a building-integrated photovoltaic system on a high-rise estate in Hamburg, Germany



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Summary

This study focuses on the effects of the implementation of a PV system on a forty-year-old high-rise estate, which is located in one of Hamburg's disreputable districts. To look at these effects in a holistic way, economic, ecological, as well as social impacts, were researched. The analysis has revealed that 45% of the settlement's electricity demand can be covered with the suggested PV system. Furthermore, the investment can be amortised within a reconcilable time span creating a win-win situation between the owner and the tenants. Moreover, such an installation would lead to an avoidance of about 131 tons of CO₂-equivalents per year. The valorized visual appearance of the building could reduce vandalism, increase the energy awareness and lead to proudness among the inhabitants, enhancing the neighborhood's character and its reputation within the rest of the city.

Keywords: roof-integrated PV system // façade-integrated PV system // social impacts of PV systems // holistic approach of on-site electricity production

1. Introduction

Solar energy and PV systems are just a partial answer to the manifold questions concerning sustainable development - and should always be seen as a part of a bigger picture in the conception of a project development. We decided to do the research, to understand the possible effects of an on-site power production by implementing PV systems on the flat roof as well as on the façades of a high-rise estate of Kirchdorf Sued, located in Hamburg (Germany). There is a myriad of papers confirming the benefits and pitfalls of such systems, but normally the knowledge gained is limited to the technology itself or to its environmental and (socio-) economic effects. In this paper, by adding a possible social value of a PV system, we aim to widen the field of opportunities that are within the realms of possibility.

2. Methodology

After having analysed data regarding areas, population density and energy demand of a part of the Kirchdorf Sued settlement, the possible energy harvest from a PV system (combining façade and roof harvesting) has been computed. The economic benefits of such a project have been elucidated in different scenarios taking into account various stakeholders and the feed-in tariff given in November 2014 (German Renewables Energy Act). The ecological benefit, namely the avoided CO₂ emission, has been computed by using the data given by the Fraunhofer Institute (664g CO₂-equivalents per produced kWh). The social benefits are based on desk research and expert interviews as well as on conversations with the inhabitants during field research.

3. Results and Conclusion

The analysis and the subsequent calculations have revealed that with the suggested PV system the settlement's electricity demand can be covered by between 31% and 45%. Furthermore, the investment can be amortised within a reconcilable time span. If the produced electricity is directly used on-site, a win-win situation between the owner and the tenants can be created: the owner getting his investment back and with the tenants having a small share that could be invested in community projects. Moreover, such an installation would lead to an avoidance of about 131 tons of CO₂-equivalents per year. However, the numerical results must be regarded carefully. While some of the encountered numbers were congruent with the manifold sources, some others were widely differing. Particularly in the range of the social effects, many benefits would evolve. The PV system's omnipresence could increase the inhabitant's energy awareness. The valorized visual appearance of the building could help to reduce vandalism and simultaneously lead to proudness among the inhabitants. Furthermore, the neighborhood's character and especially its currently infamous reputation within the rest of the city might change to the better.

However, energy generation as well as, economic revenues and - generally speaking - monetary benefits can be calculated beforehand in a fairly precise way, non-monetary benefits have to be examined in the long run. Although, the results are associated with some uncertainties, it was worth to look at the topic from different standpoints.

The installation of solar modules is much more than “just” a technical issue and perfectly indicates that sustainable development is a wide field. In order to tackle the highly complex transition to post-fossil carbon societies, a broad variety of innovations is needed. Therefore multi-disciplinary thinking, research as well as practical implementation are needed to bring about progress in sustainable development.

Space for notes

Effects of different reference study periods of timber and mineral buildings on material input and global warming potential

Extended Abstract



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Summary

In EN standards for life cycle assessment for buildings, time-related parameters such as the Reference Study Period (RSP) of buildings and Reference Service Life (RSL) of building products are only vaguely defined. Therefore authors often chose, depending on their background, arbitrary time-related parameters for LCA calculations.

This study examine the impact of different RSP on LCAs over 30, 50, 80 and 100 years with regard to the input of building material masses and associated global warming potential (GWP) relating to building construction and technical equipment. Life cycle assessments of buildings of different sizes and construction materials according to the method of EN 15978 (2012) are performed over RSPs of 30, 50, 80 and 100 years. For the RSL of building products the specifications of the German Assessment System for Sustainable Building (BNB) (last updated in 2011) and the Guideline Sustainable Building (2001) published by the federal institute for research on building, urban affairs and spatial development are applied. In summary the analysis show that the LCA results for a building depend on the RSP and the number of replacement of replaceable building components over the building's use stage. Looking at the different results between RSPs of 30 and 100 years, the importance of an adequate choice, or rather of uniform guidelines, for RSP and RSL in LCAs is obvious.

Keywords: reference study period, reference service life, life cycle assessment, use stage, replacement, EN 15978

1. Introduction

The new European standards EN 15978 (2012) for assessment of environmental performance of buildings and EN 15804 (2014) for environmental product declarations do not provide explicit data for the Reference Study Period (RSP) of buildings and Reference Service Lives (RSL) of building

products, which are influential parameters on LCA results. Consequently, LCA studies of buildings are performed with arbitrary RSPs and RSLs, depending on the author's professional and geographical background. These discrepancies contribute to inconsistent LCA results in the building sector. Especially in building assessments time-related characteristics play a significant role, since components require maintenance, repair and replacement over the building's use stage. This study analyses the EN standard 15978 concerning time-related characteristics and its scope of interpretation. On this normative base building LCAs are calculated focusing the building's use stage (module B) and the effects of different RSPs.

2. Methodology

Building LCAs of residential buildings according to EN 15978 are performed. The buildings are analysed with regard to the input of building material masses and the associated global warming potential (GWP) as one of the most researched indicators in LCA calculations. All construction material and technical equipment required over the RSP was considered. The results were assessed by the functional unit of one m² GEA and one m² GEA for one year of the RSP. LCA calculations were done with the LCA-tool LEGEP that bases on the German open-source database Oekobau.dat 2011 published by the federal ministry for the environment, nature conservation, building and nuclear safety.

The LCAs are performed over RSPs of 30, 50, 80 and 100 years. For the RSL of building products the specifications of the German Assessment System for Sustainable Building (BNB) (last updated in 2011) and the Guideline Sustainable Building, published by the federal institute for research on building, urban affairs and spatial development (2001) are applied.

3. Results and Conclusion

Building LCA results vary with the RSP. Generally speaking, the longer a building is used the less material input and the less GWP emissions over its functional unit of one m² of GEA for one year of the RSP are accrued. The impacts relate to the number of replacement of a building product within its RSP, which is determined by the RSL of the building product. In this respect, the influence of technical equipment does not change significantly over different RSPs.

The results of the performed LCAs in this study point out the demand for clear specifications of time-related parameters to achieve comparability of building LCAs.

Space for notes

Effects of energy efficiency measures in district-heated buildings on energy systems

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Summary

In this study, we evaluated primary energy savings of different energy efficiency measures in a multistory district-heated building in Sweden. We considered various locations of the building with different district heat production systems (DHS) of different scales, technical characteristics and heat-load profiles. We showed that the primary energy savings of the energy efficiency measures vary with the type of measure and with the type of energy supply system. Of the energy efficiency measures, the measure that gives electricity savings but increase the use of district heat is the most primary energy efficient in relation to the final energy savings. Heat savings in buildings connected to small-scale DHS using heat-only boilers is more primary energy efficient than that in buildings connected to medium- and large- scale DHS using combined heat and power units. Evaluation of energy efficiency measures for district-heated buildings requires a systems perspective where the final energy savings in buildings are matched to the actual energy supply systems.

Keywords: energy efficiency, district heated building, primary energy use, district heat

1. Introduction

The energy renovation of existing buildings is crucial to develop an energy-efficient built environment. End-use energy efficiency measures could improve buildings performance by minimizing final energy use. However, the primary energy savings due to energy efficiency measures depend on the energy supply system of the buildings.

District heating is commonly used for buildings in regions with cold climate. The different scales and technical setups of DHSs could influence the amount of cogenerated electricity and hence the overall electricity production system if heat demand is varied. As a consequence, effects of different energy efficiency measures in an existing district-heated building could be different and could go beyond the local heat supply system of which the building is connected. Therefore, a system analysis is needed to quantify the primary energy savings due to energy efficiency measures and to understand the effectiveness of energy efficiency activities in buildings.

2. Methodology

An existing, 4 stories multi-apartment building in Växjö, Sweden was used as a case-study building. All the energy efficiency measures applicable to this building were grouped into three different categories, including: (a) measures reducing heat demand; (b) measures reducing heat but increasing electricity demand; and (c) measures reducing electricity but increasing heat demand.

The building was assumed to be connected to either one of the three actual district heating systems in three municipalities of Helsingborg, Växjö and Ronneby corresponding to different district heat production scales and technical set ups. Effects of energy efficiency measures were evaluated by taking into account the hourly variation of final energy savings and of actual operation amongst different heat supply units.

3. Results and Conclusion

Energy efficiency measures give large final energy savings but their primary energy savings vary significantly, depend on measures and on the related energy supply systems. Of the considered energy efficiency measures, measure reducing electricity but increasing heat demand gives the largest primary energy efficiency whereas measure reducing heat but increasing electricity demand gives the smallest primary energy efficiency. Also, heat saving is more primary energy efficient in small-scale DHSs using heat-only boilers than in large-scale DHSs using CHP units.

Evaluation of energy efficiency measures in district-heated buildings requires a systems perspective where the final energy savings in buildings are matched to energy supply systems. Analysis of primary energy savings requires a comprehensive approach, of both the demand side considering the time interval of the savings, and the supply side considering the configurations and operation of different district-production units including the potential impact on the overall electricity production system.

Space for notes

Embodied impacts in stakeholder decision-making in the construction sector



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Summary

Increasing attention is being paid to embodied impacts of buildings and their products to reduce the overall impact of the construction sector on the environment as part of an effective life cycle approach to address the challenge. The question is how to incorporate them into the design and decision-making processes in the sector. Here, the different roles and decision-making contexts of different stakeholders in the construction supply and value chains are presented, and some guidance on how the key stakeholders can contribute to reducing the overall embodied impacts in the sector is provided. Specific opportunities and directions for further development are identified.

Keywords: embodied energy, embodied greenhouse gas emissions, sustainability, life cycle, building

1. Introduction

Until recently, the assessment of building sustainability and energy-efficient building design has not fully included the embodied impacts of buildings and construction materials. The strong focus on improving operational energy efficiency in buildings has progressively reduced energy use and related greenhouse gas (GHG) emissions. However, this has only highlighted further the increasing importance of the impacts associated with the other phases of a building's life cycle, i.e. the embodied impacts. Additionally, the growing emphasis on life cycle thinking in the construction industry worldwide naturally leads to explicit consideration of the embodied impacts as part of such an analysis. This is also reflected in the recent standardization activities of ISO TC 59 /SC 17 and CEN TC 350 related to sustainability of construction works.

Assessing and managing the embodied impacts associated with buildings is a challenge and additional task for all parties in the building supply chain. All involved stakeholders should begin integrating this aspect into their decision-making and shift from a vision where achieving low, or

even net-zero, operational impacts is the ultimate goal to one where minimizing the overall life cycle impacts is the norm. This paper aims to assist them in understanding their role in identifying, assessing and reducing embodied impacts by analyzing, among others, different opportunities for actions. The paper focused explicitly on the indicators “embodied energy” and “embodied GHG emissions”, as a first introduction into the subject of embodied impacts. The basic concept can then be extended later into other areas such as water and wastes.

2. Methodology

The main objective of the paper is to improve the understanding of the diverse concerns and decision-making contexts of the various stakeholders in the building sector and evaluate the possibilities and challenges of integrating the aspect of embodied impacts into their decision-making. The key elements of the methodology used to achieve this objective are: a) the creation of a typology of selected examples of stakeholders groups, their primary roles and concerns, as well as their main decision-making contexts in relation to these roles and concerns, and b) the analysis of key challenges faced by selected stakeholders and the development of related recommendations.

3. Results and Conclusion

Considering the overall impact of the building sector on the resources use and global environment, the explicit consideration of embodied impacts as part of a life cycle approach in all the activities in the sector is very important. To enable and support the various stakeholders to manage embodied impacts decisions, their different roles and decision-making contexts were here discussed, and some guidance on how they can contribute to reducing the overall embodied impacts in the sector has been provided. The recommendations developed by the authors focused specifically on helping five groups of stakeholders: construction product manufacturers, design professionals, professional associations, policy makers and experts/scientists.

As a next step in the research, it was suggested the mapping of information flows between stakeholders, while identifying the type and nature of information transferred from stakeholder to another and what type of tools are required to aid decision-making. Hopefully, the expected outcomes of the international project IEA EBC Annex 57, in which the authors participate, will provide a solid starting point for all stakeholders across the world to build on.

Space for notes

Emerging Envelopes: Design Education for adaptive and sustainable Facades.

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Summary

Building envelopes are considered one of the main construction elements and one of the most challenging parts which contribute to the wellbeing of its users. The task is to inspire the new generation of façade planners to follow new ways of thinking and to improve the communication skills between different disciplines. This is achieved through the interdisciplinary initiative of the European Façade Network (efn) which aims to establish an academic collaboration to integrate disparate façade education, training and research across the EU.

Keywords: User needs, Building product design, Communication, Sustainability, Learning from experience

1. Introduction

There is a high demand on façade planning (product-related) and computational design (tool-related) in the construction field, therefore offers the Ostwestfalen-Lippe, University of Applied Sciences (HS OWL) two involved master courses - International Façade Design and Construction (IFDC) and the Master of Computational Design and Construction (M-CDC) – in cooperation with efn. The master courses are built and developed based on a communication concept in order to provide better results and solution for the development of buildings envelop in the future.

2. Methodology

The teaching methodology in approaching innovation and design for building envelopes in the IFDC and M-CDC master courses is based on a communicational concept which is divided into six main levels. These levels vary from cultural and personal communication to professional and technical communication. These six levels of communication could be described as the following: 1- Communication between cultures, 2- between architects and engineers, 3- between the master courses IFDC and M-CDC, 4- between teaching, research and industry, 5- between the user and the building, and 6- Communication in the efn.

3. Results

Each semester a facade symposium that deals with current issues concerning the facade and innovation is organized in one of the efn partner universities. It is accompanied by seminars and workshops with international speakers and participants from the partner universities, which are - as a part of the curriculum - prepared and followed up at the course lessons.

Three of these workshops and their results are presented in this paper to show how creativity, interculturality and internationality is used to create innovative application and to put theoretical knowledge into practice by applying it “hands on” to models and prototypes that are using the assigned technology.

Space for notes

Enabling energy sufficiency as a sustainable development concept in shrinking urban districts: the case of Wuppertal-Vohwinkel



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Summary

This paper analyses chances and problems of sufficiency theoretically and presents results of a transdisciplinary research design with local stakeholders and scientific experts. Based on the Multi-Level-Perspective of transition research it analyzes how stakeholders and experts define energy sufficiency structures for the shrinking district of Wuppertal-Vohwinkel (Germany). The paper also presents a compilation and evaluation of measures which facilitate energy sufficient behavior in the fields of space heating and passenger transport on a local level. A shrinking population is seen as a chance to actively adapt the built environment to foster sufficiency.

Keywords: energy sufficiency, sustainable urban transition, transdisciplinarity, long-term vision

1. Introduction

De-industrialization, climate and demographic changes are only a few key words that indicate the challenge of urban development in many industrialized countries for the coming decades. A fundamental transformation of infrastructure and the built environment is expected to adjust to future needs. Numerous concepts of integrating efficiency and renewable energy sources into urban planning were elaborated in recent years. Energy sufficiency in the meaning of voluntary demand reduction of energy intensive goods and services is the third and mostly forgotten pillar of sustainable development.

The main aim of this paper is to conceptualize sufficiency as a strategy to enable sustainable urban transition based on the case study of Vohwinkel. In a transdisciplinary approach, local stakeholders identify chances and problems of implementing sufficiency in their shrinking district and develop measures to foster sufficient behavior.

2. Methodology

The following case study is based on an explorative, transdisciplinary and qualitative oriented research design. Meeting the requirements of a transdisciplinary approach, stakeholders play a crucial role during the whole research process. They not only provided their expertise during the

data collection phase (co-production) but also during the initial phase when the research questions were developed, a reference area (Vohwinkel) was chosen and a first understanding of energy sufficiency was elaborated (co-design).

The main data collection phase comprised 15 expert interviews (step 1), 15 thought experiments with stakeholders to develop a vision of an “energy sufficient Vohwinkel 2050” (step 2) as well as a stakeholder workshop to discuss the findings (step 3).

3. Results and Conclusion

The paper gives a first idea for starting points to transform the fields of space heating and passenger transport to more energy sufficient systems. The analysis of strategies to enable energy sufficiency shows that most of the actual measures are neither radical new instruments nor technical solutions for a sustainable urban development. It is rather a modification of infrastructural, spatial and organizational conditions in the district (e.g. number and location of schools, shops and residential areas). The Multi-Level-Perspective, a concept of the *sustainable transition* approach, constitutes a valuable scheme to analyze the ongoing developments and to envision future pathways.

Furthermore, the research shows that districts and cities are a suitable level to foster energy sufficiency. Stakeholders express their motivation to engage themselves more actively with energy sufficiency in combination with enabling energy efficiency and renewable energy sources at the urban level.

The advantage of choosing a shrinking district as a case study can be seen in the fact that a declining population results in the need for infrastructural changes with regard to the transport and spatial structure. That is why measures to enable energy sufficiency can contribute to an enhancement of otherwise challenged districts.

Space for notes

Energy-plus primary school Hohen Neuendorf: Measurement based evaluation of a hybrid ventilation system



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Summary

The energy-plus primary school Hohen Neuendorf (GSHN) is characterised by an innovative, hybrid ventilation concept; it combines natural (free) pulse ventilation with basic mechanical ventilation.

After two years of intensive monitoring, research has shown that this particular type of ventilation system provides a consistent high quality of air for indoor use, whilst minimizing energy consumption.

However, this concept also requires that there is a continuous error-free operation in order for it to work effectively. Under normal conditions the operation and user acceptance as well as efficiency of the system can be improved by a more controlled strategy of user handling and system operation.

Keywords: monitoring, hybrid ventilation, air quality, energy-plus, energy efficiency

1. Introduction

The primary school Niederheide in Hohen Neuendorf (GSHN) was designed and built around an energy-plus concept and was funded by the German Ministry for Economic Affairs (BMWi) as part of the research program 'Energy Optimised Building' (EnOB). This involves intensive monitoring over two years, conducted by the Hochschule für Technik und Wirtschaft Berlin.

The energy concept of the building is characterised by an innovative, hybrid ventilation system which combines natural (free) pulse ventilation with basic mechanical ventilation. The mechanical ventilation injects supply air into the teaching areas. Subsequently the air streams through the corridor area into cloak and sanitary rooms where exhaust air is absorbed. A natural (free) pulse ventilation overlies basic ventilation. Determined by the air temperature outside, vertical, motorised airing panels open automatically during break times, facilitating regular airing of the room.

2. Commissioning and operation behaviour

In practice, the natural ventilation system built in the GSHN is very susceptible to faults, and regular maintenance is essential to ensure trouble-free ventilation. Hence, troubleshooting procedure must be planned at an early stage and technologies used should be robust.

But even in regular operation the control strategy can be improved. In particular the dynamic interaction between heating and ventilation system needs to be refined in order to avoid unnecessary heating periods. More research is needed on this subject. Furthermore, the implemented weather protection controller frequently disables the natural ventilation function. Additionally, energy efficiency of the system can be improved by disconnection of power from motor control units outside operating times which effectively reduces standby consumption.

3. Results and Conclusion

Hybrid ventilation concepts which combine natural (free) pulse ventilation and mechanical ventilation have been rarely used in practice, but can achieve good indoor air quality with a minimum of electrical energy consumption.

The hybrid ventilation system of the GSHN obtains, in regular operation, a maximum value of 1900 ppm and undercuts 1500 ppm most of the time. Related literature and norms recommend a more strict instantaneous value of 1000 ppm for CO₂ concentration in teaching areas. This, however, is difficult to achieve with natural pulse ventilation due to the classroom's high occupation rate and comparatively short breaktimes. If a more strict value is desired, systems with continuous fresh air supply are more suitable for those areas.

The air change rate of natural (free) ventilation system is mainly dependent on temperature differences between inside and outside air. This correlation implies an inefficiency in the system during the summertime when temperature differences are very small. In the GSHN the user counteracts this downside by opening additional windows manually.

Natural ventilation allows external, unconditioned air into the building which may lead to thermal discomfort when outside temperatures are low. In order to run the system successfully throughout the year it is important for the user to understand the operating mode. Involvement of the user at a development stage is recommended to produce a suitable ventilation strategy.

Space for notes

Environmental and Social Concerns in Architectural Education: Experience of School of Architecture, Tianjin University



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Summary

Sustainable design is becoming a major concern in architectural education globally. The highly dynamic construction activities and social development of China has caught global attention. Hence it is of special importance to promote sustainable architecture education, so as to equip the next generation of architects with knowledge and concerns for a better environment and better life of people. School of architecture, Tianjin University has made efforts in this direction with various topics of design studio, such as building in life cycle, the places for urban migrants, and green refurbishment of existing buildings. We have also tried to combine international experience through joint studios with foreign faculty and students. In this contribution, the topics and methods of the sustainable design studios are demonstrated with prize-winning student works, which made the effort in dealing with the climate, social and economic conditions of China.

Keywords: architectural studio, sustainability, China, social, environmental, life cycle

1. Introduction

The focus on social and environmental issues has been the main themes architectural design idea competitions continue to address. These are also the issues we want our students to consider in their design proposals for the Thematic Design Module (TDM) in the Third- and Fourth-Year undergraduate design studio courses. Over the years, sustainable architecture has become one of the main areas, in which research-based education develops at the School of Architecture of Tianjin University. The main themes of TDM include: Environmental performance optimization under the building life-cycle theory; and Improvement of urban built environment and building function based on social research. Design competitions play an important part in the TDMs. In leading TDM, the tutors either suggest appropriate competitions for students to consider as their

design project, or make adjustment to appropriate design competition calls to suit the themes and requirements of the course.

2. Methodology

Sustainability is a comprehensive concept. In the six-week design-research studio of the TDM, we have designed a variety of topics, including: “Life-cycle Architecture”, “Bionic Architecture”, “Resilient Cities”, and “Places for Urban Migrants”. The design modules emphasize research-based design and encourage students to study the ecological characteristics of, and the macro social issues around the built environment, in order to develop low-cost and low environmental impact buildings. Hitherto, submitted students’ works from the TDMs have won several awards in a variety of design competitions, including: “UIA HYP Cup International Student Competition in Architecture Design”, “BADI International Green Building Design Competition”, “LANXING Cup National Student Competition in Architecture Design”, “Best Teaching Syllabus of National Higher Education in Architecture”, “UA International Concept Design Competition”, and “Best Students’ works of International Collaborative Design Studios”.

For the topic ‘building in life cycle’, we have focused on the concepts, methods and simulation tools for passive climate design and sustainable use of building material. Students were asked to consider not only the spatial and construction solutions for energy efficient design, natural lighting and ventilation, but also encouraged to develop flexible construction system with local, recoverable or recyclable materials. The students had learnt from traditional architecture and natural prototypes. Simulation tools such as AirPak and Ecotect were used to improve and verify the schemes.

The topic ‘Places for urban migrants’ concentrates on the architectural solutions of social equity. At the same time, we put emphasis on the cost, energy and resource efficiency of the building. Students learnt to observe and analyse the problems in the living or working conditions of various urban migrants using social survey methods.

The topic ‘resilient city’ deals with the social and environmental risks of the modern city, and tries to find the balance between idealistic and realistic solutions.

3. Results and Conclusion

- (1) “Sustainable Architecture” emphasizes the relationship between nature, society and the built environment and seeks to achieve the integration of function, aesthetics and technology.
- (2) The Thematic Design Studio combines design assignments with the opportunities of student design competitions, and encourages students to compete on the national and international stage. Over the past three years, the students’ works from the TMS have won several national and international awards, which demonstrates the importance of the topic.
- (3) The Thematic Design Studio encourages students to undertake research in a variety of related areas and propose innovative design solutions based on their research. The unique perspective and creative thinking of the students are valuable for our teaching experience.
- (4) Cross-disciplinary and international collaboration have played an important role in the delivery of the TDS. The use of simulation software and analysis tools has also been an important part of the TDS.
- (5) So far the life cycle perspective of the design studio is based either on simple calculation of the life cycle costs and embodied energy, or on the qualitative analysis. The method can be improved by introducing simplified LCA and LCC tool in the designing process.

Environmental performance of urban transit modes: a Life Cycle Assessment of the Bus Rapid Transit



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Abstract

Motorized modes of transportation, whether car or plane, bus or train, play a major role in developed societies. As they essentially trade energy against distance and speed of travel, their share in the overall consumption of energy and materials is high, making the reduction of that share an important objective for sustainability. This calls for both the systematic evaluation of environmental performance and the eco-design of transit modes. This twofold objective is addressed in the paper, which applies a Life Cycle Assessment (LCA) methodology to a transit mode, encompassing both infrastructure and vehicle fleets. The methodology is applied to a case study of a Bus Rapid Transit (BRT) system in Martinique, a French Caribbean island. The results show the contributions of the project's subsystems and life cycle phases to its environmental impacts, as captured by a set of 13 indicators. Impacts are normalized per passenger-kilometer. Comparison with other modes demonstrates the influence of vehicle occupancy rates and therefore the relevance of demand estimates in ex-ante evaluation. Finally, a sensitivity analysis is conducted to underline the respective impacts of input parameters on environmental impacts and to assess the potential of eco-design for BRT modes.

Keywords: LCA; road transportation modes; eco-design; Bus Rapid Transit; environmental performance

1. Introduction

The transportation sector contributes significantly to human environmental pressures on the planet, pressures that bring with them a cortège of negative impacts. It is therefore important to seek a systemic reduction in these impacts. In particular mass transit, provided that vehicle occupancy rates are high, has less environmental impact than automobile transportation. This article presents an eco-assessment of a Bus Rapid Transit system conducted using a Life Cycle Assessment (LCA) method. The case study focuses on a dedicated public transport line in Martinique designed to reduce congestion on existing roads. This forking line, with a total length of 15 km, will link the center of Fort-de-France to the town of Lamentin and to the airport. It includes 16 stations and 2 interchange hubs, and will be serviced by 14 hybrid 24 meter long bi-articulated buses. The project is being conducted under a public-private partnership and Caraïbus will hold a 20 year operating license for the line. The line is currently set to open at the end of 2015.

2. Methodology

LCA is a method used to estimate the materials and energy flows – and the potential environmental impacts – of a product or service throughout its life cycle: extraction and processing of raw materials, production, use, maintenance and end-of-life processing. Our study is the first multi-criteria process LCA conducted on a BRT system: it presents the environmental balance of the line over an observation period of 28 years – corresponding to the infrastructure's structural design – for each subsystem and life cycle phase, and then per passenger-kilometer covered. Our model was produced using OpenLCA software and is based on the European EcolInvent inventories. A set of 13 indicators was chosen to cover the main current ecological priorities. The specific data come from industrial partners in the BRT project, and were combined with modelling assumptions for each of the subsystems, divided up as follows: earthworks, pavements, sidewalk curbs, sidewalks and platforms, green spaces, street furniture, buses and their electric batteries.

3. Results and Conclusion

In the study, we obtain the contributions to environmental impact of each subsystem, then of each part of the construction process. Three subsystems in particular contribute to most of the impact categories: the road section infrastructure, the buses and the fuel they consume. With regard to the infrastructure, the pavement production impacts most heavily on the indicators, with some 30% of the total primary energy consumption, of the use of nonrenewable resources, of solid and radioactive waste, and of ozone layer depletion. Next, the line's environmental impacts per passenger-kilometer and under 3 occupancy scenarios are compared with other competing transport modes using the generic EcolInvent inventories: globally, the BRT's impact is much lower. Finally, trivial sensitivity tests were carried out on 4 parameters. The variability is high for the lighting and fuel consumption. The article goes on to discuss the use of LCA as a decision-making tool in the transportation look right sphere and avenues for development are proposed.

Space for notes

Environmental product declaration (EPD) for sustainable construction - new challenges



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Summary

The European standard EN 15804:2012+A1:2013 for EPD in construction is based on a horizontal mandate M350. Today almost all European Program Operators (PO) have committed to apply the standard. However, as expected, the practical implementation is still struggling with interpretations and differing data quality. European POs have founded the Eco-platform (www.eco-platform.org) to overcome difficulties in a concerted way. The first step was the realisation of a high common quality of EPD, by common verification procedures and qualifications. Next step will be the common applicability for sustainable construction, e.g. for national databases and building rating tools. The European commission has announced a revision of the M350 mandate to push an alignment between PEF and EPD rules - a chance for closing interpretation gaps on both sides. Trade-offs for new indicators, which could provide a new product performance perspective next to the energy dominance of the common LCA applications, are discussed.

CEN TCs for harmonised product standards specify the horizontal technical requirements in EN 15804 for their individual product groups, e.g. CEN TC 175 “round and sawn timber”. The specifications of one TC often also address issues significant to other TCs, e.g. how to deal with biogenic carbon. To support this intricate net of requirements CEN TC 350 will finalise in 2015 a guidance document answering a collection of questions resulting from practical application.

Keywords: EPD, LCA indicators, construction, standardisation.

1. Introduction

This contribution details the results of recent standardisation activities in the field of sustainable planning, construction and operation of buildings supported by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety on national, European and world-wide level.

The introduction of “The Single Market for Green Products Initiative and Product Environmental Footprint” (PEF) has stimulated further discussion of extending the scope of EPD for the European construction sector by introducing new indicators. The development of Product Category Rules (PCR) for EPD of specific product groups by individual technical committees for harmonised product standards requires a thorough check on the horizontal level. In consequence CEN TC 350 has developed new guidance for the implementation of EN 15804:2012+A1:2013.

2. Methodology

With the gradual shift of the relative environmental importance of a building's energy use to other environmental aspects, the need to consider indicators e.g. for human and eco toxicity, land occupation will become more apparent and increasingly important in the construction sector.

A CEN TC 350 workshop on additional environmental indicators held 24-25/06/2014 showed that the existing building certification schemes already address some of the indicators, mainly human toxicity and land use. However the assessments are as a rule not performance based and use completely different approaches.

Including new indicators like an indicator on toxicity on the standardisation level will satisfy a demand from society to understand better the environmental performance of construction product. The question is however if the methodologies available today are fit for standardisation.

The technical report of CEN TC 350, "Sustainability of construction works — Additional environmental impact categories and indicators — Background information and possibilities", Evaluation of the possibility of adding environmental impact categories and related indicators and calculation methods for the assessment of the environmental performance of investigates this question.

The existing program operators (PO) have to deal with changes compared to their own – sometimes more than a decade – history how they have supported manufacturers, verified and published their EPD and the respective PCR documents. The Eco-platform, started in 2011 is a European association of European POs, which support this change for established POs and help emerging POs. The applicability of Eco-platform EPD all throughout Europe is the goal for the next months. This addresses a common access to national databases and acceptance in all building rating tools. A major issue still is the difference in the background databases.

From the standardisation side, support is given by an official questions and answers section on the AFNOR website. In addition a guidance document is developed, which supports product TCs to develop their PCR documents in accordance with EN 15804, where they want to use the standard as reference.

3. Results and Conclusion

The information tool EPD based on EN 15804 is well accepted in the European construction sector. There are still obstacles in applying EPD uniformly throughout Europe. The Eco-platform shows success in a common implementation of EN 15804 by providing a common verification procedure, common EPD format allowing EPD to be accepted by all members. Further work is needed to achieve a common applicability e.g. in all national databases of EPD data.

A challenge is also the alignment between EN 15804 and the PEF approach. So far negotiations have shown differences arising from different goals of the two approaches. An amendment of EN 15804 to clarify some interpretation issues is pushed by the announcement of the European Commission to amend the mandate M350 for CEN TC 350. The overlap for EPD and PEF with respect to calculation rules and pre-set indicators should be identified by early 2016. A major, common difficulty for additional indicators – which would be beneficial an both approaches - and their fitness for standardisation or regulation is the lack of inventory data. For some indicators the methodology is not ready yet. Interim solutions giving an incentive to provide data and collect experience are still under discussion.

European LCA data network – open public online database and data format of ÖKOBAUDAT as a starting point?



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Summary

An international open LCA data network structure with a common standard data format is presented, which allows open access to EPD (environmental product declaration) data from all participating databases. There already has been developed an infrastructure for an online database situation with tools and interfaces for data exchange. This system, as established within the German Assessment System for Sustainable Building (BNB) for Federal Buildings, which is following European and International Standards, offers a good starting point for the establishment of an open international data network for LCA databases.

Keywords: life cycle assessment (LCA), sustainable buildings, data exchange, building assessment system, building products, environmental product

1. Introduction



Fig. 1 Scheme – open international LCA database network for sustainable building

LCA is a central instrument to calculate the ecological impact of a building. Currently, in many European or other states a rising number of EPD is produced conform to EN 15804. As products are used within the European or global market, there is an interest to use data from any other EPD program operator, for LCA at building level. To avoid the development of a great variety of databases with the danger of incompatibility of data, the idea is the initiation of an open International LCA data network structure for sustainable building with a common standard for the data

format (Fig. 1). The idea is to not to establish anything as a new (background) database but to offer a format and a structure which allows to commonly share EPD data (following EN 15084), i. e. these data may base on whatever chosen background database such as e.g. GaBi or ecoinvent.

2. Methodology

A suitable LCA infrastructure has been established in Germany within BNB. EPD data are imported in a database (ÖKOBAUDAT), which is subsequently used by LCA tools at building level (“eLCA”) and contributes to final evaluation. All used programs and tools are open source and publicly available. This supports the idea of an open and transparent exchange of data. These structures are a good basis for joint international activities for the following reasons: the data format is compatible with EN 15804 as well as ILCD format; multi-language support is built in; open source and systematic of underlying soda4LCA allow for further development and adaptations required for an open network with many stakeholders; suitable interfaces allow online data import and export to other tools and systems. Currently within Germany both ways of data import (direct or indirect using open source tool “openLCA”) are used by EPD program operators or other data providers. Considering international co-operations EPD data from Austrian program operator are imported in ÖKOBAUDAT. A database link between ÖKOBAUDAT and Spanish opendap is planned. Denmark is using the data of ÖKOBAUDAT. These activities show potential and practicability of the idea, which is proved by the strong interest of other states in further joint activities.

3. Results and Conclusion

The idea of an open data network would support European ideas and lead the way to a harmonisation of LCA calculations and evaluation in the building sectors. The challenge is, to get started with joint activities and to develop concepts which meet the demands of various stakeholders. A common standard for data and information will have to be found which still allows for additional national information. The overall goal of a harmonisation and a sensible use of data will require a high transparency of data and background information, also, the determination of different level of data quality. Furthermore, a common basis regarding the technical framework is required, e.g. software, interfaces, hosting.

Space for notes

Evaluation of green roof hydrologic performance for rainwater runoff management in Hamburg

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Summary

Adaptation to the unpreventable consequences of climate change is one of the main challenges for cities in the coming decades. Our research focuses on one example of climate adaptation measures: green roofs. In addition to long-term economic benefits they offer a wide range of benefits for urban ecosystems. Besides thermal benefits, like reduction of heating and cooling costs and reduction of the urban heat island effect, green roofs improve the urban water cycle, reduce and air pollution, and enhance biodiversity. In Hamburg, heavy precipitation events regularly lead to overwhelmed urban drainage systems. Such events are expected to occur more often in the future with increasingly frequent extreme precipitation events. Therefore, rainfall-runoff measurements of an extensive green roof on the HafenCity University building are carried out to determine the water retention capacity of the roof and to estimate the potential retention during heavy precipitation events. The long-term results show rainfall-runoff relationships under various weather conditions and are important for the development of future water management strategies and to overcome doubts about the effectiveness of green roof water retention, especially related to extreme precipitation events.

Keywords: green roof; climate change adaptation; water management; extreme precipitation

1. Introduction

Several studies regarding rainwater runoff retention state that the rate of rainwater retention for certain rainstorms depends on roof slope [14], substrate depth [4], rainfall characteristics like duration and intensity [15], season [16], soil moisture [17], roof age [18], plant species [12] and growing media type [19]. It is clear that over a whole year, green roofs with a substrate layer thickness of more than 6 cm can retain about 50% of precipitation and intensive green roofs with growing medium thickness >50 cm can retain up to >90% [20]. For urban rainwater management, especially the dimensioning of sewage systems and prevention of flash floods due to sewage overflow, the retention capacity of green roofs during local extreme precipitation events is of interest. It is still not clear whether comprehensive implementation of green roofs can have significant impacts on rainwater retention, runoff reduction and the delay of heavy rainfall events that cause flooding due to overcharged sewer systems. This problem is tackled by a comprehensive systematic review of literature regarding green roofs and water retention and a rainfall-discharge measurement approach on the green roof of the HafenCity University (HCU) building.

2. Methodology

To get an overview of the published research regarding green roofs and their possible effects on rainwater management, a systematic review methodology was applied. With these data, water management related factors were analyzed and statistically tested to recognize significant dependencies between different factors. Precipitation and runoff from the HafenCity University green

roof are measured separately. A Lambrecht rain gauge including a tipping counter is situated at the North-eastern part of the building. Runoff from the roof is drained from 3 roof outlets into a measurement box in the ground floor of the building. The measurement system was installed in March 2015 and has been recording rainfall and runoff since then in a temporal resolution of 1 minute.

3. Results and Conclusion

The systematic review results indicate a wide variety of properties characteristic for rainwater management. Across all studies, the average yearly (or whole study period) water retention was 56%, ranging from 12% to 90%. The periodic retention rates differ within colder and warmer periods. For single precipitation events investigated in the studies, the average water retention of green roofs was 57% and the average peak discharge coefficient was 0.4 (range: 0-1). The duration till runoff initiation from the green roof and peak delay from rainfall peak intensity to runoff peak intensity were delayed for 277 minutes (-8 – 2290 min) and 192 minutes (0 – 2000 min) on average. Correlation tests with data from the reviewed studies showed that the runoff-retention described were significantly correlated ($p < 0.05$) with the thickness of soil substrate, the soil moisture before the rain event, the precipitation intensity and duration, the roof slope, the season and latitude. During the here presented period of study, 410 mm precipitation were recorded whereof 142 mm were discharged; this means 65% of the rainfall were retained by the green roof. During the study period 2 short heavy precipitation events were recorded and evaluated from which about 50% of water was retained. By analysing precipitation events and related green roof retention it could be shown that there is a wide variety of characteristics (technical and climatological) that influence retention on a roof. Therefore, the green roof measurement campaign on the HCU green roof is intended to collect data of a wide variety of (extreme) rain events and retention to draw conclusions for urban stormwater management.

Space for notes

EVALUATION OF RISKS ASSOCIATED WITH BONDS AND GUARANTEES IN CONSTRUCTION PROJECTS



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Summary

Construction bond was introduced to enhance performance of construction projects by protecting or indemnifying its recipients against projects' risks and problems, but the challenge over the years lies in the practical enforcement of bonding conditions and its overall benefits to the construction industry. This research therefore examined risks and problems inherent in projects with and without bonds, with a view to ascertaining their effects on construction projects sustainability. Primary data were collected through administration of questionnaires on identified construction bond stakeholders namely: clients of public projects: quantity surveying and architectural firms; and contracting firms. Questionnaires were administered on 337 respondents out of which 242 were returned while 236 were certified fit for analysis. Mean item score was used for ranking the identified factors while Kruskal-Wallis and Mann-Whitney tests were employed to examine relationship and differences in sample means of different groups of respondents respectively. Despite the high importance attached to usage of construction bonds, the study revealed that projects executed without these bonds and guarantee are more susceptible to problems and risk which can emanate during or after construction of projects. It also revealed that sustainable construction can be achieved through the use of bonds and guarantees. The study therefore recommended the need to adopt the use of construction bonds for all forms of projects either public or private as against the current practice where it is only mandated for public projects.

Keywords: construction stakeholders, construction bond, guarantee, risk

1. Introduction

Construction industry is plagued by diverse problems among which are project abandonment, building collapse, contractor insolvency, projects not delivered to time, cost and quality, etc. These are construction risks resulting in disputes/conflicts among stakeholders which may eventually lead to claims and award of damages. One of the ways of managing issues and conflicts arising from construction works is the use of bonds.

2. Methodology

The population of the study are stakeholders in the Nigerian construction industry that are directly involved with the management of risks emanating from administration of bonds. These includes: Contractors (and sub-contractors), Clients of public projects as well as Consultants (Architects and Quantity surveyors) in Lagos and Ondo states, Nigeria. Various forms of validity and reliability tests were carried out in order to enhance the quality of the research. Out of 379 identified population, only 337 could be reached after conducting an initial survey. Questionnaires were administered on these stakeholders using census method but due to time constraints and lack of commitment from some of the respondents, 242 were returned out of which only 236 were certified fit for further analysis (the remaining 6 questionnaires were not completely and correctly filled by the respondents).

3. Results and Conclusion

Generally, bond risks are more inherent in bonded projects since they are identified for such type of projects. A major notable problem with bonded construction projects is that it increase cost of construction projects which is related to economic aspect of sustainability. However, this cost which is directly related to administration of construction bonds can be accommodated by client in as much as such projects are delivered to cost, time, quality, energy efficiency, friendly environment and satisfaction of the client, owner or sponsor. Other construction problems such as contract failure, project abandonment, dispute and conflicts, poor quality, etc. are more inherent in projects that are not under any of the identified construction bonds. This implies that sustainable and economic construction devoid of common risks and problems can be achieved through the use of bonds and guarantees. Such projects will not only be socially viable but will also be environmentally friendly. It is therefore necessary to adopt the use of bonds and guarantees in all forms of projects either public or private against current practice where it is only mandated for public projects. This will be of great help in minimizing problems associated with infrastructural projects and thereby, enhance sustainable construction projects.

Space for notes

Evaluation of Sustainable Infrastructure - Using the Southern Quay of the Island of Heligoland as a Case Study



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Summary

The construction sector and infrastructure projects in particular have a significant impact on the environment. In an effort to minimise these adverse environmental effects, the building industry has developed numerous sustainability rating systems. In regard to infrastructure most of the rating systems focus, however, on bridges and roads, leaving out other sectors with enormous environmental optimisation potentials. To bridge this gap, a sustainability rating tool focusing on the ecological dimension of sustainability has been developed for port infrastructure projects. We ran a life cycle assessment on a major deep-sea quay construction project on the Island of Heligoland in the North Sea. Our goal was to find the most climatically sound option between a king post wall and four different types of sheet pile structures. The results show that the king post wall is the best planning option. More important, however, is that our approach is successful in selecting climatically sound planning options for port infrastructure projects, beginning to make sustainability rating systems available for infrastructure projects.

Keywords: Sustainable Infrastructure Projects, Life Cycle Assessment, Port Infrastructure, Waterway Engineering, Island of Heligoland

1. Introduction

The newest report from the International Panel on Climate Change (IPCC) shows that greenhouse gas (GHG) emissions have continually increased since the 1970s. The building sector contributes significantly to the overall GHG emissions. This clearly shows that the construction sector and infrastructure projects in particular have a significant impact on the environment. In an effort to minimise these adverse environmental effects, the building industry has developed numerous sustainability rating systems. For infrastructure, however, most of these rating systems focus on bridges and roads. To bridge this gap, we at WTM Engineers have made an important step towards a sustainability rating tool for port infrastructure projects.

Our approach focuses on the ecological dimension of sustainability. We ran a life cycle assessment (LCA) on a major deep-sea quay construction project on the Island of Heligoland in the North Sea, where the Local Government Authority decided to build a new offshore quay. WTM Engineers have been responsible for major civil engineering works in the reconstruction of a new southern quay. Our goal was to find the most climatically sound option between a king post wall and four different types of state-of-the-art sheet pile structures. The results show that the king post wall is the best planning option.

2. Methodology

Given Heligoland's remote location in the deep sea, the local government opted for a long-lasting and sustainable solution that would minimise the need for costly maintenance and replacement throughout the lifetime of the quay. We subsequently ran an LCA in line with DIN EN ISO 14040 where we considered the project's entire life span. An LCA is typically run in four interacting phases. The goal of the LCA and the scope are defined in the first phase. The next phase is a life cycle inventory analysis (LCI) where all flows crossing the defined system boundary, e.g. raw materials, fossil fuels, are identified and recorded in terms of bulk material quantities. The climatic impact of each of these flows in the LCI is then assessed using so-called impact categories in the life cycle impact assessment phase. These three phases culminate in the final phase, a life cycle interpretation with a summary and discussion as starting point for conclusions and decision-making in compliance with the pre-defined overall objective of the LCA.

3. Results and Conclusion

Applying these four phases on our case study on Heligoland, we found that the king post wall is the best planning option over a service life of 100 years, with a climatic impact four times lower than for the sheet pile wall options. An important explanation for this finding is the difference in life expectancy and the need to replace sheet pile walls four times in 100 years. Our LCA approach is hence a first key step towards developing a sustainability rating system for port infrastructure which had generally not been covered by rating systems before despite the enormous potential for environmental optimisation. We have subsequently taken an important step to close this gap.

Space for notes

Exemplary Results of the Implementation of the Assessment System BNB in the Public Sector



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Summary

With the introduction of the Guideline for Sustainable Building the Federal Government has enforced an important component of its sustainability strategy in the public sector. In the first step the Federal Building Authorities are obliged by edict to evaluate their buildings, using the Assessment System for Sustainable Buildings (BNB).

The Federal Government plays a model role, especially with gold standard certified buildings, such as the new build Federal Ministry of Education and Research or the Office Building “House 2019” for the Federal Environment Agency in Berlin. The actual task is, to establish good conditions for a broad implementation of the Assessment System BNB into the practical work of the public sector in total. Now other clients, such as the federal states and the local authorities are invited to make use of the BNB-System.

Further result would be considered by the presentation. Further information is carried out with the Information Portal Sustainable Building “www.nachhaltigesbauen.de” of the BMUB.

Keywords: building; guideline; assessment system; strategies; public sector

1. Introduction

With the introduction of the Guideline for Sustainable Building the Federal Government has enforced an important component of its sustainability strategy in the public sector. In the first step the Federal Building Authorities are obliged by edict to evaluate their buildings, using the Assessment System for Sustainable Buildings (BNB).

2. Instruments and Tools for the Evaluation of Sustainability

As a result of concrete specifications by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), the Guideline for Sustainable Building and the introduced Assessment System for Sustainable Building (BNB) have become the most important tools with which to implement high quality standards in federal construction. With the introduction of the

Guideline for Sustainable Building the Federal Government has enforced an important component of its sustainability strategy in the public sector. The documents needed to implement the Guideline for Sustainable Building are included in Annexe and can be downloaded via the “Information Portal Sustainable Building (www.nachhaltigesbauen.de). These documents include, for instance, the criteria profiles, input data or minimum fulfilment levels for the BNB Assessment System. This concept enables the ongoing updating of the information, tools and other documents which supplement this Guideline and thereby ensures that these documents are as up to date as possible.

3. Implementation of the Sustainability Assessment

In the first step the Federal Building Authorities are obliged by edict to evaluate their buildings, using the Assessment System for Sustainable Buildings (BNB). For instance for newly erected office, administration, educational and laboratory buildings with investment costs of €2 million and above, the appropriate BNB requirements must be applied so that the building quality fulfils the “Silver Standard”. This Standard is going far beyond today’s usual standards in terms of energy efficiency, environmental effects and user comfort, among others. The Federal Government plays a model role, especially with gold standard certified buildings. Ambitious new construction projects such as the Federal Environment Agency in Berlin-Marienfelde and the Federal Ministry of Education and Research (BMBF) in Berlin have already been awarded the highest “Gold Standard” BNB certification.

4. Results and Conclusion

The actual task is, to establish good conditions for a broad implementation of the Assessment System BNB into the practical work of the public sector in total. The intensive specialist exchange between the newly created compliance testing offices and the Department of Sustainable Building achieves quality assurance with respect to the uniform interpretation and application of the BNB and thereby makes a decisive contribution towards implementing sustainable building within federal building authorities. Now other clients, such as the federal states and the local authorities are invited to make use of the BNB-System.

Further result would be considered by the presentation. Further information is carried out with the Information Portal Sustainable Building “www.nachhaltigesbauen.de” of the BMUB.

Space for notes

Façade design for night cooling by natural ventilation in different climate zones



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Abstract

Depending on the climate region, the local comfort standard and the efficiency of existing building services, the share of energy for cooling, heating and artificial lightning of buildings is between 30% and 50% of the overall final energy consumption of the country. The required energy for cooling of buildings can be significantly reduced by night ventilation. In this case cool air is ventilated through the building to discharge heat energy stored in walls, floor slabs, and furniture. The efficiency of this method depends mainly on the air exchange rate between the outdoor environment and the indoor air volume. Driving forces for the air flow through façade openings are the outside air temperature drop during night, wind pressure distributions acting on the façade due to local wind and the availability of cross wind flow through the building. Resistances for the air flow are given by the size and the geometry of facade openings which can be quantified by discharge coefficients. In the facade design phase the relation between window size and effective opening area must be considered. With predicted discharge coefficients the overall energy efficiency and indoor temperature of buildings with natural ventilation can be analyzed in transient multi zone models. Exemplary buildings in Campinas, Brazil and Hamburg, Germany are analyzed concerning their potential of this method to save energy.

Keywords: energy efficiency, facade opening, discharge coefficient, night cooling, natural ventilation

1. Methods

The energy efficiency and indoor temperatures are analyzed with transient multi zone simulations. The thermo-energetic performance using night ventilation in exemplary office rooms of non-residential buildings is simulated with EnergyPlus. The studied rooms are located in Brazil (Campinas) and Germany (Hamburg) in university facilities with typical office activity. The analyzed room in the hot Brazil climate demands the use of air conditioning systems during most hours of the day to provide comfort for the users. Natural night ventilation can be used to reduce the cool-

ing loads, but with significant different efficiency in the analysed climate zones. The office room in Germany is naturally ventilated and has no mechanical ventilation. To ensure the desired user comfort, the hours of overheating shall be minimized. Hourly local weather data are used for both entire year simulations. The thermal loads are given by internal gains from occupancy, equipment and lighting systems. Air flow resistances by openings for passive ventilation modes are taken from the literature and adjusted for the use in each façade.

2. Results and Conclusion

The use of natural ventilation for summer night cooling is an efficient method either for reducing indoor temperatures, increasing energy conservation and air quality. Besides local climate conditions the design of window openings is a key factor for natural ventilation. In moderate climate with cooler nighttime air temperatures the efficiency is also driven by the ventilation strategy. In hot climates the positive effect of natural ventilation is less noticeable. An adaptive opening control allows the usage of temperature difference between indoor and outdoor for passive. The discharge coefficient and the effective area for ventilation of windows are limiting factors for the air exchange rate.

Static night cooling (windows are open in a defined time period) decreases the energy consumption for air conditioning in both countries. Night cooling in Brazil was not as effective as in Hamburg, as the air temperature drop by night is lower. An intelligent facade controlled by the difference of temperature between outdoors and indoors to allow natural ventilation for cooling when needed can further noticeably reduce the energy consumption in moderate climate regions like Germany. Dynamic simulations of airflow should consider an appropriate description of the window geometry (discharge coefficient, effective area for ventilation) in order to reduce the uncertainty of the model. The study demonstrates the application of a model to represent bottom pivoted windows (Hamburg) and a simplified approach for horizontal eccentric pivoted windows with lateral barriers (Campinas).

Space for notes

Faithfulness in small things?



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Summary

Looking at the individual decisions made in a municipal school project some aspects are shown that lead to more sustainability – or just the opposite.

Keywords: public-sector constructions, educational constructions, project management

1. Sustaining project flow

"Sustainability of new buildings as well as of existing buildings needs visions, concepts, planning and financing, above all, however, a day-to-day-implementation!" This day-to-day approach does not only apply to large projects with a view to public appeal, but also to much smaller construction projects. Public authorities in particular should lead the way here. The following school construction project will be outlined and commented on according to the main ideas of sustainable constructions here as an example from real life.

2. The Hans-Carl-von-Carlowitz School in Unterschilda

Officially, the principal calls the shots in the Hans-Carl-von-Carlowitz-School in Unterschilda; the caretaker, however, was the actual landlord. He was very attentive and skilled at the same time and mended even small damages immediately. After the caretaker retired from work in 2005, the municipality decided for financial reasons not to fill the vacancy. At the same time, the municipality decided to downsize the communal building department both in size (by removing the archive) and also concerning human resources.

"Creeping" changes became obvious: more graffiti, more vandalism, more damages. Hall monitoring was not implemented and the students' carelessness finally caused a fire in the former caretaker's house. Both the fire and the water used by the fire brigade led to a first renovation, which was combined with an inside insulation of parts of the school basement. A general contractor, familiar with town councils, fulfilled an overall performance for the caretaker's house. The communal workers built in the inside insulation with a drywall shell on their own initiative in the basement.

However, the construction did not last long. On the contrary: it was again damaged by vandalism. Apart from that, mould began to cover the shell. In winter, the situation grew even worse, so calls were made for general renovation. As the building department did not dispose of the necessary resources to carry out this work, an architect had to find out what the school needed. This first planning fulfilled the high expectations of the users, but did not meet the budget requirements. On top of this, the financial situation of Schilda changed dramatically due to the economic crisis in 2008.

The second planning phase failed after one year of work, as an additional funding pool which was necessary for the budget was combined with energy saving requirements, but this could not be realized with the existing building. This led to a third planning phase, whereby individual measures with public appeal were to be advanced. In 2014, many trees were cut down and the former caretaker's house was demolished in order to provide space for the new buildings, the plans for which were far from completion. At the same time, the city council decided to no longer entrust municipal staff with the project management but engage an external partner. The planning is still going on ...

3. Comments and discussion

“What’s wrong here? - Nearly everything is wrong!” This quotation could probably also apply to several aspects of sustainability in the above project. One example is the missing building maintenance, which caused the change from a school building being a cultivated public property into an expensive “demolition building”. Another one is the unprofessional performance of the first renovation – or the lack of competence of the public building owner. Yet other examples: the depreciation of the existing building and the lack of clearly defined objectives.

As the attentive reader possibly guessed, the project described is completely fictitious, although it has been compiled from various occurrences which took place similarly to the way pictured. Moreover, on the basis of experiences derived from public building projects, many architects may confirm: these incidents are not far from their day-to-day experience.

“However important sustainable new buildings are – energy efficiency and sustainability is much more important with respect to existing buildings”. Therefore, sustainable thinking needs to be applied to the large number of smaller construction tasks carried out today by both private and public property owners.

Space for notes

Functional building surfaces - Self-sufficient facade module Extended Abstract



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Summary

The focus of the research lies on development of a more changeable highly adaptable active self-sufficient facade module, constructed from glass louvers. The advantage of the facade module lies in the self-sufficient regulation of the interior climate. In the case of refurbishment a high user comfort is reached by a minor intervention in the existing building facade - a resource efficient way of refurbishment.

The adaptability facade module is carried out nearly appropriate for circulation of materials. The development is checked by a parametric life cycle analysis. The facade acts as a building cover and provides cold weather protection, amongst other functions. The single-pane glass louver take over active functions, for example passive energy gain, protection against burglary, and / or screening while fulfilling architectural demands.

FGL control the louvers in the load case temperature and work self-sufficient. The control of the load case CO₂ concentration of the room and from the load case precipitation occurs about the energy entry from the louver covered with photovoltaic and the storage in the frame.

Keywords: parametric life cycle analysis, form memory alloys, self-sufficient air-conditioning, self-sufficient energy supply

Space for notes

Global Sequential Sensitivity Analysis for Building Energy Simulation of Residential Quarters



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Summary

In this paper a dynamic sensitivity analysis approach is presented, which uses the Elementary Effects method in connection with a moving mean smoothing function to get a ranking of the influence of parameters. This is demonstrated on a model of an urban quarter, which uses EnergyPlus to simulate 25 buildings of a block. The information for creating the building models stems from statistical, GIS and building typology data. For the majority of model parameters no data is available. Therefore assessing the influence of these parameters is crucial in order to give recommendations, what data should be acquired in future projects to have the possibility to create reliable models for refurbishment scenarios of urban residential quarters.

Keywords: renewable energy supply, building energy simulation, sensitivity analysis

1. Introduction

Renewable decentralized energy supply of buildings will become more and more important and due to its fluctuation the focus of energy demand and supply calculations have to change from monthly or yearly cumulative examination to detailed hourly examination using transient simulation tools. Additionally existing buildings offer a huge range of possible refurbishment measures. Effects of these measures have to be considered in detailed examination to select the best option regarding all relevant target functions like peak power or self-sufficiency for electricity.

For simulating the buildings, data about the building envelope is mostly available. But data about the used heating systems, local power generation or user behavior is insufficient. Therefore for modelling the buildings in detail recommendations for data to be collected in the future have to be derived by analyzing the influence of different parameters on the model using sequential sensitivity analysis.

2. Methodology

An approach for extending the global sensitivity analysis method of Elementary Effects (EE) to assess dynamic effects of building's energy behaviour in a simulation model of a residential quarter is presented.

In this approach sensitivity indices for every single hour of the year are calculated. The result is a time series with 8760 values. To evaluate this time series it is useful to use smoothing methods like moving means to reduce short-term fluctuations. The size of the moving mean window is important here and has to be adapted to the model result data..

This method can be applied to other sensitivity analysis methods in a corresponding way, EE was chosen due to its relative low calculation effort.

3. Results and Conclusion

The presented method is used to identify the dynamic parameter sensitivities of a simulation model of a city district for one winter week. Using moving mean with window size of 95 hours to calculate μ_i of the parameters of the model for the target function final energy demand of the heating systems, the ranking in table 1 for the importance of the parameters can be assessed.

Table 1: influence ranking of parameters when using moving mean window size of 95

Parameter	Rank	Parameter	Rank
Infiltration rate	1	Setpoint temperatures	5
Boiler efficiency	2	Heat capacity of walls	6
Conductivity of insulation	3	Window opening	-
U value of windows	4		

Using the moving mean method in connection with the Elementary Effects method gives a better understanding for the influence of parameters and its dynamics. Constant parameters like infiltration rate or U value of windows can be ranked easily. For parameters which define events like a one hour window opening at some time of the day the smoothing method is not very helpful, the dynamics of the overall influence and the interaction effects are still too variable. Here other methods have to be developed.

Space for notes

Graphical User Interface for Plus Energy Multi-family houses



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Summary

The user habits concerning energy outline a key factor for the energy demand of a building - in addition to cubic content, quality of shell and efficiency of the technical systems. To integrate the user into the Energy Management can contribute to a lower energy consumption. The User Interface exploits those potential of saving energy: a tool via touch panel makes the tenants' manner concerning energy transparent without infantilizing them. Moreover, the announcement of the availability of in-house gained energy encourages using this on-site renewable energy source. In fact, the focus rests on information, not automation. Since August 2015, the User interface finds his first application in practice in an eight floor building including 74 units which is built in Frankfurt: Aktiv-Stadthaus.

Keywords:

Graphical User Interface, user information, personal's and building's energy production and demand, plus energy multiple dwellings

Introduction

In energetic optimized houses referred to prospective energy standards, the demand of electricity acquires an increasingly value across from the demand of heat. The user's consumption comprises the largest part. Besides, the usage of energy efficient devices, one's individual lifestyle influences this need significantly. The heat requirement also varies applicable in dependence of the user. The project's aim is to make use out of the potential of the user's energy performance in plus energy multiple dwellings. In a playful way, a graphical user interface makes one's individual energy consumption transparent. The announcement of in-house gained energy provides another potential for optimizing the household's energy demand.

Methodology

An interdisciplinary team, consisting of experts in architecture, energy and building technology, programming, graphics, socio-science and housing industry works on the graphical user interface. The conception and the design have been developed basing on the previous research project "Aktiv-Stadthaus". Finally, the team realizes a first prototype for a first implementation in the pilot

project in Frankfurt. In principle, the User Interface is adaptable to further multiple dwellings and independent from vendors and systems in order to guarantee a general application.

The following work packages present the essential steps to reach the overall objective.

- | | | | |
|-----|-------------|-----|------------------------|
| [1] | Conception | [4] | Revision and finishing |
| [2] | Programming | [5] | Cut surface monitoring |
| [3] | Evaluation | | |

Results and Conclusion

Three different user modes allow various levels of detail regarding content and function. A needs-orientated energy budget for thermal and electrical energy is calculated for each dwelling in order to maintain the efficiency house plus standard. By the means of such a credit, it is expected that the user is encouraged to an energy saving behavior. The user is informed about the building's consumption as well as about the production of the in-house gained, self-sufficient energy. The system reports the current usage and supplementary provides a comparison to the calculated budgets. By these means the user is given the opportunity to evaluate the energy performance independently and possibly optimize the consumption. In order to enhance the acceptance and a frequent application, the user receive extra services such as a ranking, tips on saving energy or the possibility to hire cars or e-cars of which one rental station is located in the ground floor of the pilot building Aktiv-Stadthaus.

In the case of the pilot project the touch panels are installed in every unit and went into operation since August 2015. This clearly limits the significance of the success monitoring referring to a lower energy consumption. One might consider a prospective project which arranges that the User Interfaces are applied in half of a multiple dwelling. Such a strategy provides to point out the cost and benefit ratio of such systems.

In fact, various contents and functions depend on points such as owner ship status, programmability and financial and technical basic requirements. Overall, the vast amount of complex information could be reduced to a well selected level which is visualized in a modest and classy appearance. It turned out that designing based on models is auxiliary in view of readability and user-friendliness.

Due to the statements and mainly favorable outputs of the first evaluation with test user, it can be suggested that people are both interested and poised to integrate such a tool into the everyday life. An expanding demand for such innovative projects can definitely be expected. The User Interface provides a solid base and extendable ideas for such prospective researches. If we carry on involving the user, we could in fact achieve an increasing success. The purpose is: not only saving energy through automation - rather through information.

Space for notes

Green Buildings: A Concept aligning the interests of Stakeholders (Developers / Clients and End-users) in Estate Development Projects in Abuja - F.C.T (Federal Capital Territory), Nigeria.



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Summary

Nigeria is the most populous country in Africa, with Abuja as its capital city. The Population of growth rate of Abuja is about 25% - 45% annually and is expected to 10million by 2018. This explosive growth rate has created severe housing problems resulting in overcrowding, shortage of electricity and water supply, other degrading public infrastructure, and deplorable urban environment etc. Many Housing estates were developed by both Public and the Private sectors but do not reflect the desired housing needs of the end-users. Incorporating green building features are basically at the developer's disposal but should be checked with potential end-users because it affects rental and sales value. The objective of this paper is to identify green building features that can be incorporated in housing estate development projects which can align the interests of the Stakeholders specifically the Developers/Clients and the End-users / Occupants. Review of literatures helps identify and narrow few environmentally sustainable elements in the particular context of Abuja. A *5-point Likert scale* questionnaire survey was conducted on Estate Developing Firms and Occupants / End-users from 20 different housing estates in Abuja; selected through random sampling method. The results showed that green building features such as; *Energy Efficiency, Water efficiency, Building Envelope, Indoor Environmental Quality and Day-lighting systems* were the favoured and affordable green building elements that can unify and align the interests of both the Residential Estate developers (clients) and the End-users (Occupants) in estate development projects in Abuja.

1. Introduction

Nigeria is the most populous African country located in western Africa; a former British colony till October, 1960 when it gained independence. Lagos (a coastal city) was then the capital city till December, 1991 before the seat of power was moved to Abuja within the Federal Capital Territory (FCT) in the same year. Geographically, the FCT is located at the centre of Nigeria. Abuja under Köppen climate classification features a tropical wet and dry climate with three weather conditions namely; warm, humid rainy season and a blistering dry season; with a brief interlude of harmattan in between the two (WECSI 2014, demographia.com; and Wikipedia.org)

Abuja is considered among the fastest growing cities in the world, with a population of about 330,000 in 1990; 1.995million in 2010; presently about 4million; projected to reach 10million by 2018-20 (Muhammad 2013; Sundaram, 2012; demographia.com; Wikipedia.org). This shows that the Population growth is about 25% - 45% annually and affirms the rate of migration of people in

Nigeria to its capital city Abuja in the FCT. This explosive growth rate has created severe housing problems due to high demand resulting in overcrowding, inadequate electricity (power) and water supply, other degrading public infrastructure, deplorable urban environment especially the Built environment etc. Despite being a pre-planned city, Abuja is also affected by spontaneous and uncontrolled urbanization like any other city in a developing country and has led to growth of suburban city-like districts and springing up of many satellite towns around the city.

1.1 Housing challenges in Abuja and Nigeria at large

Social housing schemes in the form of state and federal low cost housing schemes has been the housing policy of the Nigerian government in the 1960s to early 1980s, but it was abandoned due to series of military coups and their regimes. This led to shortages of Housing in most of Nigeria's urban areas and has remained a mirage to all carder of the society in Nigeria (Olotubara 2007 as cited by Toyobo et al., 2011).

Housing demand in urban centres (like Abuja FCT) is a manifestation and reflection of different household desires to live in an urban centre (Todd, 2007, Akinyode & Tareef, 2013), which is increasing at an alarming rate. Various reasons have been attributed to an increasing taste for urban living which includes employment opportunities, urban amenities and utilities consumption opportunities (Olayiwola et al, 2005). This situation has consequently led to housing shortages where most people are found living in non-decent building apartment due to their socio-economic background which cannot cope with ever increasing price of decent houses (Ibid).

Abuja FCT, like any other capital city of a developing country is not exempted from the housing problems; as it continues to grow in population and expand in physical terms, the housing conditions have continued to evoke considerable concern due to its effects on the built environment and also, the need for modern infrastructure that will serve the needs of the present and the future. This goes a long way in affirming the increase in global population growth accompanied by massive resource consumption and its negative impacts on the environment.

The built environment showcased the impact of human activity on resources; buildings have a significant impact on the environment, accounting for one-sixth of the world's freshwater withdrawals, one-quarter of its wood harvest, and two-fifths of its material (Eurostat, 2011); 40% primary energy consumption (Bauer et al., 2007). Structures also impact areas beyond their immediate location, affecting the watersheds, air quality, and transportation patterns of communities (Eurostat, 2011). The combination of these challenges gave birth to a new concept in design, construction / renovation, operation and maintenance of buildings in conformity with sustainable practices known as Green Buildings (Dalibi, 2014).

Successful delivery of projects, their operations and management (including green building projects) is attributed to many factors of which stakeholders' perceptions, participation, roles and responsibility are among (Bourne, 2005 and Dalibi, 2014). Stakeholders' input, participation, roles and responsibility in Green buildings projects must be of high cognizance than conventional building projects because of the divergent stakeholders' interests. These warrants the need for embracing green elements in estate development projects in Abuja based on the stakeholders requirements and interests.

1.2 Research Problem

The problems of housing supply in meeting the ever increasing housing demand remains one of the most pressing problems facing Nigerian urban centres (Israel and Basiru, 2008). Although residential quality studies have gained increasing attention in recent times, the majority of such studies was foreign and focused mainly on factors affecting the quality and performance of construction, particularly in public or social housing programs within specific housing environment (Shinnick,1997; Djebari and Al-Abed,1998, Saari and Tanskanen,2011). A few studies conducted

Green Roof Integrated Photovoltaics: Technology and Application on a high-rise settlement in Hamburg, Germany



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Summary

Since some years, there exist technologies, which enable the combination of solar technologies with a vegetated roof. So-called green roof integrated photovoltaics (GRIPV) feature considerable synergy effects, whereas the increased PV output due to PV/plant interaction is probably the most important one. This study focuses on the implementation of GRIPV on a forty-year-old high-rise complex in Hamburg, taking into consideration the complexity and challenges of its context. The results show that the most important benefits of such a system would be: 1) partial reduction of water stress on the area caused by storm-water run-off, 2) significant reduction of discharge in the existing sewerage system, 3) in-situ production of renewable electricity that could cover the demand of about 26% of the households, 4) recovering the costs of both the green roof and PV-system in a reconcilable amount of time. Even if the results are associated with uncertainties, the beneficial impacts as well as the innovation potential are remarkable and have shown, that green roof integrated photovoltaics can be an essential puzzle piece on the path to sustainable urban development.

Keywords: photovoltaic systems // green roofs // Green Roof Integrated Photovoltaics (GRIPV) // decentralised stormwater management // synergy effects due to PV/plant interaction

1. Introduction

Even if green roof integrated photovoltaics (GRIPV) are a rather new tendency in the building sector, various studies have already proven the significant synergy effects. Especially the increased PV output due to PV/plant interaction holds a lot of promise. For this paper, GRIPV have been considered for implementation on a forty-year-old high-rise complex in Hamburg. Herewith, the system's beneficial impact on local stormwater management was calculated. Furthermore, the increased PV performance's positive influence on payback periods and number of supplied households was evaluated.

2. Methodology

The first section provides a brief overview on the current state of knowledge and is based on a research in scientific publications and technical brochures. Afterwards, a comparison of three different roof configurations in terms of discharge coefficients has been carried out and, also evaluating each roof's impact on the municipal sewage system. Thereafter, a calculation of the black roof's PV output and a comparison with the GRIPV's improved outputs due to the PV/plant interaction is given. Furthermore, the innovation potential, the beneficial effects as well as the limitations of such a project are discussed.

3. Results and Conclusion

With the aid of various calculations, it has been possible to dimension a system that could work satisfactorily - also thanks to the synergies created by its components. The high-rise complex's inhabitants, as well as the island's drainage system, would benefit from an installation of GRIPV. Among the most important beneficial effects are: 1) partial reduction of the area's water stress caused by stormwater run-off, 2) reduction of discharge into the municipal sewerage system, 3) in-situ production of renewable electricity, which could cover the demand of about 26% of the settlement's households, 4) payback period within an reconcilable time span.

Sustainable development is facing a vast number of multifaceted challenges. To progress toward a post carbon society, innovation is necessary. In order to create prospective sustainable solutions, we have to move on from stagnant, rather unilateral mindsets. Therefore, innovations are required, which are based on multi-disciplinary thinking, research and practical implementation. For this paper, we aimed to bring together two topics, which are usually taken into isolated consideration. Even if the results are associated with some uncertainties, the beneficial impacts as well as the innovation potential are remarkable and have shown, that green roof integrated photovoltaics can be an essential puzzle piece on the path to sustainable urban development.

Space for notes

Guiding the building stock to a post-carbon future



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Summary

Taking Germany as an example, this paper describes a possible strategy to make the building stock of a country climate neutral. The strategy supports existing policies. It includes elements of information und target setting and focuses on creating effective financial incentives using a “push and pull principle”. The recommended strategy takes into account building stock data, the long-term need for climate action (decarbonisation) and barriers impeding ambitious building refurbishments.

Keywords: building stock, strategy, climate neutral, energy efficiency, renewable energies

1. Introduction

Climate change is one of the major challenges we are currently facing. The development of low-carbon strategies is essential. The buildings sector is responsible for approx. 40% of the total energy consumption of the European Union. Renewable energies are available to a limited extent only; this increases the priority of energy savings and energy efficiency. Energy refurbishment of the building stock is a key component of ambitious climate action strategies. This paper presents a strategy for making the building stock climate neutral, using Germany as an example. The strategy focuses on a long term goal underpinned by several regulatory instruments.

2. Methodology/approach

Measured data from energy statistics showing development of the building stock are analysed in terms of influences and restrictions. The long-term needs for ambitious climate action and its implications for the building stock are described. Based on this, targets for the building stock are defined and an effective policy approach is derived.

3. Results and Conclusion

The strategy for a climate neutral building stock in 2050 combines flexibility and reliability. Multiple obstacles like low awareness, risk aversion, financial restraints and individual expectations of building owners etc. have to be addressed as well as the question of how to connect buildings to

a future carbon-free energy system. The strategy takes technical and political framework conditions into account and has four key elements:

- 1) Energy performance certificates (preferably based on calculated energy demand) are used to describe the current energy efficiency status of a building; this information is gathered centrally to get an overview of the building stock.
- 2) A long-term target and intermediate targets are defined both for individual buildings and for the whole building stock. Achievement of the targets is monitored.
- 3) Individual renovation plans are drafted for individual buildings and for quarters.
- 4) To create financial incentive a “building climate tax/levy” is levied.

This can increase the rate of energy refurbishment. It incorporates a “push and pull effect”: A “push” incentive supports energy refurbishment measures in order to reduce the financial burden on affected building owners. A “pull” generates additional financial resources to finance funding programmes for early and ambitious refurbishments continuously, and independently of the uncertainties of public budgets. In addition, a legal right to obtain support for ambitious energy refurbishment measures should be introduced to give building owners sufficient security for planning. To bridge the time gap until a “building climate tax” is implemented, energy tax rates could be increased in the short term and the revenue fed into funding programmes.

This strategy is examined in terms of its legal viability in Germany and at European level and is evaluated according to functionality criteria. It is a recommendation for an effective set of policy instruments including a time frame for its implementation.

Finally the policy instruments suggested here constitute only one part of a more comprehensive set of policies. The key instruments must be accompanied by various and target-group-specific measures (e.g. including information, motivation, qualifications, quality assurance) in order to effectively and efficiently tap the substantial saving potentials in the buildings sector.

Space for notes

Hempcrete from cradle to grave: the role of carbonatation in the material sustainability



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Summary

Sustainability studies of building materials often focus on a single stage of their lifecycle. This approach is wrong for materials that improve or reduce their environmental performance during the operational phase or at the end of the building's life. This is the case for materials containing lime, whose strength and sustainability increase theoretically along with the carbonatation process. An innovative building material containing lime is the hempcrete brick: a non-structural composite material obtained from a mixture of hemp shiv (woody core of the hemp stalk) and a lime based binder. The goal of our study is to assess the real rate of carbonatation of hempcrete bricks in order to include the results in a thorough LCA study and to understand the weight this process can have in the overall sustainability of the material. Results show the importance of evaluating the behavior of a material in all the phases of the lifecycle and could be used for future LCA studies on hempcrete materials exposed to similar conditions

Keywords: hempcrete, LCA, carbonatation, carbon footprint, building materials

1. Introduction

Building sector accounts for about 32% of global energy use and for about 19% of energy-related greenhouse gas emissions. Natural materials allow the reduction of non-renewable resource depletion and of environmental impacts related to fossil fuel consumption. Hemp lime composite, often referred to as hempcrete, is a building material formed from the mixture of hemp hurds as aggregate and lime based binders, which finds application for insulating walls, insulation layers for floors and roofs and, combined with a load bearing structure, for perimetral masonry. The aim of the study is to assess the environmental impacts of hempcrete bricks produced by the Italian company Equilibrium (www.equilibrium-bioedilizia.it) located in the province of Bergamo, and to understand the role that carbonatation could play in their LCA analysis.

2. Methodology

The LCA presented in this paper follows the methodology defined by international and European norms. The functional unit considered is the square meter of non-load bearing wall made of hempcrete bricks. Primary data are used for the production phases inside the factory (“from gate to gate”) and secondary data for the production of the materials used in the mixture of the brick. Three mid-point indicators are considered in the study: CML-IA Baseline, Cumulative Energy Demand and Greenhouse Gas Protocol. To extend the sustainability analysis of the hemp bricks wall from a “cradle to gate” perspective to a “cradle to grave” one, the operational phase of the system must be evaluated. Through the process of carbonatation, the wall can absorb carbon dioxide from the atmosphere and improve its environmental performances. The carbonatation of the hempcrete brick vs time was investigated via semi-quantitative X-Ray Powder Diffraction (XRPD) analysis. The phase composition of samples extracted at regular time intervals was studied, starting from the brick production up to 5 months (30, 75, 110 and 150 days). Thanks to the results obtained with the carbonatation analysis, it was finally possible to extend the sustainability study to the entire wall’s lifecycle.

3. Results and Conclusion

Thanks to the X-ray diffraction analysis on hempcrete brick samples, it was possible to estimate the amount of CO₂ that a hempcrete wall in contact with air absorbs in the first 5 months. After 150 days from bricks’ production and considering the whole material lifecycle, the ratio in terms of greenhouse gases’ emissions is 1.65 kg of CO₂ absorbed per kg of CO₂ emitted. The ratio could exceed the 2 kg CO₂ absorbed/kg CO₂ emitted if all the Ca(OH)₂ available in the brick carbonatated. In a functional unit of 1 m² of wall with bricks of 25 cm thickness with two sides exposed to air, the expected carbonation after 150 days is 1.7 kg of CO₂, about 9% of the maximum. Thanks to the results obtained with the carbonatation analysis, it was possible to extend the LCA study from a “cradle to gate” approach to a “cradle to grave” one. The LCA results indicate that throughout its lifecycle, the hempcrete wall has a net negative balance in terms of global warming potential. As regards to the other environmental impacts, the CML-IA baseline and the Cumulative Energy Demand results show that the calcination process in the lime production is the main contributor to the environmental burden.

Space for notes

How Future-proof Is Your Campus? Sustainability in the Real Estate Management of Research Organizations



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Summary

Some of the well-known research institutions in Germany want to comply with their social responsibility and support sustainable development. They are seeking to enforce an integral concept for enhancing sustainability in their business operations and develop practical advices for sustainability management and reporting in line with the specifics and needs of non-university organizations. An example is the “LeNa” (Leitfaden Nachhaltigkeitsmanagement, sustainability management guidelines) project. It focuses on the development and evaluation of strategies for establishing a future-proof campus, including the corresponding performance measurement and sustainability reporting instruments. Other important aspects are the levels and fields of action, a workmanlike provision of information and tools as well as accounting, and discussion of existing and supplementary assessment criteria that are to be applied in a transparent and comparable manner.

Keywords: CSR - real estate management - campus development - sustainability assessment - sustainability reporting

1. Introduction

Education and research institutions largely contribute to implementing sustainable development in a variety of ways. Their spectrum of tasks covers the generation of new knowledge, imparting of knowledge, and application and dissemination of findings. As they are institutions of model character in society, their responsibility also consists in making the own real estate management consider economic, ecological, and social aspects. Sustainability reports serve as both communication and management instruments. The acknowledged guidelines of the Global Reporting Initiative (GRI) may serve as framework regulations, on the basis of which the companies’ achievements in the area of sustainability can be evaluated. In addition, formal and contents-related aids are required for the education and research institutions to meet their specific needs.

2. Methodology

Under the “LeNa” (Leitfaden Nachhaltigkeitsmanagement, sustainability management guidelines) project, among others guidelines consisting of instructions, aids and tools are developed to implement a sustainable management of real estate as well as single buildings of campus areas, furthermore for sustainable planning and realization of new construction and modernization projects in interinstitutional cooperation with representatives of science, administration, and management. For sustainability assessment and potential subsequent reporting, indicators are formulated with respect to operational ecology, which is one parameter characterizing building management. Based on these indicators, the development of sustainability performance in an organization can be assessed.

3. Results and Conclusion

It is a major and superordinate task of real estate management to provide for an appropriate and future-oriented work environment tailored to specific needs. Sustainability-oriented real estate management covers all tasks of planning, building, using, and operating real estate. For relevant fields of action and topics, user-friendly aids in the form of fact sheets, case examples, and short reports are developed for the successful integration of sustainability aspects into conventional real estate management. Transparency and comparability are of decisive importance when describing energy efficiency and ecological quality of buildings. Hence, action-oriented fact sheets are complemented by assessment-oriented indicator sheets, by means of which selected aspects of operational ecology can be analyzed. The appending results will be shown at www.lena-projekt.de.

Space for notes

Impact of the Project Initialization Phase on the Achievement of Sustainable Quality in Building Projects in China



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Summary

The impact of the programming phase to the overall objective achievement and sustainability quality of building projects is assessed on three case studies. Key activities of the project initialization were deducted from a Reference Building Process Map. Deviations in the evaluation of process quality and added-value were analyzed. The results show that a structured project start with well-defined and communicated targets leads to smooth project progresses and high target achievements. Advantageous constellation of project participants and their homogenous understanding of the project targets may compensate gaps in the project initialization.

Keywords: programming, case study, Reference Building Process Map (RBPM), sustainable certification, China

1. Introduction

Sustainable certification is sought for in building projects worldwide as for a sign of quality. In China especially, international certifications are considered as a premium label, superior to the local status-quo. Yet, to ensure reaching the targeted quality, a process management is needed all along the planning and construction process. It appears that Programming – a well-structured project initialization phase where goals and project frameworks are defined – is still often lacking in China. Significant gaps may result from this shortage, which can lead to quality deficiencies. To avoid these deficiencies, the impact of the execution quality of the Programming activities on the overall project outcomes is investigated on both theoretical and practical grounds.

2. Methodology

To investigate the detailed composition of the programming's contents, the process evaluation tool Reference Building Process Map (RBPM) was used. It contains the process steps needed to manage the development of buildings to a defined quality. These were reviewed against the literature to ensure their relevance for deriving a best practice Phase 0 reference set of activities.

Three real cases in China were then studied. First, they were evaluated on their overall project quality: outcomes were assessed disregarding the process flow. Second, the real flow of activities during the projects was documented. On one side, activities were evaluated considering their added-value to the overall project, on the other side, the activities' execution quality was evaluated. Last, activities showing the most discrepancies in their evaluation grades were considered closely.

3. Results and Conclusion

The literature review has validated the specific activities included in the RBPM. An own set of activities was compiled for the initialization phase, contributing to good objectives and process quality. Once fed back with the practical results into the RBPM, it provides a structured process management tool with guidance for using building certification systems from the project start.

In practice, sustainable building quality gaps due to poor process quality were identified in the case studies. It was shown, that the initialization phase is critical for the achievement of sustainable building quality. Lessons learned were yet derived on how a well-organized initialization phase can affect the achievement of overall objectives. Among others, setting and communicating clear goals to the design team appeared as a key process for securing the sustainability quality. Yet, specific support for formulating the targets is often missing. Results produced at each stage also lack follow-up to get the most value of it. Thus, a framework for monitoring the project quality is required. Further research should focus on tools to answer these problems. The "Corridor Approach" and the Validation and Verification method are potential solutions to be tested.

Space for notes

Implementation of Sustainability Success Factors in Processes of Portfolio Management



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Sustainable products reduce the risk for suppliers, consumers, the environment and society. They also pay off in another way, by creating opportunities for long-term growth and capital appreciation. The existing triad of risk, return and liquidity is increasingly being combined with the triad of ethical, environmental and social standards. This is particularly the case for investors in open-ended real estate funds. The sustainability characteristics of real estate portfolios are therefore becoming increasingly more important for investors. Many commercial tenants consider rental property certification a necessary condition for concluding a lease agreement. Occupying an appropriately certified property also helps companies achieve their own sustainability goals. Sustainability characteristics are increasingly joining other criteria – such as location and the "war for talents" – in determining the long-term competitiveness of individual properties and are therefore becoming more economically relevant. This must be appropriately reflected in fund and property strategies. Especially portfolio investors, tenants and public sector ask for clear sustainability strategies in order to fulfil their own sustainability requirements. Based on the portfolio strategy and its planned holding period of a building in the investment fund, portfolio management processes are linked to the lifecycle during this holding period. Therefore, one core element of a sustainable portfolio management strategy should be the focus on sustainable buildings during acquisition and the improvement of their sustainability during holding period. Larger companies of commercial real estate investors are facing in practice often the challenge provided, but are very much data that can be used for the measurement of sustainability, but a systematic treatment of this data and its integration capacity is not known. On the other hand, substantial data but again lack critical key locations.

Sustainability related factors play an essential role in nearly all processes and can influence the success of the management. Overall, a functional real estate risk management should exist that recognizes sustainability related factors and implements them in the continuous risk assessment. Sustainability is a process which concerns all stages of value added. The notion of sustainability is now an integral part and cause of many discussions in the real estate industry worldwide. This, in addition to providers of real estate-related products and construction services providers, including associations, science and politics are involved. Nevertheless, the process of defining sustainability how it can be measured and on which areas it can be applied is still not finished. In many cases sustainability is considered real estate focused on the individual building rather than a process that affects all stages of value added and thus helps to ensure the economic performance of providers in the long term. Key point of discussion is the question of the efficiency of measures to enhance the sustainability, because often only

insufficient "safe" yields can be generated in comparison to the generally well discoverable costs.

Sustainable products reduce risks for providers, the environment and society. At the same time, they open up opportunities for long-term growth and value creation — and pay off this twice. Increasingly, social, ethical and ecological standards form an inclusive triangle to the existing rate of return, risk and liquidity. Within sustainable production the real estate / portfolio management as well as the risk management are of central importance.

In addition to the real estate portfolio, another essential factor for sustainable products is an appropriately aligned and integrated risk management to ensure the sustainable carrying capacity of risks. Therefore, real estate funds invest according to the principle of risk spreading. For the selection of properties for the Fund its sustainable profitability as well as the scattering according to location, size and use is a major point that has to be recognized. These are the conditions that ultimately the producer itself in terms of its shareholders and other stakeholders sustainable stock and can meet the expectations placed on him in the future. Continuous development of responsibility and adaptation to the market conditions on all levels of a company to business management makes an important contribution to the increase of corporate value and stands for a sustainable business model in terms of customers, shareholders and the environment.

Space for notes

Improving energy performance: many small interventions or selective deep renovations?

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Abstract

Since the implementation of the EPBD, energy efficiency is a matter of great concern in the Dutch non-profit rental housing sector. In 2012 *Aedes*, the national umbrella organisation for housing associations (which almost exclusively own the non-profit housing stock in the country), signed a covenant with several other national bodies, in which it agreed to attain in 2020 an average energy performance rate for all homes in the non-profit housing sector within the bands of label B. In the Netherlands categories ranging from A++ (very high energy efficiency) to G (very low energy efficiency) are used. Label B can thus be seen as a high standard.

Since 2010, a monitor is operational that follows the improvement of the energy performance of the Dutch non-profit rental housing stock on a yearly basis. Results from this monitor show that this improvement is too slow to attain the agreed level in 2020. Although more than 35% of the homes have undergone an improvement of the energy performance in only three years (2011, 2012 and 2013), deep energy renovations are rare and most improvements are small. In half of the improved dwellings, only one single measure is applied. Advocators of deep renovations nevertheless believe that such improvements are the most appropriate way to substantially reducing energy consumption and argue that the developments and proliferation of energy renovation concepts is the best way forward. Others, however, do not see this as realistic and argue that reality forces us to proceed on the path of small interventions. This explorative study sheds more light on this debate from the way in which housing providers conceive and implement their portfolio and asset management strategies. From these investment policies, it seeks explanations for the dominance of the small interventions and investigates the room for a more concentrated allocation of budget resources.

For the study 12 housing associations have been selected and interviewed. We did not apply a random selection, but selected housing associations from which we, on the basis of professional platform membership or earlier investigations, expected more advanced energy investment policies. At each organisation, we spoke with persons which were responsible for the implementation of energy policies into investment planning, for example heads of real estate planning. The interviews took place in October 2015; one interview was conducted in November 2015.

Most interviewed housing associations applied the national covenant agreement of an average label B for the whole stock in 2020 directly to themselves, and/or strived to having phased out the most

energy-inefficient dwellings in about the same year. Some housing associations, however, stated that they had lower targets, because their financial means would be insufficient.

Except from the replacement of boilers and so-called “open” heating installations (e.g. geysers, gas heaters) energy investments are combined with other more or less planned forms of investment, notably renovations (mentioned by 10 out of the 12 selected organisations) and planned preventive maintenance (mentioned 9 times). Combination with void repairs was also mentioned, but less often (5 times). Important to note is that housing associations can be highly selective in the measures that they take: building elements are usually replaced at the end of their lifespan, meaning that early write-off hardly takes place, even if this would result in an improvement of the energy performance. Especially this is an explanation for the small number of measures per home.

The interviewed housing associations think different about including deep energy renovations. Some of them reject these investments, mostly because of the costs, others argue that different homes should be treated differently, and argue that deep energy renovations can be executed if the technical and market prospects of the respective dwellings allow this. These organisations carry out experiments with zero-energy renovations or plan to do so in the near future.

It can be concluded that the investment practice of housing associations shows little room for acceleration of energy performance improvement in the non-profit housing stock on the short term. Deep renovations are mostly seen as innovations, which could be suitable for individual experiments, but not (yet) for wide application. This may change when these kinds of renovations will be more generally recognised, but to date this is not the case. It would be helpful that zero-energy renovations, which are still in their infancy, but are developing rapidly, will continue to follow the current trend of decreasing expenses.

Keywords: portfolio management, asset management, non-profit, housing, energy performance

Space for notes

Improving energy retrofit strategies with definitions of human interaction parameters in residential building

Extended Abstract



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Summary

This paper presents a review of the most common strategies for renovation of buildings and suggests some possibilities based on the energy performance and the interactive potential for human well-being. The main objective of the project is to establish a guideline for energy retrofit assessment. More analytical methods are needed to discuss about variable parameters which play a significant role in the creation of a proper assessment for designing and evaluating energy retrofit systems that addresses the complexity of human needs in buildings. It seems that unfortunately existing retrofit perspectives are insufficient. As a result, this research aims to create such an effective and practical basis by considering the relation between different technical parameters and human well-being.

Keywords: retrofitting, energy efficiency, human needs, integrative performance, windows replacement

1. Introduction

Retrofitting is an effective method for improving energy efficiency of the existing buildings. Building energy retrofitting depends significantly on the criteria affect health, productivity and comfort of the occupants also used for the indoor environment (temperature, ventilation and lighting) and building (including systems) design and operation. In the retrofitting, the interaction between psycho-physiological and sustainable built environment should be taken into account, as well as considering features related to energy performance and architectural aspects, and also human needs and well-being.

2. Methodology

According to the existing literature, upgrading U-values of a building envelope and windows is the most approaches in many retrofitting strategies. Replacement of the windows is attributed to re-

duce the heat and energy demand. However this strategy needs to include the design elements depending on window's condition which is consequences of physical measures such as size, type, orientation and other elements of a window. The impact of these elements on energy performance and more importantly on human comfort, health and well-being is considered. While, this method offers benefits regarding managing and optimization of a building retrofit project, but still a wide range of studies are needed for an integrated assessment method.

3. Results and Conclusion

The goal of this paper is offering a deeper insight into retrofit perspectives in order to reinforce the links between technical performances and other fields that deal with psychophysics or related to comfort-based and well-being aspects of human life. This goal includes some different performances of a building, like performance in lighting or thermal comfort. Each performance should be studied in terms of its relevance and interdependence on user satisfaction. This research reviews the performance of a building's elements regarding human needs. Although a great deal of this objective and development toward the advancement of the systems approach remains to be accomplished.

Space for notes



Increase in Efficiency and Quality Control of Construction Processes through Off-Site Fabrication



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Summary

This paper compares and assesses modular prefabricated building systems according to material use, process efficiency, ecological potential, i. e. sustainability of construction processes, and market relevance. To provide a holistic overview of the current market situation, two best practice examples are examined and evaluated. Covering favourable materials and prefabrication methods essential for the development of sustainable, cost-efficient housing, selected projects comply with current and future energy efficiency standards in construction. Due to systemized planning strategies and optimized utilization of materials, recyclability properties of buildings and their parts enhance significantly. Furthermore, prefabrication processes contribute to the reduction of waste. Beyond achieving ecologically and economically advanced processes, prefabrication enables technical improvement of manufacture by simultaneously increasing the quality buildings and their parts.

Keywords: Off-Site Construction Processes, Prefabrication, Integrative Planning, Resource Efficient Fabrication

1. Introduction

Rising global population growth and urban migration rates are indicators of a continuously increasing demand for housing. Higher building densities and compact building designs are essential to reduce associated land use as much as possible. This paper describes how current building production techniques must rapidly change in order to accommodate these factors.

Examining methods of the prefabrication industry, key aspects of modular building processes for residential construction are conveyed and highlighted. Serial manufacturing methods and automated processes are assessed and evaluated to categorise indicative workflows, outlining advantages and shortcomings. Thus, transfer strategies of technological analogies for industrial construction are defined.

2. Methodology

The following research compares two modular building systems of similar size. For a boarding house in Neuhausen (Germany), construction methods combine in-situ concrete and modular timber prefabrication. For the student-housing block in Sant-Cugat (Spain), precast concrete cells are used to generate a two-storey building structure.

This paper focuses on the assessment of construction systems and material performances. Technical properties, behavioural aspects, manufacturing and assembly processes of buildings and their components are essential for the ecological, economical and technological optimization of buildings and their design. The analysis identifies joints and transition areas of structure, building envelope and technical services. Outlined projects in modular construction exemplify the manufacture of building components following smart assembly and disassembly strategies that contribute to efficiency enhancement of building and construction processes.

3. Results and Conclusion

The coherence of materiality and building structure remains significant for the valid evaluation of current construction methods. The optimisation of buildings regarding fabrication process and structural systems requires an integrative approach to architectural design. The interrelation of building systems, technologies, and functional and environmental aspects is significant to define valid statements for the development of progressive architectures.

The modular design approaches enable high efficiency of production and assembly, and lead to significant time and cost savings. Controlled operations and monitoring of workflows contribute to increased security on site, and at the same time reduce waste and water consumption. Finally, the modular structures enable easy exchange and removal of individual components; thus straightforward restoration and changes regarding future building modernization are provided.

Due to shifting the majority of processes from the construction site into the production hall environment, time and cost savings are achieved. Compared with the conventional construction in-situ concrete or masonry savings of up to 60% are expected. As a consequence, the overall energetic optimization of processes is provided.

Yet, the comprehensive assessment requires consideration of the structural materials, significantly influencing a building's ecological performance and technical properties. Compared to the use of wood products, concrete affects the primary energy balance, and leads to substantial limitations regarding the weight of the modules. Depending on size and dimensions, the units weigh up to 45 tons, requiring heavy-duty transport and special equipment for on site works. Ranging between 5 to 6 tons, the timber modules facilitate assembly and installation procedures, as well as transport and logistics.

Space for notes

Innovative building technologies and technical equipment towards sustainable construction – a comparative LCA and LCC assessment



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Short Summary

Sustainability assessments of buildings have become more and more common. They include the assessment of environmental and economic performance. However, the influence of construction technologies and their technical building equipment as well as the way in which they vary depending on different energetic standards have not been described systematically in literature. For this reason, we evaluated the influence of these aspects and the impact on the environmental and economic performance of residential buildings. The comprehensive results show a high optimisation potential for the life cycle performance of buildings in general. However, variation of the technical building equipment and energy standards lead to a higher improvement potential than the use of different construction techniques. Results also indicate that the use of a plus energy standard does not prove to be optimal in all cases.

Keywords: Innovative building technologies, LCA, LCC, technical building equipment

1. Introduction

The building sector is responsible for approximately 40% of primary energy and about 24% of greenhouse emissions, both in Europe and globally. Therefore, the international energy agency (IEA) and the European Commission (EC) aim to achieve an 80% reduction of global emissions by 2050. In the past many articles were published on the energy performance optimisation of buildings. However there is now a clear trend of investing in the design of more energy-efficient buildings, and paying more attention to the embodied energy and related embodied impacts of such building concepts, taking the whole life cycle in to consideration (e.g. the activities of IEA Annex 57 and CEN/TC350). In the current literature on LCA on buildings a cross building related assessment of different energy standards and the influence of technical and/or different construction materials can hardly be found [1]. There is also no systematic description of the influence of construction technologies and technical building equipment on the variation of different energetic standards (e.g. low energy, nearly zero energy or plus energy). For this reason, we evaluated the influence of these aspects and the impact on the environmental and economic performance in the case of a single-family house, which served as case study.

2. Methodology

The aim of the paper is to analyse the economic and environmental performance of the case study using the methods of Life Cycle Assessment (LCA) and Life Cycle Costing (LCC). These methods are used to quantify the difference in design options, by using different construction materials, different energy systems and different energy standards. The whole variety of different combinations shows 45 scenarios, which were evaluated on their life cycle performance. The assessed scenarios consist of four main construction types (brick, concrete, wood-chip concrete and prefabricated timber wood construction) in combination with different energetic standards (low

to plus energy) as well as different technical building systems (pellets, heat pump, solar heating and photovoltaic) [2], [3].

3. Results and Discussion

The results of the environmental performance are shown in figure 1. The different life cycle stages (A1-A3, B4, B6 and C3-4) are highlighted in different colours.

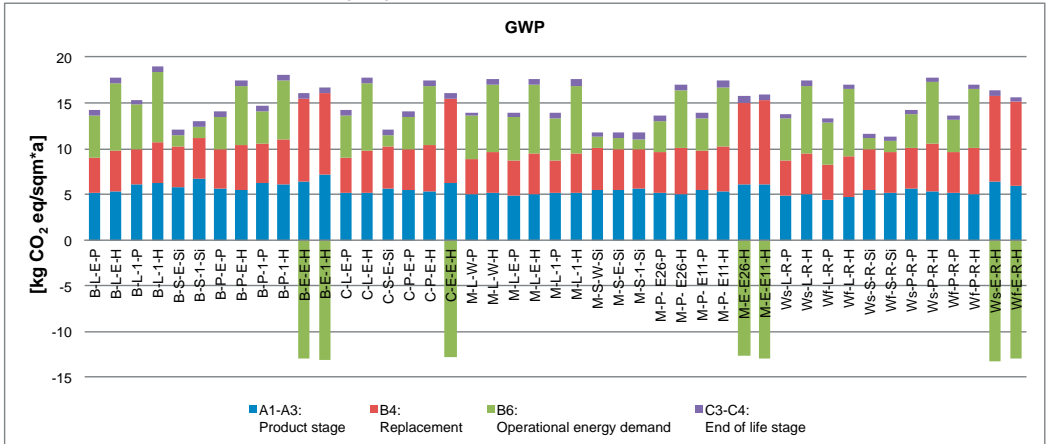


Fig. 2a Global Warming Potential [kg CO₂/m²a]

4. Conclusion

The comprehensive results show a high optimisation potential for the life cycle performance of buildings in general. The results indicate that the choice of different construction technologies and building materials does not lead to as high an improvement potential as the variation of the technical building equipment and the energy standard. However, in every case the results show an increasing importance of material related embodied impacts. Due to the current trend towards more and more energy efficient buildings, the role of materials within environmental assessments will increase dramatically and should therefore be researched more precisely.

In the case of the plus energy buildings, the authors recommend evaluating the aspect of primary energy factors and LCA allocation rules for delivered and exported energy in detail, as the results of the environmental performance can change with different scenarios.

Regarding the sensitivity analysis of the results of the environmental and economic performance, the authors do not agree with the definition of the functional unit on a gross floor area, which is standardised for economic calculations, as the results differ with highly insulated buildings due to the increase in wall thickness. This fact should be evaluated in more detail.

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Institutional conditions for sustainable private sector-led urban development projects: A conceptual model



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Summary

Across the globe sustainable private sector-led urban development projects (SPUDPs) in the built environment rarely commence as real estate developers face several institutional barriers which limit their capacity to develop economic-viable, social-responsible, environmental-friendly urban places. Hence, SPUDPs are a promising development strategy for cities as the scale of such projects could be an effective means to integrate public planning policies and private development decisions with a broader social impact as opposed to solely developing sustainable buildings. However, it is largely unknown how SPUDPs can be effectuated as insight is lacking into institutional conditions that could incentivise real estate developers to make decisions for sustainable urban development practices. This paper explores the institutional conditions, in particular the policy instruments from local planning authorities, that nudge private decision-making to realise SPUDPs, by means of a literature review resulting in a conceptual model. The paper reveals that developers can be incentivised by pro-active local planning bodies using a combination of planning policy instruments which foster a sustainability-sensitive market decision-making environment.

Keywords: sustainable urban development projects, institutional conditions, real estate developers, local planning authorities, market decision-making

1. Introduction

Despite the ample opportunities for developing sustainable urban places, it remains largely unknown which institutional conditions support real estate developer decisions to realise sustainable private sector-led urban development projects (SPUDPs). This poses questions about how SPUDPs can be effectively delivered by setting the 'right' institutional conditions for market actors. Therefore, the main question this paper addresses is: *Which institutional conditions for delivering sustainable urban development projects can be identified by linking planning policy instruments to markets decisions?*

2. Methodology

This paper is based on a preliminary literature review of real estate, urban development and spatial planning literature regarding sustainability. Goal of the literature review is to define the institutional conditions for delivering sustainable urban development projects, which consist of aligning barriers for private decision-making with incentives attributed to public planning policy instruments.

3. Results and Conclusion

The table indicates how planning policy instruments can create incentives for real estate developers to make favourable decisions about investing and delivering sustainable private sector-led urban development projects by linking them to barriers experienced within the real estate development sector. The findings reveal that many and various barriers for sustainable private decision-making need to be overcome, but that the development industry – once consciously, pro-actively and comprehensively steered by planners – might take a more active stand towards contributing to a more sustainable built environment. These preliminary findings and insights generated can assist academics and practitioners to explicitly explore and better conceive of the real estate industry’s role in delivering sustainable urban places.

Policy instruments	Impact on market decisions	Sub-types and examples	Incentive created	Barrier overcome
Shaping	Shape decision environment of development actors by setting broad context for market actions and transactions	Development/investment plans <i>Development/investment priorities</i>	Brownfield development sites	Lack of policy certainty
		Regulatory plans <i>Statutory land-use plans, mandates</i>	Formal sustainable requirements	Lack of commitment
		Indicative plans <i>City sustainability visions, policies</i>	Synchronisation of policies	Lack of imagination/vision
Regulating	Constrain decision environment of development actors by regulating or controlling market actions and transactions	State/public regulation <i>Planning permissions, building permits</i>	Formal sustainable procedures	Lack of consistent rules
		Contractual regulation <i>Tenders, development agreements</i>	Certain development directions	Lack of power/influence
		Direct state action <i>Brownfield land acquisitions</i>	Competitive advantages	Lack of market support
Stimulating	Expand decision environment of development actors by facilitating market actors and transactions	Price-adjusting instruments <i>Taxes, charges, loans, grants, bonuses</i>	Improvement of cost-benefit ratios	Lack of financial benefits
		Risk-reducing instruments <i>Certifications, measurement tools</i>	Investment in certified buildings	Lack of demand/benchmarks
		Capital-raising instruments <i>PPPs, investment funds</i>	Leverage for sustainable investments	Lack of social-eco benefits
Capacity building	Enable development actors to operate more effectively within their decision environment and so facilitate the operation of other policy instruments	Market-shaping cultures <i>Sustainable behaviour subsidies</i>	Increased responsibility/awareness	Lack of responsibility
		Market-rich information <i>Sustainability best practice promotions</i>	Insight in proved practices	Lack of empirical prove
		Market-rooted networks <i>Business/community networks</i>	Increased participation/innovations	Lack of governance
		Market-relevant skills <i>Sustainability education/training</i>	Development of learning skills	Lack of expertise/knowledge

Space for notes

Integrating Climate Responsive Principles into the Design Process: Educating the Architect of Tomorrow

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Summary

In the 20th century the world hailed a new type of construction. Following modernists' theories for minimalistic and functional buildings, a contemporary unified style based on standardization evolved into the International Style buildings. Steel, concrete, and glass-wall high rise buildings respond neither to different functional demands nor to different urban environments and climates. Such design choices influence thermal comfort and potential for natural ventilation negatively. Compensation with AC leads to higher energy consumption.

In times of vigorous debate about rapid climate change this architectural style threatens the ecological equilibrium. Nowadays, the architect's role should be to design energy efficient buildings embedded in sustainable urban environments. Therefore, the need for corresponding principles and strategies must be included in an academic curriculum to shape conscious architects. The paper reports about experiences from a university course. It starts with an analysis comparing an international style office room and an optimized one at 14 locations worldwide covering all main different climates. The used different tools combining energy and design aspects are presented as well as results and conclusions for the design process. Furthermore, the desire and fitting time for using climate responsive principles and the manageability of the multiple stages of design are tested through surveys distributed to students in construction-related disciplines.

Keywords: Climate responsive architecture, energy demand, architectural education, design strategies, international style buildings

1. Introduction

There is no "recipe" for one building in all climates and locations. Instead, climate environmental and spatial data significantly influence the design decisions and shape final sustainable solutions. This idea has been challenged many times by buildings with same characteristics regarding form, material and type of construction and appeared in many areas globally, despite differences in climate, cultural reference and geomorphology of the surroundings. The alienation of construction from place results in buildings with high energy demand and consumption.

Currently the building sector shows an increasing interest towards the application of Climate Responsive Design Principles thus architects equipped with relevant competences. This suggests that the departments of architecture and others related to building environment should play a decisive role in shaping the architect and planner of tomorrow.

2. Methodology, Results and Conclusions

The study reports the experiences of students in the master program Resource Efficiency in Architecture and Planning at HafenCity University with climate responsive design and planning principles during a semester's course. It addresses the problematic nature of International Style buildings regarding their energy consumption. Additionally, it challenges the participants to place such a building in different climates and urban contexts and optimize it to the point it becomes part of a Zero Energy Building (ZEB). Participants realized that optimization of an International Style building with passive measures presupposes alterations on design, type of structure and application of passive measures based on the analysis and requirements of local climate.

Based on the positive response from the course participants and their reported future commitment to the principles, a second part of this research seeks to further investigate the level of knowledge, understanding and interest of other HCU students and whether Climate Responsive Design and Principles (CRDP) are part of the academic curriculum of all disciplines in the University. The research was conducted with the help of a questionnaire distributed to all HCU students.

The course demonstrated that CRDP along with a site analysis resulted in an adaptive, unique and pleasant building which responded to an existing urban context. For many participants, the course also created a correlation between ideas and principles already taught empirically in architectural design and planning. Additionally, it provides a tool kit for future. Finally the survey revealed commitment to implement CRDP but a lack of understanding. The majority of the students feel they need to be better informed and that there are not enough courses related to the matter in their current studies. Although many departments of architecture have realized the necessity of nurturing architects and planners with environmental related competences, additional efforts must be made in order to create a greater awareness. Suggestions include that the learning process of CRDP can be fostered through small scale projects and through a better integration of technical courses of the curriculum into practical and designing studios.

Space for notes

Integrating Urban Ecodesign in French engineering curricula: an example at École des Ponts ParisTech



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Summary

In the era of climate change and energetic transition, industrial players are driven to adapt their activities. Eco-design has emerged as a major approach to enhance the environmental performance of products as well as services. Yet it still needs to be developed for complex issues such as neighborhood development and urban planning. This is the very objective of the academic Chair on the Eco-design of building sets and infrastructure that was established in 2008 by ParisTech and Vinci, the well-known leading group in construction and infrastructure operations. The chair involves three schools with different specializations within ParisTech: “Mines” deal with energetics, “Agro” with biodiversity and urban agriculture and “Ecole des Ponts” (ENPC) with transportation and urban development. The paper presents a one semester full-time specialization training for master students launched in 2014 at Ecole des Ponts. The curriculum, targeted to the “eco-design of sustainable cities”, is in two main parts: on the first hand, four specialist courses deal with spatial design, evaluation, urban modeling and big data, respectively; on the other hand, an intensive group project targeted to eco-design a sustainable neighborhood. The paper presents first the context of engineering education in France and its orientation towards sustainable development of cities, then the principles of the education program; next, details are provided about the specialist course in evaluation, which is based on Life Cycle Assessment, then on the intensive group project and the topics it addresses in years 2014-2015 and 2015-2016. Lastly some lessons and perspectives are drawn.

Keywords: eco-design, engineering curriculum, industry-academic partnership, built environment, transportation

1. Introduction

Ecodesign is an approach to designing a product or service that focuses on greater economy of resources which is gradually spreading into all sectors of economic activity, reflecting a general and growing awareness of sustainable development issues. Training student engineers in ecodesign, to prepare them for their careers serving companies and society, is an aspiration particularly crucial at ENPC. It even poses a major challenge to the school: training students in ecodesign in its traditional city related sphere requires recognition of its hyper-complexity and consideration of it in the design methods taught. The challenge was taken up in 2014 with the creation of a specialist subject, the “Ecodesign of the sustainable city” (ESC) specialization, in the 2nd year of the Masters program in urban (including mobility) and environmental engineering. This article describes the knowledge, skills objectives and pedagogical architecture of ESC with a project playing a central role. Then, five sections explain: the previous situation with regard to

sustainable development in the ENPC curriculum (Section 2), principles of the ESC specialization (Section 3), a description of a dedicated support course (Section 4) and of the intensive group project (Section 5). We conclude with a provisional assessment and suggestions (Section 6).

2. Training in sustainable development in an engineering school

Every year in France, around 20,000 student engineers are awarded degrees. École des Ponts ParisTech (ENPC) belongs to the elite schools. Since its foundation in 1747, it has trained students to become civil servants in the ministry for public works and transportation infrastructures, then for urban planning. Since 2007, the ministry's remit has been expanded to include sustainable development. What still needed to be taught was a hard core of concepts and methods relating to the economy, society and the environment. That has been the ambition of the VET (standing for City-Environment-Transportation) faculty department in the Masters program, since its formation in 2002 at ENPC to deliver an in-depth curriculum focusing on sustainable development.

3. The new specialization in Ecodesign of Sustainable Cities (ESC)

Created at ENPC in 2014, it consists of specialist modules (support courses) and of an intensive group project, about one half each in the first semester of the second-year Masters program (M2). There are four support courses, each of which cultivates a particular skill: Life Cycle Assessment of Urban Transportation Modes (see Section 4), urban modelling methods, Spatial Design, and big data. The intensive group project aims at pooling sectoral skills around a joint application. In 2014-2015, the first project was simplified to test the students' ability to handle an extended range of knowledge input. The task was to design an overall assessment for the concepts, products and services focused on the theme of the Sustainable City by organizations and companies located at Cité Descartes, a scientific campus in Greater Paris. On the basis of the first year, the assessment of the ESC specialization is very largely positive, both for the students and the researchers who taught the courses and the intensive group project. We infer that the young engineers who have experienced this new training can more quickly access responsibility as heads of development projects, and therefore as operation coordinators. According to the design offices which recruit engineers trained by ENPC, this coordinating engineer profile is nowadays only too rare, and therefore much in demand. By adopting it, our young engineers will make themselves useful not only to their employers, but also to society, by reinforcing the effectiveness of public action

Space for notes

Integration of building performance simulation tools in an interdisciplinary architectural practice



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Summary

The aim of this paper is to explore how a large architectural practice categorises, evaluates and embeds building performance simulation (BPS) tools, into its work practices. The paper outlines the process of identifying tools in an interdisciplinary project environment, evaluating their potential use in different types and stages of a project and how their use is integrated into workflows.

Results of the paper show that the selection and application of BPS tools in practice corresponds to a significant degree with previous research. It also demonstrates that the lack of independent comparison of BPS tools leads to significant costs for practices with regarding to selection of which tools they should use. A key recommendation would be a creation of third party comparison of tools, with results open to all and continuously updated, in order to reduce this cost.

Keywords: Practice, building performance tools, daylight, energy, organisation

1. Introduction

An ever increasing demand exists for architectural practices to adopt digital design tools to inform design. Among them, Building Performance Simulation (BPS) tools allow simulation of a building's performance with regard to several metrics, mainly energy, daylight, thermal comfort and solar irradiance. Increasingly buildings are also subjected to various third party building certification schemes, such as LEED and BREEAM and the Swedish system Miljöbyggnad, which require quantifiable energy and daylight calculations in order to show compliance.

In order to meet these demands, architectural practices must select appropriate tools and then integrate their use into their existing project workflows.

2. Methodology

Using case study methodology this paper investigates how the selection and integration of BPS tools at a multidisciplinary architectural practice conform to recent research conducted in the field. The paper explains the background of the case, a large Scandinavian practice and the authors, who are employees working as sustainability specialists. Firstly the paper examines the literature relating to the BPS tools and then considers how a recently conducted evaluation of a BPS tool compares to the different evaluation criteria proposed by academic researchers. Further to this the paper also investigates the workflow processes which are used to enable the use of an existing BPS tool, and how this organisation is connected to the different methodological approaches which have been identified.

3. Results and Conclusion

White has carried out its own evaluation of a BPS tool as there does not currently exist an independent comparison model of the different BPS tools available. This paper shows that the selection of an appropriate BPS tool for a multi-disciplinary architectural practice broadly follows BPS tool selection criteria identified by researchers. Criteria related to costs, support and maintenance also play a role.

The integration of BPS tools into projects results in a workflow which reflects a scenario by scenario approach. A future move towards a more parametric approach will therefore require that the workflow is adjusted in order to reflect the differences in approach.

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Investment vs. subsequent costs - the significance of occupancy costs in real estate life-cycle

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Summary

Occupancy costs represent a substantial proportion of the expenditures incurring over the life-cycle of real estate and play a decisive role to ensure economical sustainability. Based on the evaluation of empirical data, the main objective of the current approach is to examine the monetary significance of occupancy costs in comparison to construction costs for various types of facilities. Therefore, the temporal progression of these cost types is illustrated and the point in time when occupancy costs exceed construction costs is identified. A change of value over time is considered by application of the net present value. To reduce uncertainty, scenarios with discount rates of 1.5% and 5.5% are examined. The main findings reveal a wide range of possible results. Occupancy costs exceed construction costs after between 20 years (care retirement homes) and 42 years (church buildings) applying a discount rate of 1.5%. For a discount rate of 5.5%, an intersection can be identified after between 36 and more than 250 years. Though the results are highly depending on the employed discount rates, the significance of occupancy costs in the life-cycle of real estate is verified in the current study.

Keywords: Comparison, construction costs, life-cycle costs, subsequent costs, occupancy costs

1. Introduction

To ensure economical sustainability it is a crucial task for all participants involved in the planning process to determine all regularly and irregularly incurring costs (life-cycle costs) associated with a building from the beginning of the planning over the construction (investment costs) and the occupancy until the reclamation or demolition (subsequent costs). The current approach examines the significance of occupancy costs in comparison to construction costs for various types of facilities based on the evaluation of empirical data.

The main objectives of the current study can be summarised as follows:

- Examination of occupancy costs' proportion to construction costs.
- Illustration of the temporal progression of these cost types over a time period.
- Determination of the point in time when occupancy costs exceed construction costs.
- Consideration of a change of value over time for costs incurring in the future.
- Identification of robustness by variation of input parameters.

2. Methodology

The net present value is applied as a method to consider the value of occupancy costs incurring in the future. Consequently, the discounted value of occupancy costs over a number of time periods is compared to construction costs in the current approach. A change of price level over time is considered by application of escalation rates. Two extreme scenarios with different discount rates of 1.5% and 5.5% are examined in order to demonstrate a wide range of possible results. The approach is based on the analysis of construction cost data including 620 observations provided by the Cost Information Centre of the German Chamber of Architects (BKI). Furthermore, operating cost data consisting of 231 observations is employed, based on a data collection conducted in the years 2008 until 2014 in Germany. The net present value is calculated for all possible combinations of the available observations to consider the range of cost data and reduce uncertainty of calculation.

3. Results and Conclusion

The main findings reveal a wide range of possible results. The annual shares of occupancy costs on construction costs vary between 2.4% for church buildings and 5.0% for care retirement homes applying a discount rate of 1.5%. For a discount rate of 5.5%, the annual shares vary between less than 0.4% and 2.8%. Despite the fact that the results are highly depending on the discount rates for the calculation of the net present value, the significance of occupancy costs in the life-cycle of real estate can be verified in the current study. Nevertheless, the quality of the presented results may be improved by extension of the data sample. Further approaches may include additional facility types (e.g. laboratories, industrial buildings, medical buildings, health service facilities) for an analysis. Furthermore, future research may extend its focus on regularly and irregularly incurring repair costs as a substantial part of occupancy costs.

Space for notes

LCA, EPD and Labels – How to Select Green Building Products?



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Summary

Environmental labels Type III according to ISO 14025 (Environmental Product Declaration/EPD) and labels Type I according to ISO 14024 (Environmental labels) specify criteria to support the selection of sustainable building products. Although industry and politicians prefer environmental declarations, environmental labels demonstrate their greater suitability in the tendering process: They provide the procurement bodies (both private and public) with sustainability criteria that reflect public consensus as well as the corresponding proofs. This is the finding of a current research study that provides public authorities with appropriate procurement guidelines.

Keywords: EPD, Labels, LCA, Market Change, Green Public Procurement

1. Introduction

The EU Public Contracts Directive 2014/24/EU has made it possible to use the process of awarding contracts in the building sector to support social and environmental objectives. In future it is possible, and intended, that sustainability criteria can be included in every phase of the procurement process by public bodies and private investors. This requires that goals are defined and evidence procedures established. Both EPDs and labels facilitate the process of selecting sustainable products. The question arises of just how suitable these are in supporting all those involved in the procurement process and motivating them towards sustainable procurement.

2. Methodology

At a natureplus e.V. specialist conference in May 2015, 11 life-cycle assessment specialists from 7 countries analysed the practical difficulties presented in finding clear product selection guidance when comparing products based on EPD data. Numerous national life-cycle assessment programmes as well as different software programs lead to incompatible results.

In a natureplus e.V. research project supported by the German Federal Government, completed in 2015, the sustainability characteristics of 21 Type 1 environmental labels from 8 European countries were compared. 62 characteristics in the areas of the restriction of harmful substances, resource and environmental protection as well as social criteria were identified as appropriate for the tendering process.

3. Results and Conclusion

Life-cycle assessments (LCA) provide a holistic overview of the environmentally relevant product characteristics. Their publication in the form of an environmental declaration (EPD – Type III Label) has recently been regulated through EN 15804 and shall, according to CPR EU 305/2011, become part of the product accreditation and CE marking. However, the different national EPD programmes – also due to the various software – have, as yet, failed to provide comparable results suitable to select “Green Building Products”. The use of generic data, favoured by industry, has also prevented a comparison of products. A product evaluation is, in any case, not part of the framework of an EPD and important product characteristics are not included in an EPD. They are not aligned to compare products but constructions and thereby contribute little in facilitating the selection of ecological products.

Type I environmental quality labels are often criticised as being single-issue-based and not providing a holistic product overview. In the meantime however, a number of Type I labels include numerous criteria in the areas of the environment, health and social standards and even use life-cycle assessment methods in evaluating products. These criteria are relevant to procurement bodies for two reasons: On the one hand they represent a level of societal consensus which provides the investor with valuable information on feasible sustainability goals and, on the other, they facilitate the proof of such aims for all those involved in the tendering/procurement process.

In a project funded by the German Ministry for Construction, natureplus has developed tendering process aids for 6 building product groups relevant to interior applications (gloss paints/oils, wall paints, floor coverings, insulation materials, wood-based materials, plasters/screeds) which contain up to 62 sustainability criteria and which comply with the stipulations of the public procurement directive. They contain criteria on environmental and health-related product characteristics which can be verified by non-expert participants and which are also fulfilled by a number of products available in Europe. 21 relevant environmental labels, in addition to other documentation, are used as proofs. The aim is to further promote the procurement of sustainable materials.

Space for notes

Learning by Doing



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Summary

The seminar “Materialization 2 – Construction Site Visits“ which was held in the 2014 summer semester at TU Graz, was about teaching site-related aspects of sustainable building. By means of a holistic approach as well as a variety of methods, competences which architecture students will need later in their profession, can be awakened and promoted.

Keywords: seminar, teaching methods, building sites, skills development

1. Situation in architectural Teaching

The term “sustainable teaching” has at least two meanings in the construction sector. On the one hand, it means the teaching of sustainable building, certifications, backgrounds and the like. On the other hand, it can be understood as the teaching that is sustainable itself. It has both meanings in the seminar that this article is about.

2. The Seminar “Materialization 2 – Construction Site Visits”

In the course of a seminar for master students, which is credited with 3 ECTS, only limited competences and sustainable ways of thinking can be taught. Nevertheless, this opportunity was used to develop sustainable competences among a group of students by means of a holistic approach.

The seminar was aimed at bringing construction practice, building sites and the possibility of working there closer to the students. At the same time, they were supposed to work for and to acquire competences which they will need in the long run and are therefore sustainable.

Quite often, site visits are block courses. But in order to achieve the teaching targets, this seminar was dispersed across the summer semester. The early start allowed students to organise the expected achievements in their own authority – and forced them to do so.

Site visits are a common way of transferring knowledge in the field of architecture and civil engineering. They are often associated with rather low amounts of student activity. In this seminar, additional elements were planned that stipulated students’ activity apart from the common academic teaching methods, leading to a more sustainable transfer of knowledge.

Common methods are reports, joint construction site visits, talks, project reports, group work, corrections and final presentations. The applied exceptional methods in this seminar included distributing incoming students into nearly all groups, individual construction site visits, requiring student to coordinate with external parties and a final, internal review-process.

One aim of the seminar was for the students to contact sites and on top of that deal with site-relevant issues. Therefore, the seminar's content was not only designed with the "product" in mind - the complete building - but focused on the necessary steps, resources and methods. Besides general information, the students had to find out about temporary site facilities as well as documentation and quality management measures.

Looking at the entire life cycle of a building is increasingly recognised. The fact that part of this life cycle can include multiple, in part very elaborate measures and some that are only of temporary need as well as energy intensive provisions at the site, was clearly demonstrated in this seminar. Economy and ecology as aspects of sustainable construction can – or cannot – find their way into construction site facilities.

3. Results and Conclusion

In the online evaluation, the students mostly marked the seminar as "very good" regarding content, execution and requirements. The teacher's effort was enormous, but worth it, as mobilising students and practice-oriented content may be the best way of teaching sustainably.

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Learning from Ethiopia – A discussion on sustainable building



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Extended Abstract

“Appropriateness is a moving target” was the name of an article written by Dirk Hebel, then director of the Ethiopian Institute of Architecture, Building Construction, and City Development in 2010. What he meant with this was the ambiguity of deciding what would be *good* architecture in Ethiopia, a land-locked country at the Horn of Africa, with nothing but an ever-growing human capital to support a booming construction sector. Consequently, we used this research to find out what would happen if we directed this question towards the term “sustainable building” in the context of Sub-Saharan Africa. Is this standard, which was established in the developed world, appropriate in the context of contemporary Ethiopia? How can we explore and present this issue in a way that it represents the Ethiopian reality and not our perception of it as Western foreigners?

With the help of this paper, we intend to give answers to these complex questions. The goal was to discover the reality of “sustainable building” in the capital Addis Ababa. Subsequently, new ideas on how to achieve the goals of sustainability could be developed.

Two texts from Ethiopia – one scientific, the other one commercial – and two interviews with construction practitioners unfold a web of cultural, educational, economic, political, construction, functional, aesthetic, and historic layers which influence the implementation of and the critical discussion on “sustainable building” in Ethiopia. Carefully listening to this Ethiopian discourse, our paper critically reflects the appropriateness of “our” (i.e. Western) understanding of sustainability.

Listening to the story unfolding through our case studies, we found that there is awareness about the concept of sustainability, but that it is not implemented “correctly”. Either it is completely neglected due to budget constraints, lack of alternative building materials, or knowledge or it is reduced to the issue of sustainable resource management, such as material use, renewable energy, recycling, etc. Urban design, socio-cultural aspects, or adaptability are neglected.

Referring to the idea that appropriateness depends on the availability of alternatives, we conclude that “sustainable building” as “we” know it is not appropriate in contemporary Addis Ababa. This lack of appropriateness is why it is “sustainable building” is not being implemented at the moment. What, then, can be done to implement sustainability goals in Ethiopia? One chance certainly lies in Ethiopia appropriating the concept of “sustainable building” for herself instead of wasting resources on trying to “enforce” a foreign concept through tools that are not appropriate for the context. This would require an honest discourse amongst Ethiopian building professionals and intellectuals.

If appropriating “sustainable building” is one option, changing the toolbox could be another option to reach *good* architecture. We suggest to work with *urban resilience* as a concept that is more responsive to the local context, more flexible, and more adaptable. Urban resilience is the potential of an urban system to adapt to and learn from changes while retaining its basic functions. If the goals of *improving human life*, *replacing resources used*, and *preserving the ecosystem* remain but the toolbox becomes more flexible and adaptive, we might as well achieve a more satisfying result. We claim that resilience as opposed to “sustainable building” is much better suited to achieve a construction economy in Ethiopia that serves its society and environment rather than exploiting it. Firstly, because of its novelty and great potential for appropriation. Secondly, because the core values of resilience are change and creativity, both of which are qualities that can without a question be attributed to Ethiopia’s urban spaces.

The way, in which this research was conducted and presented as well as its consequent focus on the practical application of sustainable building in Ethiopia has not been attempted before. We therefore hope that we can contribute to a much-needed professional discourse in Ethiopia on sustainable building and a just as much much-needed global discourse on creating appropriate standards on what *good* building in developing countries means.

Space for notes

Life cycle approach as a method for optimizing building services systems in extremely low energy buildings



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Summary

An evolutionary algorithm is used to optimize the environmental impact in terms of greenhouse gas emissions (GWP_{100} , kg CO_2 -eqv) from a ventilation ductwork system. Embodied emissions from different sizes of ductwork components and pressure drop calculations, served as input for the optimization. Based on a case study ventilation ductwork, we conclude that the duct dimensions in today's green office buildings are optimal neither in terms of GWP_{100} or operational electricity use.

The optimized results are sensitive to emissions from electricity, air flow rate, standby power, years of operation and embodied emissions. To ensure a robust solution, great effort should be given to determine these parameters as correctly as possible. The life cycle approach used in this work can contribute to a more holistic design of building services systems in future buildings.

Keywords: LCI, electricity emissions, optimization, ventilation ductwork, specific fan power

1. Introduction

The purpose of this work is to answer the following research questions:

1. Are duct dimensions and fan power used in today's "green" office buildings optimal in terms of Global Warming Potential (GWP_{100} , kg CO_2 -eqv)?
2. Given uncertainty in future (next 30 years) electricity production mix (kg CO_2 -eqv/kWh_{el}), how much will the optimal duct dimensions change? (Material use vs. pressure drop/fan power)
3. When optimizing ventilation ductwork in terms of GWP_{100} , which parameters are more sensitive?

2. Methodology

We use LCI-data for ventilation ductwork components and an evolutionary optimization algorithm in MS Excel to assess and minimize greenhouse gas emissions impact (GWP_{100} , kg CO_2 -eqv) caused by embodied emissions from the production of a ventilation ductwork system and the operational emissions from the ventilation fan. One part of a ventilation ductwork system in an existing Passive house office building, serves as a case study. The life cycle phases included in this in this work are raw materials supply (A1) and manufacturing (A3). The expected service lifetime of the ducts and components are set to 30 years.

3. Results and Conclusion

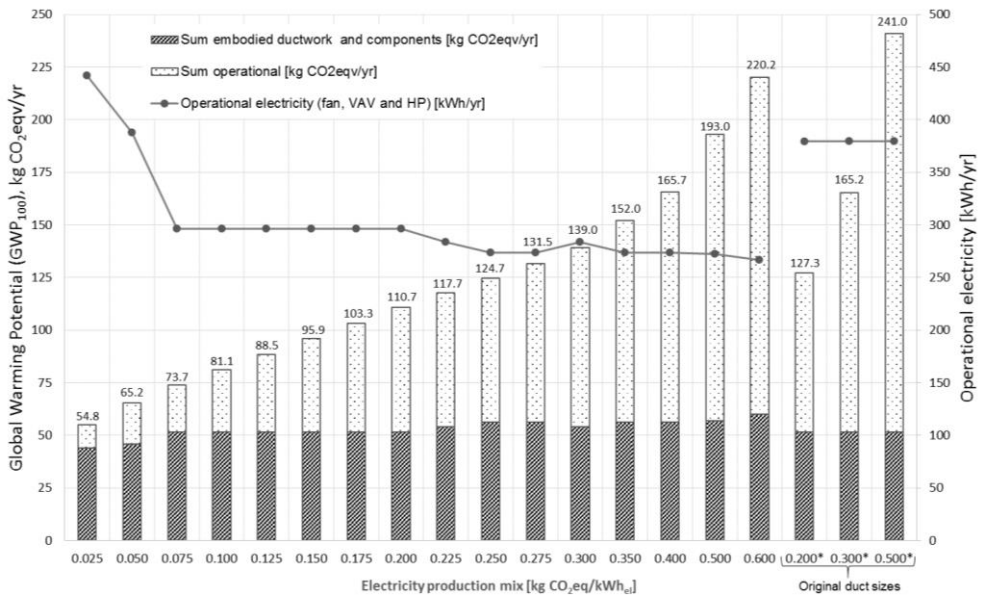


Figure 3: Environmental impact (GWP₁₀₀) from ductwork optimized with different el-mixes. The maximum diameters range from Ø_{max}=315 mm + insulation for el-mixes 0.025 and 0.050, to Ø_{max}=500 mm + insulation for el-mix 0.600. For all other el-mixes, Ø_{max}=400 mm + insulation. Penalty are given for duct + insulation > 500 mm.

Based on our case study, we conclude that duct dimensions in today’s “green” office buildings, are optimal neither in terms of GWP₁₀₀ or operational electricity use. Compared to the original ductwork design, and a future optimistic and pessimistic el-mix scenario (0.200 and 0.300 kg CO₂-eqv/kWh_{el}) respectively, we are able to improve the environmental impact in terms of GWP₁₀₀ (kg CO₂-eqv/yr) by 13% and 16%, and reduce the operational electricity by 22% and 25% over the next 30 years.

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Life cycle assessment of small road bridges: Implications from using biobased building materials



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Keywords: Life Cycle Assessment, Road Bridges, Wooden Bridge, Concrete Bridge, Dynamic LCA

1. Introduction

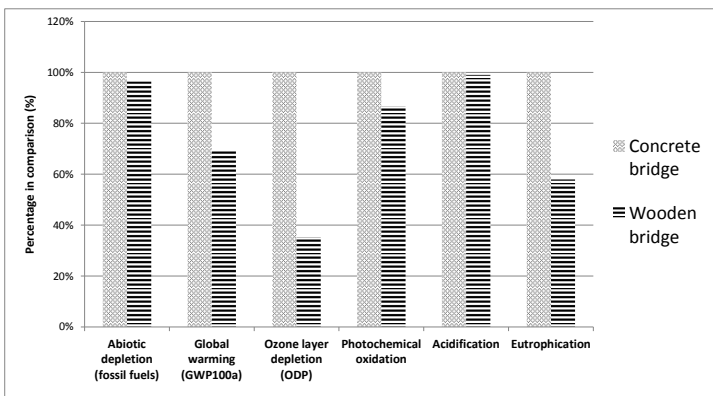
The construction sector is under pressure to decrease its environmental impacts. LCA has been used extensively to compare the environmental impacts from buildings, but seldom for bridges. In most of the research where wood construction is compared with other alternatives the results favour wood-based designs. The goal of this study is to use Life Cycle Assessment (LCA) to compare the environmental impact from two designs for a small road bridge with the same functionality, one in wood and another in concrete.

2. Methodology

The case study used is a small road bridge in Åstorp, Sweden, which was rebuilt in concrete 2014 using the old foundation. The environmental impact from this bridge has been analysed using LCA and compared with a wooden alternative with the same functional road area and load capacity. The concrete bridge has been cast on-site, while the wooden bridge has been prefabricated. The Product Category Rules (PCR) "Bridges and elevated highways" were followed, using a functional unit of one road bridge for 80 years. The study included material production, transports, construction activities and prefabrication of elements and maintenance. The connecting road, traffic diversions, filling, foundations, demolition and disposal have been excluded. Environmental product declarations (EPD) have been used when available, and when not Ecoinvent data has been used instead. Ecoinvent datasets were modified to use the relevant electricity mix for the country or region where the product is manufactured. The CML baseline method was used for impact assessment.

3. Results and Conclusion

The results show that the wood design has a lower environmental impact than the concrete bridge for all the evaluated impact categories. The material production and maintenance were the life cycle stages with highest contributions in both case studies. The biggest share of these contributions comes from the manufacturing of steel components and reinforcements. The contribution from the transport for the wooden bridge is relatively low even as there is an increase in transport distances due to the prefabrication of wood elements. The impacts from the maintenance come mainly from asphalt and steel production, which are required in similar amounts for both bridges. This is why the impacts from maintenance are comparable for both bridges. The results from this study can contribute towards deeper understanding of the environmental impacts from road bridge construction, and further research should be carried including aspects such as the end-of-life stage, the carbonation of concrete and the effects from carbon storage in wood materials.



Results for all impact categories studied, compared in terms of percentage

Space for notes

Local initiatives for motivating Danish house-owners for energy improvements. Extended abstract



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Summary

Energy retrofitting of existing buildings is a central challenge for national and international climate policies. Although many countries have formulated national goals and policies for this, it is often on a local level and typically in a municipal context that these policies are implemented. In Denmark there are 1.1 million single family houses, representing 44% of all existing dwellings in the country. In this regard, this area is considered to have a huge energy saving potential. A growing number of municipalities have ambitions on reducing energy consumption in these buildings, and several municipalities have established initiatives for this. The paper presents the findings from a survey-based project on local initiatives to encourage Danish house-owners to save energy through energy renovation. The paper outlines actors, governance incentives and experiences related to local renovation-based policies. Based on a literature review on international research regarding home-owners motivations for energy retrofitting, the paper discusses how the municipal initiatives can promote energy renovation of detached housing. Methodologically, the research is based on interviews with municipalities and energy suppliers, whom are considered as some of the major actors to provide energy renovation among private house owners.

Keywords: Energy retrofitting, home-owners, single family houses, local initiatives, networks

1. Introduction

As for many other countries, national and international climate goals in Denmark turn attention to challenge of retrofitting the existing building stock. In spite of national and international initiatives to regulate and promote energy retrofitting and energy savings, evaluations and studies suggests that there have had limited influence on the actual renovation activity regarding energy retrofitting. Therefore it is interesting to observe that a number of local initiatives are taking place in cities, municipalities and regions to promote energy retrofitting of private homes. Therefore the aim of this paper is to identify and present some of the different local (and mainly municipal) initiative and policies for making house-owners energy retrofit their buildings.

2. Methodology

This paper report on a broader study of how both Danish local authorities and energy companies work with promoting energy retrofitting of owner-occupied detached housing, however in this paper the focus is primarily on the municipalities. The study builds on document analysis, telephone survey to municipalities and follow-up interviews with 12 municipalities selected out of the 98 municipalities in Denmark. The theoretical part of the study consist of a review of international and Danish literature on house-owners' motivations to carry out energy retrofitting.

3. Results and conclusion

The initiatives launched by the 12 interviewed municipalities include the following core elements:

- Collaboration with energy suppliers on financing energy consultants that meets personally with the house-owner and makes individual reviews, suggestions for energy retrofit and financing plans
- Re-education of local craftsmen to give them more competences in guiding the house-owners towards energy retrofitting, and thereby generate more renovation projects and create more local jobs.
- Establish collaboration with banks and finance institutions
- Initiatives in villages using collective approaches to reach the house-owners

The municipal strategies demonstrate a profoundly different approach to make house-owners energy retrofit compared to the hitherto efforts on a national scale. The municipal strategies seems to fill the gaps reported in research on home-owners motivations to energy retrofit, as the municipal initiatives addresses many of barriers for energy retrofitting outlined in these studies, including the direct contact to the home-owner, independent assessment of retrofitting solutions and qualified craftsmen to carry out the retrofit. An important precondition for the initiatives is that they are often embedded in ambitious climate plans and regional development strategies. Moreover, the municipal initiatives have been enabled by national and international regulation, especially the energy saving obligations amongst energy suppliers, but also national education facilities for craftsmen. Another important parameter is that the local housing market in many of these municipalities is dominated by low housing prices, where energy costs takes up a much larger proportion of the household budget, compared to the housing market in the large cities, and thereby makes energy retrofitting more attractive, but also makes it more difficult to find external financing for the housing renovation. Nevertheless, the initiatives remain fragile, partly as the business case for municipalities and energy suppliers remain uncertain due to the high costs from contacting the house-owners. Therefore, we will probably see a continuous development and adaptation of these initiatives in the future.

Space for notes

Marginal costs and benefits in building energy retrofitting transaction



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Summary

Since some pioneering studies published during the late eighties, an increasing amount of research has addressed issues related to the economic and financial valuation of buildings' energy retrofitting transactions over the span of the last two decades. Nevertheless, conflicting results emerge: some actions turn out to be feasible, while others do not, depending on several variables such as investment costs, energy supply costs and energy price trend. Moreover, the supposed price premium for green buildings is still unclear and ambiguous.

According to the economic theory, a way to assume decisions related to feasibility issues relies on the comparison between marginal costs and benefits. A couple of recent studies discussed about marginal costs and benefits in building energy retrofitting transactions, arguing that marginal costs are found to be steeply increasing with raising the thermal standards of buildings. Nonetheless, due to the paucity of systematic studies and consistent data, the topic deserves further investigations.

This essay aims to expose and discuss results obtained in a research conducted on public housing settlements. Analysing several hypotheses of energy retrofits, marginal costs are found to assume a near-parabolic shape: it is, firstly, mildly decreasing and then sharply increasing. Moreover, marginal costs are compared with marginal benefits, in order to highlight feasible intervention options.

Keywords: Building energy-efficiency; marginal cost; Life cycle costing; Cost-optimum approach.

1. Introduction

Buildings are crucial to achieve the EU goals of reducing gas emission. Different energy measures can be used in the buildings in order to reduce energy consumptions, improving the thermal performance of the buildings with actions in the envelope, efficient lighting and hot-water production, heating and cooling. These measures are combined together to obtain maximum results in terms of energy savings. But what is the best combination of measures in terms of energy-efficiency, marginal costs, investment costs and life cycle costs?

This essay aims to expose and discuss results obtained in a research conducted on few public housing settlements, located in the metropolitan area of Milan. Analysing several energy retrofitting actions, marginal costs are found to assume a near-parabolic shape: it is, firstly, mildly decreasing or being constant, and then sharply increasing. Moreover, different life cycle costs combined with

the benefits are used to assess the impact of diverse options for energy-efficient and renewable on a building over its service life.

2. Methodology

Three case study analysis is performed. The reference buildings are public housing estates, which have been erected during different periods, and their opportunities of retrofitting are compared. To improve energy performance in comparison to the building as is, five retrofit scenarios were defined, keeping the constructive structures and arrangement of dwellings as constraints. The feasibility of the outlined scenarios is analysed with the marginal cost approach and the life cycle costing.

3. Results and Conclusion

The marginal cost curves of buildings #1 and #3, which are quite modern, do not increase as sharply as does that of the building #2. The marginal increase in investment costs leads to an increase, albeit less effective compared to the first group of scenarios, of achievable energy savings. The building #2, which is a 50's construction of a poor maintenance level, shows a curve that despite substantial actions of energy retrofits, increases very rapidly, and it is almost vertical in its last part: subsequent measures do not improve the energy standards. Old buildings in poor maintenance conditions, even if proposals include the combination of efficient energy measures, do not get proportional improvements in energy performance, and surely cannot reach the standards of buildings with low energy consumption. The decision makers should find the optimal scenario, and that point in the curves of marginal costs is represented by the scenario preceding the rapid growth of cost. In case study #2 and #3, this point corresponds to the package of measures that characterize the scenarios 3_S and 4_S, while in #1 costs increase rapidly after the scenario 2_S. As far as LCC concerning, the range of economic optimum is obtained when the overall cost gets its minimum at the level of the energy requirements of approximately 55 kWh/m² year. Such energy consumption values are very similar in all case studies, although in the building #2 and 3 these could be reached through the actions of the 4_S, while in building # 3 those measures concern the 5_S. The life cycle costs increase when energy demand is around 30-40 kWh/m² year due to the high investment costs. Further developments are identified in the opportunity to analyse the market value of the buildings renovated, so to treat simultaneously the initial costs, the life cycle costs and their values.

Space for notes

MODELLING APPROACH FOR THE THERMAL RESPONSE OF A RESIDENTIAL BUILDING EQUIPPED WITH A CHP UNIT IN AN URBAN AREA

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Summary

The work presented in this paper was carried out within a research project in the city of Bottrop, Germany, where 100 combined heat and power (CHP) systems were installed in existing residential buildings. In order to analyse the dynamic thermal behaviour of a residential building including its CHP units, Modelica was used to model the behaviour of both the buildings and CHP units. These buildings differ with regards to construction type, insulation standards and age. Based on previous modelling and verification of a multi-zone model for an existing technology demonstration centre at Gas- und Wärme-Institut Essen e. V., this paper shows the physical and mathematical simplification by using an alternative one-zone model (figure 1) in order to reduce the numerical effort. Finally, a validation of this approach is presented by comparing simulation and experimental results of one building for three separate periods of time, including heating and non-heating periods. Additionally, a simulation covering an entire year is shown, based on Test Reference Year (TRY) weather data as boundary conditions.

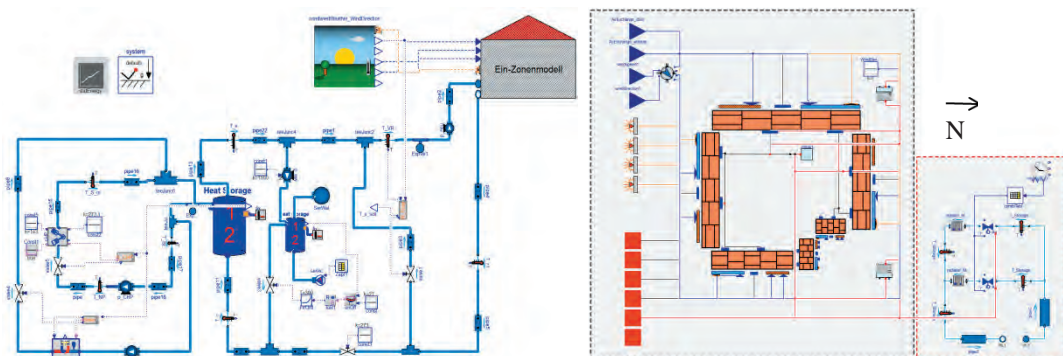


Figure1: Left: Single zone model with the hydraulic system in Modelica. Right: A one-zone model with a radiator in Modelica.

The employed methodology starts first with the reduction of the number of buildings in order to provide a manageable sample which represents the districts reasonably well. As a result, the number of the simulated buildings reduced to 10 “reference buildings”. The selection of reference buildings is based on the location of buildings, year of construction, number of occupants, heating technology and energy heat load. Accordingly, inspections were carried out by visiting each reference building to measure the volume of each heated room for each reference building. Likewise,

the surface areas of the outer walls, windows and doors for heat transfer calculations should be specified. Thereafter the obtained data were implemented in each building model. Similarly, the radiator types and geometries were compiled and used as boundary conditions in the model approach to enable calculating the total thermal power supplied by all radiators in each building, based on reference data.

The next step was to simplify the complex house model by reducing the multi-zone model into a one-zone model. A single heating zone is taken into account considering an effective thermal zone in which all internal inner masses are lumped together, i.e. summing up all inner volumes (air) into a building with single volume. Unheated zones were assumed to have a constant temperature during the simulation time scale. The other components were characterised to be lumped into one area on each side of the building block model (north, east, west, south, roof, and ground). In addition, the whole air volume inside building was modelled to balance the whole thermal energy. The mentioned building components were physically modelled and parameterised based on the real chosen building.

The comparison between empirical and simulated results for three periods shows that the simplifications and reduction of the model cause only a small error percentage. The simulation of the thermal behaviour of the building over the span of a year agrees well with theoretical expectations. This demonstrates that the models both for single components and the entire system are now available and can now be used to numerically investigate different scenarios.

Keywords: Modelica; thermal zone simulation; urban simulation; CHP

Space for notes

Monitoring of Energy-Saving Processes in Residential Building Stocks



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Summary

To check if strategies, objectives and activities undertaken in residential building stocks are appropriate and contribute sufficiently to the formulated European and national climate protection targets, a well thought out evaluation and monitoring framework is necessary. In the frame of case studies, undertaken in 16 countries during the EPISCOPE project, special attention was paid to the identification and discussion of available data sources including information on different residential building stocks as well as data quality, data gaps and possibilities to improve data collection. It can be summarised that the data situation is in general unsatisfactory. Therefore, more awareness needs to be created concerning the importance of setting up a more robust information base, because reliable and up-to-date data are needed to form the foundation for the discussion on climate protection strategies in building stocks.

Keywords: Residential Building Stocks, Monitoring, Energy Savings, Data Availability, Data Quality

1. Introduction

The EU and its member states have formulated ambitious CO₂ reductions and energy efficiency goals for the next decades. The potential of the housing stock to contribute to these savings is considered to be significant. But setting up targets and milestones is not enough – they have to be met in practice. To check if strategies, objectives and activities undertaken are appropriate and contribute sufficiently to the formulated aims, a well thought out evaluation and monitoring framework is necessary.

2. Methodology

In the frame of the EU project EPISCOPE case studies on either national, regional or local level were undertaken in 16 countries to map existing housing stocks, and show prospective energy and CO₂ reductions by means of scenario calculations. Apart from a discussion on applicable

indicators, special attention was paid to the identification and discussion of available data sources including information about the considered building stocks as well as data quality, data gaps and possibilities to improve data collection.

3. Results and Conclusion

It can be summarised that the data situation of European residential building stocks is in general unsatisfactory. In most cases, the information sources available are not sufficient to fulfil the prominent role they should play for climate protection strategies. Currently available data sources often are not representative, incomplete, outdated, and/or inconsistent. As a consequence, there are wide information gaps concerning the actual state as well as the trends of building thermal insulation and efficient / renewable heating systems.

The effort and research on buildings and energy efficiency in the recent years as well as the variety of data sources available might raise the impression that a sufficient database should have been generated somehow by these activities and projects, and the only task is to compile and merge all this information to draw a complete picture. But what needs to be considered is the fact that in publications data gaps are filled with assumptions because in many cases this is the only possible way to proceed.

Therefore, more awareness needs to be created concerning the importance of setting up a reliable information base, because consistent and up-to-date data are needed to form the foundation for the discussion on climate protection strategies in building stocks.

Space for notes

Monitoring of the new building of the Ministry for Urban Development and Environment in Hamburg

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Summary

The new building of the Ministry for Urban Development and Environment (BSU) in Hamburg is scientifically monitored by Hamburg University of Technology within the framework of the research initiative EnOB. The present paper shows results of the energetic evaluation of the building as well as energy demand and system behavior analysis for the period of October 2014 to September 2015. All results shown in this paper are based on measurement data.

Keywords: monitoring, measurement data, primary energy demand, user-specific demand, shallow geothermal energy

1. Introduction

The new building of the Ministry for Urban Development and Environment in Hamburg is a demonstration project within the framework of the research initiative Energy Optimized Building (EnOB). The guideline are “buildings of the future” with the long-term vision of energy efficient and sustainable buildings, providing high user comfort and being characterized by acceptable investment and operation costs. To examine the fulfillment of these objectives as well as to optimize the operation of buildings, all EnOB demonstration projects are scientifically monitored for at least two years.

2. Energy Concept

The heat supply of the building is based on the use of shallow geothermal energy. Approx. 950 energy piles in conjunction with two electrical heat pumps are used. To cover the peak load and to ensure the domestic hot water supply, a local district heating network is utilized. Cooling of the building is achieved by a combination of free cooling concepts. On the one hand the existing energy piles are utilized, on the other hand cold outside air is used during the nighttime. Electricity is provided from the Hamburg Energie power grid.

3. Results and Conclusions

Despite some implemented optimization measures, the actual measurement data based annual heating energy demand of the BSU-building is more than twice as high as the prescribed target value of the planning phase. Nevertheless, the actual annual heating energy demand of the BSU-building is quite low in comparison with other energy efficient buildings of similar size and usage. The objective to achieve passive house standard for the building envelope of a building with unitized facade and corresponding size and complexity does not seem to be compatible with reality. Overestimating internal heat gains seems to be one reason for a significantly less heating energy demand estimated in the planning phase.

The user-specific demand represents a significant part of the total energy demand of the BSU-building. This knowledge seems to apply especially for large office and administration buildings in general. Decentralized IT and telecommunication shows by far the largest part of the user-specific demand of the BSU. Thus, implementing energy efficient computers, screens and phone systems is one simple but effective measure achieving a low total energy demand, especially regarding primary energy level.

The amount of heat brought into the soil during cooling period is low compared to the amount of heat extracted from the soil during heating period. Nevertheless, the temperature level in the soil is significantly increased by the heat input. Therefore, summer heat input is a useful and important addition to natural regeneration of the soil. Achieving a leveled annual energy balance of the soil in terms of a long-lasting utilization of the geothermal field seems to be possible in the context of further optimization measures. These are optimization measures in terms of enlarging operation in cooling mode and further reduction of the heating energy demand in connection with available possibilities to adjust heat extraction and heat input specifically by recooling plants.

Space for notes

Naturalism in Architecture – Extended Abstract

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Summary

Naturalism is the philosophical belief that everything arises from natural properties and causes, and supernatural or spiritual explanations are excluded or discounted. It is the stimulator of organic, green, sustainable, and ecological architecture, which are different movements in the field. The thesis aims to examine the notion of naturalism by rereading architectural movements, influenced by nature and biological theories, such as terms, models, projects, and building.

Keywords: naturalism, metabolism, green, sustainable

1. Introduction

Extensive biological researches and the evolution of natural sciences in the end of the nineteenth century and the beginning of the twentieth were the contributing factors to the domination of naturalism. The theory of evolution and modern biological researches are considered the main trends that have deviated architecture from its classic trends to modern trends. This is through aspiring to become similar to nature and its forms as well as adapting to it.

2. Methodology

My aim is to critically examine the notion of naturalism by rereading architectural movements, influenced by nature and biological theories, such as terms, models, projects, and building. This is for better understanding of the present discourse.

3. Different Architectural Styles

Organic Architecture is considered one of the first trends that have deviated architecture from its classic trends to modern trends. This is through aspiring to become similar to nature and its forms as well as adapting to it. Organic architecture is one that promotes harmony between human habitat and the natural world.

Metabolism architects are inspired by the idea that everything in life changes and is altered by rapid technological developments. As a result of the changing human needs, buildings must adapt their spaces to the new activities.

Mega structure is like the natural evolution of the organic idea with respect to growth and development. Different parts of the same organism work in the same mechanism as flowers, leaves, and fruits that grow from one tree. Huge technological development in the 1960s helped with the development of that idea.

Eco architecture developed when the human consciousness globally identified the effects of the industrial revolution on the global environment. The concept of environmental preservation has become mainstream.

Sustainable architecture supports the environmental balance by meeting the needs of the present generation without compromising the ability to meet the needs and requirements of future generations.

Green architecture, also known as green design, is an approach to building that minimizes harmful effects on human health and the environment. Green architecture attempts to safeguard air, water, and earth by choosing *eco friendly* building and construction materials.

Smart architecture delivers useful building services that make occupants productive at the lowest cost and environmental destruction over the building lifecycle.

4. Conclusion

Naturalism has influenced architecture in different ways. Its different aspects created several architectural approaches, organic, green, sustainable, ecological architecture. All kinds of architecture are conceptual tools that evaluate models derived from nature and ecosystem. They also provide a framework for conceptualizing environmental and technical issues. Different approaches in architecture are inspired by nature and its sustainable, conserving, diverse, flexible, and adaptable qualities. Architectural movements are influenced by nature and new natural science theories. This inspiration had created a different approach in dealing with architecture. Architecture is also translated into design process, materials, motifs, and basic ordering principles.

Space for notes

Networking Intelligent Cities for Energy Efficiency – The Green Digital Charter Process and Tools



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Summary

The Green Digital Charter (GDC; <http://www.greendigitalcharter.eu>) is a declaration committing signatory cities to use information and communication technology (ICT) to address climate change issues (“ICT for green”) as well as improve their resource management (“greening ICT”). In the course of the FP7 funded NiCE (Networking intelligent Cities for Energy Efficiency) project under the lead of EUROCITIES an action framework, application guidance, and monitoring tools were developed and best practice exchange, learning and networking activities organised. The paper presents the elements and implementation of the toolkit and the results of a follow up survey of signatory cities on progress and challenges of GDC implementation.

Keywords: ICT, energy efficiency, smart cities, climate change, resource management

1. Introduction

The Green Digital Charter (GDC; <http://www.greendigitalcharter.eu>) is a declaration committing signatory cities to work together to deliver on the EU climate objectives through the innovative use of information and communication technology (ICT). Cities are encouraged to use ICT to address climate change issues (“ICT for green”), as well as improve their resource management (“greening ICT”). NiCE (Networking intelligent Cities for Energy Efficiency) was an FP7 funded project under the lead of EUROCITIES (<http://www.greendigitalcharter.eu/projects/niceproject>), to support signatory cities in the implementation of the GDC commitments into practical and hands-on activities. Four research and practice partners and five “reference cities” (Bologna, Eindhoven, Linköping, Manchester and Warsaw) were involved.

2. Methodology

In the course of the project an action framework, application guidance, and monitoring tools were developed and best practice exchange, learning and networking activities organised. The project was concluded by a survey of signatory cities on progress and challenges of GDC implementation. This paper takes a closer look at the action framework, the monitoring tool and the concluding survey.

As a “coordination and support action” the project methodologically followed a transdisciplinary approach involving practitioners from the signatory cities in the co-creation and dissemination of knowledge and tools. The survey on progress and challenges of GDC implementation was conducted in a qualitative approach as a semi-structured telephone survey. All 41 signatory cities (at the time of the survey) were contacted, 18 expert interviews could be derived of which 13 covered the full range of issues.

3. Results and Conclusion

A core challenge at the beginning of the project was to extract and structure the detailed commitments and targets behind the political phrasing of the GDC for practical implementation. To this end and as a baseline document for all further work an “*Action framework*” was designed as a three dimensional matrix. The dimensions of the action framework represent 1) the application areas for a city (e.g.: Buildings, Transport, ...), 2) the type of activity cities might undertake (e.g.: Operational, Governance, ...) and 3) the role that ICT can play (e.g.: Analysis, Perception, ...).

As a *monitoring tool* for the implementation of the GDC 26 “*Self-Assessment Questions*” (SAQ) were developed and implemented as an online questionnaire. The SAQ are structured along the activity types of the action framework and relate to all GDC-commitments. The tool helps the cities to assess their state of the art and progress over time as well as compared to other signatories.

The *survey results* confirm the assumption that the GDC provides a lot of ideas and starting points for green digital activities and most cities claimed to be making good green digital progress - at least in terms of a multitude of ongoing individual projects. However, all in all a concluding impression is that most interviewed cities do not yet seem to have a clear strategic and operational plan for the implementation of green digital progress beyond individual solutions to individual problems.

Space for notes

Occupant discomfort due to background passive ventilation



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Introduction

Passive through-wall ventilation remains the standard mode of ventilation in Ireland. It is listed as one of 4 options in Irish building regulations for the regulatory means of ventilation in new builds. In retrofit applications it is also the most common method of air change provision. Similar to the UK [1], grant incentives are generally provided for shallow retrofit and less frequently for deep retrofit, and hence this practice of ventilation will remain common in housing retrofit and new build. Alternative means of ventilation, including mechanical and hybrid means, are available and increasingly commonly specified in European countries. However, as long as passive through-wall ventilation remains the standard in Ireland and the UK research questions related to the comfort of occupants require consideration. Revisions to the Part F Technical Guidance Documents [2] of the Irish building regulations which consider building ventilation and hence the means of good air quality provision are due in the near future.

This paper examines the response of occupants in a terraced housing type common to Irish cities and towns and assesses the impact of passive through wall vents on occupant comfort through an experimental and simulation study. Risks of localised discomfort are highlighted in the Irish conditions and alternatives to this practice are discussed.

Results and Discussion

Experimental results exhibit the inherent uncontrollable nature of this means of passive ventilation, showing it to be highly dependent on external weather conditions. Ventilation of the space increases considerably as wind velocity increases. Findings of experimental and simulation studies support the claims of surveyed occupants who complain of significant discomfort in the seated area of their living rooms due to cold air falling from the through-wall vents installed at a high level on the wall behind their seating area.

The current, and common, means of natural ventilation provision has the potential to set up significant conditions of discomfort in localised areas of Irish homes. Air ingressing through passive through-wall vents is at a significantly lower temperature than room temperature and incoming colder air can dump on occupants in the vicinity of vents. In small rooms, common to inner city housing this can have an amplified impact. The temperature range in small rooms can vary outside of guidance ranges proposed in the adaptive comfort models. This study validates the sensation of discomfort experienced by occupants in homes in which through wall vents have been installed. The adaptive action taken by these occupants to block vents, although creating a significant danger to health and wellbeing is understandable when considered in the context of thermal comfort. Passive ventilation allows for the experience of a living, breathing architecture. It has a range of benefits including occupant sensory and psychological enhancement. However, when provided for using through wall vents localised drafts result in zones of comfort asymmetry.

Revision of Irish ventilation regulations has long been called for by members of the ventilation industry who offer a range of alternative products [16] including some of the discussed. Technical guidelines are called for that stipulate designed ventilation solutions only, and do not prevent innovation and future adoption of alternative solutions. They should specify requirements for actual air movement in homes and means of testing and ensuring minimum standards. The future of passive ventilation in the context of climate change is uncertain. In recent work by these authors it has been shown that discomfort hours are high in climate change scenarios [17] and passively ventilated homes may be overheated for extensive periods. This is particularly a concern for elderly and vulnerable occupants.

Space for notes

On your roofs – get set – Green!



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Summary

Hamburg is the first German city to have developed a comprehensive green roof strategy, to deal with the challenges of climate change, densification, biodiversity and air quality. The strategy combines different policy instruments: incentives, public relations and regulation. The implementation process comprises an incentive programme about 3 Mill. Euro, combined with mandatory requirements and quality standards and a local communication campaign. The strategy is being assessed to identify success factors of- and barriers to the successful implementation. In the first, qualitative assessment it is found that the essence of the success of the implementation of the green roof strategy lies in the comprehensive approach, with the three action points enhancing each other in a continuous process.

Keywords: Green roofs, Subsidies, Legal Framework, Communication, Science-Practice

1. Introduction

Hamburg faces diverse challenges in the daily praxis of urban planning and development: climate change, densification, biodiversity and air quality are all important issues that have to be dealt with throughout the coming decades. Green roofs provide an answer to these challenges. Commissioned by the Senate of Hamburg, the city administration has developed a green roof strategy, adopted in April 2014, formulating the aim to increase the green roof surface within the city by 100 hectares. Since then, the first actions were taken to put this strategy into action. In this paper we present an assessment of the first experiences in the implementation of the strategy.

2. The implementation process

After the assignment by the Senate to develop a green roof strategy, the city administration at the federated state (*Bundesland*) level has taken up the challenge to create a strategy with a broad

instrumental approach, covering the range of policy instruments that are available to the public sector within four action points:

Promotion: rooftop greening is promoted through positive financial incentives and good examples. The main activity in this action point is the subsidy programme for voluntary rooftop greening measures by private and commercial land owners within the entire city of Hamburg.

Dialogue: key players in the implementation of the green roof strategy are involved in an ongoing dialogue. The approach within this action point can be divided into three separate elements: providing information, internal communication and external communication.

Stipulation: rooftop greening is being stipulated through the instruments of spatial planning and nature protection. The activities in this action point concentrate on utilizing the potentials of the legal frameworks.

Scientific support: the scientific support concentrates on quantifying the rain water retention capacity of green roofs under the local climatic conditions of Hamburg and on getting an overview of the worldwide scientific knowledge regarding water management on green roofs. Furthermore, this action point includes the assessment of the implementation of the green roof strategy in the other three action points.

3. Results and Conclusion

The comprehensive character of the Hamburg green roof strategy is unique in Germany; the experiences in Hamburg can provide valuable lessons for other cities that have to deal with similar contemporary challenges. The comprehensiveness of the implementation process, covering a range of policy instruments is one of the main success factors in this process. This is amplified by the actuality of the challenges and the political will behind the strategy, making it possible to make the necessary resources available. We argue that the workshops within the dialogue, especially with the representatives from the housing industry, logistics and architects are an important step towards a widespread implementation. The open dialogue enables to discuss the different possibilities, to exchange ideas and to overcome hurdles in the implementation.

Space for notes

Optimization of energy planning strategies in municipalities: Are community energy profiles the key to a higher implementation rate of renewable energies?



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Summary

The paper evaluates the current status of community energy planning in northern Europe via a review of literature, practice and the performance of a barrier analysis for successful community energy planning. Main findings of the paper are that current community energy planning lacks a systematic approach, suffers from insufficient information, tools and resources. Municipalities are often unable to take on a steering role in community energy planning. To overcome these barriers and guide municipalities in the pre-project phase, a decision-support methodology, based on community energy profiles (CEP), is presented. The methodology was applied in a case study in Germany. With CEPs, a possibility to merge qualitative data from local settings into generic energy modelling is shown, which could contribute to improved community energy strategies.

Keywords: Community energy planning, infrastructure and energy concepts, implementation of renewable energies, community energy profiles

1. Introduction

Energy - its efficient use and its CO₂ neutral provision - will become a major task for urban development. Communities will be a main field of action to transform cities into sustainable spatial structures, because many technical synergies can be realized, promising scale effects be reached, and decision makers be mobilized to act in their common interest. With urban planning largely being carried out at community scale, municipalities should facilitate this transition and link urban and energy planning. Community energy planning can be an important strategy to reach this target; the current paper sets out to ascertain how this could be achieved, which barriers for successful community energy planning do exist and how these could be bypassed.

2. Methodology

In the first research phase, based on grounded theory, a review of community energy planning literature and 10 Community Energy Concepts (CEC) was executed. The assessment of the state of community energy planning enabled a barrier analysis for successful community energy planning, which led to the development of a decision-support methodology. The second phase tested the methodology on a case study: the author developed a CEC to supply a community solely with renewable energies and suggested a planning methodology based on the outlined decision-support methodology. Following, the author, as an external consultant, accompanied the process from generation of the technical energy concept until the final decision about the implementation of the energy strategy. The data was collected via active participant observation.

3. Results and Conclusion

Two major mismatches have been identified. First, CECs and the available literature are too technical and rarely consider qualitative factors that are crucial for implementation of energy strategies. Thus, there is a general gap between literature, CECs and implementation. Second, municipalities lack knowledge on energy planning and ensuing a guideline on choosing adequate planning procedures to implement technical concepts. As a reaction to the found barriers, a decision-support methodology is introduced that should help the municipalities in the pre-project phase to:

Step 1: Identify possible community energy technology strategies and assess their suitability

Step 2: Connect technical strategies with qualitative information on the community, allowing the choice of adequate planning procedures to implement the suggested energy strategies

The basic function of the methodology can be described as a rough energy strategy feasibility analysis, with an addition of soft factors to find the technology bundle that is most likely to be implemented and advice about possible planning strategies to achieve this. In **Step 1** the energy demand and energy potential for the community is estimated via building archetypes, followed by the finding of adequate technology bundles to match energy demand and supply. In **Step 2** an analysis of soft factors that are characteristic for the community is conducted. Different energy related dimensions relevant for communities – such as stakeholders, materiality, budget, technology, environment or legal framework – get summarized in community energy profiles (CEP) that identify tasks and barriers for the implementation of the specific community. A CEP can be related to a library of CEPs from successful community energy developments. Thus, suggestions for successful energy planning methodologies can be transferred from communities that faced similar challenges in the past. The advantage with CEPs lies in the comparison of patterns instead of a comparison of unique local settings. Hence, the meta information of case studies gets accessible.

The application of the decision-support methodology in the case study lead to feasible options, systematic data on energy demand and knowledge about planning procedures, which resulted in the establishment of a successful self-sustaining community energy planning process. Thus, CEPs can in this case contribute to a better implementation of energy strategies. Still, the CEP methodology needs to be improved into a semi-automatic community energy planning tool.

Space for notes

Optimizing Low Carbon Retrofit Strategies in Residential Buildings from the point of Carbon Emission and Cost-effective

Extended Abstract



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Summary

This paper presents a simulation-based procedure to enable architects in residential building retrofit to predict and account for CO₂ emissions and retrofit cost so that optimization selection of strategies could be made beforehand. Current performance of existing building is examined to diagnose the retrofit potential. Then low carbon retrofit measures are proposed. Next, CO₂ emissions and retrofit cost of each option is quantified before and after retrofit by using Design Builder, Autodesk Ecotect and Microsoft Excel. These results are aim to help architects to determine the most recommended retrofit approach, and to save money for stakeholders.

Keywords: Residential Building; Retrofit Strategy; Low Carbon; Retrofit Cost; Simulation-based

1. Introduction

In order to meet the national emission reduction targets, it is essential to retrofit and adapt the existing domestic building stock to improve their energy performance and to reduce their CO₂ emissions. However, residence refurbishment practice in China has always been defect-remedy oriented, without much concern on carbon emission reduction. The purpose of this paper is to present the simulation-based procedure, which is expected to be replicable and affordable for a large scale application in the future. It intends to provide some reference to low-carbon domestic retrofit in China.

2. Methodology

At the early stage of a retrofit project, a set of investigations were conducted to gather information from the specific residence and to diagnose the retrofit potential, including weather data, dimension

and fabric of building, design condition indoor. Then low carbon retrofit measures were proposed such as fabric approach, system based approach, appliance approach and integrating renewable energy supply, depending on the climate and pre-retrofit condition. Measures were proposed and form a list of groups, such as elemental (for instance, external wall insulation), multiple (for instance, external wall insulation and roof insulation) and holistic approach. The software employed to calculate CO₂ emissions and retrofit cost included Design Builder, Autodesk Ecotect and Microsoft Excel.

In a case study of a 1980s 45-unit residential building in Tianjin city, six retrofit measures were proposed including external wall insulation, flat roof insulation, low-E double glazing, household heat metering and separate zone control valves, LED lighting, and solar water heater for DHW. Then CO₂ emissions and retrofit cost of base case and 63 simulation cases were quantified before and after retrofit to assess the effectiveness of different groups, and evaluate the best group of options available.

3. Results and Conclusion

It can be seen that the CO₂ reduction rate increases as the retrofit cost goes up. As indicated by the case study, carbon reduction follows the law of diminishing returns. Architects may put forward the recommended retrofit approach based on the amount of money owners can pay. On condition that retrofit cost was without limits, the recommended case with multiple approach of fabric insulation including external wall, flat roof and window, LED lighting and solar water heater for DHW should save 63% of total energy use, and corresponding 66% of CO₂ emissions comparing with the base case. Renewable energy technologies and fabric approach could greatly optimize the energy demand and reduce CO₂ emissions of a poor insulated house with a conventional system.

By using the proposed simulation-based retrofit method, the objectives of optimizing low carbon retrofit strategies can be achieved. The function provides the architect and owner with a chance to guide the design and approve effective retrofit measures, and help to achieve the carbon reduction targets.

Space for notes

Planning of ecologically and economic optimized district refurbishments



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Keywords: District, refurbishment, life cycle assessment, life cycle costing, tool

Facing the refurbishment backlog in Germany’s building stock and supporting sustainable development, a district lifecycle tool for refurbishment planning was developed to facilitate the consideration of ecological and economic aspects in early refurbishment planning phase. As the tool is intended to be used by decision-makers and planners on district level, the application requires no further measurement effort. Nevertheless, relevant aspects of sustainable buildings, namely Life Cycle Assessment and Life Cycle Costing issues, can be integrated in refurbishment planning to identify measures that are both economic and ecologically beneficial. The refurbishment potential is calculated based on typological data from component level up to districtwide energy supply solutions as depicted in Fig. 1. The attainable energy savings of the buildings are calculated using a quasi-stationary calculation method based on floating monthly average temperatures considering user behavior as well. Both ecological and economic savings are calculated using the principles of Life Cycle Assessment, including production and End-of-Life of the energy-related components that are used for refurbishment.

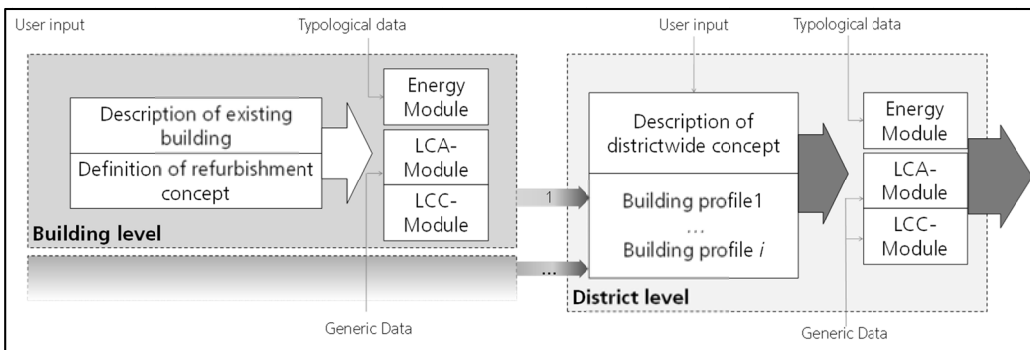


Fig. 1 Applied Modelling structure and required data sources

The level of refurbishment quality is delineated through several refurbishment scenarios facilitating an optimization based on energy, ecology or economy on building level. Thus, potentially beneficial combinations and the added value of districtwide measures can be identified. This includes the dimensioning of heat generation systems such as cogeneration plants based on optimization algorithms to maximize environmental or economic saving potentials. To show the results at a glance an eco-portfolio is presented including direct comparison of ecological and economic efficiency of the scenarios.

To further validate the tool, a case study has been carried out based on the refurbishment of the district Rintheimer Feld of Karlsruhe that has been executed by Volkswohnung GmbH. For seven types of residential buildings refurbishment scenarios have been modelled and evaluated. Based on the results on building level, the district refurbishment is assessed regarding both building specific improvements and the implementation of a district heating network including an optimized cogeneration plant. The Eco-efficiency saving potentials for the district Rintheimer Feld are assessed for three refurbishment scenarios. Furthermore, the ecological and economic advantages of the integration of a cogeneration plant (chp) are analyzed. The present methodology successfully shows, that saving potentials of district refurbishments in terms of economic and ecological efficiency can be predicted solely based on data already available in initial project stages. This facilitates the integration of ecological considerations from the beginning, allowing to identify districts of promising saving potentials at the beginning. Further optimization potentials are identified in terms of an enhanced implementation of user behavior. Within the next steps, the tool will be expanded to cover non-residential buildings such as educational institutions and commercial buildings as well.

Space for notes

Potential and Risk for Zero-Energy-Buildings under Defined Urban Densities

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Summary

The aim of this paper is to develop a method to evaluate the potential and risk of renewable energy development by examining the land-use requirement of zero energy building (ZEB). A wider definition of ZEB would allow producing a part of energy off-site (outside of town) on compensating areas. This leads to the competition between the area of use to be served, which creates energy demand, and the size of building envelope or the size of the estate to cover this demand with renewable energies. We hope to contribute to the discussion about urban sprawl and compact city and also to encourage land-use policy makers to include land-use requirement of renewable energy production into consideration.

Keywords: Zero Energy Building, compensating measure, urban densities, energy demand, land-use requirement

1. Introduction

To date there is still a lack of knowledge about which kind of building and which kind of building arrangement would be optimal to save as much as possible land for compensating measures of ZEB. How does the compensating area change with number of floors or plot ratio? Does the compensating area required by one unit of area of use increase or decrease with the number of floors and plot ratio? We intend to develop a method to these questions.

2. Methodology

We propose that the land-use requirement of compensating measures could be evaluated in several ways. Firstly, it can be evaluated by how much total space is required and how the differences in the total space requirement change with number of floors. The measurement of space-saving consists of two indicators: 1) comparison of compensating area among buildings with different heights and plot ratio; 2) comparison of the sum of estate area and compensating area among buildings with different heights and plot ratio. Secondly, urban density can be evaluated by land-use efficiency, which is measured by the total area, including estate area and compensation area that is required for each unit of area of use. This standardized compensating area makes it easier to carry out comparison of land-use efficiency among different types of buildings. Finally, we compare the changes before and after compensating area are included into the calculation of urban density. The density calculation which includes compensating area is thus defined as extended urban density. The results are presented in figure 1, figure 2, and figure 3.

3. Results and Conclusion

Based on our results, we derive some general suggestions with regard to the planning of land-use requirement of energy production:

- If the priority of land-use planning is to save land inside the town, use high plot ratio.
- If the priority of land-use planning is to save land for compensating measure, use a small number of floors.
- If the priority of land-use planning is to save land in general, use high plot ratio. And, within high plot ratio, use small number of floors.

With the results of this research, we hope to contribute to the discussion about urban sprawl and compact city. We also hope to further advance the investigation about the relationship between urban density and energy production. It may also encourage land-use policy makers to include land-use requirement of renewable energy production into consideration.

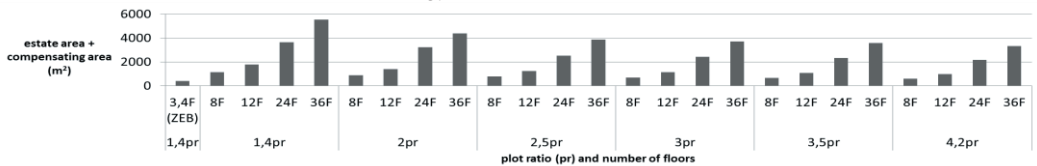


Fig. 1 Total required area by number of floors and plot ratio.

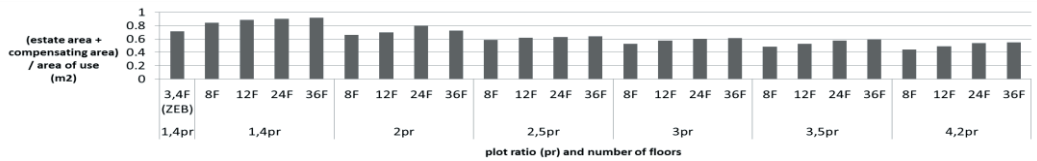


Fig. 2 Ratio of total area and the area of use by number of floor and plot ratio

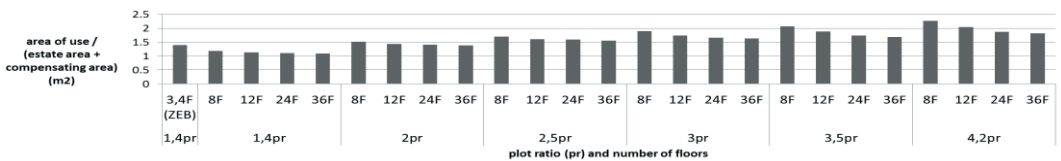


Fig. 3 Extended urban density by number of floor and plot ratio

Space for notes

Pre-Design Steps for Regeneration of Urban Texture



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Summary

The following paper provides an overview of author's last academic project focused on regeneration of urban texture as her thesis for Master of Urban Design. The paper is in line with the topic of sustainable neighbourhood and urban development by describing a method for redesigning the access network (including both riding and pedestrian), developing public open space, and injecting new functions in a decaying urban quarter. The context of case study is historic centre of Tehran, the capital of Iran, which was the original core of city formation in the past and is presently situated at the heart of the contemporary city.

Keywords: urban regeneration, neighborhood, pre-design method

1. Introduction

One of contradictions between heritage conservation and urban sustainable development could be identified when dealing with an old quarter of city, suffering from the problem of insufficient traffic accessibility and permeability. This problem usually turns out to be a major one, since it itself raises other social and environmental difficulties not only for close by areas but also for a much larger part of city or even sometimes the entire city. As long as there remains the problematic situation, such an aged neighborhood is most likely - or at least the case study of this project was - inhabited by lower income and socially vulnerable groups living in unsanitary conditions and high risk housing. As a result, it does not appeal to investment activities and forward looking urban intervention practices due in part to uncertainty about the success and profitability. However, according to the criteria of heritage conservation, urban fabric of the neighborhood is generally considered worthwhile for preservation. It is the built inheritance from the city's past which needs to be protected as an entity. Thus, on the one hand, the historic access system requires to be redefined mainly by retaining those narrow pathways within the densely compact texture and deploying them as the basis of any change. On the other hand, it is highly essential that the structural order of public space in the neighborhood area get revitalized. Either way, there are other needs to be met; for instance, the demand for more public parking lots for residents and above that to have open and green space expanded as well as public services with regard to land use.

2. Methodology

To minimize probable unavoidable demolition of building plots (including: residential, commercial, and etc.), most of which privately owned or rented, a process-led intervention was planned. Only to describe it in short, recognition and analysis of existent state resulted in setting some theoretical strategies and practicable solutions based on which three different preliminary conceptual alternatives were proposed on how to fulfill the project's objectives. However, comparative evaluation led to a composed final alternative which was an optimum choice of those three. Actually, conducting a survey on local willingness for participation accompanied by the previously done fieldwork, a pre-design method of three reciprocating steps was innovated and employed.

Then, the project continued on smaller scale of urban design. After situating the public open realm (including: roadways, sidewalks, parking lots, mixed traffic routes, footpaths, open and green spaces) in lands which have been purchased before, readjusting the functions and activities could be done.

Finally, revitalization of the main structure was on the basis of spatial and functional relations. Public activities were centralized in the central open spaces. Subordinate routes with mixed traffic connected public spaces of the quarter and neighborhood units. They provided accessibility to more plots. Additionally, they coordinated with characteristics of context.

3. Results and Conclusion

The method which was explained above could be sensibly applicable to broader contexts either in countries with similar urban planning background or even in European countries, since the whole process emphasizes on the cautious use of on site potentials.

Space for notes

Promoting Sustainable transport Reviewing the case of pioneer cities

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Summary

The research brings into focus the importance of promoting alternative clean transport modes to solve the cities pollution related problems, especially the city of Cairo. It reviews the case of the pioneer cities in Europe, illustrates their successful strategies and the possibility of implementation in crowded polluted cities.

Keywords: Bikeways, Streets, Cycling, Environment

1. Introduction

The dominance of motorized movement over other modes of transport is one of the factors that are responsible for global carbon dioxide emissions to the environment. It is essential to encourage other sustainable ways of travel. Cycling is considered an environmental-friendly mode; it is an easy, cheap and clean transport mode that should be encouraged. There should be a clear plan for cycling in every city street; the cities need to be people-friendly rather than car-friendly, thus more liveable and more sustainable. The Netherlands, Denmark and Germany have made bicycling safe, convenient and practical way to get around in their cities.

2. Methodology

Based on a hypothesis that cycling has a positive impact on the environment problems like (GHG) emissions resulted from vehicles, there is an essential need to put a plan of policies to be applied in streets, first to promote cycling as a mode within the travel network through planned bikeways and related facilities, and second to encourage people for a safer, convenient and attractive mode. The research illustrates the analysis of all given data on the successful strategies of the countries in promoting cycling and focuses upon the possibility of following them in crowded polluted cities such as Cairo, with the involving of Government, planners and people. A case study of a neighbourhood in Cairo took place.

3. Results and Conclusion

The main findings revealed that the provision of designed separate cycling paths along heavily travelled streets in the city with traffic calming approaches and measures in most streets leads to achieving high levels of cycling dominance, together with the application of Governments' policies that encourage cycling indirectly. The research proposed a set of complementary strategies deducted from the cases to promote cycling in suffered polluted city streets such as the streets of the city of Cairo that lack the existence of such transport mode networks.

Space for notes

Rehabilitation of Public and Semi-Public Space of Housing Estates: the Case of Lubartow



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Summary

Demographic trends, changes of lifestyle, stricter technical and safety requirements towards infrastructure of housing estates, and natural wear and tear make the existing housing environment from the times of mass housing projects fail to meet current standards. To select value-adding modernization measures, the planner should base on a thorough investigation of needs and requirements. The paper presents a case study of rehabilitation of areas between housing blocks of a nineteen-sixties estate in a small town in south-eastern Poland. The scheme was inspired by a research project – an inhabitant's opinion survey. Improvement guidelines derived from this survey were used in constructing an operating plan for the town district, incorporated into the town's operating plan, and finally won EU grant. The quality of the space is exceptional – and the project can serve as a template for similar schemes in other locations. One of the main success factors was empowering inhabitants to take decisions on the function and form of their living environment. User satisfaction monitoring helps maintain the users' interest in the development of their neighbourhood.

Keywords: Built environment rehabilitation, public spaces, user involvement, opinion survey

1. Introduction

Urban revitalisation programmes set aims for enhancing social infrastructure and economic growth of the neighbourhoods to stop, reverse or avoid degradation processes. As it is more economical to prevent than to cure, these programmes are not limited to areas already dilapidated and dysfunctional. Revitalisation projects involve improvement of physical infrastructure, initiatives to support development of businesses, and social work. The paper is a case study of a small revitalisation project of mostly technical character. Despite its small scale, the project is interesting and unique, as it is one of the first Polish revitalisation projects that concern relatively new housing estates: erected in the nineteen-sixties, typical to urban landscape of all Polish towns and cities. The project's aim was to improve public and semi-public spaces around the housing blocks. The quality of the space justifies presenting it as a template for similar projects in other locations. The main success factors were: empowering the members of the community to decide on the functions

of the areas in the neighbourhood, and the determination of the cooperative's management in convincing the local government on the importance of the project.

2. Methodology

Case study approach proved useful in social sciences has been adopted to built environment research. In the case study research one defines objectives of the research and selects a case, sets procedures for collecting evidence from multiple sources, collects input, analyses it, and draws conclusions. In the case study presented in the paper, the project evidence came from project records, project participants, the town's planning documents, and user opinion survey.

3. Results and Conclusion

A success in reaching technical objectives such as elimination of architectural barriers or enhancing thermal properties of buildings is achievable with no regard to the opinions of the inhabitants. However, revitalisation projects are not aimed only at improving parameters of physical assets, but at improving satisfaction of living conditions, preventing development of unwelcome trends in social life. As such, they must be tailored to the case and to the needs of local people. These needs must be identified. The simplest way to do that is ask questions. Care should be taken to make people aware of what is being made and why, and if the effects are to last – to make them become involved in revitalisation activities. This can be achieved by empowering the users to decide on their surrounding.

The case study project was in large extent defined by the users. Post-project observations indicate that the new infrastructure becomes a useful element of local life. The project was possible only thanks to determination of the housing cooperative management, who persuaded the local authorities to include it in local revitalisation programme which gave access to funding opportunities unavailable to such relatively new areas. The opinion survey conducted by the authors in the project preparation phase indicated also that some inhabitants of the estate would be willing to contribute their work to improvement activities. This potential has not been noticed by the local authorities yet. The authors' independent post-project survey found out that the inhabitants of the estate are satisfied with the project outcomes. They also become aware of and interested in other possibilities of improving their living environment. The surveys can thus become a springboard to planning new improvements and searching for funds.

Space for notes

Renewable Energy and Thermal Comfort in Buildings as Smart Grid Components



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Summary

This paper presents results of a research and demonstration project which is set up to avoid grid instability in electrical supply. It is a contribution to protection of the climate an environment as one of the global goals of sustainability.

The central idea of the experiment is to store and shift stochastic load peaks of electricity caused by wind turbine generation in a high efficient building in order to extend the sustainability of the building supply.

The process chain starting from electrical power generation, electrical grid control down to the occupational use of energy is covered. Electrical energy is stored by Power-to-Heat technology controlled by the supplier.

A signal based on measured loads of a wind turbine and another signal based on grid and market characteristics have been the indicators to simulate the realistic operation of fluctuating renewable energy fed into the grid.

Keywords: Renewable Energy, Smart Grid, Power-To-Heat, Thermal Comfort

1. Introduction

Germany aims to substitute partly power generation by generation with renewable energies as part of the “Energiewende”. A significant amount of the electric power consumption shall be met by power from Wind Turbines and Photovoltaic plants.

Buildings and their supply components are to be considered in smart grid concepts. Energy storage in tanks for domestic hot water, heating or direct control of heat pumps are technologies to cut load peaks. The different approaches of electricity grid control and heating control for thermal comfort in buildings and their interaction to activate storage potentials have not well investigated yet.

2. Methodology

The idea of the presented experiment is driven by the aim to control the balance of the electricity grid by using the heating of the building by the energy supplier. The balance of the so called residual

load shall meet the inflexible feeding into the grid with variable loads especially in times of high wind power generation. In the optimal way heating should be used only on wind load peak as excess power. In that way the experiment joins the two technical systems electricity grid and building to an interaction by activating a negative load control using the power-to-heat concept.

The experiment has been set up to demonstrate the potentials of Buildings in smart grid systems. The complete process chain has been set up starting from power generation to electricity grid control to energy consumption in the building. The storage system is a non-electric power storage using Power-To-Heat-Technology.

3. Results and Conclusion

Using typical network signals it can be shown that it is possible to meet round about 80% of the energy consumption with stochastic loads. The prerequisite is a high efficient building which offers potentials for load shifting.

It has been found, as a side effect, that building occupants is very dissatisfied if they lose the ability to control the building. It has to be concluded that the corridor always has to be open for change in addition to the indoor temperature control. A minimum temperature corridor (0,5 K) is accepted and does not disturb thermal comfort. To extend the range additional incentives must be offered. It can be observed as a critical reaction if occupants feel loss of control. A control, which can be modified any time, could lead to acceptance.

Space for notes

Research on Innovation Development for Residential Real Estate Investment Projects



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Summary

Technological and business innovations have a strong impact on the global goods and services market. Thus, innovation development in real estate sector cannot be attributed as a self-going process. This development is regarded as the consequence of number of causes identified as internal and external environment factors.

While seeking to maintain competitive advantage real estate companies integrate the innovation issues within the development of residential projects from the conceptual design stage. This paper presents the theoretical innovation development model for real estate investment projects including all stages of project life cycle.

The practical part of the research is based on investment alternatives analysis of a new low-rise residential real estate development project with well-developed infrastructure. Effectiveness of different innovative alternatives was evaluated by applying multi-criteria decision-making methods.

Keywords: innovation, investment project, effectiveness evaluation, multi-criteria decision making

1. Introduction

The paper provides extended survey of scientific literature on the innovation concepts in real estate and construction industry. By using analytical framework based on the existing literature the essential factors, which affect the adoption of innovations in real estate and construction sector, embracing the processes of design, construction and facility management, were identified. The findings also revealed that, despite numerous efforts to explore innovation barriers and drivers within industry, very few attempts have been presented that pursue evaluation of innovations performance.

2. Methodology

By taking into consideration the major sources of resistance to or acceptance of innovations in the real estate and construction industry broadly discussed in the scientific literature mentioned above,

the authors of the paper developed the model that is recommended for evaluation of real estate investment project effectiveness due to adaptation of innovations during various stages of project life cycle. Concept stage of real estate investment project refers to exploring the external and internal innovation barriers across multiple levels of analysis from market research and feasibility study to examination of internal organizational issues. After developers have decided on the innovation types to be created or adopted, investment alternatives are evaluated by using particular methods for assessment of project effectiveness, expected value and various qualitative and quantitative criteria. Real estate development alternatives have to prove mainly the financial viability issues, together with sustainability and other selected factors.

3. Results and Conclusion

The innovative approach by implementing intelligent building management systems and alternative renewable energy resources is a challenge for project developer and different stakeholders. However, by analysing different scenarios of innovative approach, the conclusions can be made that the project innovativeness and risk of the investment first depends on the clients' preference to pay more for the comfort of their individual housing as well as for the future savings of energy costs. The developer takes his own risk to find the right time for the innovative project introduction to the market and to convince the customers to look for the best value for their money, considering the innovative approach.

The innovation development for real estate model developed by the authors incorporates the systematic components affecting the development of new technologies and innovative ideas in various stages of investment project life cycle as well as enables evaluating the overall investment effectiveness of real estate development in the context of innovativeness. Proposed innovation development for real estate model was verified by applying it to the case study of residential development to determine optimal investment approach from the point of view of real estate development company.

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Resilient Community Centers for Nepal Earthquake Victims



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Summary:

Keywords: Nepal, sustainable, affordable, safe, community

On April 25 and May 12, 2015 earthquakes of 7.8 and 7.3 magnitude devastated Nepal, destroying nearly 700,000 homes and leaving over 2 million homeless. In some areas the devastation to centers of community was almost total: clinics, temples and schools were all damaged or demolished.

Within days of the earthquakes UNM4Nepal was formed by a group of students and faculty from the University of New Mexico engineering, architecture, and economics departments. In collaboration with UNM's Nepal Study Center and four Nepali organizations: the Pratiman-Neema Memorial Foundation (PNMF), the Lumbini Center for Sustainability (LCS), Kathmandu University (KU), and a private Nepali engineering firm (Construction Management Technologies (Pvt.) Limited, (CMT)), UNM4Nepal developed the Himali Dream Partnership (HDP) to address the needs of the poorest Nepalis and those made most vulnerable by the earthquake: women and children.

After consultation with PNMf it was determined that the HDP would focus its initial activities at the community level by designing and constructing a Women's Community Center (WCC), thereby supporting existing PNMf and KU projects relating to community building through healthcare, education and microfinance initiatives.

UNM4Nepal is coordinating closely with PNMf, KU, and LCS to provide detailed architectural drawings, simplified drawings for non-experts, and instructional videos based on a model WCC to be built in New Mexico. HDP will also work with Nepali Village Development Committees (VDCs) to establish support networks and social mechanisms to enable the proliferation of the WCC designs and construction methods in a safe and sustainable manner. In Summer 2016, a group of UNM4Nepal members will travel to Bahunipati, Nepal to: (1) build the WCC demonstrating the HDP design; and (2) train local community members and VDCs in safe and repeatable construction methods.

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Resource saving potentials through increase recycling in the building sector – sensitivity studies on current and future construction activity



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Summary

Despite adequate supplies of materials for recycling as well as the introduction of dedicated norms on the use of recycled materials, a poor level of secondary raw material use persists in the building industry. Before political action can be taken to improve this situation, it is first necessary to gain a clear picture of current and future material flows, and in particular, which rates of recycling can be achieved when good framework conditions for the circular flow of materials are implemented. The aim of the described research was therefore to determine the potentials for the high value recycling of construction and demolition waste from buildings by means of sensitivity studies. Estimates were made of material flow masses in the building sector for 2010 as well as projections for the years 2030 and 2050.

Keywords: resource efficiency, recycling potentials, development of building stock, material flows, urban mining

1. Introduction

In the year 2002 the German government adopted a national sustainability strategy. Conserving natural resources is an important aim. By using recycled materials resources can be saved. However, recycled materials still make up only a small proportion of total material used for construction. In order to change this situation politicians need information about the building stock and its material flows before introducing economic instruments or incentives. Therefore the core of the investigation was to determine the extent to which construction and demolition waste could in future flow back into the building sector as recycled materials.

2. Methodology

Recycling potentials were estimated by undertaking four sensitivity studies on material masses. The studies investigated whether levels of material recycling can be increased through alternative

forms of construction, new recycling technologies and admixture of applying recycled materials in new products. The basis for these calculations were publications on development scenario 2050 for Germany and a material flow model developed by the authors.

The material flow model incorporated two different methods of calculating flows. Thus the building stock and construction activities were quantitatively analyzed in a top-down approach, while the classification of materials followed a bottom-up approach. The material calculations were based on a classificatory system of 25 types of residential and non-residential buildings using characteristic material indicators for construction types and technical fittings. By combining the indicators for building type with data on the stock of residential and non-residential buildings as well as current and future construction activities, total material masses within the building stock as well as total material flows in tons could be estimated. Applying hypothetical recycling ratios to these material masses, it was possible to determine likely flows of recycled material for the years in question.

3. Results and Conclusion

Values for the masses of recycled materials for new construction as well as renovation are based on material input and output flows. Here the determined inputs are the decisive factor. Corresponding to the estimated recycling ratio, in 2010 only 8 m tons of recycled materials were consumed by the building sector. With improved framework conditions to promote the circular flow of materials, this figure could increase by 2030 to reach a peak of between 19 and 20 m tons. However, the mass of recycled materials will decrease thereafter to somewhere between 12 and 14 m tons by the year 2050. This fall in the use of recycled materials can be attributed to a slowdown in the building sector due to demographic trends. Although the total mass of recycled materials will fall, the average recycling ratio is forecast to rise continuously from 7 % in 2010 to 16 % in 2030 and 21 % in 2050.

Despite the availability of recycled materials (in particular, mineral-based materials), rates of recycling of materials are still low in the building sector. For example, although norms and regulations permit a larger amount of materials to be employed as aggregate in concrete structures, only high-grade crushed concrete is been used and this only in 2 % of ready-mix concrete. Thus the potential for using recycled building waste as aggregate remains unexploited.

Perhaps the simplest way to increase the proportion of recycled materials consumed by the building sector would be to systematically use such recycled mineral aggregates as fill for damp-proofcourses, as levelling sand or to fill pipeline trenches.

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Risk and scenario-based approach assessing sustainability

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Summary

Future developments such as global climate change, shortage of resources or ageing society are so-called megatrends which can significantly affect the future viability of a property. Depending on the attributes of property, these developments may introduce either a risk or an opportunity due changing requirements for property. To this end, previous study identified a set of 34 sustainability indicators which in turn constitute the sustainability rating, namely the Economic Sustainability Indicator (ESI Germany). In the current study, further assessment was conducted as the ultimate aim is set to weight the previously identified indicators by adopting a risk and scenario-based weighting model. Therefore, the probability of occurrence of property's future requirements and the impact of their consequences on property value are estimated and included in the risk model. Consequently, the sustainability rating assesses the risks and opportunities of German office buildings concerning the property's future viability due to sustainability-related building and location attributes. The proposed rating model can be used in decision-making processes of investment decisions and portfolio management as well as for the consideration of sustainability aspects in property valuation.

Keywords: sustainability, rating, property evaluation, risk model, economic sustainability indicator

1. Introduction

Effects of global climate change, ageing society or rising energy prices are examples for long-term developments of ecological, economic, political and social framework conditions which can significantly affect the built environment. The slow transformation towards a more sustainable built environment can be attributed to the absence of knowledge of potential benefits, especially from the financial perspective. In order to enhance the attractiveness of investments in sustainable properties, it is essential to raise the awareness regarding the effect of sustainability issues on property value and the associated opportunities and risks. Therefore, the aim is set to quantify the consequences of long-term developments of external framework conditions on property value based on a previously identified set of sustainability indicators.

2. Methodology

The consequences of long-term developments and the resulting future requirements are quantified when using a risk and scenario-based weighting model, the ESI risk model. This model comprises the components scenarios as well as the estimations of the scenario's probability of occurrence and magnitude of consequences for each sustainability indicator. In this way, the expected value and resulting from this, the relative weights of the sustainability indicators are determined.

3. Results and Conclusion

The sustainability indicator measures the risk of a property depreciating value or the opportunity of gaining value based on long-term developments of exogenous framework conditions. The quantified consequences result in the individual weights of the ESI rating and can be grouped in following five sustainability attributes:

- Flexibility and adaptability for third party use: 18.6%
- Energy and water dependency: 32.8%
- Accessibility and mobility: 10.2%
- Safety and security: 7.1%
- Health and comfort: 31.3%

By the means of this study, the opportunities and risks regarding the property's future viability due to sustainability-related building and location attributes can be disclosed transparently. Sustainability issues which are either not or only insufficiently taken into account can be thus regarded and integrated into the assessment. Uncertainties as a result of incomplete information particularly on future developments can be minimized. This results in well-founded and more transparent evaluations and can be used in decision-making processes.

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Risk Management for Construction Green Building in Kuwait



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Summary

This research aim to identify risks perceived for the implementation and practice of green construction in Kuwait to form a view of the likely impacts of these risks. Data were collected through a questionnaire distributed to local stakeholders associated with the Kuwait construction industry. The study reveals that the risks affecting the development of green construction processes vary and are unevenly distributed throughout the construction industry in Kuwait, but common risks, such as 'lack of experts', 'limit of a green supply chain', 'lack of experts' and 'higher cost', are considered the most important risks overall; improved measures concerning the use of energy-saving materials can facilitate the achievement of energy-effective building design. The findings of this study provide valuable information for organizations that intend to participate in green construction projects in Kuwait.

Keywords: risk, green construction, green building, built environment, risk management

1. Introduction

The construction sector plays a vital role in meeting the needs of society and enhancing the quality of life. However, the responsibility for ensuring construction activities and products consistent with environmental policies needs to be defined and good environmental practices through reduction of wastes need to be promoted. These negative impacts of the construction industry on the environment and the population are both serious and alarming. In order to overcome this situation and mitigate these effects, the new concept of "green buildings" has arisen. This concept has become the new philosophy of the construction industry and has introduced various enhancements to previous concepts i.e. use of more environmentally friendly materials and resources, improvement in quality of the indoor environment, and implementation of techniques to save resources and reduce waste consumption. The green building movement offers many business opportunities to members of the construction industry. However, these opportunities carry significant risks and barriers. It is therefore necessary to understand and address the main drivers, barriers and risks associated with implementing new "Green" construction practices in order to manage them and accelerate the expansion of sustainable building projects. In order to assess the present state of the construction industry, this study focuses on a critical examination of the risks associated with implementation of the practice of green building projects from the stakeholders' perspectives

2. Methodology

The first step was to identify risks associated with construction green building. This was done primarily through literature review. A comprehensive list of 30 risks was developed based on previous studies. The questionnaire in its final version, including categorical questions and question based on the Likers scale questions. The majority of the questions in the questionnaire were deliberately short and closed-ended. Risk assessment in terms of the perceived level of impact and probability of the occurrence of a list of 30 risk factors in relation to the implementation process of green construction projects using a five-point Likert scale (1 = very low; 5 = very high probability and impact). The questionnaire was distributed to local stakeholders with experience in Kuwait's building and construction industry. Snowball and purposive or judgmental sampling techniques were used to maintain a high degree of legitimacy of the received data. To assist respondents and improve the response rate, a web based questionnaire was designed and the link was sent by email to all respondents. To maintain high degree of legitimacy of received data, a total of 210 questionnaires were distributed to the sample population and 132 questionnaires were collected from the respondents with a response rate of 63%. The data collected from the questionnaires was then collated in Microsoft Excel spread-sheets and data analysis was performed using SPSS software. Data gathered from the survey was analysed using the Relative Importance Index (RII).

3. Results and Conclusion

The main findings of this research are as follows: implementation of the concept of sustainability is low in the Kuwaiti construction industry; more action and strategies to improve and encourage this concept are therefore required in order for it to be applied efficiently in future construction projects. The risks affecting the development of green construction processes vary and are unevenly distributed throughout the construction industry in Kuwait, but common risks, such as 'lack of experts', 'limit of a green supply chain', 'lack of experts' and 'higher cost', are considered the most important risks overall; improved measures concerning the use of energy-saving materials can facilitate the achievement of energy-effective building design. The findings of this study provide valuable information for organisations that intend to participate in green construction projects in Kuwait.

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Shenzhen's New Energy Vehicles and charging infrastructure – policies, instruments and development



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Summary

Billions for green growth. Shenzhen, one of China's richest cities and home of New Energy Vehicles (NEV) producer Build your Dreams (BYD), will invest 5 billion Yuan (804 million USD) in NEV development by the end of 2015. Especially for pure electric vehicles. The megacity is using electric mobility as an instrument to reduce carbon emissions while creating economic growth. Against the background to the negative effects of traffic-related air pollution in China, the key is to promote sustainable transport. Comprehensive solutions have been adopted in several low-carbon city projects that prioritize Transit-Oriented Development (TOD) strategies. From 2011 to 2020, Shenzhen wants to reduce carbon emissions by 40-45 %. To activate green public and private investments, the city leaders formulated several policies for New Energy Vehicles (NEV) and charging infrastructure promotion and application. With the development of existing fast charging networks from 1,100 to 1,800 piles for commercial NEVs and slow charging piles in 5 % of all residential and 10 % of all public parking spaces, policymakers hope to overcome the bottleneck constraint in a lack of charging infrastructure. From 9,392 NEVs by the end of 2014, an additional 15,000 new energy taxis, buses, municipal vehicles, e-car-sharing services and private NEVs are to be subsidized in the coming years. Several top-down policies support these goals, for example purchase or tax incentives connected with sanctions for fuel car number plates. Shenzhen's challenge is to encourage citizens to use NEVs while finding the balance between economic development and environmental protection.

Keywords: New Energy Vehicle (NEV), charging infrastructure, sustainable transport, policies & instruments, Shenzhen

1. Introduction

Electric mobility provides a strategic technological solution towards sustainable transportation systems - particularly for China's urban growth. Therefore, the Chinese government is pushing the rapid development of NEVs. China's cities suffer from high levels of air pollution, and NEVs are needed in order to reduce carbon emissions by 40-45 % by 2020, compared to 2005 levels.

2. Methodology

Based on a quantitative data collection from relevant urban development projects in Shenzhen, the main actors in the field of electric mobility and urban development were identified. Qualitative expert and stakeholder interviews with group discussions and professional Chinese interpreters, an analysis and translation of policies, planning documents and leapfrog methods were conducted.

3. Results and Conclusion

Eighty-eight Chinese cities and 26 provinces are part of the Chinese NEV demonstration regions and serve as test sites for NEV policies and instruments. With around 10,000 NEVs, 81 fast charging stations and more than 3,000 slow charging piles, Shenzhen is one of the top cities for NEV development worldwide. Taxis and buses accounts for 1,1 % of all vehicles in Shenzhen, but they are responsible for 20 % of traffic-related air pollution. For that reason, the municipal leaders decided to start with the promotion and application of electric vehicles in the public transport sector. With a target of 25,000 NEVs by the end of 2015, Shenzhen set up a fund of 5 billion Yuan for NEV industry development. The city leaders follow national, regional and local guidelines to implement NEV technology systematically, including: public transport, municipal fleets, innovation systems, industry development, purchase, monetary and non-monetary incentives, charging infrastructure construction and penalties. Shenzhen's construction land is still expanding and sustainable solutions are needed. Low-carbon plans and projects will integrate electric mobility from the beginning stages of the planning process, but overall masterplans are still missing. TOD and NEV concepts have been used as examples from international good practice cities like Copenhagen or Seoul. Otherwise, there are projects with implementation challenges, especially for private users. After 2010, the local government selected 14 residential areas in which to integrate thousands of slow charging facilities, most of them are currently not in use. The availability of billions for 'green growth' is a step in the right direction. But is only one part of what should be a comprehensive system where decision maker and user follow a unified path. Future research may show which instruments are working and which have to be adjusted.

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Single family home stocks in transition – implications for urban resource efficiency



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Summary

Single-family homes (SFH) – that make up about 65% of the residential building stock in Germany – have high potential to improve resource efficiency of urban development. At the same time, we observe indications, that demographic change and change in user preferences may lower the demand for such dwellings. In particular, regions with population decline and economic shrinkage are facing the risk of growing vacancy rates in single-family home neighbourhoods. This leads to growing inefficiency of infrastructures, material and land consumption, which challenges the implementation of sustainability goals of resource efficiency and land use reduction.

Keywords: Demographic change, resource efficiency, settlement structures, built environment, single-family homes

1. Introduction

In Germany, about 65% of the residential building stock is made up by single-family homes (SFH); in 2011, more than 50% of the population in Europe lived in SFH. However, indications can be found, that economic crises, demographic change and changes in user preferences, are raising new challenges to these stocks. While multi-family residential buildings enjoy a high level of attention from residential policy-makers and the housing industry, the developments in the area of the SFH segment, with its small scale private ownership structures – approximately 90% of these buildings are user-owned – is prominent neither on the academic nor on the political agenda. Against this background, initial results from an ongoing project on demographic trends and related implications for the resource consumption for low-density SFH settlements are presented.

2. Methodology

Literature review, statistical analysis of census data and case study visits are combined into an explorative description of the status quo to generate a basis for the projection of reliable development scenarios for SFH settlements including estimations of resource consumption implications.

3. Results and Conclusion

Trying to summarize the quite different explorative impressions from the literature, statistical analysis and case study visits, we first of all have to acknowledge the typological diversity of suburban SFH neighborhoods and the need of tailor-made approaches when trying to develop these settlements in a more sustainable manner. However, a few general implications already show up and guide should guide further research and practice.

Demographic projections for Germany indicate, that the population in the age group, that is traditionally seen as most relevant for property acquisition (between 30 and 45 years old) will decrease by about 1/3 while at the same time the age group asking for accessible housing for seniors will significantly increase. This might result in a market situation where an increasing supply of vacant traditional single-family homes meets a decreasing demand, potentially leading to growing vacancy rates in this market segment. Vacancy, in terms of resource efficiency, means a waste of resources. Since SFH stocks are generally much more resource intensive – up to factor 10 compared to multi-family houses if the related infrastructure is included in the analysis – small changes have a significantly higher impact. Even today's average rate of 2,2% vacancy (census 2011 for Germany) in the SFH segment in terms of efficiency means an equal or – depending on the building types – even considerably higher relative “waste” of resources than induced by the 5,4% of vacant flats in multi-family houses. Calculated for a synthetic neighborhood and depending on the building and neighborhood type 2,2% vacancy calculatory means up to 10 tons additional per capita “material rucksack” for the remaining inhabitants in SFH neighborhoods.

On the other hand there is still considerable demand for existing as well as new built SFH, the latter even observed as bungalow type accessible SFH built by senior households, while traditional SFH fall vacant at the other end of the city. There may also appear new user groups, entering the market encouraged by historically low interest rates. However, for a growing number of cities and towns single-family home neighborhoods may form the redevelopment districts of the future with considerable implications for the implementation of sustainability goals of resource efficiency and land use reduction.

Space for notes

Solar collectors in a prefabricated housing estate: lessons learnt after four years of operation



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Summary

In the practice of Polish multifamily housing stock, environmentally friendly systems are rarely used. The paper investigates into the reasons of reluctance of facility managers and their clients in investing in what is expected to be, in the long term, beneficial for the nature and for the purse of users. A case study – a solar collector project in a housing cooperative – presents particular technical solutions adopted in 30-years-old precast panel blocks, and effects of the project in terms of financial benefits and user satisfaction.

Keywords: Solar collectors, hot water, system performance, user satisfaction.

1. Introduction

In the times of rapid technological development of technology related with renewable energy sources, and growing environmental consciousness of the public, investment to enhance energy performance of the existing housing stock seems obvious. However, the practice of Polish multifamily housing is not reach in examples of introducing modern environmentally-friendly systems to the existing (so most numerous) assets. So far, most effort was devoted to insulating the building envelopes and refurbishing heating systems with minor changes to their design. One of the bolder thermal renovation projects, involving solar hot water heating system applications to a multifamily housing complex, is the object of this case study.

2. Methodology

Case study method is widely used in built environment research. In the case study research one defines objectives of the research and selects a case, sets procedures for collecting evidence from multiple sources, collects input, analyses it, and draws conclusions. In the case study presented in the paper, the project evidence came from project records, project participants, the town's planning documents, and user opinion survey.

3. Results and Conclusion

Immediate reduction of hot water cost in effect of the solar collector project was considerable (about 35% in the 4-years perspective compared with the basic year of 2010). As supported by the evidence from the case study, investment in modernizing hot water system and introducing solar collectors proved profitable. However, from the point of finance, it was possible only due to public grants. Solar energy becomes popular, but mostly in private detached houses and new build blocks, and examples of a thorough redesign of heating systems in the existing housing stock, applied in more than one building at once, are still extremely rare.

Apart from direct satisfaction with lower hot water bills, the inhabitants express overall contentment with their living environment. Despite the fact that their experience with environmentally-friendly systems is positive, their willingness to further invest in other kinds of environmentally friendly systems seems lower - compared to findings of similar surveys conducted in other locations where no renewable energy sources were introduced yet.

Space for notes

Stakeholders Awareness of Green Building and Sustainable Development Issues in Abuja, Nigeria.

Extended Abstract

Niger State,



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Summary

The built-environment is a major consumer of non-renewable resources, producer of substantial waste, and a formidable polluter of air and water. Due to the limited reserves of our natural resources, the world will be faced with a situation of increased prices as the reserves are depleted while our natural environment is completely destroyed. Building sector in Nigeria consumes 60% of the total energy utilization in the country and the resources are not efficiently utilized. The goal of the study was to examine stakeholders' awareness regarding sustainable development issues, respective policies and constraints limiting their involvement in sustainable development. The sample consisted of 80 respondents randomly selected building owners, investors, developers, and others in Abuja, Nigeria. Descriptive statistics was used to analyze research questions 2 - 5. Findings revealed that majority of those surveyed are aware and highly involved in sustainable development efforts. Unsuccessful governmental implementation of environmental laws and government policies were also revealed. Inferences were made to improve awareness education through creation of guideline for improving awareness, advocacy and enlightenment programmes and empowering regulatory agencies to enforce and strengthen existing regulations.

Keywords: Awareness, Constraints, Green building, Sustainable development, Stakeholders.

1. Introduction

The construction industry is the largest destroyer of the natural environment, and buildings are the major contributor to greenhouse gas (GHG) emissions in many countries. It is estimated that at least three billion tonnes of materials are used in buildings every year, which is equal to about 40% of total global material flows. The International Energy Agency estimated that existing buildings are responsible for more than 40% of the

world's total primary energy consumption and for 24% of global carbon dioxide emissions.

Nigeria as a country depends mostly on crude oil and electricity for its energy fulfillment. A recent survey conducted in Nigeria revealed that 60% of the total energy utilization is consumed by the building sector [1]. In order to combat the increasing pressure from climate change, Nigeria joined other countries across the world to ratify Kyoto Protocol in December 2004. The protocol mandate signatories to propose targets for greenhouse gas (GHG) emissions reduction.

Despite the increase in public awareness regarding environmental issues through a series of seminars and conferences to promote sustainable developments in the country, the levels of awareness and participation in the Construction industry is still very low and ineffective. The goal of the study was to examine stakeholders' awareness regarding sustainable development issues, respective policies and constraints limiting their involvement in sustainable development.

2. Methodology

The population for the study includes building owners, investors, developers, architects, engineers and facility managers in Abuja, Nigeria. The analysis involved the use of descriptive statistics such as mean and percentages. A questionnaire was used for data collection, to answer the research questions, and descriptive statistics (frequencies and percentages) were used to analyze the data relating to the research questions 2 - 5.

A five degree Likert-type scale was used and arbitrary values of 1-5 were assigned to each of the degree of agreement or involvement, or awareness, respectively. The scoring of responses to the questions and statements of the questionnaire was based on the "Likert's method", where each stakeholder was asked to respond to each item in terms of several degrees of agreement or involvement.

3. Results and Conclusion

The research findings indicated that majority of those surveyed are aware and involved in sustainable design and construction in Nigeria but that the Nigerian government is ineffective in implementing environmental laws and policies. Inferences were made to improve awareness education through advocacy and enlightenment programmes and empowering regulatory agencies to enforce and strengthen existing regulations.

Space for notes

Strategic Urban Energy Planning - Vienna 2050



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Summary

In behalf of the Vienna Municipal Department 20 - Energy Planning a guideline including nine concrete operational steps and a computer-aided tool to support a scenario based decision making for strategic urban energy planning were developed. The guideline and the tool are designed to structure the planning process and to secure the achievement of ambitious sustainability targets for the housing sector. These targets are defined by the Vienna city authorities and include the reduction of energy consumption and of CO_{2eq}-emissions.

Keywords: strategic urban energy planning, housing sector, emission reduction, continuous output reduction

1. Introduction

Vienna is a rapidly growing city with an average annual influx of 14.000 people and an estimated yearly need for 8.000 additional flats to the existing stock of 880.000 units.[12][14] Simultaneous the Smart City Wien – framework strategy fixes strict reduction targets for CO_{2eq}-emissions and energy consumption for 2050.[5] Against this background, the municipal authorities decided to systematically coordinate the superordinate planning of energy provision and power supply with the overall design of city development areas in the early stage of conception. This task was named strategic urban energy planning and needed situation specific instruments. These instruments should empower all stakeholders to participate in the planning process and secure the sustainability of the development.

2. Methodology

The development of the guidelines and the computer-aided tool for the strategic urban energy planning starts in parallel with the preliminary phase of a cooperative planning procedure for the development area of Oberes Hausfeld with 3.500 flats projected. The municipal authorities establish an open exchange of information and support between the stakeholders involved in these two planning processes. Thus the theoretically elaborated instruments for the strategic urban energy planning considerably benefit in their development from the possibility to assess their practical

suitability in the cooperative planning procedure. Within the process the essential concrete operational steps to generate an adequate depth of planning are identified. Moreover the state of complexity is determined that reasonably asks for support of a computer-aided tool for a scenario based decision making. The design of the tool makes a user-friendly application focusing practical solutions on a professional technical basis available.

3. Results

The objective of strategic urban energy planning is defined as formulating clear requirements for the area development to secure the achievement of the sustainability targets determined by the city authorities. The need of strategic urban energy planning as an integral task within the preliminary strategic planning phase of city development areas is confirmed.

3.1 Locating strategic urban energy planning within super ordinated development processes

To make the implementation of strategic urban energy planning into development processes easy the new element is introduced integrated into the scheme of guidelines of project controlling of the Austrian chamber of architects and consulting engineers most planners are familiar with. [1] There the strategic urban energy planning is ranged in the strategic preliminary planning phase with comparable other processes.

3.2 Nine operational steps towards a strategic urban energy planning

Nine concrete operational steps are identified to practically structure the process of strategic urban energy planning and generate an adequate depth of planning. These nine steps are; one - clarifying the energy demand to expect, two - analyzing the potential of environmental energy on-site, three - calculating the local energy coverage rate, four - covering the residual demand, five - developing energy supply scenarios, six - controlling of target achievement, seven - comparing life cycle cost, eight - taking a binding decision and finally nine - formulating requirements for the overall design of the development area.

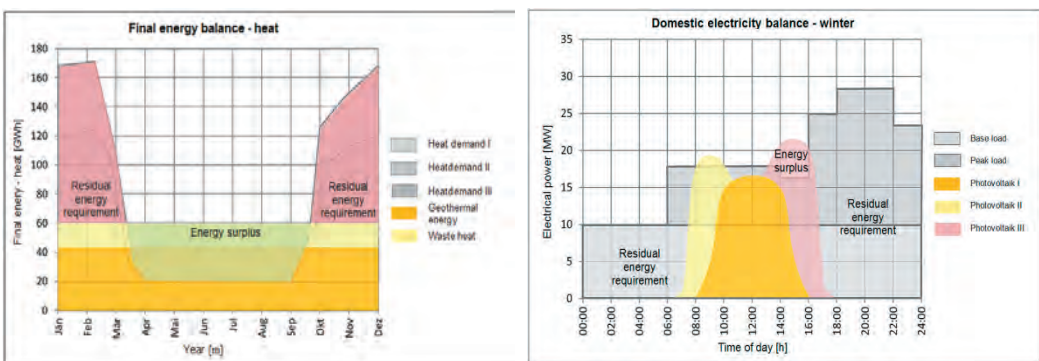


Fig. 1 and 2:

Exemplary balance sheets resulting operational step three: calculating the local energy coverage ra

Strategies Analysis on Simulation Application of Sustainable Strategies Development in the Conceptual Design



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Summary

The paper is about strategies analysis on simulation application in the conceptual design stage, which serves as a guidance for architects confused with simulation. Based on a review of typical case analysis supported by simulation tools, a strategy framework is provided in a view of architects operation. The study exemplified the strategy through a practical project for a museum and shows how simulation can effectively contribute to the improvement of the sustainable design process in the two fields, CFD and natural light. Finally, the paper summarizes the role of the simulation and some potential drawbacks in the sustainable design process in order to combine simulation and design more effectively.

Keywords: Application Strategy, Sustainable Design, Simulation Application, Case Analysis, Conceptual Design

1. Introduction

In terms of sustainable development, the conceptual form of architecture is determined by the environmental particularity, which means by the beginning of a project, architects need to find a proper conceptual form to handle the problems about various limits or conflicts of the site and local micro-climate. And BPS (Building Performance Simulation) has the potential to contribute to a sparkle of inspiration about the concept and the logic of an organized form in the complicated process, because of exceling at the quantification of the abstract problems and the visualization of the weakness in the conceptual form.

The drive towards sustainable design raises challenges for architects. These, especially deeply in association with practical process, may stem from the desire to start a sustainable concept in a proper design logic, and the need to develop a design with proper association of BPS in the early stage.

2. Methodology

2.1 Case Analysis through BPS

As an effective way for architects to grasp the logic organization of green architectural form and get a deep understanding of green architecture design, case analysis contributes to establish the framework of strategies. Cases are characterized by unique shape, reasonable design logic and building performance improvement strategies.

The study makes a computational research framework to verify different original design concepts by the means of BPS, with a main focus on examining buildings' geometric shape and its interaction with the physical environment elements. The accumulation of results can provide systematic strategies and critical reference of integrated design method with BPS application.

2.2 Strategy Framework

Based on the case study, the strategy framework of BPS application is established with three phases - strategies-making with fast and simple simulation, optimization of construction with detailed simulation and simulation evaluation. The framework can accommodate different skill levels of architects from the operation level. It means that practitioners could easily pay more attention to the design itself rather than the confusing assessments.

2.3 Case Experiment

This part will exemplify the strategy framework above through a practical project of a museum design. This way helps to concentrate on the framework itself without the uncertain influence of single case so as to testify the framework and find out some potential drawbacks.

3. Results and Conclusion

The paper has describe a framework of BPS application and design workflow in the conceptual design. It is aimed to the analysis of workflow rather than the integrated design tools development, which contributes to establish the framework of sustainable design in the view of architects no matter what the simulation tools or design tools was used during the design process.

Space for notes

Success Criteria for Green Building Projects in the Nigeria's Construction industry: "The Stakeholders' perception"



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Summary

Green building projects design and construction are characterised by the problem of lack of shared perception and agreement on the objectives of the green building projects by stakeholders. The need and the cost for incorporating Green features varied among various stakeholders in the Nigeria's construction industry. Going by these characteristics, each stakeholder perceives the success according to a hierarchy of dimensions, which comply with his / her own agenda. The purpose of the study is to appraise the importance of success criteria for green building projects in the Nigeria's construction industry based on the clients, the end-user's and the construction professionals' perceptions. Research data was obtained through manually distributed research questionnaire. A total of 380 questionnaires were distributed and 200 questionnaires were returned and analysed statistically using Frequency counts tables, mean item score and Chi square statistics. The result showed that the top ten most important criteria for each stakeholder. In the overall analysis, there is a significant difference in the perceptions of the three groups of stakeholders in the green building projects with respect to their ranking of the project success criteria.

1. Introduction

Green building projects differs from conventional building projects in terms of siting, design, construction, operation and maintenance, efficiencies (Energy, Water, Lighting, IEQ, Envelope etc.) and impact on the built environment etc. such building project is usually characterised by incorporating sustainable design elements into a building to make it environmentally friendly, water efficient, energy efficient etc. These design elements will depend greatly on a wide range of factors including building type, project location, local climate, site conditions, and the familiarity of the project team with sustainable design and construction. The combination of these factors and Green building features has a noticeable impact on the overall success of the project in the context of Nigeria's local climate, local materials, construction, occupation and operation etc.; also characterised the problem of lack of shared perception and agreement on the objectives of the green building projects by stakeholders. The need and the cost for incorporating various Green building features such as energy efficiency systems, water efficiency systems, Day-lighting, indoor

environmental quality (IEQ) systems and building envelope etc., varied among various stakeholders in the Nigeria's construction industry especially the Client (project owner) and the End-user (occupant). Going by these characteristics, each stakeholder perceives the success according to dimensions, and a hierarchy of dimensions, which comply with his / her own agenda. The purpose of the study is to appraise the importance of success criteria for green building projects in the Nigeria's construction industry based on the clients, the end-user's and the construction professionals' perceptions.

2. Methodology

Secondary sources of data such as journals, conference/seminar/workshop papers, text books, newspapers, magazines and internet etc. were used to review literatures on project success/failure in the relation to green building field, which help identify and narrow success criteria among the various stakeholders. A *4-point Likert scale* questionnaire survey (as the primary source of data) was manually distributed to Clients, End-users and the various construction professionals in Nigeria selected through random sampling method. A total of 380 questionnaires were distributed and 200 questionnaires were returned and analysed statistically using Frequency count tables, Mean item score and Chi-square statistics for data analyses.

3. Results and Conclusion

The result showed that the top ten most important criteria for each stakeholder. Project completed within Budget is the first most important criteria for the clients followed by Commercial Success. The End-users ranked their satisfaction of the green building project as the first most important criteria followed by the impact of the project. The Project Team ranked Client's satisfaction as the most important success criteria followed by on-time project delivery. In the overall analysis, there is a significant difference in the perceptions of the three groups of stakeholders in the green building projects with respect to their ranking of the project success criteria as attested by Chi-square statistical analyses which accepts the null hypothesis.

Key words: Green buildings, Stakeholders, Clients, End-users, success criteria etc.

Space for notes

Supporting urban district development by accompanying sustainability assessment



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Summary

One essential approach in the transformation of cities to improve their future proofness is the use of the principles of sustainable development. For selected issues, it may be an advantage to have as an object of assessment not the entire city but its parts (here urban districts). The paper discusses whether and to what extent an urban district development can be supported by the use of sustainability assessment systems. It presents partial results from the project Reallabor 131 Karlsruhe, while discussing the possibilities of combining a top-down and bottom-up approach in the selection of indicators and creating a typology of indicators and their description.

Keywords: sustainability assessment, urban district, existing districts, actor groups, indicators

1. Introduction

Cities have a significant impact on sustainable development. At present, transformation processes take place to prepare the cities for future challenges and to contribute to an improved quality of life, the conservation of resources, the environmental protection, as well as to their robustness and economic strength. There is a need for analytical foundations and tools to support and monitor this process. One approach is to support sustainable development through the use of neighbourhood sustainability assessment systems. However, these need to be adapted to specific “local” needs.

2. Methodology

The starting point was the analysis of existing sustainability assessment systems. However, it emerged that these do not always find acceptance in cities. In particular, systems designed for the sustainability assessment of newly constructed neighbourhoods, turn out to be too inflexible when applied to existing neighborhoods. Using the example of a specific district in Karlsruhe an indicator system for sustainability assessment of existing districts is under development.

3. Results and Conclusion

The results of the project include, among others, the development of:

- a methodological approach that differentiates between systems assessing the sustainability of urban districts and systems assessing the sustainable development of urban districts. The difference is that the first category follows a performance-oriented approach and is appropriate for motivating developers in the case of newly developed districts. However, a need has been identified for systems of the second category following a distance to target approach and facilitating the identification of relevant stakeholder groups and interpretation of their needs in the form of indicators to be applied for the further development of existing neighborhoods.
- a methodological approach to the development of indicator systems, combining indicators emerging both from analysing existing standards and certification systems (top-down) and from cooperating with relevant stakeholders at a local level (bottom up). An “indicator-kit” flexible enough to be adapted to specific conditions in specific districts is recommended.
- a typology of indicators making a distinction between the ones that “can be influenced” and the ones that “cannot be influenced” (background indicators) as well as a systematic approach to their description, including also the interactions and conflicting goals with other indicators as well as how these are influenced by various stakeholders and intervention measures.
- a list of sustainability indicators suitable for supporting urban district development through their assessment.

Thus, sustainability assessment systems can support the sustainable development of existing urban districts when allowing for flexible adaptation to specific contexts, identification of relevant stakeholder groups and consideration of their interests and objectives, inclusion of information on possible strategies and measures, and measurable progress. In the coming years, such a system will be evaluated and tested within “Reallabor 131” in Karlsruhe by an interdisciplinary work team from Karlsruhe Institute of Technology (KIT).

Space for notes

Sustainability assessment of building materials



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Summary

This paper assesses the evaluation of sustainability in the construction context. A userfriendly assessment tool for relative sustainability degree of building materials (PhD work of the author) is presented. Also it is added a new parameter to the tool, the "odor". The investigation shows how the rating is modified by the inclusion of this parameter and verifies if a building material that is considered sustainable could have a negative odor review. To see the difference about including or not the odor parameter the results of a case study are compared. The case study evaluates three different interior plasters to a standard solution: cement (REF); gypsum (A), clay (B) and lime (C).

Keywords: assessment; tool; building materials; sustainability level; odor

1. Introduction

It is noted a reduced existence of a tool relative to building materials which can include broad criteria while being simple and clear for common users.

Building materials have a vast impact on the sustainable performance of a building, since they are used in big extensions. Emissions can lead to unpleasant odors and thus lead to dissatisfaction and lower productivity of the users. Through increased ventilation, the indoor air quality could be led to an acceptable level, but this increases the energy consumption. This connection between ventilation rate and odor-related emissions, makes the selection of suitable building materials an important aspect of energy efficiency for buildings.

2. Methodology

Sustainability is an issue that should be evaluated in comparison to the common practice - the standard solution - of a country or a specific location, thus making it possible to verify, for each parameter, if the analyzed solution has a better performance than the reference option. The minimum threshold of sustainability must represent the most expressive solution on the market and should be regularly adjusted according to technological development. The most sustainable solution depends on the state of the art at the moment [1].

The assessment tool that is used in this research is supported by three main criteria: ecology, comfort, and economy. These criteria are built by specific parameters. The raw data is filled into the parameters, normalized and aggregated, into subresults for each criteria and to a final value. The tool can assess any material type.

For the case study, we choose to compare tree plaster (gypsum (A), lime (B) and clay (C)) to a standard solution (cement – REF) for a standard office building in Berlin. These materials were chosen because in a current research project [2] they show to have the significant impact (when used as a finish layer) on the odor in the rooms.

In a second step of the investigation, we include a new parameter into the human comfort criteria, the odor. With this new parameter, we redo the evaluation of the same 3 materials to compare now the results and be able to understand how the new parameter changes the evaluation.

3. Results and Conclusion

The possibility of introducing other parameters that better suit the object of study in analysis, giving it another perspective, so it shows to very important to choose well the parameters that are important in the case study. For example it makes sense that in an office, were you stay at least 8 hours of your day, the odor is more important than when you choose the material of an exterior finishing of the wall. The results of the case study show that the rating changes by including the odor parameter in the assessment.

The holistic view of the tool is very evident and tries to find balance between the tree criteria. The practical utility of the tool is that it is user friendly, applicable in various stages of the project and includes the multidisciplinary character of sustainability. It is user friendly because the introduction of the raw data is easy and the results are also easy to interpret, the graphic design facilitates the user to distinguish between the general classification and the partial results, allowing, in a specific case, to decide whether a deficit is relevant or not, or whether or not it could be easily resolved.

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Space for notes

Sustainability elements in the Danish Building Regulations



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Summary

The general framework for new buildings in Denmark is set by the Danish Building Regulations. The building sector experienced a growing market demand for buildings with sustainability standards above the Building Regulations level and therefore the voluntary sustainable building certification system with the national adaptation, DGNB system Denmark, was launched in 2012. The Danish Energy Agency, which is the authority responsible for the Danish Building Regulations, wished to assess how well sustainability aspects were already covered by the Danish Building Regulations and what central sustainability aspects were lacking in order to ensure sustainable development of buildings in Denmark. The results of the assessment carried out in year 2013 showed that many sustainability elements are already incorporated, but it also clearly indicated the need for greater efforts, particularly in relation to information through practical guidelines and the development of national tools.

This paper provides an overview of the sustainability elements already included in the Danish Building Regulations and to what extent they are covered. Furthermore, it includes an overview of the elements that were pointed out in the assessment as elements that should be included in the regulations in order to ensure holistic sustainable development based on a balance between environmental, social and economic sustainability. The paper concludes with a brief update on current actions towards a more sustainable development in the Danish Building Regulations.

Keywords: Building regulations, sustainable buildings, sustainability tools

1. Introduction

Focus on the importance of sustainable development in the building sector is intensifying. There is an enormous potential for sustainable development in the building sector in a European context, where the construction market accounts for 10% of GDP and 7% of the workforce. The construction and use of buildings in the EU account for about half of all extracted materials and half of the energy consumption and about a third of the water consumption. In addition, the building sector generates about one third of all waste in the EU. Europeans also spend 90% of their time indoors so the quality of the indoor environment of buildings is important for people's well-being as well as

their productivity. The great impact from buildings calls for further focus and development of sustainability based on a holistic life-cycle approach within the building sector.

2. Methodology

Based on indicators of sustainable buildings from CEN / TC 350 Sustainability of construction works, these indicators are analysed in relation to the requirements of the Danish Building Act, the Danish Building Regulations, DGNB system Denmark a voluntary sustainability certification scheme, Danish practice and the basic work requirements, BWR from the annex of the Construction Products Regulation.

3. Results and Conclusion

The analysis performed in year 2013 examines how the Danish Building Regulations can support a development towards more sustainable buildings in Denmark. There is consistence between CEN/TC 350, the BWR and DGNB system Denmark. This shows that there is a mutual understanding of sustainability in buildings. The BWR in force for all EU member states have a wide coverage compared with CEN / TC 350. BWR 7 on sustainable use of natural resources is interesting especially in terms of using a life-cycle approach, which may support implementation of LCA and LCC and a general focus on sustainable development.

Denmark has come far in reducing energy consumption in new buildings, and there is sufficient focus on social sustainability in terms of indoor climate. There is a great need for specific requirements, standards and tools in relation to environmental sustainability by environmental impacts and resource use and also for economic sustainability.

Following the analysis, the Danish government in autumn 2014 presented a national strategy for buildings with five focus areas where one area is sustainability of buildings. This was followed by the launch of a guideline for sustainable buildings and two new tools and guidelines for life-cycle assessment, LCA and life-cycle costing, LCC in spring 2015. The tools can be downloaded for free and there is no license fee. The tools are supported by guides on both LCA and LCC.

Space for notes

Sustainability profile of urban planning in Algiers



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Summary

This article proposes a tool for sustainable assessment -“Sustainability profile”- to guide the transformation and adaptation of a territory to meet sustainable development requirements. The evaluation study not only contributes to a better understanding of local challenges, but it also provides decision support elements for planning and urban development. The application of the tool on a district of Algiers should allow both the implementation of its urban characteristics and highlight its potential and dysfunction.

Keywords: Sustainable urban planning, local assessment framework, sustainability profile, Algiers.

1. Introduction

The profile of urban sustainability is one of the new decision support tools. Integrated upstream of strategies and decision-making process, this tool helps to set up a three-dimensional image of the urban situation while defining local criteria and indicators for assessment (Srir & Akrou, 2011). Sustainability profile can be specifically considered as a shared diagnosis of sustainable development (Rouxel & Rist, 2000) of a given urban situation (district, municipality or city). It covers, not only the definition of the main urban, environmental and socio-economic issues, but also the definition of local stakes and development strategic goals.

2. Methodology

The model of sustainability profile developed in this present study, proposes a general framework for the urban planning in Algiers. It allows territory to assess its own situation, to define its goals in terms of sustainable planning and to create appropriate mechanisms to achieve them. This profile is intended to provide guidance and support to improve decision-making and action on sustainability. This assessment framework is also designed to be adapted and expanded according to the particular situation of either the city or the municipality (issues, specific objectives and indicators).

According to these considerations, the design of the tool result from the combination of several interactive elements, following three steps : first, analyzing the strategic planning documents to identify key issues, then identifying thematic fields that hold challenges and finally modeling a system of assessment indicators.

3. Results and Conclusion

The sustainability profile as a tool for measuring the local urban sustainability was particularly relevant through its application for the case study of Algiers. It showed the potential uses of shared diagnosis and evaluation indicators system. However, this work represents only the first part of an iterative process to improve urban practices and produce measurable and comparable indicators for local sustainability in the Algerian context. Through its integrated assessment process, this tool will effectively provide guidance and improvements in decision-making process.

Adaptations of the tool are necessary for effective local application. The definition of reference values must arise from the application context for more consistency and more relevance. The results of this case study raise questions about the relevant indicators of our context and more specifically of the neighborhood scale; which is the subject of the assessment as well as on local reference standards to be defined. It is also a challenge for this tool to be adopted and used by local authorities, and to be linked with other sustainability initiatives being taken in supra-municipal levels such as the strategic project of planning and development of Algiers in 2030.

Space for notes

Sustainability survey amongst architects in the German state of Baden Wurttemberg on the adaptation level of sustainability aspects in the real estate sector



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Summary

In modern societies people spend most of their time in confined spaces. The work processes as well as the well-being of those who occupy these spaces are affected by both the design as well as the composition of rooms. To ensure the quality of living for future generations a responsible and sustainable interaction with resources is needed. According to estimates, 40% of the entire primary energy usage will be required for to operate the buildings. This shows that the real-estate industry must have an essential involvement in the development of sustainable strategies.

Sustainability highlights more than just energy balance and environmentally sustainability — at a basic level, sustainability also takes in economic and social aspects.

Thus, this discussion paper describes the level of adaptation of the three sustainability dimensions in analysing the adaptation levels among architects. To achieve meaningful results, about 1.200 architects in Baden-Wurttemberg were interviewed with the aid of a standardized online survey. As a result, coherences, differences and developments could be precisely captured.

The aspiration of this research work is to evaluate the existing practice of social sustainable buildings. The empirical analysis of the survey data shows that from the perspective of the architects, ecological and economical dimensions have a much higher adaption level over that of social sustainability. The architects who took part in the study also see the advantages of sustainable versus non-sustainable structures as well as the benefits of the ecological versus the economic.

In addition, the study investigates how the adaption level of social sustainability within the real estate sector can be increased and which barriers to adaptation could occur during this process from the architects' perspective. In this regard, it should be noted that the funding of social sustainability, as well as an increased awareness of the real estate owners for social sustainability is play an important role. In the building sector this knowledge could contribute to a more in-depth understanding of the realization of sustainability, in particular of social sustainability.

Keywords: Sociology of architecture, social sustainability, sustainability, survey results

1. Introduction

In recent years an increasing trend can be observed in the real estate industry: sustainable real estate [1]. Based on the three-component model, the concept of sustainability consists of ecological, economical and social dimensions. This study examines the adaptation level of the three sustainability dimensions in the real estate sector by means of a quantitative survey of architects.

2. Methodology

Based on a quantitative online survey with over 1200 participants, this article focuses on architects, both as experts in the real estate sector as well as operating actors.

3. Results and Conclusion

The results of this study show that the issue of sustainable building is of high importance for architects in their everyday working lives. According to the architects interviewed, the respective dimensions of sustainable building are viewed differently at the national level. The ecological and economical sustainability dimensions point to a similarly high level of adaption, whereas the social sustainability dimension is attributed to a lower level of adaption. In respect to the normative general outline of the polled architects, it should be stated that first of all ecological advantages can be noticed by sustainable real estate objects. Furthermore, economic benefits are considered more important than social sustainability aspects. These results indicate that the ecological and moreover economic sustainability dimension is being adapted proactively from the architects questioned due to attributing a bigger use of these components. Furthermore, a higher importance of the ecological and economic sustainability dimension opposing the social sustainability dimension can have a stabilizing self-strengthening effect. Due to the difficult relation of the sustainability dimensions, proactive adaption of the social sustainability could prove difficult within the real estate sector.

The study results show a low adaption level of social sustainability during the practice of building which means the whole process must be rethought in respect to its appropriateness. Only through critical reflection of established practices unwanted side effects can be considered and thus prevented. A higher adaption level of social sustainability cannot be achieved by only adapting the regulative framework, but also requires a sectoral problem perception from the architects and other involved actors.

Space for notes

Sustainable Housing Design. Integrating technical and housing quality aspects of sustainable architecture in civil engineering education.



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Summary

An integrated design approach to sustainable architecture is outlined that combines concerns for zero energy building, good indoor climate and adequate constructions, private and public outdoor space, housing, urban and architectural quality. The educational framework, curriculum and integrated design methods are preconditions for optimizing a design process where technical criteria, functional concerns and housing quality are addressed from the initial phases. The outcome shows that integrated design further solutions where sustainable urban forms of settlement can be highly energy efficient while also attractive from a user perspective.

Key words: Sustainable architecture, integrated design, zero-energy-housing, dense urban living.

1. Introduction

When designing sustainable housing, energy optimization and satisfactory indoor climates are central issues that need to be incorporated from early design phases if to reach a coherent design. It might also be argued that the energy consumption of contemporary buildings only plays a relatively minor role compared to energy consumption related to private transportation of the occupants. Research points towards high urban density if to reduce the need for transportation. But Danish families prefer to live in detached houses situated in less dense suburbia to achieve sun, fresh air and green space. Thus, if one wants to realistically solve the issue of sustainable housing design one must address the intertwined aspects of building construction, urban density and neighborhood qualities which calls for an interdisciplinary design approach. This paper tells of a thoroughly tested civil engineering education program at university master level dealing with the complex issue of combining zero energy building with dense urban living for children families.

2. Methodology

The students are recommended to use the Integrated Design Process-method as described by Mary-Ann Knudstrup, that has been developed especially for the A&D architectural program and its intention of combining architectural and engineering skills in design work where 'artistic learn-

ing, the creation of ideas, and an ability to see new possibilities and be creative become just as important parameters as the ability to identify problems and suggest a rational solution’.

3. Results and Conclusion

The described educational program encompasses three major aspects and allows them to profoundly influence the building design: The first being dense settlement in order to reduce the environmental impact from transportation, to reduce the use of land and to increase the efficiency of infrastructures. The second being low energy consumption and local energy production that in northern climates involve passive and active solar which is difficult to obtain in dense urban areas. The third being that most residents like to have access to private or semi-private outdoor spaces; that residents especially in the Nordic countries prefer to have well-lit housing units and that children families in general benefit from being close to green areas and playgrounds. This is difficult to achieve in areas of high urban density, but the ambition must be addressed in a sustainable perspective.

The student designs on mixed-use zero energy-housing show that sustainable forms of settlement and good residential life can unite and that a dense human biotope reaching zero energy may be an attractive one. This is difficult to achieve and takes integrating design skills that carefully merges technical, social and aesthetical criteria and considerations, which is not self-evident in contemporary building practice.

Space for notes

Sustainable neighbourhood in Saint-Petersburg



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Summary

The dominant urban development strategy in Saint-Petersburg could be described as unsustainable with constant outer expansion, extension of transport links and complication of energy supply systems. This paper contains a practical proposal for a sustainable neighbourhood in Saint-Petersburg based on alternative “inner-city development” strategy. The location of the project is on the island in the city centre, on flows of Neva River. In terms of new development strategy, the following aspects were considered: new urban typology (building configuration, building height, building distance), urban quality, energy supply concept (district heating, alternative energy sources), transport concept.

Keywords: inner-city development, mixed use, rehabilitation, alternative energy sources

1. Introduction

Constant outer growth of the city combined with lack of legal instruments for managing projects in a sustainable way leads to a list of problems in current city development and it could cause more problems in the future concerning economic sphere, people well-being, increasing pressure on the environment etc. Saint-Petersburg took a second place in Russian Environment rating among big cities in 2011, but requirements for energy efficiency are still low and some aspects of environmental performance of buildings and neighbourhoods are not being taken into consideration on planning, constructing and operational stages.

2. Methodology

Ecotect 2011 Simulation Tool was used in this work for a deeper investigation of environmental performance of existing urban forms. Based on the results and short comparison of development configuration of case studies (building height, building distance etc.) the proposal characteristics were developed. Further development follows the examples of HafenCity district (Hamburg, Germany) and Hammarby sjöstad (Hammarby Lake City, Sweden) – existing areas with rehabilitated streamside territory in similar climate conditions.

3. Results and Conclusion

According to simulation results better environmental performance with sufficient urban density level is represented by modern elite quarters (building high – 6-7 storeys, building distance – 16 m). Therefore set standards for residential buildings in the proposal: number of storeys – 6 (including stylobate), housing width – 20.4 m. Courtyard type of development was chosen, the inner courtyards are elevated above the ground. It helps to split the transport streams and limit the car access inside the residential quarters.

Public access to the basement floors and multifunctionality were determined as serving for better urban quality of the area and were taken into account in the proposal. Then, encouraging the use of alternative transport, provision of car-free zones inside the residential quarters became aspects of new transport concept. Parks and greenery are conserved where it is possible; a lot of vegetation is added in new quarters. Solar, wind and geothermal energy were analyzed in terms of availability for developing energy supply concept.

Saint-Petersburg despite its historical status is a modern developing city. Since the rates of its territorial growth, energy consumption and growth of environmental impact become distressing, significant changes in its urban development strategy, construction methods and requirements related to energy efficiency and reducing the pressure on the environment should be made. To say more generally, something has to be changed in planners, builders and users attitude, and these changes have already started in low rates.

This proposal develops the new urban development strategy, which excludes expansion of new territories, involves development of abandoned territories in the city centre and increases the availability of these areas in a city scale.

Space for notes

Sustainable Public Procurement of construction works – a literature review and future requirements



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Summary

In today's economy a growing interest in "greening" the construction industry can be recognized. Therefore the procurement of construction works opens up an important opportunity for implementing not only environmental aspects into all processes as well as products of a building. Furthermore it contributes to a reduction of the environmental impact caused by construction actions. Purchasing of construction works therefore is potentially a powerful agent of change towards a more sustainable portfolio management of building projects.

In recent years, the interest in the cross-disciplinary area of procurement research (used interchangeably with green purchasing, environmental purchasing, sustainable sourcing and supply management) continues to grow in both academia and industry. A main driver of this development is the increasing number of policies and regulative dealing with these issues of procurement (e.g. COM (2008) 400; Directive 2014/24/EU)

Various research examine the positive effect of green and environmental purchasing as a useful instrument that improves resource efficiency, promotes recycling and other environmental benefits. But for a holistic consideration not only environmental aspects should be targeted. In terms of sustainable procurement of construction services also economic and social aspects should be considered besides ecological issues.

The aim of the paper is the review of existing evaluation approaches in public tendering and awarding of construction works, focusing on how they assess the use of sustainable issues in terms of dealing with life cycle management in the procurement of construction works. However the environmental pillar of sustainability seems to be very popular, by phasing out hazardous materials in produced products and services, furthermore requiring a certain amount of recycled content or focusing on lower energy consumptions of buildings.

Finally a more performance-orientated approach could be recognized through this research. There are many research efforts towards a more cooperative procurement. Especially joint specification, selected tendering, performance-based bid evaluations, collaborative tools have direct effects on the project performance towards its life cycle.

Keywords: Green Public Procurement, Sustainable Public Procurement, Selection Criteria, Procurement Process, Holistic Approach and Literature Review

1. Introduction

The increasing awareness of climate change implies the needs towards more comprehensive strategies especially in terms of public policy design. Construction industry is one of the most energy and resource consuming industries. About 40 % of the global energy use is related to buildings as well as 50 % of the resource consumption is linked to construction activities. Therefore the implementation of strategies is one of the most crucial aspects in this field of research.

Public procurement can be seen as an important tool to implement these approaches into a more holistic life cycle consideration in construction industry. Therefore several strategies have been developed on international and national level in the last few years to strengthen the impacts of public authorities. In this context green and sustainable public procurement approaches are considered more for awarding construction works and services.

2. Methodology

This contribution seeks to provide a rigorous, critical analysis of the state-of-the-art research in the field of sustainable public procurement of construction works. Therefore a comprehensive literature review has been performed and developments have been pictured. The literature analysed here, comprises of international peer-reviewed English language papers in the time period from 1990 to 2015. The keywords for the research have been limited to green and sustainable public procurement related to construction works, to picture the development over the last few years towards a more life cycle orientated approach in construction industry.

3. Results and Conclusion

Green and sustainable procurement approaches have received considerable attention in construction industry in the last few years. This contribution provides an overview on the state-of-the-art in the academic field. It has identified research trends in procurement methods and criteria development for awarding construction works and services based on their environmental performance. Therefore several green criteria exist which mainly target the product level, based on environmental specifications and highlighting the potential impacts of a building project to help identifying its critical process. One of the findings is the lack of interactions with the procuring organisation and the contractors, which cause a different understanding of the whole life cycle starting from identification of needs to adopting and diffusion, resulting in uncertainties and higher follow up costs.

In consequence a shift towards a more performance-based cooperative procurement approach could be identified. The view is, that this will drive change towards a more life cycle orientated consideration of building projects, implementing newer and greener technologies and stimulating innovative developments targeting a life cycle perspective.

Space for notes

Sustainable Real Estate Education: Competencies and Didactics for a Transdisciplinary Master's Program



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Summary

The real estate economy with its high impact on sustainability urgently needs graduates who employ a multi-perspective approach and are able to act holistically. The purpose of this paper is to provide a framework for competencies and didactics of a transdisciplinary real estate Master's program. Starting with the perspectives that should be addressed in sustainable real estate management, we find a lack of programs dealing with the interfaces. Higher education programs on sustainable development face similar challenges, therefore comparative research helps identifying requirements and effective didactics. Empirical research regarding a sustainable real estate Master's program in Germany confirms major analogies between both areas. Thus, proven educational concepts can be applied to develop an auspicious transdisciplinary real estate curriculum.

Keywords: Real Estate Education, sustainable Master's Program, Transdisciplinary Approach, Competencies, Didactic Concept

1. Introduction

The complexity of real estate and its large impact on sustainability require generalists who combine holistic knowledge of real estate with communication and coordination skills. Educational real estate programs should therefore provide students with inter- and transdisciplinary knowledge and skills that allow them to find sustainable solutions together. However, real estate Master's programs that generate graduates with transdisciplinary real estate competencies are rarely offered while urgently asked for by the industry. Real estate research and education has mostly focused on the "pure" perspectives of 'users' (e.g. urban sociology), 'producers' (e.g. architecture), 'investors' (e.g. finance), and 'regulators' (e.g. urban planning). While there have been several developments to integrate those fields (e.g. industrial engineering; facility management), they are either set up multi- instead of interdisciplinary, or are rather practical than scientifically oriented. A transdisciplinary real estate program should instead provide students with balanced knowledge from all perspectives as well as skills that foster the development of integrated competencies. The relevance of the topics can be ensured if this development takes place in cooperation with non-academics from the industry. The purpose of this paper is thus to develop and provide a framework for competencies and didactics of a transdisciplinary real estate Master's program. This is

done by analyzing insights from an empirical study in the real estate sector and by deducing and transferring knowledge from higher education in sustainability to the field of real estate education.

2. Research and Empirics regarding Sustainable Education

To develop a transdisciplinary real estate Master's program, three threads are being considered: Research on higher education in sustainable development and its didactics, on sustainability in the context of real estate, and on real estate education. As there is a gap in sustainable real estate education and its didactics, the competency structure of Novo and Murga-Menoyo with its four competence groups "systemic and critical thinking", "anticipative thinking", "social commitment", and "ethical commitment" has been used as a framework to identify analogies between the two fields of higher education. The results of an empirical study, surveying and interviewing members of the real estate industry, professors, and students regarding knowledge and skills needed to sustainably handle real estate were therefore compared to those regarding sustainable development. As many similarities were found, it seems to be reasonable to use recommendations from higher education in sustainable development for the design of a sustainable real estate program.

3. Implications for Real Estate Education

Real estate Master's programs should employ a holistic real estate perspectives approach, stimulate critical reflection of real estate issues, foster leadership, communication, and coordination skills, encourage transdisciplinary learning, and develop a responsible attitude for the broad variety of real estate matters. Furthermore, didactic methodologies from sustainability education can be applied effectively, such as problem-based and cross-disciplinary learning, real life projects and the integration of experts and field trips. Based on these aspects, a Master's program curriculum can be developed that fulfills the requirements of sustainable real estate education through a transdisciplinary approach.

Space for notes

SUSTAINABLE RE-USE OF A BUILDING IN THE CASE OF CULTURAL INDUSTRIES: 'SALT GALATA' ON VOYVODA STREET IN ISTANBUL



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Summary

Main interest of this research is 'use value' that refers to the public image. In this study re-use of a building is going to be analyzed in terms of sustainability. In the process of time, 'building' becomes 'devaluated' and its level of productivity goes down. 'SALT Galata Cultural Institute', the former Ottoman Bank of 19th century, one of the most important architectural forms of capitalism of the Ottoman Empire and Voyvoda Street, is going to be introduced as the architectural case. This paper attempts to make a contribution to limited urban studies of Voyvoda since it is not as much exotic as the other areas in Istanbul with its architecture of Modern West [8]. It will begin by reviewing how Bank has transformed into a Cultural Institute and finally the contribution of use value will be discussed to sustain critical thinking of architecture as an urban culture. Exploratory case structured through interviews and observations along street. It is important to underline that most of the old photos are having Ottoman Bank building as a focal point as an architectural reference of the street. This phenomenon makes the building a landmark which has sustained its legibility by variety of urban images over a century and the research is questioning how SALT Architecture as an image of Voyvoda sustains urban culture.

Keywords: Architecture, Landmark, Use Value, Urban Culture

1. Introduction

SALT is located in Istanbul, Galata Region on Voyvoda Street. Voyvoda is an historical route of financial activities and today synthesis of eastern user profile and western style buildings [8]. After restoration of building, 'Money' issue has transformed into production of 'Culture', cultural industries. SALT is re-organized to enable a multi-layered program which makes it a center of attraction for public. It offers public access to Auditorium; Museum; an Archive and Library; an exhibition space; a Café and Bookstore [20].

Architecture has thus been the quintessentially universalistic expression of civilization and reflection of culture [3]. As an image of urban culture it is an evaluative process of perception. Use of architecture is a value, which creates a ground for critical thinking that needs to be a sustainable social and cultural practice of community (Gould, 2001) [11]. French Levantine architect Alexandre Vallauri designed the original building of SALT in 1892 and it has distinct architectural styles; neoclassical and oriental; applied on opposite façades [20].

From 19th century on, building has been a landmark, which is referring to an architectural reference point in an area, which can be either symbolic or physical. Cultural industry is used as a common concept of cultural and creative activities and this heterogeneous group of industries comprises the cultural or the creative economy [2]. The head office building of Ottoman Bank and today's SALT was symbolic in more than a way; matching the prestige of the bank in magnificence and also the

first modern bank building of the period initiated as a new architectural design, which would soon prevail in the city, particularly on Voyvoda Street [17].

The claim is that; landmark is an entity that has to be sustained as a cultural practice of community and an image of urban culture. Sustainability is widely accepted as an important conceptual framework (Williams et al., 2000) where one of the main sources of disagreement within the debate about sustainable development is what is to be sustained. A discussion of sustainable development might be discussing how to sustain a person's livelihood, a development project, a policy, an institution, a business, a society, a community, culture or economic growth [6].

2. Observation and Interviews

Variety of behavior has been detected among street's environmental context; retailer sits outside the shop to spend time; sitting over bended knees is the common position. A tourist is walking through street and looking for SALT and meanwhile another tourist is taking a photo of historical stairs of street; not SALT which is not a distinctive architecture along street. Interviews have been done with the retailers who are last two decades' most dominant actors of Voyvoda. SALT is an image of prestige and public value for them who are leaving area in the long run of transformation.

3. Conclusion

It has been a landmark for financial purposes and today has variety of image. Evolution shows that as a bank and then SALT has formed different types of use value. For Ottoman Bank staff or customers; it used to be a financial landmark whereas for retailers; also a prestige landmark; on the other hand for researchers, tourists, intellectuals visiting art gallery it might be an art and culture landmark. Considering this entire 120 years, it is going to keep its image of urban culture even if its architecture isn't distinctive. It promotes a ground for mixed-use and delivers the initial scheme for cultural industries as a tool for economic sustainability of the street. SALT is a trivet model of sustainable re-use and socio-economic incubator of sustainable regeneration of the street. Image of SALT has to be sustained to create a ground for perceptual thinking as a cultural practice of urban community and innovative economic development.

Space for notes

Sustainable Urbanism: Research-based collaboration of intercultural and transdisciplinary student teams towards resource-efficient solutions for challenges of current urban planning on exemplary neighbourhoods in Hamburg.

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Summary

Sustainable urbanism leads socio-cultural setting and resource-efficient use of materials, water, energy and traffic to a synthesis. Aspects of sustainable urban planning are densification, mixed use, urban sprawl, green technology or human scale neighbourhoods. This can be reached by promoting diverse urban sub-centres, in a so-called polycentric city like Hamburg.

In order to apply this conceptual framework in a comparative way, seven teams of international graduate students proposed solutions on sub-centres in Hamburg, based on an in-depth analysis of those neighbourhoods. Participants have different academic and professional backgrounds in order to be able to analyse, discuss and propose in a broad, interdisciplinary way. Also, they have a diverse cultural background, which constitutes a global understanding with regards to technology, politics, culture and climate.

The aim of this collaboration is to derive strategies for the improvement of livability and sustainability of urban neighbourhoods through extensive communication among diverse perspectives. The presented outcome is based on critical theoretical discussions, case study analysis and contextualised, detailed physical interventions which shall be adapted to other locations in a useful way.

Keywords: Interdisciplinary Planning, Polycentric City, Sustainable Urbanism, Best Practice

1. Introduction

Find out what makes a neighbourhood sustainable and propose measures to make it more sustainable and livable. Basically, this was the task of a research-based project work at HafenCity University Hamburg for 29 international students of the master of science degree programme Resource Efficiency in Architecture and Planning (REAP). Cities need to become more compact and resource-efficient and planning requires holistic approaches.

Intercultural and transdisciplinary work is practical reality in planning, which requires to prepare students as future decision makers of urban development for that too. This paper reports of a one-term, 10 credit points course called Project 2 in the second term of REAP. It presents major outcome related to traffic, material, water and energy, which serves as an example of how to apply the concept of sustainable neighbourhoods through academic knowledge exchange. We argue that intensive interdisciplinary master's programmes have potential to transform the way Sustainable Urbanism (SU) is being transmitted and applied.

2. Methodology

The project was divided into two parts: analysis and proposal. During the first part, the groups used a multi-criteria analysis and various indicators to analyse a neighbourhood. The presented results include floor area ratio, infiltration potential, rent index, land use ratios, photovoltaic potential, and cyclomatic numbers eg.

3. Results and Conclusion

The energy assessment of the first example in Hammerbrook resulted in a demand side management of electrical power and decentralised, local supply through photovoltaic. Food Security as a global issue became the focus topic of the second example, which dealt with different solutions to improve efficiency in food consumption and waste management. The third example was lack of connectivity, which was identified in many neighbourhoods. All of the shown examples report of demand side related topics. This echoes the need for more participatory planning and tells us the importance of bottom-up strategies as result of the projects by REAP.

Another more abstract conclusion of the projects is the question of how to disseminate and apply ideas of SU. Many interventions show that urbanism principles cannot be just adopted but need to be contextualised. We see potential in masters programmes like REAP, because it is more broadly discussed than common best practice culture. Participants not only learn concepts and principles, they are part of an academic process in order to reflect the challenges and opportunities of SU.

Space for notes

Teaching Sustainability & Strategies of Reuse: Critically Examining Sustainable Design Parameters and Methods of Evaluation



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Summary

In the future, most work for architects and allied professions will involve creatively applying sustainable design principles and impacting existing buildings. These are not new concerns for architecture, which has always been concerned with balancing the natural and built environments; negotiating present and future needs; and utilizing appropriate technologies and materials. However, the ways schools are teaching sustainability in architectural education is a point of debate. This paper aims to add to the discourse in architectural education for sustainable design. This paper presents findings and discussion relating to the author's experiences teaching sustainable design to architecture students, in two courses designed to take an alternative approach to teaching sustainability. This paper discusses the first phase of a pedagogical study in which findings were focused on the design instructor working directly with students working in groups in intensive courses. The next phases will involve collaborations from neighbouring specialist disciplines, by inviting guest lecturers from climate science and engineering to provide deeper insight on certain topics and facilitating a collaborative workshop with other students from areas of fine arts, environmental engineers, and other areas to mimic realistic design processes with multiple actors.

Keywords: teaching sustainability; architectural education; teaching methods; sustainable renovation; strategies of reuse;

1. Introduction

In the future, most work for architects and allied professions will involve creatively applying sustainable design principles and impacting existing buildings. These are not new concerns in the practice of architecture, which has always been concerned with multi-parameter optimization concerning the natural and built environments; negotiating present and future needs of both clients and society at large; and utilizing appropriate technologies and materials. However, both the profession's approach to sustainable design [1] and the ways schools are teaching sustainability in architectural education are serious points of debate [2].

2. Methodology

This paper presents findings from the author's experiences to teaching sustainability and sustainable renovation to undergraduate architecture students. The aim of the pedagogical study was to

encourage the students to critically reflect about what it means to be sustainable and to foster concepts of environmental stewardship. This paper discusses the first phase of a pedagogical study focused on a course design where the design instructor worked directly with students. The architecture students worked primarily in small groups of two or three of their peers. The next phases will involve collaborations from neighbouring specialist disciplines in order to mimic a realistic design process with multiple actors.

3. Results and Conclusion

Architects are well placed as a profession to grasp the overall complexity inherent in sustainable design and sustainable transformation, but how can educators encourage this advocacy in design students? The intention of the teaching was to make the topic of sustainability into a creative theme with many different ways to approach it. One finding from the course 'Designing Sustainability' was that the students found that sustainable design criteria is dependent on the specific design problem and context, so they set about selecting sustainable design priorities for their design to be able to respond and evaluate accordingly. They found it was meaningless to try to design for general "sustainability" qualities but rather they needed to develop a local, specific and tuned approach. Students found it hard to graphically represent aspects of sustainability, like reused materials, time, and sound, because language and representation of many sustainable design concepts is not a part of a typical architectural education. In group discussions, they found it hard to defend or evaluate what they could not draw. In the second example, the 'Strategies of Reuse' workshop, students worked in small groups to construct a 1:1 prototype from local found materials. A main finding was that the 1:1 studied helped students overcome difficulties in drawing material details. After they made a series of full-scale assemblies or joint details they were then more confident in drawing them. The feedback by the group and instructors to students was primarily about architectural concept and material details, not about why they chose the particular waste material. The short, hand-on workshop format gave the students a deeper understanding of reuse of material and especially an appreciation for how the method of connecting materials is important if they are to be reused again, deepening their understanding of lifecycle and strategies of reuse.

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Space for notes

The aspect of space in future energy systems – Extended Abstract



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Summary

The concept of hybrid grids is focusing on regional and supraregional levels. Energetic Neighborhood (EN) adapts the abstract concept and offers a set of technical and conceptual approaches to face the local situation. From the perspective of stakeholders and facilities within a district (companies, houses, plants etc.), the approach of EN means, that those who are in close proximity to each other, exchange energy and energy surpluses with each other so less primary energy is consumed in total.

Using a space-analytical approach, a method will be developed that integrates different, previously separated energy domains considering the specific “effective radius” of technical solutions and energy domains. The paper shows framework conditions, first analytical model concepts and interfaces to municipal energy planning issues.

Keywords: Energetic Neighborhood, hybrid grid, local implementation, energy planning

1. Introduction

Making the theoretical concepts of hybrid grids more explicit on local level is the challenge to implement the future energy system. The dynamic of demand and generation of energy and the necessity of placing plants lead to a relationship of tension and to an economical competition between different solutions. The idea of Energetic Neighborhood gives a conceptual framework to cope with this challenges.

The current contribution analyse existing approaches and concepts and presents an explicit spatial approach with the focus on future energy systems. It represents the incipient project at the Jade University of Applied Sciences in Oldenburg.

2. Existing Approaches and Concepts

Based on the spatial fuzziness of neighbourhood, an energetic collaboration should be very flexible and take into account the coupling of different energy domains.

Existing spatial approaches normally focused on an optimization of a certain technology or on localization of potentials and demands. The concept of effective radii goes towards supply plan-

ning. The cost and technology dependent ranges of e.g. surplus heat energy of production processes can be integrated into the energy strategy.

A very important information base are heat maps of energy demand. They give a spatially concretized overview for further planning. But energy demand and the supply of renewable energy and surplus energy are not a static fact. It changes in time and space, so an integrated approach could help to localize solution areas with a set of technologies and coupling potentials.

3. Integrated Approach and Outlook

The idea of the fuzziness of neighbourhood transferred to energy issues could be a very interesting approach to localize areas with preferred supply technologies (e.g. district heating or gas heating) and hybrid grid areas on local level. The challenge is to define core areas of specific generation and distribution technologies (e.g. district heating systems), areas of individual energy generation and areas to couple those areas, if a useable surplus energy is available. In the respective areas there will also be decentralized couplings. In specific investigation areas the existing grid (gas, power, sewage etc.) should be taken into account as a base for scenarios. More exact boundaries are to be determined from the energy point of view.

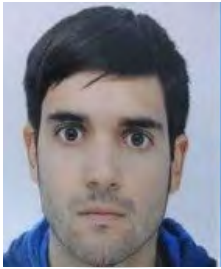
The project “The spatial reference in future energy systems” just started at the Jade University of Applied Sciences in Oldenburg (Lower Saxony, Germany). In the next three years it is foreseen to develop a method to define and describe solution areas of Energetic Neighborhoods with an optimized set of energy supply systems under the perspective of climate protection and cost efficiency. The fluctuation of Energetic Neighborhoods in space and time will be formalized and tested in concrete urban areas. Different approaches will be tested:

- Spatial modelling:
Modelling the spatial fuzziness and suitability of solution areas for EN
- Visualisation of spatio-temporal energy flows
The visualisation of complex energy issues supports the decision making
- Modelling the facility setting:
Modelling different sets of facilities and coupling points of energy domains within the solution areas. Agent based modelling and prediction by neuronal networks will be analyzed

The project is carried out with close relation to planning authorities on municipal level, and with the intention to develop a transferable planning guideline.

Space for notes

The effect of water dosage on the properties of wet spray cellulose insulation



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Summary

The thermal and mechanical properties of cellulose fibre insulation, installed via the wet spray projection method, were studied. The isotherms of loose fibres were determined using dynamic vapour sorption to study their behaviour with water. Wet spray cellulose samples with varying water dosage were subjected to compression, and thermal conductivity testing. Results showed density, modulus of elasticity, and thermal conductivity all increased with water dosage. These factors are to be considered for when applying wet-spray cellulose fibre insulation to ensure the properties of the material are consistent.

Keywords: Cellulose insulation, thermal conductivity, recycled paper, compression, moisture sorption,

1. Introduction:

In the building sector, there is an increasing interest in construction materials that incorporate natural fibres, in order to reduce carbon emissions. One such material is cellulose, an insulation material that is made of ground newspaper fibres treated with fire retardant chemicals. A process of applying cellulose, known as the wet spray method, wherein fibres are sprayed into wall cavities with water, shows many benefits compared to the traditional “dry” method. The wet spray method provides a material that is evenly distributed, doesn’t sag, and has better resistance to air infiltration. The issue with this process is the control of water dosage. Applicators of cellulose insulation might have trouble controlling the amount of water sprayed during installation. An excess of water might lead to a material that resists sagging but takes longer to dry. As well as this delay, the increase of applied water could affect the thermal and mechanical properties of cellulose insulation, which has yet to be studied.

2. Methodology

Cellulose samples were sprayed into square moulds for mechanical and thermal conductivity testing. Samples were dried in ambient conditions and the mass of samples were logged daily. The drying behaviour of cellulose samples with different moisture content was studied. Loose cellulose insulation fibres were characterised with regards to their behaviour with water using dynamic vapour sorption isotherms. Compression tests, adapted from the standard EN 826 were made on 100x100x90mm³ samples. Thermal conductivity measurements, made on 150x150x50mm³ samples were made at 10° C and 25°C, according to the standard NF EN 12667.

3. Results and Conclusion

Dynamic vapour sorption isotherms on cellulose insulation show the high affinity of cellulose to moisture, especially in the super hygroscopic region (relative humidity > 95%), the oswin model provides a good approximation of cellulose insulation's interaction with water. The delays caused by drying of cellulose insulation (at constant ambient conditions) were exposed, further supporting the need to control initial water dosage.

Density, compression resistance, modulus of elasticity and thermal conductivity of cellulose insulation all increased with initial moisture content. This is due mainly to compaction of the material through increased water pressure and the hardening and strengthening of cellulose fibres as they dry. A linear relation was established between the mechanical and thermal properties and initial moisture content. A baseline of 14.05 kPa modulus of elasticity E and 0.62 kPa, and 1.34 kPa for E , $\sigma_{5\%}$, $\sigma_{10\%}$ was defined as an approximation of the minimum resistance of the material (at ambient humidity conditions) to prevent sagging. While the changes in thermal conductivity could be considered insignificant, there is still a loss in thermal efficiency of the material once an excessive amount of water has been used. Proper knowledge on the behaviour of these types of materials can improve its attractiveness for the use in new constructions and renovation projects.

Space for notes

The Future of Urban Development in Egypt under the Impact of Water, Fossil Fuel Energy and Climate Change Barriers, Green Infrastructure and Renewable Energy as Sustainable Urban Development Approaches

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Summary

For several years, the process of urban development (UD) in Egypt has witnessed new barriers, first the water shortage, Egypt has reached a state where the quantity of water available is imposing limits on its national UD, Second the fossil fuel crisis, Egypt depends mainly on fossil fuel to generate electricity, Egypt doesn't produce enough energy to meet demand, and it lacks the hard currency to import fossil fuel, finally the Climate Change is another barrier which is usually neglected or concerned as a secondary priority. The study hypothesizes that the employing of Green infrastructure (GI) and renewable energy (RE) together as approaches for future sustainable urban development (SUD) in Egypt can overpass the new barriers and achieve UD sustainability. This hypothesis is based on the results of various cases of using (GI) and (RE) as new approaches that support the seeking for SUD in developed and developing countries as well.

This paper discussed the nexus between GI, RE as new approaches for SUD and water shortage, fossil fuel crisis, and climate change as the new barriers that hinder the progress of SUD in Egypt. This paper used qualitative methods by analyzing case studies, and quantitative methods through statistical data, Etc., the study analyzes and evaluates several various cases of UD that seeks sustainability by using GI and RE as new urban approaches to clarify: why and how to use GI and RE as SUD approaches under the impact of the new mentioned barriers, also the other local expected constraints. The local social economic conditions in Egypt are generally representing the common conditions of the emerging countries, that is why the study has selected some cases which represent emerging countries. The results showed the possibility of employing GI and RE as approaches for future SUD in Egypt and to overpass the new barriers, the cases of study have illustrated why and how to use GI and RE to achieve SUD and also how to deal with the local problems in emerging countries such as the bureaucracy of the administrative system, and GI and RE as technical solutions.

Keywords: Sustainable urban development, Water shortage, Fossil fuel energy, Green Infrastructure, Renewable Energy, Climate change

1. Introduction

Egypt is an emerging country that is witnessing a growing economy, and a steadily increasing population besides its common urban problems like other emerging countries, these conditions have led to the phenomenon of the chaotic urbanisation, the government awareness of the need to deal with this urban problem has started early in the mid of the twenties century, during more than five decades the government has adopted successive UD plans, those plans have followed the west and developed countries experiences which were not in line with the local conditions and priorities, also institutions of the government have dealt with the UD global trends such as the

need to sustainability for the next generations in shallow way and without enough studies to determine the actual local needs and priorities. Moreover new barriers that can hinder the UD process have appeared recently, Egypt is actually facing a water shortage, and fossil fuel crisis, which mean the necessity to rethink the current strategies and policies that already were not effective to solve the old common urban problems. The study is discussing the need to new national strategies and policies which depends on new approaches of SUD planning, the study results were extracted from the study cases, these results represented how and why to employ GI and RE in the SUD plans as lessons from practices.

2. Methodology

This paper used qualitative methods by analyzing case studies, and quantitative methods through statistical data, Etc., the study analyze and evaluate several varies cases of UD that seeks sustainability by using GI and RE as new urban approaches to clarify: why and how to use GI and RE as SUD approaches under the impact of the new mentioned barriers, also the other local expected constrains such as the administrative system of the state and the urban legislations that can impeded the efficiency of using GI and RE as SUD approaches.

3. Results and Conclusion

The results revealed that there is a possibility of employing GI and RE as approaches for future SUD in Egypt, but to achieve the target there are several aspects that must be taken into account, these aspects relating to the bureaucracy local administrative system and the complicated social economic conditions of Egypt, besides the fact that the GI and RE are technical solutions which may be another constrain in Egypt case as there will be a necessity for hard policy decisions and to reconsidering the legal regulations that governs the UD process in Egypt.

Space for notes

The geocooling, bioclimatic solution to conventional air - conditioning for existing residential building



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Summary

In the present paper, we propose to progress knowledges about integration of geothermal energy into existing building to improve thermal indoor environment in summer. In order to study the cooling potential with this system, our choice was focused on an individual house located at Tizi-Ouzou town. Referring to physical data related to the ground and building envelope, we use **Sciab** as a platform for simulation implemented in a modular environment. It acts on a representation of the mathematical function in the form of block diagrams. The results obtained by present simulation, will enable us to define the geometrical configuration of the exchanger in order to obtain a suitybal ambient temperature.

Keywords: conventional air-conditioning / ventilation /renewable energy/ thermal mass / energy retrofit

1. Introduction

In hot climate areas as Algeria, the thermal comfort requirement inside residential building - especially in hot summer - is considered as a first reason of Electricity consumption. This fact, is related to unresponsive recourse to air conditioning systems. Countries concerned by reducing conventional air-conditioning demand and its harmful effect on environment, while maintaining thermal comfort; have developed more concretely the bioclimatic strategies. Yet, the energy retrofit for the existing household conceals a significant potential in energy saving, taking into account the significant number of the residences. As building envelopes improve, in this paper we are interested about summer cooling systems based on renewable energies. One of them consists on forcing air from outdoor through an air-soil heat exchanger.

2. Methodology

This study consisted on the modelisation of earth to air heat exchanger integrate to existing building in North Algeria. The house chosen for this study located at Tizi Ouzou state. Before earth-cooling techniques can be discussed, the thermal properties of soil and envelope properties must be considered .

To regard thermal behaviour of the air inside pipes and identify most performante configuration of this installation, we use Scilab as multi-fields platform of simulation to modeling dynamic systems. By present simulation, we wish to check that we will obtain at the exit of the pipe a temperature of 21°C according to the length of tube (39,6) equipped by one pipe or three pipes .

3. Results and Conclusion

In this paper, have progress knowledges relating to the concept of inertial cooling It is a geothermal application which uses in passive way the temperature of under ground to cool the indoor air of building by the means of air/sol heat exchanger. The modelisation of earth to air heat exchanger is related to the lenth, diameter and nember of pipes. This combination must be thought as an integral part of the building and not to be added with this one. It may be possible with a careful improvement of envelop prorporities.

Space for notes

THE LINKAGE OF ENVIRONMENTAL REQUIREMENTS WITH THE SELLING OF BUILDING PLOTS – AN EXAMPLE



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Summary

Today, cities are searching for ways to comply with national climate targets. City authorities are responsible for city planning and therefore defining the eco-efficiency of cities for decades to come. They need clear guidelines on how to reduce greenhouse gas emissions from the building stock in a particular area. Increasing the use of sustainably sourced wood in the construction could play a vital part in the transition towards eco-cities. In this paper an actual research project creates target values for cities regarding greenhouse gas emissions, primary energy and mass of renewable material for specific building plots. The proceedings and up-to-date results are shown in this paper. To achieve this, we studied life cycle assessments for different buildings. Wood as a building material is introduced for a minimal environmental footprint. The focus is set on linking the sale of building plots with the agreement to build primarily with wood. Target values for the buildings were developed in close cooperation with the city and are currently linked to tendering of the plots. The implementation of these values will be monitored in the near future.

Keywords: Sustainable real estate development; wood; carbon storage; timber structures; life cycle assessment

1. Introduction

In the past discussions on climate change the building sector concentrated on energy efficiency, but now the focus has broadened to include sustainability of materials. Increased energy efficiency in the operational stage shifts the focus to primary energy consumption of production and the greenhouse gas emissions in the production stage. Further possibilities for increased CO₂-reductions are always searched for. Wood as material which stores carbon temporarily is one way to increase the CO₂-reductions further. City authorities are responsible for city planning and therefore defining the eco efficiency of cities for decades to come. They are gatekeepers of building permissions, ensuring buildings meet environmental goals. Hence local authorities' guiding role in energy efficiency issues and "low carbon building" is growing, they need advise on methods and tools for the design process. Increasing the use of sustainably sourced wood in building construction could play a vital part in the transition towards eco-cities. Therefore city planners need specific guidelines on how to reduce greenhouse gas emissions with the building stock in a particular area.

2. Methodology

Actual ongoing research on general life cycle analysis values for timber buildings in Germany and their implementation in city planning on an exemplary plot are presented. The paper is based on the research project *development of a method to specify target values for CO₂-equivalent and primary energy input* funded by the DBU - German federal Environmental Foundation. The projects aims at three objectives: Developing of environmental reference values for erection of buildings, support of the implementation of timber construction in urban development, monitoring of the individual planning steps.

In this paper we show the proceedings and up-to-date results. The project started with the creation of reference values for greenhouse gas emissions, primary energy and mass of renewable material for specific building plots.

We defined average and target values for the amount of renewable material and the maximum of permitted greenhouse gas emissions for building construction. With exemplary realised timber buildings and buildings with mineral construction, reference values were generated.

We developed these target values in close cooperation with the city and currently are linking them with the tendering of the plots. The implementation of these values will be monitored in the near future. Planner will get advice on how to reach the agreed benchmarks and how to comply with building regulations (e.g. fire safety). Reference values need to be developed so that LCA calculations can be used for planning purpose and to highlight the influence of material choices in energy efficient buildings.

3. Results and Conclusion

The building sector has been identified as a major contributor to reduce greenhouse gas emissions in Europe. Due to the fact that buildings get more and more energy efficient in use stage of buildings, the carbon footprint of building material comes into focus. Here already in procurement of building plots target values for carbon emissions can be implemented. From environmental perspective wooden products have various advantages. An approach to promote timber buildings can contribute to reach climate protection targets. At the same time it helps to foster building with wood in urban areas. All based on the requirement that the wood derives from sustainable forestry.

Space for notes

Thermal mass behaviour of concrete panels incorporating phase change materials



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Summary

Phase Change Materials (PCM) have been incorporated into a range of building envelope materials with varied success. This study investigates two different methods of combining concrete and phase change materials to form PCM/concrete composite panels. The first method involves adding microencapsulated paraffin to fresh concrete during the mixing process. The second method involves vacuum impregnating butyl stearate into lightweight aggregate which is then included in the concrete mix design. The primary aim of the study is to determine which method is the most effective way to improve the thermal mass characteristics of a concrete panel in the context of a thermal energy storage system for space heating in a building. This study also investigates and compares the thermal behaviour of concrete panels that contain GGBS together with phase change materials that are incorporated using the methods noted above. The study observes the rate at which the panels absorb and emit heat, ie, the heat flux, and also how the heat flux changes throughout the depth of the panel. The panels are heated in a controlled environment provided by a specifically designed light box. Radiation is used as the heat transfer mechanism. Surface and internal temperatures of the panels are recorded during heating and cooling periods. The data recorded, together with the determined densities and thermal conductivities, are used to compare the thermal mass behaviour of each type of panel and to determine the influence that the method of incorporating a phase change material into a concrete panel has on the effectiveness of the PCM to improve the thermal mass characteristics of the concrete panel. The study highlighted the complexity of thermal behaviour of PCM/concrete composites. The panels containing PCM displayed significantly greater thermal storage capacity despite having reduced thermal conductivity and density. The study concluded that the panel containing lightweight aggregate/PCM composite is more effective at providing additional thermal storage particularly within the first 100mm of depth of an element of structure.

Other key results and conclusions of this study include;

- At a depth of 50mm the LWA PCM and LWA PCM+GGBS panels provide the greatest increase in thermal storage capacity over and above the control panel.
- The overall thermal storage of the PCM panels reduces relative to the control panel as depth increases due to the fact that the diffusivity of the control panels is higher than the PCM panels. Hence the heat will take longer to reach a depth of 100mm in the LWA PCM and ME PCM panels. As a result the PCM becomes less effective with increasing depth.
- As depth increases the level of thermal storage provided by the ME PCM panel approaches the storage provided by the LWA/PCM panel and at a depth of 100mm the storage provided by the ME PCM panel was slightly greater than the LWA PCM panel. This means that for a 100mm thick wall panel or floor slab, the incorporation of a LWA/PCM composite is a more effective and efficient means of achieving a significant increase in the thermal energy stored.
- As thermal diffusivity is the parameter that is hindering the effectiveness of the LWA/PCM composite, improving the conductivity of the LWA PCM panels would further enhance the thermal performance of the material.

Overview

This work is building into the IMPRESS project¹ funded under the Horizon 2020 Framework Program. The aims of the IMPRESS project are to develop innovative precast products for renovation of our building stock thereby improving the performance and energy efficiency of European buildings.

¹ <http://www.project-impress.eu>

Space for notes

Timber Building Details for a Leaner Design Process



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Summary

This paper explores the feasibility of utilizing pre-designed details as standard components in the design process to streamline the production of timber buildings. The study bases on four recent built cases. Selected structures and joint details as built are compared to pre-designed timber building details in six European collections. The conclusion is that a vast selection of pre-designed details exists. However, built solutions are often the result of a collaborative development process based on earlier experience. For the competitiveness of timber building the findings are problematic.

Keywords: Details, leanWOOD, planning process, timber-building

1. Introduction

Building with timber is complex and often requires extensive efforts in design. Research identifies the design process as one challenge for leaner building production. Sources of waste include e.g. the redesign of details. This paper explores the option of optimizing this phase with pre-designed details. This study is part of project *Innovative lean processes and cooperation models for planning, production and maintenance of urban timber buildings* (leanWOOD).

2. Methodology

Several European collections of pre-designed timber building details are published. Collections used in this study include the Austrian *Baubook* and *Dataholz*, the Finnish *RunkoPES 2.0*, the French *Catalogue Construction Bois*, the Swiss *Lignum Bauteilkatalog Schallschutz*, and German *Erarbeitung weiterführender Konstruktionsregeln/-details für mehrgeschossige Gebäude in Holzbauweise der Gebäudeklasse 4*. They illustrate national solutions of discussed cases.

Studied cases were designed, built or commissioned by partners in project leanWOOD. They represent different structural timber building solutions and typologies. The external wall and intermediate floor structures are compared to available solutions in all discussed collections. Joints between the external wall and roof, intermediate floor and foundation are compared to national versions. The Swiss case is additionally assessed against the Austrian Baubook.

3. Results and Conclusions

This paper presents a case study comparing two structural and three joint details of four timber-buildings across Europe to selected collections of pre-designed details. The aim is to evaluate whether the buildings could have been designed using ready-made material.

The collections offer a broad variety of exemplary details corresponding to current building regulations but the results show a large variation. The smallest amount of pre-designed details corresponding to solutions as built were found in the Austrian Baubook and Swiss collection. On the other hand, the German catalogue with the smallest amount of pre-designed structures and details proved the most applicable, with several solutions close to the built benchmarks regardless of fire class. The conclusion is that common ground exists and a European library of pre-designed details could be created. However, an efficient use would require modifiable material.

Details as built are often the result of a collaborative development process between project partners and based on earlier experiences. This result is in line with lean culture suggesting work with known partners and the use of standard components optimized for the production process. However, such a working method limits the options for new manufacturers or partners to enter an established consortia and creates additional costs to new collaboration. From the viewpoint of European wide procurement and the competitiveness of timber building the findings are problematic. Without established common solutions clients must accept system solutions and do not receive comparable offers.

Space for notes

Towards Unified Sustainable Buildings Rating System Categories through Assessing Buildings' Life Cycle Sustainable Requirements



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Summary

Sustainable building rating systems encompass multidimensional criteria. Different geopolitics, regions, and microenvironments incentivized sustainable developers to generate hundreds region-based environmental and sustainable building rating systems. Review of eleven well-known qualitative rating systems was conducted. Water, Energy, Material, Sustainable sites and Indoor Environmental Quality categories were common categories among the compared tools. Rating systems vary in terms of buildings typology, users' types, life cycle phases analyzed and outcomes. Hence, buildings performance constructed using different rating tools cannot be compared and benchmarked due to the variations of the categories structures and weights of the different tools. This paper aimed to lay down unified balanced categories structure that can be utilized widely based on buildings' life cycle. The derived categories are further benchmarked against sustainability core indicators of ISO 21929-1: 2011

Keywords: Buildings' life cycle, sustainable building rating systems, ISO 21929-1: 2011.

1. Introduction

1987 was the cornerstone year in changing the global mind-set towards sustainability. Since then, researchers and professionals have undertaken their share of responsibilities in the built environment mainly to reduce the environmental harmful impacts namely greenhouse gas emissions and global warming. Construction in general disturbs the eco-balance, therefore, actions are needed to mitigate the time needed to set back the interrupted environment to balance. As a result, many sustainable organization, were founded to commence sustainable practices in the built environments. Accordingly, over hundred sustainable rating systems were developed with various categories based on the regional demands, geopolitical thoughts and environmental needs. The quantitative rating tools assess the building systems performance holistically. On the other hand, in qualitative rating tools , a suite of different categories form the structure of different tools according

to building function (residential, commercial, institute, healthcare...), building life cycle (New Construction, Operating and maintenance, Existing buildings....) and building components (Core and Shell, Interior.....). In general, rating tools continuously improve building performance optimization, minimize buildings' impacts on environment, set standards for buildings, raise sustainable awareness among practitioners, and enhance construction and operational management. Moreover, rating tools assess the sustainability level in buildings by setting some performance constraints and benchmarking concerned building against the constraints and among other buildings evaluated using the same rating tool. The challenge emerges from comparing the performance of two buildings assessed using different tools. In other words, would two different rating tools yield the same sustainability rating for one building? Obviously, the comparability is difficult because of assessors various backgrounds, various tools structures and standards demand and characteristics in different regions. Therefore, there is a call from the global financial and real estate's markets to develop a unified framework composed of a set of categories to assess and compare sustainable performance in buildings in different regions.

2. Methodology

This study compared eleven existing well-developed rating systems: BREEAM, LEED, CASBEE, Green Star, G-Seed, DGNB, PEARL, GSAS, Beam Plus, Green Mark and SB-Tool and extracted their common categories. It has to be noted that the compared systems are regarded in the literature as sustainable tools although sustainability pillars, environmental, economic and social aspects, are not addressed equally in these systems and environmental performance occupies major share. The authors developed Sustainability requirements list at each buildings' life cycle stage and composed different categories based on sustainability requirements. The derived categories were benchmarked against ISO 21929-1: 2011 requirements and the shared categories by the compared rating systems.

3. Results and Conclusion

This study analyzed eleven well know sustainable rating systems and extracted the common categories. On the other hand, the authors itemized sustainability requirements throughout projects' lifecycle phases and categorized the requirements in light of sustainability domains. The unified categories were Regulations, Air protection, Water conservation, Energy, Material, Waste management, Land and Biodiversity protection, Human comfort and Socialization, Economy and Operation and Maintenance Management. The proposed categories are well correlated against ISO 21929-1: 2011 core Indicators.

Space for notes

User-friendliness of current building environmental impact assessment tools: an architect's perspective



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Summary

In the building sector, the global environmental impact of buildings is gaining attention. This environmental impact includes all impacts related to the building (materials) throughout the entire life cycle. A number of tools to assess the environmental impact of buildings as a whole has already been developed, usually with an underlying life cycle approach. As architects are a central actor in the design process, they are responsible for the building design and the accompanying environmental impact. Therefore, in the future, they will most likely perform such an environmental impact assessment (EIA) during the design process. So, environmental impact assessment tools should be adapted to the architect's work method and practice. In this context, a comparative evaluation of the user-friendliness of four existing EIA tools is performed from a Flemish architect's perspective. An evaluation framework and a reference building are used to obtain comparable results on the architect-friendliness of these tools. The findings indicate that architect-friendliness is not sufficiently taken into account yet in the existing EIA tools. Therefore, a series of suggestions for improvement of the current tools and guidelines for the development of new EIA tools, oriented to usage by architects, is included.

Keywords: Architect-friendly, Building assessment, Design supportiveness, Framework, Tool evaluation

1. Introduction

The focus of sustainability in the building sector is shifting from energy efficiency of buildings towards global environmental impact of building design. To assess the environmental impact of a building during its lifespan, all environmental impacts along the life cycle of the building and its composing materials should be taken into account. Life Cycle Assessment (LCA) is the most objective and quantitative methodology to calculate these environmental impacts. A number of LCA-based tools for environmental impact assessment (EIA) on whole building level has already been developed. These tools should enable architects, key actors in the design process, to make informed design decisions on the environmental impact of buildings from early design on. However, no evidence is found that these tools are adapted to architects' needs.

2. Methodology

To gain insights in the degree of architect-friendliness of existing LCA-based EIA tools for buildings, four of these tools (Elodie[®], Eco-Bat, Greencalc⁺ and MRPI[®] Freetool), selected on their availability and suitability for the Flemish context, are studied in depth. After a brief literature review of their characteristics, they are applied to a developed reference dwelling, of which the design documentation has been classified per design phase, to ensure similar data input in every tool as a starting base. During application, these tools are compared on their design supportive value and usability along the design process. Finally, the assessment of the architect-friendliness of the EIA tools is performed by means of a criterion-based evaluation framework, developed in earlier research. The final tool evaluation is discussed and the findings are integrated in recommendations for future EIA tool development.

3. Results and Conclusion

The evaluation of the degree of architect-friendliness of four existing EIA tools for buildings shows that Greencalc⁺ best meets the (Flemish) architect's needs. However, for all tools tested in this research, there is still room for improvement. The data input requirements should be linked more to the design phase in which the architect is currently involved (from global and limited input to detailed information, with adaptable default values for missing data in early design). The output should be more adapted to the architect's preferences: a global one-number score for the environmental impact for the whole building rather than scores per impact category (especially in early design phases). Such a one-number score also enables architects to benchmark different solutions within their own design. As architects are mainly visually oriented, the interface should use more visual representations of the building (2D or 3D drawings). In addition, a clear link between modification of the input (building design) and change in the output (impact) should be pursued (real-time feedback) to induce/support a learning process on sustainable material use. These suggestions could improve the design supportive value and architect-friendliness of EIA tools for building design and with it the EIA tool usage by architects during the design process.

Space for notes

Ventilative Cooling Potential



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Extended Abstract

Europe's building stocks faces a growth of energy demand for cooling, which contradicts the targets of climate protection. Main drivers of this development are growing comfort expectations, changes in architectural design and already effects from climate change and urban heat islands.

Ventilative Cooling subsumes strategies and technologies that retract heat from buildings or increase the perception of summer comfort by deliberate air change or air movement but without use of energy consuming chillers. Typical strategies of Ventilative Cooling are night flush ventilation and comfort ventilation.

Both strategies are widespread elements of traditional architecture, but today facing numerous practical obstacles: Recent demands for air tightness, for protection from outdoor noise and pollutants, for protection from risk of burglary and from storms and driving rain make the easy choice of Ventilative Cooling in fact a challenging one.

Overcoming these modern obstacles of Ventilative Cooling and developing improved strategies and technologies for implementation of Ventilative Cooling into Net Zero Energy Buildings is the aim of the ongoing Annex 62 Ventilative Cooling within IEA Task Energy Conservation in Buildings and Community Systems EBC, running from 2014 to 2017. The author of the paper in hand takes part in this international research effort, leading Subtask B - Solutions.

Within this international research program, the authors have conducted strategic analyses of the potential, obstacles and chances of ventilative Cooling, especially focussed on its implementation in Nearly Zero Energy Buildings. The analysis is structured in a four-step-approach:

- a) Climatic Potential Analysis of Ventilative Cooling
- b) Ventilative Cooling Building Database
- c) Reality Checks
- d) Structured Experts' Interviews

The paper in hand describes this research and presents the outcomes in the form of a SWOT Analysis and a R&D Roadmap Ventilative Cooling. Both results form the basis of systematic R&D Activities during the remaining period of IEA Annex 62. The R&D roadmap for the ongoing Task is, in short, formulated like this:

1. Improvement of automation systems, including sensors, actuators and controllers, aiming at better compatibility and at intuitive operability
2. Investigation of strategies towards optimization of thermal mass activation
3. Improvement of wind driven Ventilative Cooling strategies.
4. Development of hybrid ventilation and hybrid cooling strategies.
5. Development of basic design guidelines
6. Development of design tools

Recipients of this paper, namely from ventilation and building construction industry, are warmly invited contacting the authors and considering using the gathered knowledge for own developments.

Keywords: Ventilative Cooling, Indoor Environmental Quality, Summer Comfort, Natural Ventilation

Space for notes

WECOBIS: The Challenge of Planning with Ecological Construction Material



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Summary

To plan and tender ecological construction products still challenges builders and planners and now and then overstrains project manager due to the complexity of the process itself. Finding appropriate construction products comes with questions and causes uncertainties as soon as planners start with first sketches.

Keywords: sustainable building, ecological construction material, health and environment

1. Ecological aspects of construction material

Several product qualities became fix standards in planner's everyday life. Products made out of renewable resources, products with minimized impact e. g. global warming or acid rain potential, or products that help to save energy due to their good insulation quality for example, are already approved and confirmed and became a calculable part of planning and construction processes. Parties involved know how to select, plan and construct with them in order to achieve a sustainable as well as economically successful result.

Nevertheless, managing a buildings' planning and construction phases continuously rises in complexity. The coordination of various specialist fields or high pressure on budget and time schedule do have impact on the processes. Throughout several sub-processes along the value added chain, managing sustainable aspects is often watched as an additional accessory part and its implementation is dragged along the process chain.

2. WECOBIS for material selection & planning

WECOBIS is a web portal providing basic knowledge for healthy and ecofriendly construction. Herewith, WECOBIS assists with the ecological material selection and is directed at construction specialists and anyone who is interested in sustainable construction: architects, specialist planners, construction workers and building users. Assistance is given in:

- development of material concepts for sustainable planning
- pre-selection of certain product groups based on environmental and health aspects
- classification of building material according to criteria under the Assessment System for Sustainable Building (BNB)

- definition of quality levels in early planning processes with regard to the selection of construction materials
- planning with building materials in overall comprehensive terms across the life cycle

Additional to general information about ecological construction material, the BBSR started to develop specific support for planning and tendering. The comprehensive guideline supports with three different types of information:

- general product group information
- general information on planning and tendering
- text modules on ecological material requirements

The recently published text modules ground on the BNB Criteria 1.1.6 (Risks for local Environment). It is one of several criteria with relation to construction material within the Assessment System for Sustainable Building (BNB). The text modules help to ensure that substances and products can be reduced that pose a risk to environmental resources, i.e. groundwater, surface water, soil and air. This includes the timeframe while work is being carried out or while products are exposed to weathering (e.g. washout, leaching, etc.). All available text modules can be downloaded from WECOBIS. They can be used by just copying them. Planner can use the text modules either next to individual positions within the tender document or as a compendium in the preliminary note or in the appendix.

3. Prospect and further development

Throughout 2016, a team of experts around WECOBIS will develop additional text modules with complementary relevance. The advancement will enlarge the database itself. Relevant construction material themes like BNB Criteria 3.1.3 (Indoor Air Quality) or BNB Criteria 4.1.4 (Dismantling, Waste Separation and Utilization) will find consideration.

Parallel, universal help text will be detailed with emphasizes on planning and workmanship requirements. This should give a more practice orientated overview of relevant legislation, sum up of available declarations according to ISO 14400 Type I and should give advice for strategic steps to be taken. Auxiliary content will be gradually uploaded as available throughout 2016 and 2017.

Space for notes

Where do architectural design ideas come from? A sustainability and bioclimatic-oriented teaching experience



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Summary

This paper presents a teaching experience focused on the introduction of methods and tools to enhance the design process of sustainable, bioclimatic-oriented school buildings. Results derived from the referred action-research were reflected in students' attitudes towards their engagement in activities and the completion of tasks. Methods and tools proved to be important parts of design pedagogy, as well as sound, step-by-step introduction of theoretical concepts and technical information. Students expressed greater understanding of architectural design as a multi-variable process, which demands both quantitative and qualitative decision-making. Students showed increased confidence in their own approaches to design problems, though the challenge of incorporating sustainability demands in the core design – instead of mere add-ons – persisted and inspired course advancement.

Keywords: sustainable design; bioclimatic architecture; design teaching; design process; schools

1. Introduction

Design methods developed in the last fifty years have focused on diminishing subjectivity, applying scientific knowledge more effectively, and using information technology productively in design processes. The UIA/UNESCO charter for architectural education stipulates that a variety of methods should be applied to enrich the design-studio environment. While most design schools have acknowledged the need to educate students on sustainable solutions, progress in achieving high performance levels has been mostly limited by the lack of vision or awareness to create true, built-in sustainable design instead of a mere collection of technology add-ons.

2. Methodology

This action-research involves a teaching experience applied to a sustainability and bioclimatic-oriented architecture design studio. The studio *introduces design methods and tools* to develop a school building design and helps students *to develop their own design process*. The course adopted an A-S-E (analysis, synthesis and evaluation) pedagogy. In the analytical phase, theoretical classes were combined to detailed site analysis, repertoire development exercises, a technical visit and the application of two card games, to help students develop their own school design brief and to define sustainable design goals. In the *synthesis phase*, design kick-off and mass studies exercises were followed by 3D modelling and modular design instruction. After the second hand-in, a focused feedback session addressed the major issues detected. The *evaluation phase* comprised three design package deliveries. Evaluation used a dynamic assessment sheet, which evolved as the course advanced. Reference criteria for each topic covered were clearly stated and used by both instructors and students, during peer review activity.

3. Results and conclusion

All methods and tools introduced proved to be pedagogically important, but at no expense of formal introduction of theoretical and technical information. Structured content delivery was clearly more effective than loose, on-demand teaching-learning approaches. The special feedback session guided students on how design development can move forward. Positive results were reflected in greater engagement in activities and better understanding of architectural design as a multi-variable process. Multiple design options stimulated experimentation, reflection and step-by-step analysis. Lessons were learned and students showed increased confidence in their approaches to the design problems posed. Incorporation of sustainability demands in the design coe was still not completely achieved. Next offer of this course will specifically address longer analysis modules that are also expected to allow sustainability concepts to soak in proposed designs.

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SBE16 Hamburg

Extended Abstracts of Special Sessions

PLANNING FOR ENERGY EFFICIENT CITIES – How to achieve the sustainable Energy Smart City - The PLEEC Final Conference -

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More than 50% of all people globally are living in cities today. Enhancing sustainability and efficiency of urban energy systems is thus of high priority for global sustainable development.

The PLEEC project ('Planning for Energy Efficient Cities') focuses on technological, innovative, behavioral and structural capacities of European medium-sized cities in their transition towards Energy Smart Cities by analyzing their strengths and weaknesses as well as practices and tools for enhancing the energy efficient performance of urban energy systems.

The PLEEC project is a three-year international research project funded by the Seventh Framework Programme of the European Commission. 18 partners from 13 European countries are collaborating to make European cities more energy efficient. Therefore PLEEC uses an integrative approach to achieve the sustainable, energy efficient, smart city. By connecting scientific excellence and innovative enterprises in the energy sector with ambitious and well-organized cities, the project aims to reduce energy use in Europe contributing to the EU's 20-20-20 targets.

Through the run of the project, the project consortium developed individual Energy Efficiency Action Plans for the six PLEEC cities on how to improve their energy efficiency in a strategic and holistic way considering their technological, structural and behavioral capabilities. In order to make this knowledge accessible to further European cities a model for energy efficiency and sustainable urban planning has been developed.

The core objectives of the PLEEC project are:

- To assess the energy-saving solutions and potentials for a comprehensive city planning
- To demonstrate how integrative planning is more efficient than separate measures
- To develop a synergized model for energy efficiency planning and sustainable city planning
- To create Action Plans to be presented to decision-makers in the cities
- To identify the future research agenda on the issue of energy-smart cities.

The consortium consists of 18 partners from 13 different European countries representing six medium-sized cities (Eskilstuna/Sweden, Tartu/Estonia, Turku/Finland, Jyväskylä/Finland, Santiago de Compostela/Spain, Stoke-on-Trent/UK), nine universities and three industry partners.

Methodology

The PLEEC project follows a place-based approach to enforce endogenous urban development by considering local conditions. By supporting a forward-looking and evidence-based strategic planning approach, cities have identified their strengths and potentials (city profiles). Five key fields of urban development have been identified in which energy efficiency is supposed to become important: (1) Green buildings and settlement structure, (2) Mobility and Transport, (3) Technical infrastructure, (4) Production and Consumption and (5) Energy Supply.

On the basis of these city profiles technological, structural and behavioral energy efficiency measures have been elaborated for each PLEEC city as the aim of urban energy efficiency should be seen in the transition to a **fully** sustainable urban energy system.

Therefore it is crucial that measures are not tackled isolated, but rather integrated into a holistic approach taking into consideration each city's individual preconditions. Additionally, potential counteracting trends and the risk of rebound effects have to be considered.

In the end, the challenging integration of technology, structures and behaviour is a crucial aspect for a sustainable transition into a more energy efficient smart city. The Energy Efficiency Action Plans developed by the cities have integrated these measures into a strategic approach and will guide the cities on their way to become an energy smart city.

At the PLEEC Final Conference PLANNING FOR ENERGY EFFICIENT CITIES - How to achieve the sustainable energy smart city" on 8 march 2016 (2pm – 5.30pm) the project results will be officially presented. City partners as well as university and industry experts will be present to showcase results and share their experiences gathered through the run of this project.

All results of the project will be available at www.pleecproject.eu

Space for notes

EPD and use of external data for building calculation in Denmark



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Summary

A central aspect in quantifying the sustainability of construction works is calculating the life cycle impacts on the environment. Calculating the buildings environmental profile enables the designer to choose e.g. building design, materials, product design alternatives and even specific manufacturers from environmental considerations and thus design buildings that causes less stress on the environment. However, in order to achieve this, the designer has to have lots and various products to choose from with credible and transparent datasets available in easy-to-use calculation tools.

In 2012, Danish Technological Institute initiated the development of a Danish environmental declaration programme for construction products – EPD Denmark. The same year the first Danish version of the private German sustainability assessment scheme DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen) was launched, and by the end of 2014 the Danish government launched a political strategy for the building and construction sector dealing with sustainability.

Related to one of the initiatives in the governmental political strategy, the Danish Energy Agency developed a publicly available LCA calculation tool for buildings. The DGNB system also contains a tool for calculating building LCA, and even though this was developed within the scope of certification, the two programmes are quite similar despite the minor discrepancies.

An important datainput into these calculations are product level life cycle assessment data developed according to the requirements in the European standard for environmental product declarations (EPD). Since there was, and still are, a very limited access to Danish EPD data, both of the tools are based on product and material data from the German Ökobaudat database. This was at the time deemed the most representative alternative in relation to Danish conditions. The LCA data are integrated in desktop versions of the software, which also means, that new EPD data, which are being published regularly, will not be available for calculation, unless updated versions of the programmes are developed and then distributed again.

Using external data does in addition introduce certain limitations to the accuracy and representativity of the calculations. Because almost all available datasets are based on German product manufacturing processes, there will be inconsistencies in e.g. material composition, energymixes, waste treatment scenarios, transport distances etc. in relation to Danish conditions.

Since no national database exists in Denmark, and because it is better to make it right the first time, it was decided to join the European InData collaboration, which is building on already functioning tools and principles. The goal is to build a European LCA data network linking EPD providers, databases and LCA calculation tools on a European scale. This will make LCA data exchange easy and make more product specific data available, thus strengthening building LCA calculations and the dissemination of sustainable buildings.

Keywords: EPD Danmark, LCA data network, InData, sustainable buildings

Space for notes

European LCA data network – open public online database and data format of ÖKOBAUDAT as a starting point?



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Summary

An international open LCA data network structure with a common standard data format is presented, which allows open access to EPD (environmental product declaration) data from all participating databases. There already has been developed an infrastructure for an online database situation with tools and interfaces for data exchange. This system, as established within the German Assessment System for Sustainable Building (BNB) for Federal Buildings, which is following European and International Standards, offers a good starting point for the establishment of an open international data network for LCA databases.

Keywords: life cycle assessment (LCA), sustainable buildings, data exchange, building assessment system, building products, environmental product

1. Introduction



Fig. 1 Scheme – open international LCA database network for sustainable building

LCA is a central instrument to calculate the ecological impact of a building. Currently, in many European or other states a rising number of EPD is produced conform to EN 15804. As products are used within the European or global market, there is an interest to use data from any other EPD program operator, for LCA at building level. To avoid the development of a great variety of databases with the danger of incompatibility of data, the idea is the initiation of an open

International LCA data network structure for sustainable building with a common standard for the data format (Fig. 1).

2. Methodology

A suitable LCA infrastructure has been established in Germany within BNB. EPD data are imported in a database (ÖKOBAUDAT), which is subsequently used by LCA tools at building level ("eLCA") and contributes to final evaluation. All used programs and tools are open source and publicly available. This supports the idea of an open and transparent exchange of data. These structures are a good basis for joint international activities for the following reasons: the data format is compatible with EN 15804 as well as ILCD format; multi-language support is built in; open source and systematic of underlying soda4LCA allow for further development and adaptations required for an open network with many stakeholders; suitable interfaces allow online data import and export to other tools and systems. Currently within Germany both ways of data import (direct or indirect using open source tool "openLCA") are used by EPD program operators or other data providers. Considering international co-operations EPD data from Austrian program operator are imported in ÖKOBAUDAT. A database link between ÖKOBAUDAT and Spanish opendap is planned. Denmark is using the data of ÖKOBAUDAT. These activities show potential and practicability of the idea, which is proved by the strong interest of other states in further joint activities.

3. Results and Conclusion

The idea of an open data network would support European ideas and lead the way to a harmonisation of LCA calculations and evaluation in the building sectors. The challenge is, to get started with joint activities and to develop concepts which meet the demands of various stakeholders. A common standard for data and information will have to be found which still allows for additional national information. The overall goal of a harmonisation and a sensible use of data will require a high transparency of data and background information, also, the determination of different level of data quality. Furthermore, a common basis regarding the technical framework is required, e.g. software, interfaces, hosting.

Space for notes

Implementing European harmonised EPD



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Summary

The European standard EN 15804:2012+A1:2013 [1] for EPD in construction was first publicly available in 2011, it was amended in 2013 and today almost all European Program Operators (PO) have committed to apply the standard. Alone in Germany > 2000 datasets are publicly available for construction products. However, as expected, the practical implementation is still struggling. European Program operators founded the Eco-platform (www.eco-platform.org) in order to overcome difficulties in a concerted way. The first step is achieving a high common quality of EPD, by common verification procedures and qualifications. Next step will be the common applicability for sustainable construction, e.g. for national databases and building rating tools. The added value of EPD under the eco-platform framework is the possibility to use these declarations in all European and international markets. Manufacturers providing Eco-platform EPDs to their customers will be able to optimise their investments avoiding additional fees, work repetition and reducing communication efforts.

Keywords: EPD, European harmonisation, construction products.

1. Introduction

The European standard EN 15804:2012+A1:2013 for EPD in construction was first publicly available as final draft in 2011, it was amended by specifying characterisation factors for LCIA in 2013 and today almost all program operators (POs) have committed to apply the standard. In 2011 the eco-platform (www.eco-platform.org), an association of established and evolving EPD POs in Europe had its kick off. The objective of eco-platform is to support the implementation of European harmonised EPD, i.e the development of verified environmental information of construction products through EPD according to the horizontal core PCR for EPD of construction products, EN 15804.

2. European Harmonisation in practice

The main achievement of the Eco-platform until today, next to providing a platform of exchange for its members, is providing a common verification procedure for all members. The compliance with this procedure is audited. So far 9 of 14 members have passed the audit and have published ca. 180 so called "ECO EPD" These EPD are accepted and further distributed by all member POs in

Europe. The EPD serve mainly for communicating the environmental performance of products by the respective manufacturers. In some of the existing building certification schemes EPD based data is applied for assessing the environmental performance of buildings: DGNB, BNB in Germany, HQE in France BREEAM in UK and other EU member states. LEED in USA also gives credits for providing information via EPD, Baubook in Austria

The application of the EPD information is still impeded by some technical hurdles. One is the diverging interpretation of EN 15804 by different POs. To support a uniform interpretation and also to support the PCR development for product TCs CEN TC 350 publishes a set of questions and answers (Q&A file) on its website. These refer to a set of issues as allocation, end-of-life system boundaries etc.

The explicit background to the Q&A file is given in a guidance document as technical report, WI 350020:2015, which is still in work, but can be expected in early 2016. It also includes guidance on the calculation and documentation of biogenic carbon. In detail this was also worked out by the product standard EN 16485:2014 "Round and sawn timber - Environmental Product Declarations - Product category rules for wood and wood-based products for use in construction" [15] by CEN TC 175. The eco-platform members are committed to using the guidance support as well as the PCR from product TCs. The Eco Platform members have started to pick up the issue and discuss the implementation in their program rules or PCR documents.

Another hurdle is the different philosophies in the publicly available databases which give rise to relevant differences in those data sets that are needed to complete the LCA and are normally not known to the manufacturer (e.g. processes of raw material acquisition, end of life processes). DG Environment plans to set up a publicly available collection of data sets pre-verified according to the PEF guidance handbook [16]. On the other hand the commercial providers of – more comprehensive- databases like GABI and Ecolnvent are also making efforts to provide pre-verified data sets for the construction sector based on EN 15804.

Different member states have set up databases of EPD information or equivalent LCA results from studies to support building assessment partly required through regulations. The requirements to enter these databases are not harmonised among the maintainers of the data collections. This is a task for the Eco-platform already begun. However the obstacle of different results from different databases is not yet solved.

In order to enhance the real life applicability the eco-platform members also developed a common format with respect to a common content and order of information, also applying the inversed tables recommended in EN 15942:2011 [17] "Sustainability of construction works - Environmental product declarations - Communication format business-to-business".

3. Conclusion

The information tool EPD based on EN 15804 is well accepted in the European construction sector. There are still obstacles in applying EPD uniformly throughout Europe. The Eco-platform shows success in a common implementation of EN 15804 by providing a common verification procedure, common EPD format allowing EPD to be accepted by all members. The applicability of Eco-platform EPD all throughout Europe is the goal for the next months. This addresses a common access to national databases and acceptance in all building rating tools. A major issue still is the difference in the background databases. A challenge is also the alignment between EN 15804 and the PEF approach. An amendment of EN 15804 to include new indicators and clarify some interpretation issues might be introduced by an amendment of the M350 for CEN TC 350 [18], which is also supposed to serve the alignment of the PEF approach with EN 15804.

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Title: Materials environmental performance data for building level assessments – a UK perspective.

Summary

In the UK, the application of LCA in the evaluation of the environmental performance of construction products has been led by BRE. Over the years, BRE had generated a materials database from LCA studies and EPD (referred to as BRE Environmental Profiles) for generic and manufacturer-specific construction products using ISO 21930, ISO 14025 and other relevant standards. This materials data was used to inform BRE’s Green Guide (a decision tool that enabled comparability of construction products at a building element level) recognised in BRE’s building sustainability certification schemes - BREEAM and the UK Code for Sustainable Homes. Further, a building level LCA protocol was also defined, which when used along with BRE’s materials database provides a sustainability metric also recognised in the certification schemes.

The introduction of CEN TC 350 suite of standards for assessing the sustainability of construction has led to the evolution of BRE’s approach to responding to sustainability assessment requirements in the UK. There is a complex interaction between the CEN TC 350 environmental assessment EN and ISO standards; and there are considerable variations in the interpretation of relevant standards that have direct bearings on how the LCA is carried out at the product level (using EN 15804), what data results from the LCA, how this data is presented, and to what level this data can be aggregated for a building level assessment.

EN 15804 implies a harmonised approach to the generation of materials data in Europe, and the potential for applying data both from within and outside the UK through database integration is critical to sustainability assessment today. This paper discusses in plain terms the underlying issues in this space.

Keywords: LCA, EPD, sustainability assessment, CEN TC 350, EN 15804

Space for notes

The Experience – Rules and verification processes



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Summary

ÖKOBAUDAT is a German database for the life cycle assessment (LCA) of building materials, construction and transport processes. It contains both generic datasets and specific environmental product declaration (EPD) datasets from diverse companies or associations. BMUB and BBSR, the owners of ÖKOBAUDAT, aim to present verified, consistent LCA data of building materials in compliance with standard DIN EN 15804, which shall be used in LCA for buildings. Therefore quality criteria for EPD programme operators and data sets were defined. A corresponding testing procedure was elaborated and further developed after a testing phase.

Keywords: database, EPD, LCA, verification

1. Introduction

ÖKOBAUDAT (<http://www.oekobaudat.de/en.html>) is a German database for the life cycle assessment (LCA) of building materials. It is made available by the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) to all persons involved in building construction and hosted by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). Building materials, construction and transport processes are described regarding their ecological effects. ÖKOBAUDAT contains both generic data sets and specific environmental product declaration (EPD) datasets from diverse companies or associations. A standardised interface of the online database enables importing of life-cycle analysis data into ÖKOBAUDAT.

2. Methodology

BMUB and BBSR, the owners of ÖKOBAUDAT, aim to present verified, consistent LCA data of building materials which can be used in LCA for buildings. EPD programme operators and data sets shall be accepted for ÖKOBAUDAT only if they fulfil defined quality criteria. Therefore 'Principles for the acceptance of LCA data in the online database ÖKOBAUDAT' were defined by BMUB / BBSR and discussed and agreed on in the ÖKOBAUDAT users advisory group.

The information in ÖKOBAUDAT is presented in form of a standardised data set format which was developed on the basis of the ILCD format version 1.1 and comprises data as well as describing text. The ILCD format was supplemented with EN 15804 requirements ('EPD data set format').

The quality criteria were transferred into a standardised process scheme with checklist and workflow. A corresponding testing procedure has been elaborated and further developed after a testing phase.

3. Results and Conclusion

The following quality requirements apply for acceptance of LCA data in ÖKOBAUDAT:

- The data have been generated in compliance with DIN EN 15804.
- The data have been verified by a third party (external verification according to ISO 14025 or external critical review according to ISO 14040 analogue to a verification according to ISO 14025). Non-reviewed data are not accepted in ÖKOBAUDAT.
- The additional ÖKOBAUDAT requirements for modelling and calculation have to be fulfilled.
- GaBi has to be used as background database (if other background data were used the equivalence with GaBi has to be proved).
- In principle, the datasets have to be delivered in German language / nomenclature. For English EPD or LCA datasets abbreviated versions and links to more detailed information in the English dataset are appropriate.
- The datasets have to be delivered in the prescribed data format ('EPD data set format').
- The valid time has to be given in each dataset.
- The owner of the dataset has released the data to be published in ÖKOBAUDAT.
- The required declarations / information have to be fully delivered.
- The datasets were subjected a plausibility check (completeness, plausibility) before approval to ÖKOBAUDAT.

The additional ÖKOBAUDAT requirements for modelling and calculation comprise

- specification of the standards (e.g. calculation of indicator 'use of fresh water', GaBi as background database),
- recommendations (e.g. modelling of end of life scenarios),
- support for the interpretation of the standards (e.g. calculation of biogenic carbon uptake).

The procedure of application and acceptance of LCA data in ÖKOBAUDAT comprises in short the following steps:

1. The applicant confirms in writing (date, signature, firm stamp) the fulfilment of the requirements in an application form and delivers the required explanations and documents of evidence.
 2. The documents of evidence are checked in responsibility of BMUB/BBSR and in consultation of the ÖKOBAUDAT users advisory group.
 3. After the successful check the applicant may import the data into ÖKOBAUDAT in the prescribed data format.
 4. The imported data will be subjected a plausibility check and a random check in substance, where appropriate. After the successful check the data sets will be published in ÖKOBAUDAT.
- A checklist was developed for steps 2 and 4, in order to guarantee a standardised testing procedure. The first EPD programme operator and their data were checked with the aid of the check list and finally released in the new version ÖKOBAUDAT 2015.

The Experience of data import and export as EPD program operator



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Summary

The EPD online tool of Institut Bauen und Umwelt (IBU) is the major platform for creation and verification of EPDs in the EPD programme of IBU. It is the basis for an interface to the national database ÖKOBAUDAT, to spread the EPD data to a wider public.

As first program operator IBU implemented its interface for EPD datasets to the ÖKOBAUDAT successfully in 2015. Meanwhile up to 200 EPD datasets were already transferred from IBU to ÖKOBAUDAT until end of 2015. The standardized format of the interface also allows IBU to connect with other databases via the International Life Cycle Data system (ILCD). The format datasets are transferred by XML-files.

Introduction

The development of EPDs within IBU as program operator takes place in the epd-online tool (<https://epd-online.com>). The whole process is web based, which has several advantages for the users: the tool has a multi-user functionality, so all participants can work in an EPD document simultaneously including the independent verifiers, who get access to the EPDs with the assignment. Furthermore this function also eliminates error sources, e.g. working in different versions of an EPD as a Word file exchanged via email. The tool is also adaptable to new requirements for EPDs or the EPD developing process as well as an integrated multi search function. IBU attaches importance to a tool with easy handling which is available in English or German. In addition to an individual introduction for every user via webinar and ongoing support if needed, there is a permanent optimization of the tool. The latest development is an offline editor (IBU lightning Editor) which allows the user to create the EPD offline and upload it to the online tool. Through several mechanisms it is ensured also in this tool that a user will not delete or overwrite the work of other users in the same EPD. Because everything takes place online, almost the entire EPD is suitable for further digital processing. This makes it an ideal basis for an interface between the IBU online tool and the database ÖKOBAUDAT.

Implementation

The implementation of the interface started in 2014 and was finished after several corrective measures by summer 2015 in coordination with the BBSR (Federal Institute for Research on Building, Urban Affairs and Spatial Development). During the developing IBU met some difficulties for the implementation of the interface: One problem was to get specific interpretations about the required input in some sections of the dataset (e.g. a definition for the input in the field technology description including background system). Another challenge was the handling of different scenarios in EPDs. For example two scenarios for the End of Life phase with e.g. 100 % recycling or 100 % disposal. Additionally the preparation of the datasets is important, so that they can be used in manifold software tools like a tool for building LCA. Therefore some information like density etc. are essential, which can be read by software.

At an early stage of the implementation, some major advantages of the interface emerged already. The error prevention is to be mentioned here, because the information to be transferred are generated automatically from the verified and published EPD out of the epd-online tool. It also provides the user the opportunity to attach additional information to the dataset (e.g. a safety datasheet). By using the ILCD format IBU has the option to provide its datasets also for other databases than ÖKOBAUDAT.

With this development IBU generates additional services for its members and declaration holders. The interface to ÖKOBAUDAT is easy to handle. About 90 % of the dataset (XML file for ÖKOBAUDAT) is generated automatically. The owner of the declaration only has to provide or select some additional information and may give further information in form of attachments. In order to provide help for finalizing the dataset in the IBU online tool interface IBU published a video which explains very easy how to use the interface.

The prepared dataset will then undergo a plausibility check by IBU and is then shifted to the inbox of the BBSR to be published afterwards in the ÖKOBAUDAT. IBU will have transferred about 150 datasets within two deliveries (stand 11/2015).

Results and Conclusion

The datasets are delivered in a form that they can be used in further software tools (like the eLCA bauteiledior.de) for building life cycle assessment. The technical data are also in a digital format and can therefore be processed. So users of a building assessment software tool are able to easily calculate their own buildings with specific EPD data.

Prospectively IBU's aiming on opening the ÖKOBAUDAT for English datasets. Another concern of IBU is it to also give EPD owners, not using GaBi for the EPD creation, the chance to publish their data in the ÖKOBAUDAT. The challenge here is not to mix datasets which are calculated with different background databases. Here the BBSR offered a separate solution within a separate section of the German national database.

Through the above explained and provided digitalization of EPDs the overall goal of more sustainability within the whole planning and construction process of buildings is possible.

Towards a European Data Network for Construction Product EPDs



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Summary

Quality Environmental Product Declaration (EPD) data which is compliant to EN 15804 is an important foundation in order to assess environmental impacts on building level as it is required by certification schemes such as BNB or DGNB. As more and more data becomes available across Europe, the ability for users performing building level calculations to locate the suitable datasets becomes an important factor. Given the availability of a proven technology stack with both open source and proprietary licensed software which already allows to build data networks, stakeholders across Europe are considering to leverage the existing technology in order to build an experimental data network for EPDs, which then can be used to distribute data as well as to identify potential gaps and issues that may need to be addressed in the course of the ongoing harmonization efforts.

Keywords: EPD, construction products, data network

1. Introduction

The ÖKOBAUDAT, a free public database for Environmental Product Declaration (EPD) data on construction products operated by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), a research institution under the portfolio of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, is a pioneering effort when it comes to publishing harmonized and high-quality environmental data on construction products. The database can be seamlessly accessed by calculation tools in order to assess environmental impacts on building level, addressing the needs of certification schemes such as BNB or DGNB.

As other European actors have voiced the need for sharing data internationally and mutual recognitions are being driven forth by program operators, it has been considered to join forces with other European EPD initiatives in order to pursue the vision towards an experimental European data network for EPDs.

2. Building a Data Network

EPD data usually is published in form of a PDF document. As a prerequisite for publishing on the data network, however, it needs to be available in a structured, machine readable format, since other tools rely on the data for calculation. For the ÖKOBAUDAT, the widely-used ILCD data format which was published by the European Commission has been fitted with some additional extensions in order to address the needs of the EN 15804. This format has already been implemented in open source software tools such as openLCA or proprietary solutions such as GaBi or the IBU Online tool, as well as simplified LCA tools such as the open source eLCA which is used to calculate impacts on building level based on EPD data.

That means that in a first step, existing EPD data from parties interested in joining the network needs to be rendered in machine readable form using the ILCD format.

The software that is used to run the ÖKOBAUDAT has originally been conceived as a general-purpose database application to host LCI and LCIA data in the ILCD data format. It has been published under the name soda4LCA, which stands for Service Oriented Database Application for LCA, and under the open source GNU Affero General Public License (AGPL). The soda4LCA software is widely used in the scientific domain to publish results as well as to host a number of national and international LCA databases. Furthermore, it is the reference implementation for the European Commission's Life Cycle Data Network (LCDN).

As the soda4LCA software serves as the technical infrastructure of the German ÖKOBAUDAT database and it already allows for joining nodes together to form a data network (just like it is done for the LCDN), other data providers, program operators or national institutions could just leverage the tool to host their own nodes in order to publish their data. All of these nodes, together with the German ÖKOBAUDAT, could then be joined together to form a network of independently operated databases. This scenario would allow users to search the entire network from a single entry point (which would be any node), while at the same time, data providers and national organisations maintain full physical control of the data they're publishing.

3. Conclusion

Given the availability of the necessary IT tools, a data network would be a way to distribute and publish data more efficiently across Europe and internationally. The advantage of a data network of independently operated nodes is that while potential users gain access to a vast pool of quality data, data providers stay in full control of their data.

The proposed solution builds upon established standards and technology and could serve as an opportunity to identify potential gaps and issues that may still need to be addressed in the course of the ongoing European and international harmonization efforts.

Space for notes

Authors: Artur Borowczyński, Dariusz Heim

Title: Assessment of daylight conditions in the office room equipped with reflective louver system

Abstract: Determination of indoor daylight condition using selected types of blinds or louver system are well described when material is opaque and plays a role of shading device. However, in some specific cases transparent or semitransparent elements are able not only to protect from overheating but also to provide required and useful amount of daylight. For some specific window construction the location of louver system can be determined by a sun position or required level of internal illuminance. Additionally, taking into account surface properties e.g. roughness, reflectiveness or angle dependence of total transmittance, it is possible to determine optimal tilt angle of the slats.

In the presented study authors investigated the effect of transparent louver blind with highly reflective outer layer on stimulating daylight level in building interior. For the purpose of full scale experiment, two experimental office rooms were developed and equipped with illuminance sensors. Both rooms were oriented in the opposite directions: west and east, with one window centrally located in the wall. Windows were equipped from outside with the highly reflective, flat and moveable glass blinds. Experiment was conducted during selected days of summer under sunny and cloudy weather conditions. Weather conditions were monitored using basic sensors for solar radiation as well as digital images of the sky. Experimental results were compared for selected blinds position to estimate the effect of additional daylight system on useful daylight illuminance inside the office room.

Space for notes

Energy efficiency of experimental BIPV façade in high temperatures

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Summary

The presented study is devoted to assess the effect of temperature and solar radiation on efficiency of the experimental BIPV façade. Measurements were done during warm September days for east and west oriented BIPV facades constructed from CIS modules. This configuration provides very low angle of incident in a morning and afternoon hours what gives the high amount of solar radiation reaching solar cells and consequently lead to high energy efficiency of BIPV facade. The selected PV system parameters like voltage, current and power were monitored by DC measurer. Additionally meteorological station collects data of climatic conditions. Finally, obtained experimental results show the correlation between PV power output and climatic conditions like solar radiation and temperature.

Keywords: Building Integrated Photovoltaic facade, climatic conditions, measurements, experimental study

1. Introduction

In European Union countries significant emphasis is placed at improving building energy performance to zero- or almost zero-energy standards. Particularly considering aims introduced by EU that by the end of 2020 all new buildings should be “nearly zero energy”. Considering these requirements besides increasing thermal insulation of the external building partitions there is also necessity to utilize building envelope to produce electrical or thermal energy from renewable sources. One of the most promised solution is using PV panels, widely described in the literature [1-3]. Photovoltaic technology can be applied as Building Integrated Photovoltaic (BIPV). PV panels replace traditional elements of building envelope by active components equipped with photovoltaic cells [4]. Therefore photovoltaic systems not only produce electricity, but also perform the function of the building envelope. Application of BIPV systems is the most profitable in office and public buildings where electricity consumption has the highest share in energy demand profile during working hours which is coincident with availability of solar radiation and hence in photovoltaic electricity production. Therefore BIPV is a very favorable solution especially when the internal electricity grid is connected to the outer network. Use of utility energy grid as a virtual storage system allows obtaining energy balance over long term period e.g. one year.

The aim of presented paper is the analysis of the efficiency of the experimental BIPV facades located in central Europe. Studies are made basing on measurements of existing photovoltaic installation's electrical performance and climatic conditions represented for analyzed area.

2. Case study

Presented analysis based on the experimental data from DC measurers located in off-grid electrical grid, which measure current and voltage generated by photovoltaic arrays. Additionally,

there were performed measurements of ambient temperature and solar radiation in the meteorological station located at the roof of building where experimental facades were installed. Experimental setup was placed in moderate climatic conditions in the central Poland at the building of Lodz University of Technology. Measurements were performed during September, but because of the gaps in the measurement caused by power disruptions for meteorological station, in presented paper we focus on two 3-days periods from the beginning (5-7.09) and ends (25-27.09) of September characterized by different range of temperature and various type of sky. All measurement data are presented in the form of graphs considering different orientations of the BIPV facades and two periods of time.

3. Results and Conclusion

In presented paper measurements of the power generated by experimental BIPV facades were analyze for selected days of September. Investigations were made based on data of electrical performance of the existing photovoltaic installation as well as weather parameters recorded by meteorological station. Presented results confirmed theoretical assumptions that east oriented PV installation generate the highest amount of power in morning hours and west oriented one during evening hours. Furthermore, both BIPV facades produced electricity during a whole day, even during diffuse radiation exposure. However, with absence of direct solar radiation the maximum power of electrical energy is significantly lower. Moreover, it was noticed influence of high temperature on decrease of power generated by PV installation.

Space for notes

Authors: Anna Machniewicz, Dariusz Heim

Title: Temperature distribution in the mineral wool insulation component enhanced by PCM external covering

Abstract: Stimulation of the building external surface temperature leads to significant reduction of heat flux by conduction. Even during cold winter months the solar radiation affecting external layer can heat up the surface above indoor temperature. From the energy point of view the most effective strategy is to keep stable temperature of external surface at the level of indoor one for the longest possible period of time. Considering a highly insulated external wall the direct solar heat gains by conduction are negligible. However, stabilization of external surface temperature always leads to additional energy savings and improves overall energy performance. Such an approach can be a reasonable alternative for significantly increasing of thickness of thermal insulation.

In the presented study authors proposed the unique, original solution of insulation layer enhanced by PCM coating from outside. The properties of PCM composite were investigated experimentally. Additional layer was applied on traditional mineral wool insulation and placed in an experimental, real scale façade installation. The external part of the wall was constructed as a rain-screen ventilated façade system exposed to solar radiation. The partition was equipped with platinum resistance thermometers and tested during intermediate period. The temperatures in characteristic locations were compared with temperature of traditional wall, without PCM layer. Additionally, the basic weather parameters were recorded during experiment. Based on the experimental results the effect of latent heat storage on temperature distribution in the wall was estimated.

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