

SUSTAINABLE BUILDINGS AND CONSTRUCTION IN AFRICA



Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety



OVERVIEW OF SBC IN AFRICA

PRACTICAL INSIGHTS AND ILLUSTRATIVE EXAMPLES

ORGANISATIONS WORKING ON SBC IN AFRICA

LITERATURE AND ONLINE RESOURCES ON SBC IN AFRICA

Cover pictures:

At the back: Tebogo Home, Johannesburg, South Africa – BASE*habitat*

Front left: Eastgate Centre, Harare, Zimbabwe – Mick Pearce

Front right: Habitat Research and Development Centre, Windhoek, Namibia – Nina Maritz

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FOREWORD BY THE MARRAKECH TASK FORCE ON COOPERATION WITH AFRICA, LEAD COUNTRY GERMANY

The Marrakech Task Forces are part of the Marrakech Process on Sustainable Consumption and Production (SCP), which also includes regional structures, a secretariat at UN-DESA and UNEP, an advisory committee involving regions and the most relevant stakeholders as well as numerous activities around the globe. A Marrakech Task Force is an informal group of countries and organisations coordinated by a lead country that have decided to work collaboratively on a specific issue of SCP committed to carry out a set of activities which support the implementation of projects of the Marrakech Process.

The Marrakech Task Force on “Cooperation with Africa” aims generally at supporting African activities on SCP. It will promote the implementation of measures on SCP in Africa, encourage and support African countries in the integration of SCP in existing programmes as well as initiate new ones. One priority area is the development of national and/or regional action plans on SCP that allow them to leapfrog, reduce poverty while adopting sustainable consumption and production patterns. A second priority area is the development and the implementation of an African Ecolabelling Mechanism (AEM) which shall work in all African countries.

A third priority area is the implementation of results and findings of other task forces in African countries. In that regard we are very thankful in particular to the Swiss Task Force on “Sustainable Procurement”, the Swedish Task Force on “Sustainable Lifestyles” and the Finnish Task Force on “Sustainable Building and Construction” for their work in Africa and the cooperation.

This Brief Book is the result of the cooperation between the Finnish and the German task force. It gives an overview of activities in the field of sustainable building and construction in Africa as well as it lists concrete sources for information on how to do sustainable construction and building in Africa. The aim is to promote sustainable construction and building in Africa and give guidance where needed.

Dr. Ulf Jaeckel, Chair of the Marrakech Task Force on “Cooperation with Africa”

FOREWORD BY THE MARRAKECH TASK FORCE ON SUSTAINABLE BUILDINGS AND CONSTRUCTION, LEAD COUNTRY FINLAND

Our built environment has profound impacts on people, planet and prosperity. It consumes natural resources, creates employment and property values, and provides shelter for our daily life. Worldwide, we face the same capacity building challenge to mainstream sustainability as a key principle in construction and real estate sectors. This publication does not claim to cover all aspects or examples. For example, despite of its central importance, the role of the public sector is not discussed. This is meant as an input into an ongoing discussion about sustainable communities.

A particular characteristic of buildings is that their life cycle is long – anything from twenty to thousands of years. This fact has many implications. At different stages of the process of producing and using a building a great number of stakeholders is involved. Land owners, investors, designers, builders, tenants, users, facility managers or janitors, to name just a few, may never meet each other, and may not have any interests in common.

Another implication is that every decision to build or refurbish a building has a long-term effect. As an example, if a house is constructed or renovated poorly now, its poor energy performance will be “locked in” for decades before the next renovation cycle.

Construction and maintenance of buildings requires low-technology, it is no rocket science. A lot can be learned from the traditional craft of building: use of local materials, methods of natural ventilation and creating shade, or protecting from rain and humidity. We have no illusions about “traditional architecture”, but technology is not the key solution. Sustainable buildings are user friendly, easy-to-maintain. They are economical, because they do not waste resources, neither when they are constructed, nor when used.

Let me thank the German Task Force for its leadership in cooperation with Africa, and for its generous invitation to co-author this publication. By taking the lead of the SBC Task Force in 2006, Finland acknowledged the importance of buildings as well as the great sustainability challenges and opportunities in the construction and real estate sector. We all share the same questions, but the solutions must emerge from the local cultural, societal and climatic context.

Dr. Kaarin Taipale, Chair of the Marrakech Task Force on Sustainable Buildings and Construction

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List of abbreviations

10-YFP – 10-Year Framework Programmes

AVN – Association for Voûte Nubienne

BMU – The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

BOTEC – Botswana Technology Centre

CBE – Council for the Built Environment
(*South Africa*)

CDM – Clean Development Mechanism

CERs – Certified Emission Reductions

CET – College of Engineering and Technology
(*Tanzania*)

CFL – Compact Fluorescent Lamp

CIB – International Council for Research and Innovation in Building and Construction

cidb – Construction Industry Development Board
(*South Africa*)

CSIR – Council for Scientific and Industrial Research
(*South Africa*)

CSR – Corporate Social Responsibility

DFID – Department for International Development
(*UK*)

DME – Department of Minerals and Energy
(*South Africa*)

DPADR – Provincial Directorate of Agriculture and Rural Development
(*Mozambique*)

EAIF – Emerging Africa Infrastructure Fund

GBC – Green Building Council of South Africa

GTZ – German Technical Cooperation

HRDC – Habitat Research and Development Centre of Namibia

IEA – International Energy Agency

ICT – Information and Communication Technologies

iISBE – International Initiative for a Sustainable Built Environment

ISES – International Solar Energy Society

MTF – Marrakech Task Force

MRHP – Mwanza Rural Housing Programme
(*Tanzania*)

NEPAD – New Partnership for Africa's Development

PREA – Promoting Renewable Energy in Africa
(*international co-operation*)

PRODER – Programme for Rural Development

REEEP – Renewable Energy and Energy Efficiency Partnership

SACCOs – South Africa's Savings and Credit Co-operatives

SADC – Southern Africa Development Community

SAICE – South African Institution of Civil Engineering

SARCH – Social and Sustainable Architecture
(*student initiative*)

SBAT – Sustainable Building Assessment Tool

SBC – Sustainable Buildings and Construction

SCP – Sustainable Consumption and Production

UNEP – United Nations Environment Programme

UNDP – United Nations Development Programme

UN DESA – United Nations Department of Economic and Social Affairs

UNEP SBCI – Sustainable Buildings & Climate Initiative

WHO – World Health Organisation

Acknowledgements

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The authors would like to thank everybody who has contributed to the brief book providing valuable background, ideas, comments, examples and case studies.

Introduction – Making SBC the Rule and Not the Exception

“The house-roof fights with the rain, but he who is sheltered ignores it.” – An African saying

The building and construction sector is of key importance to the development of Africa and the well-being of its population. Africa can fulfil the demand for a built environment that meets the needs of African people through the application of sustainable building and construction (SBC) concepts. SBC is important for the region and can offer potential to improve the health of people and the environment in surrounding areas as well as reduce the effects of poverty by upgrading unplanned settlements. To adapt an African maxim, those who adopt sustainable construction practices can shelter themselves from unpredictable consequences of unsustainable building and construction practices.

The building sector is one of the three consumption clusters – housing, transportation and food – that have been identified by life-cycle studies as the most important in terms of their environmental burden. Activities falling within the ‘shelter’ category, specifically the building sector, account for some 40% of overall energy use and associated greenhouse gas emissions, and a majority of material resource use. Accordingly, the sector offers a substantial emissions reduction potential at low or no cost (IPCC 2007). On this basis sustainable construction should become the rule and not the exception.

SBC is a part of the global sustainable

consumption and production (SCP) agenda. Millions of people around the world are suffering from unsustainable patterns of consumption and production – either ‘over-consumption’ and wasteful use of resources, or ‘under-consumption’ and ‘under-production’ that does not enable people to fulfil basic human needs.

Global targets and common goals

The UN World Summit on Sustainable Development in 2002 called for changes in unsustainable patterns of consumption and production. The 10-year framework of programmes (10YFP), also known as the Marrakech process, responds to this call by supporting regional and national initiatives that accelerate the shift towards SCP. The Marrakech Process has identified SBC as one of its priority focus areas. The main aim is to develop local and national policies and legislation to secure the sustainability of construction and of the use, maintenance and refurbishment of the built environment. The Marrakech Taskforce (MTF) on SBC was established with the leadership of the government of Finland to coordinate these tasks.

Africa has been very active within the Marrakech Process. It was the first region to have developed and launched its own 10YFP, which was approved by the African

Ministerial Conference on Environment (AMCEN) in 2005. SBC is one of the main themes under the African 10YFP. The “Cooperation with Africa MTF” has been supporting the development and implementation of the African 10YFP. This region focussed task force, the only such MTF with the others focussing on issue specific topics, was established by the government of Germany to support the Africa regional process on SCP.

This book on Sustainable Buildings and Construction in Africa is an output of the cooperation process between **the MTF on “Cooperation with Africa”** and the **Sustainable Buildings and Construction MTF**. The book is made possible with the financial support of the **German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)**.

The book intends to clarify the concept of Sustainable Buildings and Construction (SBC) in an African context. It is based primarily on Africa based research and building projects implemented in different parts of the region. The publication is meant for real estate developers, building industry professionals, researchers, planners, policy makers and building users.



UNEP SBCI
Sustainable Buildings
& Climate Initiative

In addition to the Marrakech Process, the global SBC agenda has been advanced through the Sustainable Buildings and Climate Initiative (SBCI) launched by UNEP. The SBCI is a global partnership between UNEP and leading global companies to promote and support sustainable solutions in the building and construction sector. The initiative provides a platform for relevant stakeholders to address sustainability issues. SBCI intends to establish common baselines on energy efficiency and CO2 emissions, develop tools and strategies for SBC and implement the tools and strategies through pilot projects.

More information:

<http://www.unepsbci.org>

Reader's Notes

Objective: This book intends to clarify the concept of Sustainable Buildings and Construction (SBC) in Africa. It is based on primarily African research and building projects implemented in different parts of the region. The publication is meant to be read by real estate developers, building industry professionals, researchers, planners and policy makers and users of buildings

Part One: Overview of SBC

Provide an overall picture of SBC in Africa, the international framework for initiatives and a discussion around projects, relevant definitions and perspectives on the issue, assessment tools, key challenges and central aspects as well as policy instruments related to SBC in Africa.

Part Two: Practical insights and illustrative examples

Illustrate selected demonstration projects that have tested new methods and technologies in different phases of the construction process. The illustrated projects demonstrate sustainable practices in architecture, indoor air quality, and energy efficiency, construction materials, freshwater and sanitation and waste management.

Part Three: Organisations working on SBC in Africa

A brief summary of primarily African public organisations and private companies that promote SBC approaches. They work in the areas of capacity building, research and development, teaching and learning, promotion of energy efficiency, debate platforms, consultancy, information dissemination, construction materials, design, and SBC promotion.

Part Four: Literature and online resources

Selected sources of information about SBC topics in Africa such as human settlements, energy efficiency, construction materials, capacity building, financial aspects, community participation, governance and corporate social responsibility are summarised. Examples of websites are given providing information regarding on-going SBC related research, initiatives, forums, and companies working in this field.

“This book highlights the African local knowledge, promotes peer to peer learning and calls for further studies in the subject.”

Part One

Overview of SBC in Africa

This section provides an overview of SBC in Africa. It clarifies the concept of Sustainable Buildings and Construction (SBC) by highlighting different perspectives on SBC. Further, the key challenges as well as the opportunities arising from SBC in the African context are discussed. Finally, linkages and actions towards SBC in Africa and relevant policy instruments to tackle energy consumption as one of the key issues in new buildings and construction are illustrated.

Sustainable Buildings and Construction (SBC) – What does it mean?

The concept of sustainability links together the three aspects of ecological, economic and social well being. In this publication we define sustainable buildings and construction as encompassing all these aspects and not only as green or ecological buildings. From the environmental perspective, energy issues are one of the most important considerations, and they are now on the top of every agenda. Accordingly, energy use is of critical importance in the SBC field.

There are many definitions of sustainable buildings. One way is to describe them as zero-impact buildings, which means that they have no negative environmental, social or

economic impacts. For example, a zero-impact building does not pollute water but instead cleans its own waste water. It produces all the energy that it needs, it does not create waste but recycles everything, and it does not occupy fertile farmland or forest areas but uses established construction sites for new construction, or renovates old buildings for new users.

In an ideal case we would construct positive-impact buildings that produce more energy than they need, grow food for the neighbourhood, provide decent jobs in their during upkeep and maintenance, and create a healthy living and working environment for

their occupants.

Other possible definitions of sustainable buildings include those developed during Marrakech Task Force SBC workshops in 2007:

Sustainable buildings and construction works fulfil their performance requirements with minimum adverse environmental impacts, while encouraging improvements in economic, social and cultural conditions at local, regional and global levels.

Sustainable construction means responsible supply, operation and maintenance of buildings that meet the needs of their owners and users over their lifespan with minimal unfavourable environmental impacts, whilst encouraging economic, social and cultural progress.

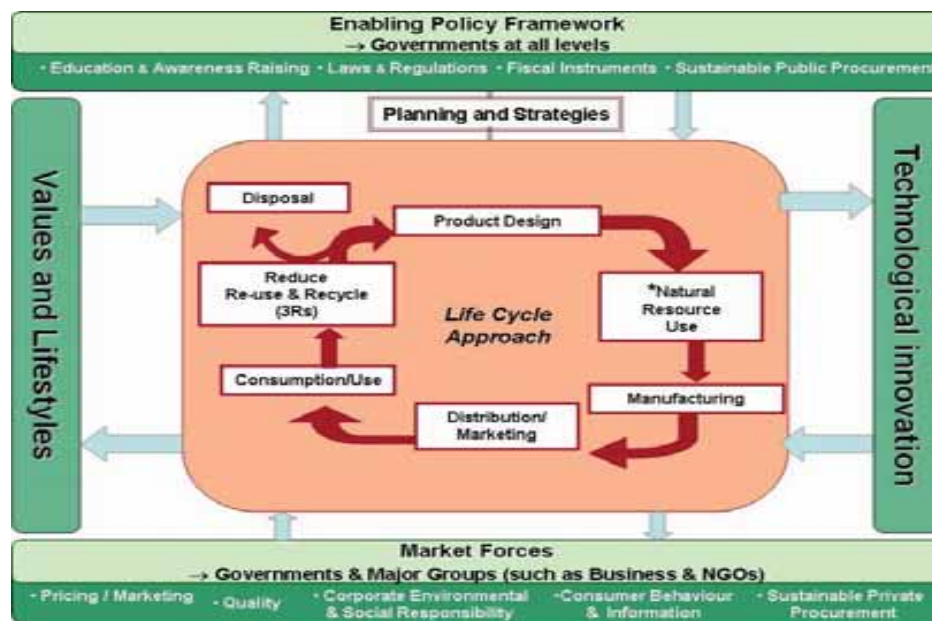
But how can a building or construction process be analysed to determine if a building or a construction process is sustainable? Taking a lifecycle approach is useful as the impacts of a building often occur over long-time periods and a great number of actors are involved in the design, construction, use and maintenance of a building. For a lifecycle assessment, several rating methods and tools are available, such as GRIHA in India, or the generic SBTool and its local adaptations (GRIHA 2009).

The life cycle approach makes it possible to study the role of different stakeholders (such as policy makers, planners, industry, users,

citizen, and so on) during different stages of a building's life cycle (see Life Cycle Approach diagram).

Another aspect that has to be considered is the variety of scales of the built environment. A relevant question is whether the impact is limited to an individual human being and his/her well-being (e.g. indoor air quality or absence of disturbing noise), or whether impacts extend to local neighbourhood or city levels (e.g. soil pollution or traffic resulting from the location of the building), or does the impact have global dimensions (e.g. climate change due to greenhouse gas emissions from fossil energy sources).

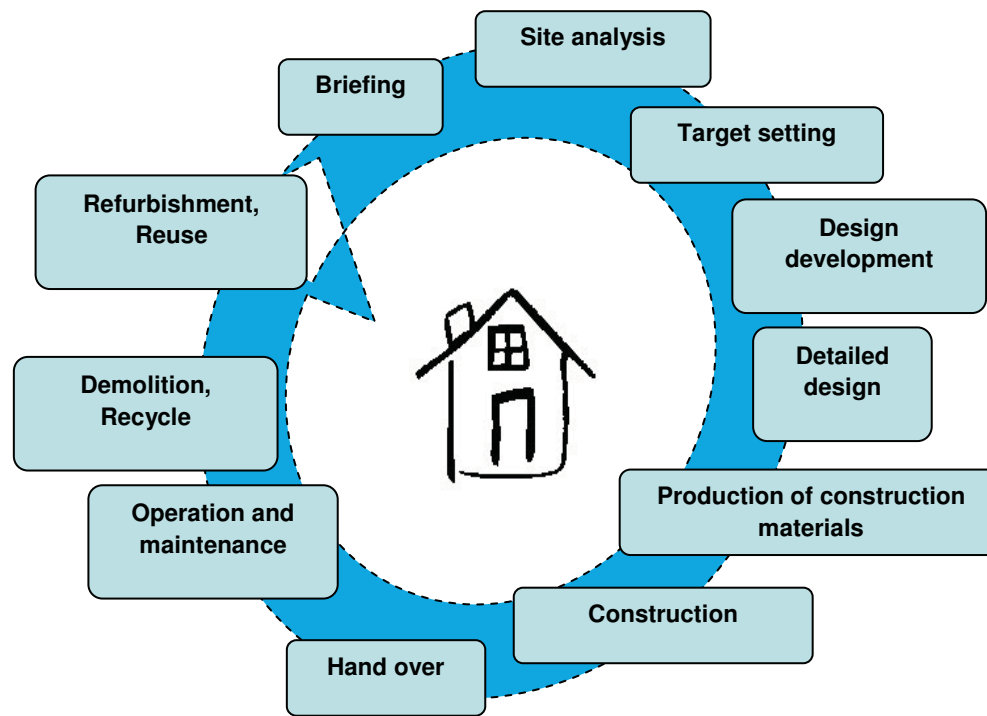
The following sections describe these two aspects – a life cycle approach and the different scales of the built environment – and the economic, social and environmental impacts of buildings and construction.



Life cycle approach (Source: 3rd public draft of the 10YFP, UNDESA and UNEP, Sept. 2009)

Life cycle perspective: The production and consumption process of a building

The process of planning, constructing, using, maintaining and reusing a building is a process consisting of discrete phases that can be individually analysed. Positive and negative impacts of buildings can be measured and assessed at each stage of the lifecycle. A building's lifecycle can be differentiated in the following stages: pre-design including briefing, site analysis and target setting; design phase including preliminary design, detailed design and building permit applying; construction phase including bidding for tenders, production of construction material and construction works; use phase including handover, use, and, maintenance and finally end-of-life including reuse and recycling.



Perspective 1: Lifecycle perspective

PRE-DESIGN PHASES

Briefing:

During the pre-design phase of a building it is important for all involved parties to agree on overall objectives of the project or undertaking. Land owners, financiers, building owners, users and the design team need to share their understanding of sustainability and agree on common priorities. It is important that all stakeholders be aware of both the possible challenges and benefits of setting and meeting sustainability targets. The potential to refurbish and reuse an existing building should also be explored as an option when considering an entirely new construction.

Site analysis:

The selection of a building site can substantially influence the environmental impacts of construction. The impacts on the existing natural resources have to be considered such that the construction site doesn't impair valuable natural values, arable land or historic landmarks. In addition, it is important to assess the impacts on groundwater. From the perspective of healthy living conditions, it is important to ensure that the soil on the site does not become polluted, and should this occur, needed remediation action must be taken. Accessibility (vicinity of services and transport options) is important from the point of view of decreasing mobility and transportation related environmental impacts. Furthermore, there may be existing structures on the site that could be utilised as a part of the new construction. In addition, the orientation of the site in terms of sun and wind are also factors that should be considered. Above all these aspects the most important question is whether the site is the most suitable for the building in question and whether the construction complies with sound urban planning principles.

Target setting:

It is important to consider lessons from best practices of similar buildings in the pre-design phase. The spatial brief for the building should allow for sufficient flexibility for possible changes in future uses as well as provide a potential for future expansion. However, it is important to avoid the wasteful use of space, in particular if there are needs for air conditioning or heating. Performance targets need to be fixed not only in terms of spatial functions but also in regard to use of natural resources, including energy for the operation of the building.

DESIGN PHASES

Preliminary design:

During this phase solutions are developed to achieve the previously determined performance targets. Design needs to be adapted to the local climatic and cultural context and satisfy the needs of the future occupant. It is also advisable to provide for adaptability in the design to accommodate possible changes in the use of the building. Furthermore, it is useful to test different alternative solutions to addressing different design performance challenges.

It is important to have sufficient expertise within the design team to ensure the defined targets are successfully achieved. In this phase all major design decisions are made, including questions such as: How can the potential of sun, wind or other onsite resources be utilised? How can future occupants be sheltered from disturbing noise? How can any necessary shade from intense sunlight be provided? How can rainwater be harvested? Which durable and locally available primary construction materials are available? For which construction technology is there local labour force available.

The decisions about technical systems, such as natural ventilation and lighting or the use of solar or photovoltaic energy, need to be made early, because they will have a profound impact on further design solutions.

Detailed design including structural, electrical and HVAC engineering:

Detailed design deals with questions such as the choice of further construction materials, and the design of individual construction elements such as windows and roofing, and how they are joined with adjacent elements to ensure suitability for local climatic conditions. Heating and cooling systems are major concerns, where traditional local solutions may better exemplify sustainable principles than contemporary short-lived technologies. Furthermore, the choice of construction materials and technical systems must always include considerations on how the ongoing operation and maintenance will be secured in the long-term given available local resources.

Applying for building permit

Different local authorities have different procedures for applying for building permits. Relevant national legislation and local building ordinances will give guidance for how to reach the required levels in safety, fire protection, access for handicapped persons, waste water treatment and so on. However, it should be kept in mind that the legal requirements are often only minimum requirements and that it is in the interest of the client to achieve the best possible performance.

CONSTRUCTION PHASE

Production of construction materials

The production of most basic construction materials is very energy intensive. In addition, if materials have to be transported long distances, the energy used for transportation will become part of the carbon footprint. There are cases where the use of energy intensive materials is necessary, but it is worth considering if it would be more advantageous to use locally produced materials and create local employment opportunities. There are some basic rules in the procurement of construction materials, such as avoiding endangered wood species, materials that are hazardous to health (e.g. asbestos or many paints and solvents) and ensuring that production processes fulfil requirements of decent working conditions. With the operational phase of the building in mind, it is important to choose construction materials and building elements that are easy to maintain or to replace, if necessary.

Bidding for tenders:

It is important that bidding documents are sufficiently detailed and provide enough information so that the construction firms are able to give a reliable price and time estimate. In this phase, as well as in site selection or building permit application process, there is a potential for corrupt practices to emerge to avoid complying with legislation or implementing targets set by the client. It goes without saying that corruption will seriously impair any attempt to achieve sustainability goals.

Construction works:

During construction work care should be taken to ensure that working conditions are safe, that workers receive a fair pay and that their professional skills are sufficient to ensure safe and effective construction. The plans and designs made in the previous phases need to be followed in addition to relevant construction regulations. On a construction site a considerable amount of construction waste is generated and action should be taken to minimize this waste.

USE PHASE

Hand over:

When the new or newly refurbished building is handed over to its owners and occupants, they need to be informed of the building's features and how to effectively use, operate, maintain and manage the building to ensure optimised performance. A clear understanding of how the building is supposed to function will motivate the owners and users to support achievement of the sustainability targets through their behaviour.

Operation:

During the operational phase of a building it is important that the building be continuously maintained according to specifications. This means that the building managers need to be informed of the technical systems and any issues connected to building materials and their maintenance. It is natural that buildings age when used and refurbishment is a necessary activity with time.

END-OF-LIFE PHASE

Reuse:

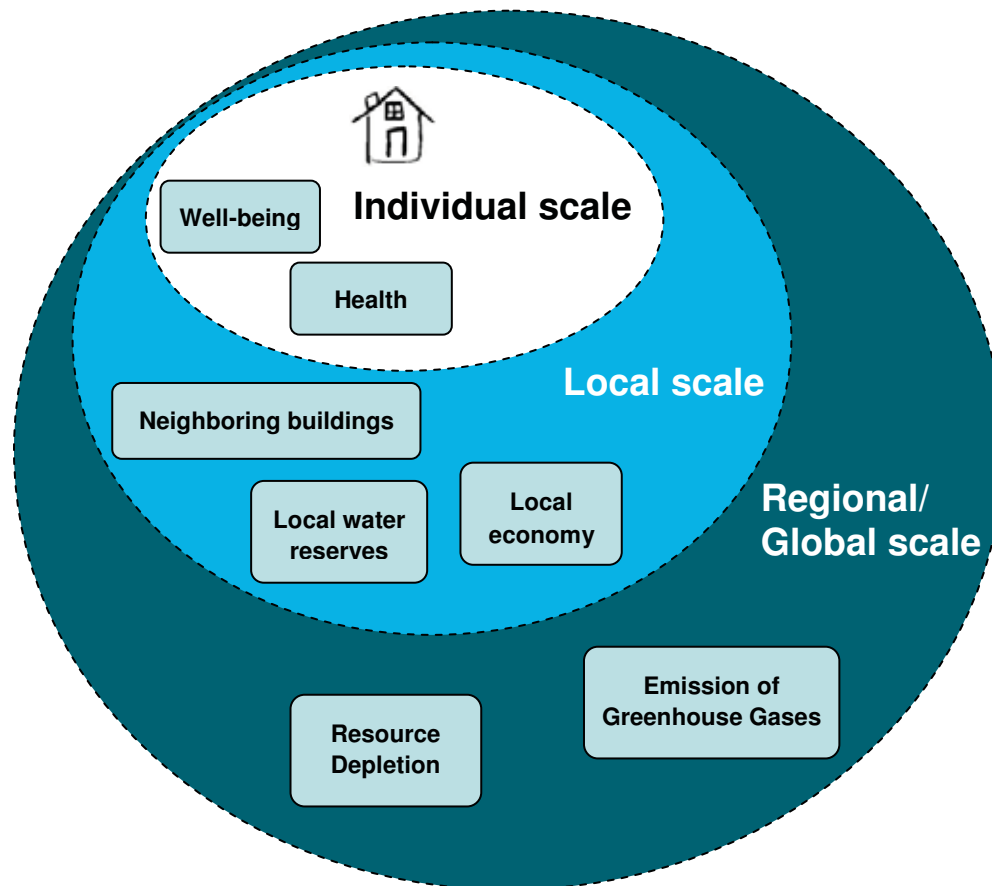
In many cases, an old building is more solid and better adapted to local climatic, urban and cultural context than newer buildings. As an example, many industrial buildings and warehouses have extremely sturdy structures and facades, and can be relatively easily transformed to house new functions. Accordingly, when a building has reached the end of its life in the current use, it should be assessed as to whether it could be transformed to serve in another use instead of demolishing it.

Demolish/Recycle:

It can be argued that no end-of-life phase actually exists for a building. Even if demolishing the structure is considered the only viable option, the embedded construction materials will continue to exist, either as waste or as recycled material and building elements. Demolition of a building should only be considered as a last alternative. Where no other viable alternative exists, quantities of waste materials should be minimised and the recovery of recyclable and reusable materials should be maximised.

The different scales in the built environment

Impacts from different activities during the lifecycle of a building occur at different scales. They influence individuals as occupants of a building, impact their local surrounding or even cause changes at a regional and global scale.



Perspective 2: The different scales in the built environment

Individual scale:

The individual scale in the built environment focuses on the overall quality of life and health risks of building's occupants. Important aspects that influence health and well-being of a building's occupants include access to freshwater, sanitation and clean energy; indoor air quality; thermal conditions, and lighting and noise levels. For instance, the choice of building materials influences indoor humidity and temperature depending on its capacity to store heat, as well as acoustic performance.

Local scale:

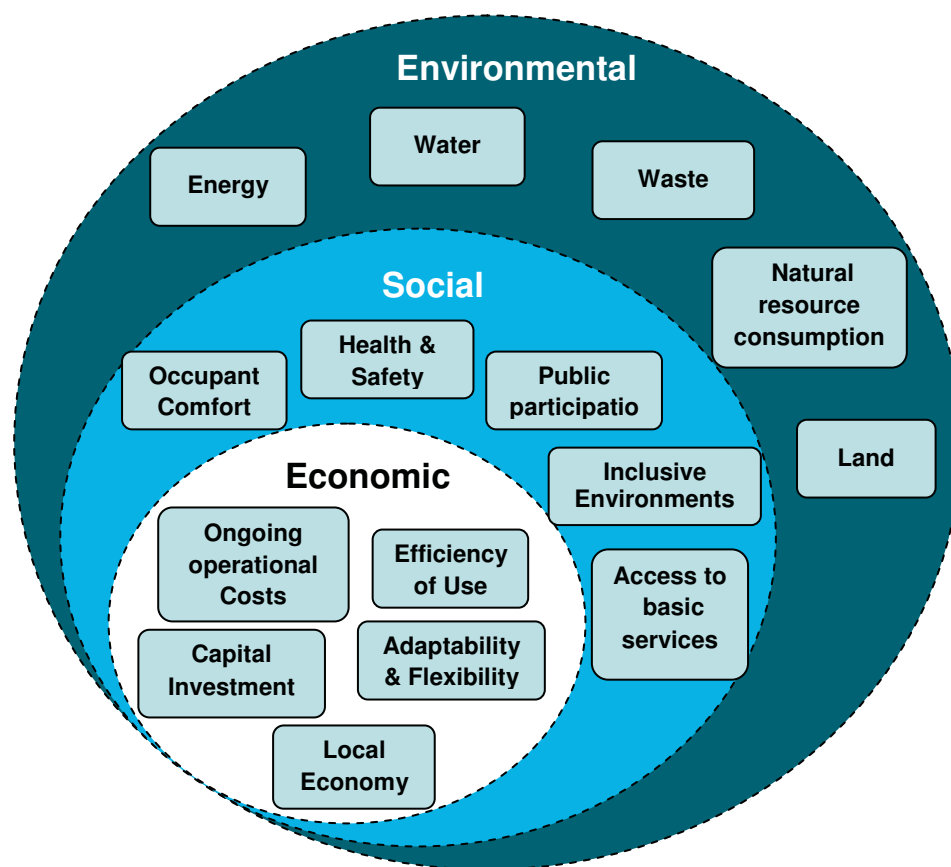
The local scale includes the surrounding neighbourhood, village or city. The building both affects and is dependent upon local infrastructure and services. Construction and maintenance of a building can support the local economy. The construction process imposes impacts on the natural environment surrounding the site and the building might interfere with access to daylight in neighbouring buildings. Water use and wastewater from a building affects local water resources and sewage treatment infrastructure. Access to and from the building will create traffic, and depending upon the availability of public transport, greater or lesser greenhouse gas emissions.

Regional/Global scale:

The use of existing buildings and construction processes for new buildings also imposes impacts at the regional and global scale. Energy use related to extraction, manufacturing and transport of raw materials for construction materials as well as the use of non-renewable energy resources to meet a building's energy needs during the operation phase all result in emissions of CO₂ which contribute to climate change. Raw material use is driver for resource depletion.

Environmental, social and economic impacts of buildings and construction

The continued use of existing buildings and construction of new buildings can have positive and negative environmental, social and economic impacts. These impacts are generated during different phases of a building's lifecycle and occur on individual, local and global scales.



Perspective 3: Environmental, social and economic impacts of buildings and construction

ECONOMIC DIMENSION

Local Economy:

Local economies can benefit to a large extent from construction activities and management of buildings. In order to facilitate sustainability, construction and management of buildings needs to engage local resources and skills and contribute towards their further development.

Efficiency of Use:

Whether used or not, buildings cost money and consume resources on an ongoing basis. Therefore, buildings need to be used and cared for their whole lifecycle to avoid unnecessary construction due to neglect of existing structures.

Adaptability & Flexibility:

Buildings stay the same while user requirements and technologies can frequently change over their lifespan. Buildings need to be designed and constructed in a way that enables cost effective and uncomplicated adaptation to new requirements.

Ongoing Costs:

Costs incurred during the operation of a building often arise from energy consumption and waste production and include payments for cleaning, maintenance and energy, water and sewage. Therefore ongoing costs need to be monitored and minimised wherever possible.

Capital Costs:

In general, construction of buildings requires large capital investments. Design and construction of buildings should be cost efficient while considering expenses during over the life cycle and intended function to avoid unnecessary spending on non-essential features.

SOCIAL DIMENSION

Occupant Comfort and health:

Health, happiness and productivity of a building's occupants depend on the quality of the environment in and around a building. Electrical lighting requirements during daylight hours should be minimised, noise abatement secured and indoor air quality maximised. Adequate heating, cooling and ventilation systems are of central importance to the building's occupants especially in climatic regions with extreme temperatures.

Public Participation:

Individuals living or working in a building need to take part in decisions concerning planning and construction processes. A sense of control over decisions concerning their home or workplace increases levels of satisfaction and motivation of occupants. The users are the best experts of their own needs.

Inclusive Environments:

Sustainable buildings need to be designed to accommodate and be accessible to everyone. This also reduces costs by avoiding costly retrofitting for special needs, be it for handicapped persons or for different age groups.

Access to Services:

Access to important basic public and private services such as health service, schools, shopping opportunities as well as public transport needs to be provided for all in order to secure equity, promote social interaction and cut environmental burdens imposed by excessive automobile use.

Working conditions

Decent working conditions are an important aspect of the social dimension of sustainability in the building and construction sector. In the construction phase it should be assured that working conditions are safe, that salaries of the workers are sufficient and paid promptly, that no child- or forced labour is used and that the construction works are procured through transparent procedures without corruption.

ENVIRONMENTAL DIMENSION

Energy:

About 40% of all energy produced worldwide is consumed in buildings and during building construction. The use of non-renewable energy resources for building energy needs is a central driver of climate change and resource depletion. Cutting energy demands through the use of passive or highly energy efficient ventilation systems, cooling and heating as well as the application of renewable energy sources for heating, cooling and electricity in buildings can make important contributions to lowering a building's environmental burden. The amount of embodied energy of construction materials should be considered during design and reduced to a minimum.

Fresh water and sewage:

Fresh water is a scarce resource. Therefore more efficient use of water in buildings and construction processes through water efficient devices, improved water harvesting capacities as well as recycling of grey water and intelligent irrigation systems is an important feature of a sustainable construction and buildings. Lack of proper waste water treatment causes severe hazards to human health. Securing access to freshwater and sanitation is the most basic indicator of sustainable construction.

Waste:

Along a building's lifecycle large quantities of resources and products are consumed causing large amounts of waste.

Site / Land:

The choice of building sites is often connected with the loss of fertile farmland and negative impacts on natural ecosystems and neighbourhoods. The use of sites that have formally been used for construction and the selection of locations that minimise distances to places where the building's users must travel will reduce environmental burdens.

Natural resource consumption

The construction and renovation of buildings consumes significant quantities of resources. This particularly holds true when building materials are evaluated from a life cycle perspective that takes into consideration their sourcing, processing and disposal. The use of natural resources can be minimised by using less resource-intensive materials, by reusing construction materials and by avoiding excess space in buildings.

Criteria, Evaluation and Rating of SBC (1)

Introduction

In order to assess the sustainability of buildings and construction activities it is necessary to be able to measure and verify their performance. Various criteria and rating systems have been designed that provide an indication of the performance of buildings and construction activities in terms of sustainability. The rating systems have two main objectives: 1) aiding the design of sustainable buildings and 2) helping to evaluate the sustainability of buildings.

The wide variety of rating systems

It can be argued that no single measuring scheme can provide a fully comprehensive and undisputable assessment of all the sustainability aspects of a building. However, this should not prevent attempts to produce at least indicative assessments through the collection of data and interpretation of indicators. The issue of sustainability in the built environment is of such importance that, despite the complexity of the task, continued efforts to better understand the issue should be made.

Early rating systems for sustainable buildings and construction like BREEAM

(Breeam 2009) and LEED began as basic checklists on what to do and what not to do. Rating systems rapidly developed into systems that awarded points for certain achievements, thus improving comparability between different buildings as well as enhancing the possibility to weight certain criteria. Currently there exists a wide variety of different evaluation and rating tools that attempt to make sustainable construction measurable. The rating systems differ in many aspects including the following:

Focus area: Dimensions of Sustainability

The concept of sustainability brings together environmental, social and economic aspects that can sometimes be hard to combine. Criteria for the social dimension range from accessibility of the buildings to occupant well-being and to the preservation of social and cultural values. The environmental dimension contains criteria related to energy use, material use and water and waste management. The economic criteria relate to aspects of affordability of residential rents or purchase prices, life-cycle costs and externalities on local economies. Historically, many rating systems have been predominantly developed to assess

environmental issues instead of the full range of sustainability issues. Many current systems also highlight social and economic aspects.

The scale of the assessment

The scale of the assessment can range from assessing an individual design feature of a building to assessing the sustainability of a whole community. Some systems focus on a certain stage of the construction process whereby others focus on existing buildings or on specific issues such as energy use or health and safety aspects. The better approach in the case of SBC is to assess the performance of the whole building but at the same time take into account how the building supports the development of a sustainable surrounding system.

Degree of technical ambition

One of the major issues defining sustainability rating systems is the degree of technical ambition. It is important that the system has a strong scientific basis to ensure the reliability of results. On the other hand the system shouldn't be too technical or academic to impair ease of use, or require inordinate commitments of time and

expertise to complete the assessment. It is advisable for any system to have different levels of technical ambition and be aimed at different user groups.

Rating system's origins and sources

Different rating systems range from schemes developed by public organisations to consultant-driven commercial systems. Public rating systems tend to be more linked to existing policy, because it is in the public authorities' interest to steer the construction practices in the desired direction. Public rating systems can also be compulsory and supplemented by regulations while private rating schemes are generally voluntary in nature and driven more by market demand; what consumers and users of the systems see as important features of a sustainable building.

Criteria, Evaluation and Rating of SBC (2)

Case study: GRIHA - Rating sustainable buildings and construction in the Indian context

Synopsis

GRIHA, an acronym for Green Rating for Integrated Habitat Assessment, is the National Rating System for sustainable buildings and construction in India. GRIHA quantifies aspects such as energy consumption, waste generation and renewable energy adoption and evaluates the environmental performance of a building holistically over its entire life cycle, thereby providing an accepted standard for what constitutes a 'green building'.

Features of the rating system

The GRIHA rating system consists of 34 criteria – both qualitative and quantitative – categorized under the following four main subcategories: 1) site selection and planning, 2) building planning and construction, 3) building operation and maintenance and 4) innovation. Eight of the 34 criteria are mandatory, four are partly mandatory, while the rest are optional. Each criterion has a number of points assigned to it. Different levels of certification (one star to five stars) are awarded based on the number of points earned by the project. The

minimum points required for certification is 50 and the maximum number of points is 100. The criteria emphasise both environmental and social aspects.

All buildings, except for industrial complexes and housing subdivisions, which are already in the design stage, are eligible for certification under the system.

Developing the system

GRIHA was developed by the Energy and Resources Institute (TERI) and the Ministry of New and Renewable Energy (MNRE) after a study of current internationally accepted green building rating systems and the prevailing building practices in India. The MNRE has set up a national and technical advisory committee comprising professionals and representatives from several government bodies to guide the evolution of GRIHA. There is a prospect of revising the guidelines and criteria at three year intervals to take into consideration the latest scientific developments during the review period.

Example of a set of indicators on water use under the category of Building Planning and Construction Stage

Criterion 10: Reduce landscape water requirement.

Reduce the landscape water requirement so as to minimize the load on the municipal water supply and depletion of groundwater resources. Landscape using native species and reduce lawn areas while enhancing the irrigation efficiency, reduction in water requirement for landscaping purposes.

Criterion 11: Reduce building water use.

Reduce water consumption in the building by using efficient fixtures like low-flow fixtures, etc.

Criterion 12: Efficient water use during construction.

Minimize the use of potable water during construction. For example, use materials such as pre-mixed concrete for preventing loss during mixing or use recycled treated water and control the waste of curing water.

More information:

<http://www.teriin.org/griha/index.php>

Drivers of energy consumption and resource use in buildings and construction

Existing buildings and construction processes consume a huge amount of energy and resource worldwide. Buildings and construction consumes 40% of the raw stone, gravel, and sand used globally each year, and 25 % of the virgin wood. Buildings also account for 40% of the energy and 16% of the water used annually worldwide (World Watch Institute 1995). Raw materials for the building sector are extracted, processed, transported, added in the construction phase and finally disposed. All these stages imply a number of environmental impacts that lead to resource depletion and biological diversity losses (UNEP 2007). Due to its energy consumption, buildings are accountable for 40% of global emissions while it has been found that on “business as usual” trends, direct and upstream carbon dioxide emissions from buildings are expected to rise 70% and 140% to 2030 and 2050 respectively (Stern 2007). Developing countries are yet to be constructed and they have a relatively low degree of industrialization making the construction industry one of the biggest factors impacting on the biophysical environment in the region (UNEP 2002). Increasing energy efficiency as well as reducing resource use is needed in order to shift towards more sustainable buildings and construction. IPCC estimates that there is a potential to reduce 29% of the projected baseline emissions by 2020 in the residential and commercial sectors by better energy efficiency (Levine et al. 2007).

Economic barriers

Due to the scarce development of private sector, construction industry relies on government to work. This means that public institutions have the responsibility to implement SCB sectors in a context of fluctuating incomes, uncertain international assistance, government's bankrupt, difficult access to capital and uncertain economic environment. This situation often leads to short term solutions, usually far from sustainable patterns.

Knowledge gap on energy efficiency

Specific knowledge and skills for implementing energy efficiency in diverse climatic zones, building types, heating, cooling and lighting systems etc. are sometimes lacking among possible involved stakeholders such as: owners, constructors, advisers and financial institutions.

Lack of life-cycle thinking

“Many designers wrongly believe that if they stuff a building with enough ecogadgets such as solar collectors, wind generators, photovoltaics and biodigestors then they will instantly have an ecological design” (Yeang, 2006). For this reason, the assessment of sustainability of buildings with life-cycle thinking as a tool is a cornerstone for sustainable building design.

Cultural barriers

Introduction of Western technologies before and after colonial times could cause a strong reaction in terms of intolerance to further interferences in local mindset, even if already touched by western influence. In addition, the long technological dependency on foreign knowledge could end in a lack of confidence in home-grown traditions, discouraging the switch towards greener building solutions and low impact traditional practices.

Dematerialisation

Energy use and energy saving are invisible, therefore, it is difficult to motivate behavioural changes among groups that are entitled to take action in addressing this topic. The general attitude toward energy rationalization in buildings and constructions is less motivated than the one of physically using green materials and brand new low energy components.

Key challenges of Sustainable Buildings and Construction (SBC) in the African context (1)

The construction industry in Africa faces several key challenges which require adequate solutions to ensure more sustainable buildings and construction processes in the continent.

Problems linked with forestry

The building material industry in Africa also contributes to prevailing problems of deforestation on the continent. When timber for construction is harvested, in many cases replacement trees are not replanted. Sometimes the timber is even harvested from indigenous forests which are of fundamental importance in terms of biodiversity conservation. If forestry and timber harvesting are going to remain important economic activities, strong action is necessary to increase their sustainability.

Need for appropriate and sustainable housing

The African urban population is expected to double from 294 million in 2000 to 742 million in 2030. Currently 72% of the urban population resides in slums that cause risks like disease and personal insecurity. Access to safe, decent and affordable housing for low-income groups remains a challenge in many African countries (UNEP 2007).

Waste management and construction

Waste generated at the construction site is another common problem in many African countries. Waste disposal in water and rivers, pits and landfills adjacent to construction sites contributes to environmental degradation and often becomes a breeding ground for mosquitoes and vermin. Therefore there is an extensive need to strengthen waste management practices in the construction sector.

The use of unsustainable construction materials

The construction of traditional communities in Africa has been characterized by use of local and natural materials. However, today the construction sector in Africa shows a tendency to the use of less sustainable contemporary construction materials. Traditional construction materials have been cheap, easily accessible and environmentally less harmful and their use has also created local jobs.

Access to financial resources

Lacking access to financial resources hampers the shift to more sustainable buildings and construction. Financial issues not only include availability of funding but also institutional frameworks that enable access to funding. Barriers for financing sustainable housing in Africa need to be addressed and funding opportunities enhanced.

Service and public transport structures

Planning and establishment of service and transport structures can support the development of a sustainable built environment. There is a need for well planned structures ensuring easy access to services for people as well as to reduce distances, and thereby private automobile use and associated environmental impacts. Mobility planning is also important from the point of view that mobility structures to a large degree determine long term land use patterns.

Key challenges of Sustainable Buildings and Construction (SBC) in the African context (2)

The need for making mining industry more sustainable

A large proportion of raw materials for construction materials is extracted by the mining industry. The mining sector is important for many African countries as it is a key source of government revenues (DIE 2008). However, mining activities can have great impacts on the ecological, economic and social dimensions of sustainability. There is a need for more sustainable mining practices in African countries to support the sustainable buildings and construction sector.

Energy use in buildings and construction

The construction sector, and in particular the use and operation of buildings consumes substantial quantities of energy. Therefore reducing energy demands, increasing energy efficiency and use of renewable energy resources is needed to reduce building environmental burdens.

Inadequate urban planning

The building site is often overlooked as one of the significant elements of sustainable buildings and construction, even though this phase of the construction process has significant impacts on several sustainability aspects. Among other things, the impacts on existing natural resources have to be considered to ensure that the construction site doesn't destroy valuable natural values, arable land or historic landmarks. In many urban areas of Africa, a large proportion of existing green area has been destroyed and all trees have been removed instead of integrating them to the built environment. In some cases the buildings have been constructed so densely that air movement is prevented even after the construction has been completed.

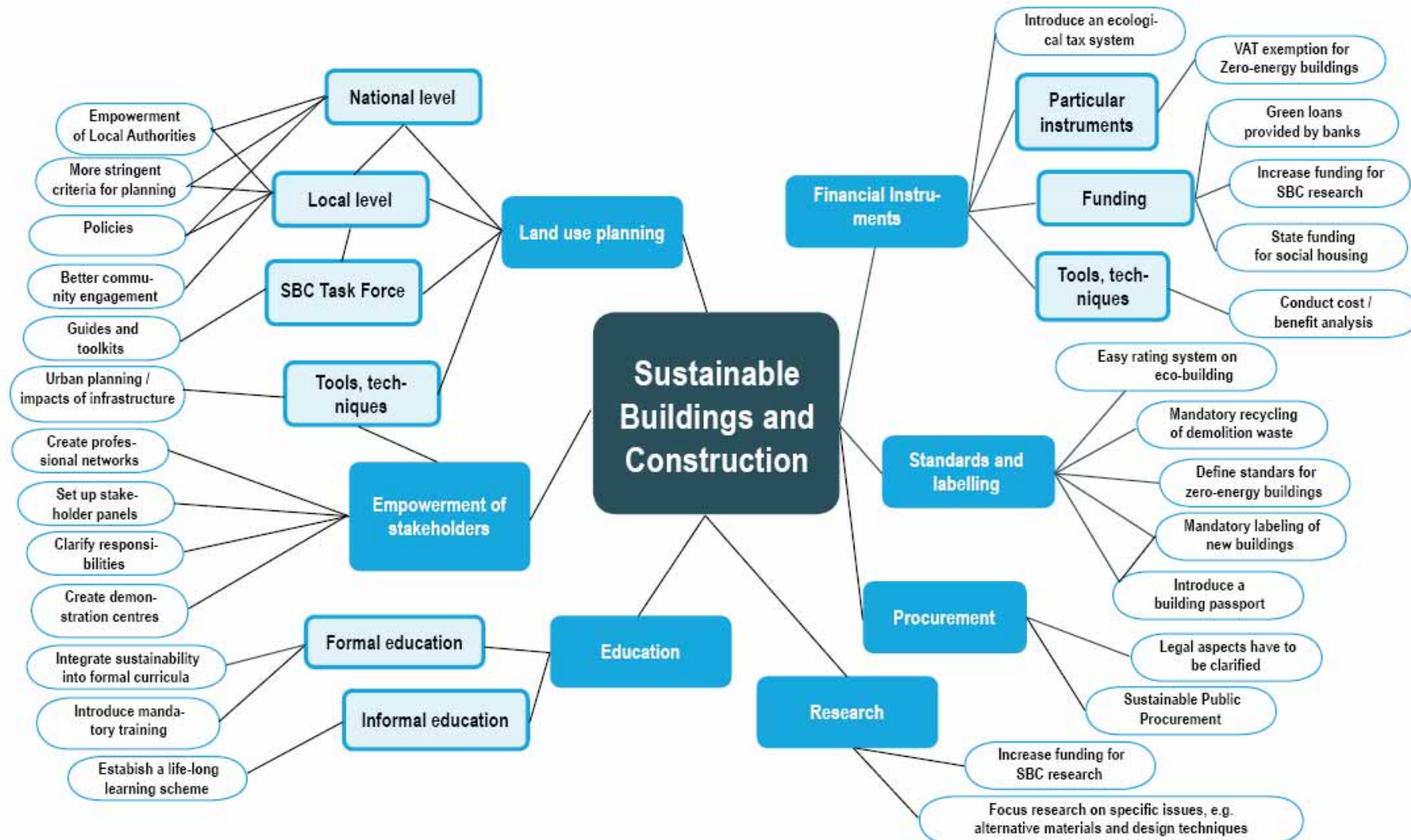
Traditional Architecture is in danger

Africa has a rich tradition in architecture. Local and indigenous cultures have practiced sustainable resource use due to their practical experience and human dependency on the earth's life support systems. Traditional communities integrated buildings into the natural environment in terms of adequate use of cost effective and easily accessible local building material for construction and maintenance on the one hand, and designs which were well adapted to the African context on the other hand. However, the use of imported materials and designs has put the African traditional and sustainable way of buildings and construction processes in danger thus contributing substantially to unsustainable resource use.

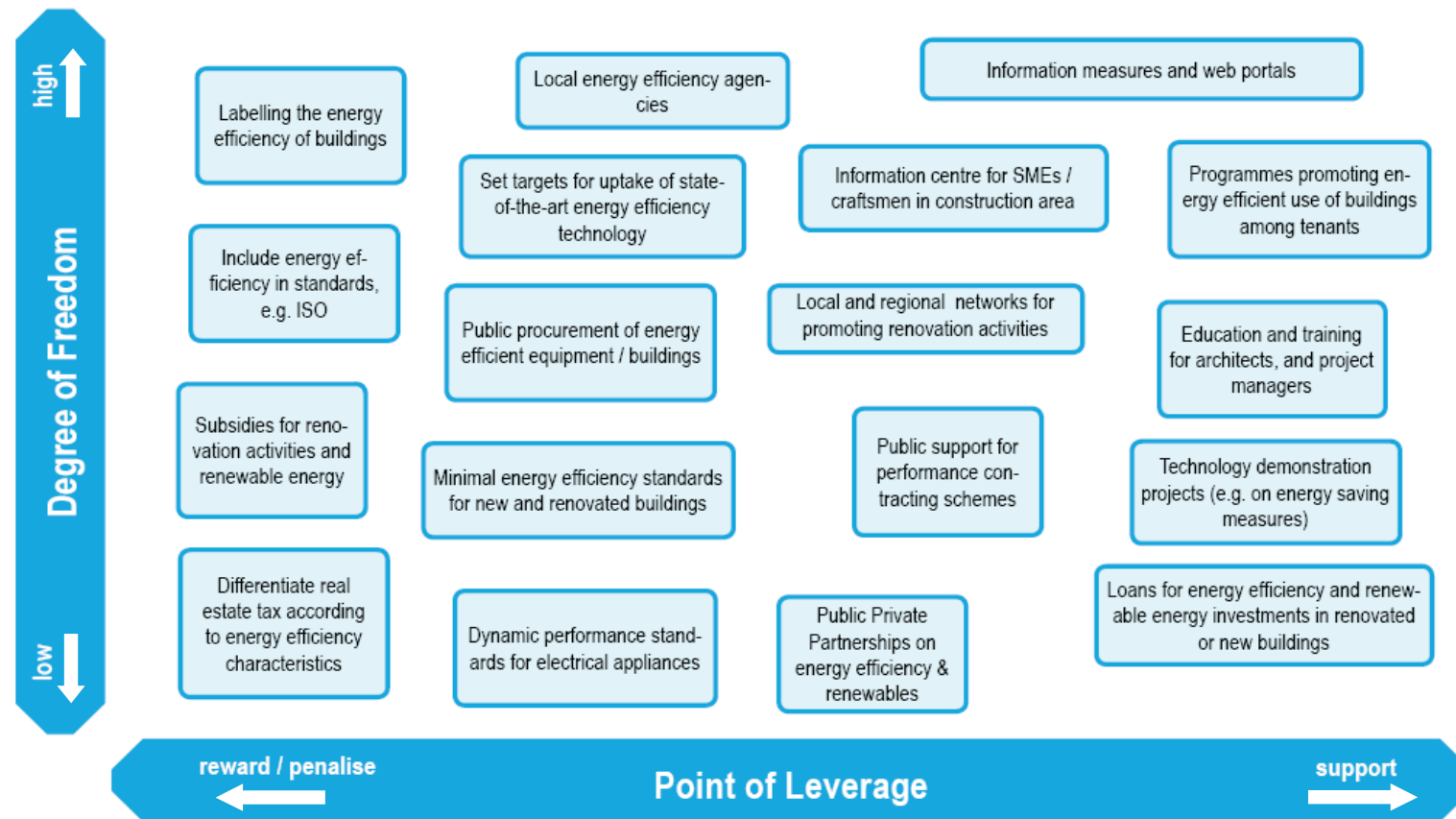
Therefore

There is the need to give the issue of sustainable buildings and construction in Africa the attention it deserves. Sustainable construction is important not only from the view point of the environment but also from the point of view of social and economic sustainability. Particularly in developing countries all of the three aspects of sustainability have to be addressed at the same time. Furthermore, there is a need to incorporate traditional building practices and local knowledge in the process. Sustainable construction practices adopted in the industrialized countries cannot be applied directly as such without taking into consideration existing traditional practices. Experience and knowledge sharing as well as capacity development and training is needed for all actors involved in the construction sector.

Linkages and actions towards Sustainable Buildings and Construction (SBC) in Africa



Policy instruments to support energy efficiency in new buildings and construction



Point of leverage: Does the instrument enable the policy maker to provide concrete rewards or penalties for SCP actions or does it support voluntary action among stakeholders to take advantage of existing SCP alternatives?

Degree of freedom: Does the instrument offer a high or low degree of freedom to the stakeholders, when applying the instrument?

Part Two

Practical insights and illustrative examples

Case studies of sustainable buildings and construction in Africa

This section presents some examples of how Sustainable Buildings and Construction (SBC) criteria can be brought into practice in urban and rural regions of the African continent. These African case studies are categorised to represent different focus areas for action, including Sustainable Architecture, energy efficiency, indoor environmental quality, sustainable construction materials and waste and water management.

Cool Architecture for a hot climate

Challenged by hot and dry climate

Namibia is a country of extreme climate conditions. It is made up of two deserts with the remainder of the country being characterised by a hot and dry climate. This presents a significant challenge for buildings. An additional difficulty is that a large proportion of Namibia's population still lives below the poverty line. Sustainable architecture can help to overcome these challenges.

A building representing research objectives

The building of the Habitat Research and Development Centre in Katutura, Windhoek has been designed to meet the difficult climate conditions in Namibia. The holistic approach of the architect, Nina Maritz,



The Habitat Research and Development Centre of Namibia

applies different elements of climate-adapted design and recycled materials to establish a culturally sensitive sustainable building.

Braving the heat through passive solar principles

Using passive solar principles to create a cool building is one of the key elements of the design. The main feature of the building is an elongated east-west axis and a

The Habitat Research and Development Centre is an exemplary structure that addresses building challenges in very dry and hot conditions. Moreover, it shows how recycled materials can be incorporated into a sustainable building in an African setting. It highlights what kind of low-cost construction materials can be made available in developing countries.

shortened north-south axis. As a result, the building has the advantages of maximising amount of daylight and is positioned in the predominant wind direction. The south facades are shaded by extended lattice overhangs. The large roof overhangs are angled to admit winter sunlight, but exclude the hot summer sun. Mainly local materials such as compressed soil

cement bricks help keep the inside cool while it is hot outside and they store the heat of the day for the cold of the evenings.

Circulating air and evaporating water

In order to address the hot and dry thermal conditions, the building smartly incorporates the cooling properties of wind and rainwater. 'Butterfly' roofs of corrugated steel capture wind and redirect it into the building. Additionally, the rainwater is collected in tanks and sprayed through misting nozzles making cooled air fall into the building.

Traditional farm cooler

Another interesting feature of the Centre is a modified ingenious cooling device for food and drinks. This device presents a cavity wall filled with charcoal that allows air to penetrate. Slowly percolating water moistens the charcoal as it flows downward to provide a cooling effect. At the bottom of the device the water is recycled by taking it to the top again through a solar powered pump.

Indigenous and recycled materials



Protected outdoor spaces

Local building techniques are implemented to draw upon the local knowledge developed over centuries while also meeting the challenges of the hot climate. Similar to traditional houses, rammed earth and brick construction forms the massive walls. Insulation made of low-grade sheep's wool is incorporated into ceilings to further reduce heat effect of the sun. Lavender is used to discourage insects. Additionally, the design does not use imported timber and shows how "waste" can be reused in a new building, while recycled materials are incorporated in walls and other elements of the building.

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Learning sustainable construction by doing

A building for HIV orphans

Recently the “Low-cost school and home for HIV orphans” project in Rakai, Uganda, received the 2008 Holcim Foundation Silver Award. The construction began in September 2007 in the Mukwano Village, 200 km south-west of Kampala, Uganda.

Sustainability in different ways

In the region, children are accustomed to gathering and having school classes under large trees. Thus, in order to respect this tradition, eight huts surrounding a tree

compose the physical structure of the school. Canopies are installed in the in-

The school emerged in response to the local need of a space where children can learn in a setting that respects community traditions. The sustainability of this project is demonstrated in a number of different ways to highlight the integrity of the initiative. Firstly, the orphans participated in the project and learned valuable construction skills. At the same time, the use of local and natural construction materials not only made the school an environmentally friendly structure, but also enhanced the children's understanding of SBC.

between spaces that connect the huts together and create triangular outdoor

spaces. The canopies can provide shade within the courtyards and inspire the activity of the children. In total, the school has two large dormitories, three lecture

who lost their parents to this illness. Beyond the possibility of having a space for learning, the school also offers the children shelter and a place for leisure activities.



rooms, two offices and a bathroom. Furthermore, efficient water and energy saving infrastructure has been installed, including and underground rainwater collection tank, and solar electric panels on the roof.

Getting more from less – for good cause

Because the project's budget was limited to USD 30,000 for 180 m² of built space, the construction of the school was based on voluntary efforts of the community. The school will also have a long-term social and contextual impact. Since HIV/AIDS threatens the path toward sustainable development in Africa, the project is dedicated to children

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Energy efficiency in a rural context

African energy consumption

In rural regions in sub-Saharan Africa, estimates suggest that the residential sector accounts for as much as 56.2 % of total energy consumption (Earth Trends, 2005). Compared to other regions in the world, modern energy consumption in Africa is very low and biomass consumption is the dominant household fuel, ranging from 55% in Senegal to 92% in Tanzania (IEA, 2003). The use of SBC methods offers great potential to fundamentally reduce energy consumption in Africa's residential sector.

Energy efficiency through simple methods

Tiholego Ecovillage is located near Rustenburg one hour west of Johannesburg, South Africa. In 1991, the local community established Tiholego in order to address the challenges of sustainable development in rural areas. The community applied sustainable designs during the construction of its dwellings which are characterised by the use of local materials and local knowledge. A series of experimental buildings have been constructed over the years following the establishment of the ecovillage. The buildings include traditional 2000 year old Tswana designs using earth and thatch as well as buildings constructed from large earth-filled bags with fired brick dome roofs.

Energy Efficiency through thermal mass and solar orientation

The choice of materials used for energy efficiency is a central aspect of sustainable construction in the Tiholego Ecovillage. Passive solar designs have been applied to ensure good thermal performance of the building. This includes the use of high thermal mass wall materials to mediate extremes of hot and cold temperatures as well as solar orientation. The houses are

built from locally available and recycled materials to form foundations, walls, floors and roofs. The orientation of the house allows solar energy to enter the large north-facing windows during the winter



The Tiholego Ecovillage demonstrates how a holistic approach to sustainable buildings on community level can be applied. Simple methods, such as the orientation of a building, can improve the energy efficiency of basic housing in Africa and improve living conditions in rural areas. The Tiholego Ecovillage can provide an example of how other African communities can also benefit from sustainable building designs.



months, and to warm the walls and floor which provide radiant heat back into the house during the colder evenings. In summer months, the roof overhangs prevent heat from the sun from entering the building and the thermal mass provided by straw reinforced unburned mud bricks aids with cooling. Applying

passive solar technology for heating and cooling enables residents to save up to 50 or 60 percent of the lifetime energy costs while providing a comfortable living space. Materials are chosen to minimise overall embodied energy and carbon emissions during manufacture. This, together with the long-life and ease of recycling of building materials, produces a housing system that minimises the production of greenhouse gases while simultaneously providing a high-quality lifestyle.

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Enhanced urban low-rise housing

Urban housing in Khayelitsha, South Africa

In South Africa the use of solar water heaters and compact fluorescent lamps (CFLs) is almost non-existent even in middle- to high-income households. Hot water is usually provided by kerosene powered storage boilers, liquefied petroleum gas (LPG) or electricity. Insulation is not part of the current low-cost housing delivery provided by public authorities. Low-income households give priority to extending their housing space when renovating. Income constraints mean that poor people tend to suppress their demand for heating and lighting. Conventional heating sources such as paraffin stoves are a fire risk and can cause carbon monoxide poisoning or respiratory health.

Energy saving measures

This low-rise housing initiative involved retrofitting state-subsidised 30 m² housing units in Kuyasa, a low-cost housing settlement, to improve energy efficiency and increase the use renewable energy. In the demonstration phase, a solar water heater (3kW input power), insulated ceiling (plasterboard, cardboard, and aluminium foil laminate) and two CFLs (11W and 16W) were installed in 10 units. The project is planned to extent over 21 years and will

provide approximately 2,300 households with energy saving opportunities.

Adaptation to local conditions

Most technologies applied in the project are locally available. The project also aims to increase local employment and build skills among local artisans, with a goal of creating 139 man-years of employment in installation and maintenance work during each of the project's 21 years. All retrofitted houses are provided with showers, shower curtains, wash basins, hot and cold water taps, and pipes for wastewater.

Households benefit from the energy cost savings

The City of Cape Town sold the first 10,000 Certified Emission Reductions

(CERs) for EUR 15 each (CO₂ tonne) to the UK government to offset greenhouse gas emissions from the G8 summit held at Gleneagles in 2005. Over the 21 year project lifetime, financial returns of approximately EUR 6.3 million in energy

To extend the applicability of retrofitting houses to other regions, it is important to devise innovative financing for the initial installation costs. In addition, governments and housing developers need to take the economic, environmental and health benefits of sustainable houses into consideration at the outset of the project planning and construction phase.

savings and EUR 500,000 in CERs are expected by 2012. This is more than four times the initial investment. However, as it was a Clean Development Mechanism (CDM) project that therefore generated tradable certificates, it was only possible to receive government financing if the



Solar water heater



Efficient lighting

benefits of reduced energy costs flowed to the households.

More information

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The Sun: a source of energy and hope

Housing in Jo'burg's Townships

The townships south of Johannesburg were originally intended to be temporary accommodations for mine workers in South Africa during the Apartheid period. However, even today South African townships are often characterised by lack of living space and infrastructure, unemployment, high rates of crime, violence and widespread poverty. People dwell in so-called "shacks", which are barracks made from iron sheets providing them with a very low living quality. Population pressures through further urbanisation are tightening the precarious living conditions and highlighting the need for solutions to improve housing comfort and energy efficiency.

Sustainable housing for the most vulnerable

The Tebogo Home for physically handicapped children is located in Orange Farm, a part of South Africa's largest township of Soweto, 40 kilometres south of Johannesburg. In November 2004, Tebogo Home suffered a devastating fire and since that time the children have been forced to live in cramped conditions. At the beginning of 2005, the Austrian NGO Social and Sustainable Architecture (SARCH) initiated a project to construct building extensions for

the children of Tebogo Home. Twenty-five students from the Department of Architecture and Design from the University of Art in Linz were tasked with responsibilities for design, planning, sponsoring and construction of a therapy building, a kitchen building and a Pergola for the Tebogo Home.

Thermal comfort through passive energy

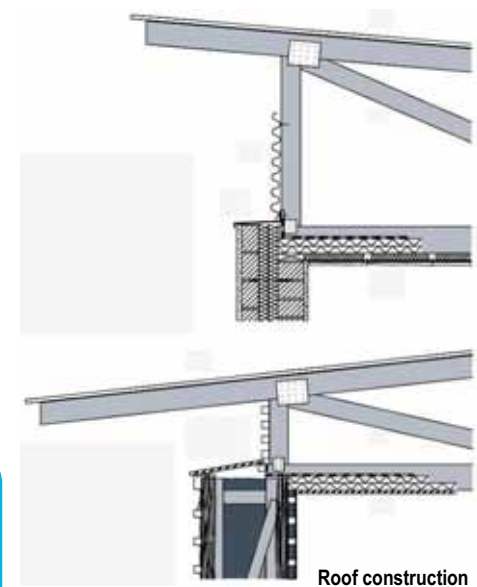
The construction materials used in the project incorporate mainly locally available resources and local construction methods. First, the students from Linz and local workers constructed wooden frames to form the walls of the buildings. Grass mats, straw and mud were used to fill the inside of the walls which were further reinforced with concrete. The

outer layers of the walls were constructed using clay, while the roof was constructed out of timber and iron sheets set up to enable cooling air to circulate through the interior of the buildings. All materials were collected directly from the township. The set of materials and roofing was not only inexpensive and appealing from an outer appearance perspective, but uniquely adapted to the climate conditions of South Africa. The roofing materials and conception ensured that the buildings do

The new buildings in Tebogo Home display a good example of how to use sustainable building methods in an urban surrounding relying on mainly inexpensive and locally available building materials. It shows that thanks to local material as well as an innovative building design, no outside energy is needed to provide a pleasant indoor climate.



not require external energy sources while achieving a crucial improvement of the thermal comfort. Traditional shacks in Orange Farm have indoor temperatures ranging from 2



C° - 45°C depending on the season. In comparison, the new buildings of the Tebogo Home reach a thermal comfort zone from 18°C – 26°C which provides a much higher indoor environmental quality.

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Schools for a sustainable future

School kids dealing with difficult conditions

Although school children in Burkina Faso do not have to pay fees to attend school, the country's education system faces fundamental problems. In 2000, data showed that average enrolment of children was 41% for boys and only 29% for girls. Another serious problem is a lack of teachers, particularly in rural areas. The average class size is 60 students per teacher, rising to 100 children per class in some schools. Schools often do not provide enough space for the children and buildings are mostly in a poor condition, which contributes to a poor learning environment.

A school to learn from

Gando lies 200 kilometres south of Burkina Faso's capital of Ouagadougou. Its forty round compounds are surrounded by scrubby savannah with patches of agricultural land which provides an image of a typical village of the region. In 1990 a government initiative provided a modest school building of concrete blocks roofed with corrugated metal sheeting. Some years later, the school building had almost fallen apart due to its low quality and lack of maintenance, jeopardising the operation of the school. The construction of a new

sustainable school building began in October 2000.

Through the community for the community's children

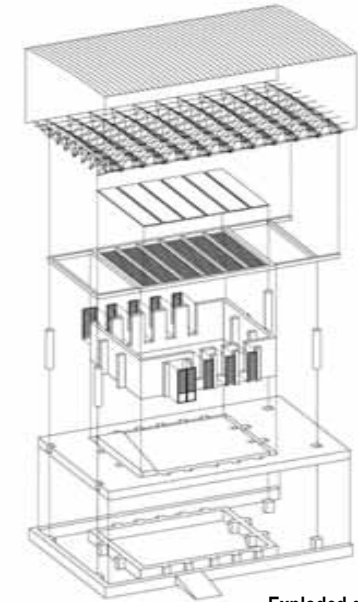
The central objective of the project was to establish a long lasting school building with a design adapted to local climate conditions to improve learning conditions. Mainly traditional construction techniques and materials were applied to enable the local community to be the owner of the whole construction process and to limit cost. All 150 people involved in the project were village locals underlining a core principle of sustainability. The skills learned by villagers

throughout the project can be applied to other local initiatives and be further spread to other villages in Burkina Faso.

Low cost climate comfort

Gando Primary School demonstrates that using SBC methods can fundamentally improve the learning environment provided for children in African countries with hot and dry climates. Climate comfort within the school buildings helps children to concentrate on the teaching and has a long lasting contribution to sustainable development. This project shows that this can be achieved through empowering the African communities themselves to apply local knowledge and building methods.

The building design is dominated by its function to provide climatic comfort. Classrooms are connected through sun protected outdoor spaces that can be used for teaching or for playing during break times. The thick walls are constructed out of bricks reinforced by concrete beams, which bear the weight of the roof. The classroom ceilings are composed of compressed earth bricks and together with the walls contribute to cool the classrooms by absorbing heat. The roof itself is constructed of corrugated metal on



Exploded drawing

steel trusses that provides a space between the ceilings of the classrooms and enables cool air to flow freely. Additionally, the overhanging roof provides climate comfort by shading the outer walls of the building.

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Learning from nature: passive cooling from termite mounds

Indoor environmental quality through natural cooling

In 1996, Eastgate Centre opened in the centre of Zimbabwe's capital Harare. Designed by the Zimbabwean architect Mick Pearce, it became the country's largest office and shopping complex with 5,600 m² of retail space, 26,000 m² office space and 450 parking slots. The design of the Eastgate Centre aimed to regulate indoor temperature of the building without the use of conventional air conditioning to reduce costs and environmental burden. The building is characterised by its innovative design that adapts biomimicry principles.

Termite's passive cooling

Termite mounds, known as "Macrotermes bellicosus", inspired the architects of the Eastgate Centre. This species build towering mounds that can rise up to four meters and can contain more than two million termites. In order to secure their activities, these termites build a complex system of ducts that provides oxygen and constantly brings cool and regenerated air into the bottom of the mounds. The termites open and close a series of cooling and heating vents over the course of the day. Using this technique, they manage to keep the inside temperature of

the mound in a constant range of only one degree, despite large temperature variations on the outside.

Adaptation of the "termite's technology"

In order to reduce energy consumption and thereby building operating costs, the design of the Eastgate Centre aimed to reduce conventional air conditioning needs. The structure of termite mounds was partly copied to achieve the objective of reducing energy consumption. A system of horizontal and vertical ducts was installed to enable an

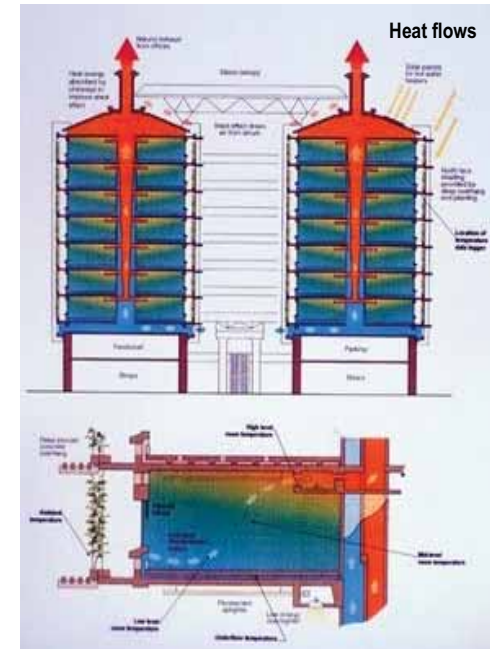
exchange of stale air by fresh air from outside of the building. Mechanical systems were installed to support the structural elements of the building and further enhance the positive indoor air quality effects. Above

The use of passive cooling methods reduces energy consumption of the building to 10% of that in conventional buildings of similar size and type. Further, the owners of the Eastgate Centre saved \$3.5 million in construction costs by avoiding in the need to install a conventional air-conditioning system.



Inside the Eastgate Centre

the first floor of the building fans draw air from outside and force it into offices above. Vertical ducts were placed in the centre of the building to keep the window area as large as possible. Fresh air flows via grills below the windows into each office. Stale air is drawn out of offices through high-level bulkheads and horizontally taken to the vertical ducts to enable it to escape via chimneys at roof level. The system absorbs 2.35% of the floor area and thereby meets the space performance criteria of conventional air conditioning systems. The air inside the building is exchanged twice per hour at day and seven times in the night to achieve optimum performance. Depending on the season of the year exchanges are adjusted to maintain the optimal temperature of between 21 and 25°C.



In addition to the air exchange system, cantilevered sunscreens support high indoor air quality for the offices and shops. The walls of the building are shaded by cantilevered sunscreens. Falling shades cool the offices during daylight hours and during the night the reinforced concrete structure retains heat captured during the day.

More Information

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Bamboo market hall in Mozambique

Bamboo construction

In Mozambique wood is the main material used for roof construction. However, because wood is also a primary energy resource in Mozambique there is a high market price for this resource which places enormous pressure on the country's indigenous wood resources. In Mozambique and other African countries bamboo is an alternative building material for the construction of houses. In comparison to wood and manufactured materials, bamboo is cheaper, easy to work with and readily available in many African countries.

construction in Mozambique. The initiative was aimed at the planning and implementation of a project that enhances the economic situation of farmers and promotes SBC through construction of a representative market hall with bamboo as the main raw material. The idea was to build a structure of 360 m² where local farmers and growers could commercialise and protect their products from "open air" weather conditions. Supporting local social structures is a central aspect to the project

Next to its availability in many African countries, bamboo has the advantage to be very strong and very light at the same time. Two different bamboo species were used in this project. The first is a yellow-green striped species that has a diameter of almost 9 centimetres and a height of nearly 10 meters with the

Market Hall



Bamboo requires only one seventh the energy of concrete to create a building material of the same capacity. Studies say that in comparison to steel, bamboo needs only 1/50 the amount of energy for processing. Furthermore, with proper treatment, bamboo structures can last up to 30 years, and since it is a renewable raw material, energy savings during the demolition and solid waste management stages are significant (International Network For Bamboo And Rattan 2009).

area and perhaps other African countries. The market hall, located in the National street EN1 in Punge, is intended to motivate potential bamboo harvesting countries in Africa to further develop new building applications for bamboo, such as in walls.

Learning from other countries

In the end of 2003, 7 students from the University of Lippe in Germany founded the Regeneraid initiative to promote bamboo

and this underlines an important aspect of sustainability. The structure of the hall promotes bamboo as a raw material for sustainable buildings in the area through the

use of fast growing bamboo types that are harvested, cut, immunized and dried in Bzui-Sofala, a region nearby Punge. This not only empowers the local bamboo economy but also reduces transportation distances of alternative materials. Furthermore, photovoltaic panels were installed on the roof to meet a portion of the onsite energy needs.

other species, a green bamboo, reaches a height of 30 meters with a diameter of almost 13 centimetres.

Working together with bamboo

To make the project a reality, Regeneraid collaborated with three partner agencies, the Provincial Directorate of Agriculture and Rural Development (DPADR), the GTZ Programme for Rural Development (PRODER) and the local community. As a result of the strong cooperation, enormous cost savings were achieved and other positive features of bamboo were promoted. It is very likely that the use of bamboo in this project will achieve multiplier effects in the



Bamboo construction

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(German)

Building a future with bricks fired with sustainable energy

From mud to fired bricks

Walls of traditional houses in Tanzania are built out of mud. Unfortunately they often lack a long lasting quality, and as a result, houses need to be frequently repaired and rebuilt due heavy rain and minor earth tremors. People try to increase the lifetime of their houses by firing the mud to make more durable bricks. The main fuel for these fires is wood taken from trees in the surrounding area, which poses a major environmental threat by accelerating deforestation.

Agricultural residue replaces wood

The Mwanza Rural Housing Programme (MRHP) is a local Tanzanian NGO that was established in 1990. The programme addresses traditional building methods in northern Tanzania. Villagers in 70 villages have been trained to set up enterprises producing high-quality bricks from local clay, fired with agricultural residues rather than wood.

The northern Tanzania region has a substantial supply of local clay for house building applications. MRHP has developed processes to optimise this potential by making the bricks more durable and firing the bricks without aggravating deforestation problems by using agricultural residues such as rice husk, cotton or coffee waste rather

than wood. The husks are the dry coverings of rice grains that are discarded during rice milling to produce polished white rice. Cotton waste consists of the outer shell of cotton seeds, poor quality seeds and dirty or broken cotton fibres which are removed during processing of cotton seed oil. Another source of agricultural residues is waste of coffee growing, which is quite common in many parts of northern Tanzania.

Reducing environmental threats emerging from construction in African countries needs to be further promoted. By replacing wood with agricultural residues for the firing of bricks, the Mwanza Rural Housing Programme demonstrates one way for this challenge to be addressed.

Economics of scale and sustainability

Prior to this project, commercial brick-making enterprises were quite rare in northern



Tanzania. The MRHP enabled over 50 brick-making businesses to be established and a total of some 100,000 homes in 70 villages have been constructed



with materials produced using these improved brick making methods.

MRHP estimates that the traditional firing of the 3,000 bricks needed for a typical house consumes 1 m³ of wood and that the 300 million bricks produced by MRHP entrepreneurs would therefore have used

about 100,000 m³ or roughly 50,000 tonnes of wood. The burning of agricultural residue does not release any net carbon dioxide to the atmosphere, unlike burning wood. The quality of the bricks will enable houses to last much longer and this innovative burning process is

now being used in both urban and rural building programmes.

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Houses built of straw bales

Straw bale housing

Straw is a renewable resource that is readily available in many parts of Africa. Therefore straw bales themselves are considered to be a cheap construction material that can be used in a way similar to bricks in the construction applications. Next to its low price, it comes along with additional advantages making it a sustainable alternative to conventional building materials. Straw bales are easy to handle, robust and locally available. Moreover they are environmentally sound due to the low primary energy content. Especially in hot climates, houses built of straw bales are desirable due to their capacity to provide a high indoor quality.

The Project

The House Brodie project was developed by Eco Design between February 2002 and May 2003 in Cape Town-South Africa. This project demonstrates how natural local materials can be used in housing construction.

The main concept was to build a double floor straw bale house at minimal cost.

Benefiting from straw bale

The house responds not only to environmental challenges but also to the customer's expectations. These

advantages extend to aspects like the fact that straw bales are a renewable resource that reduces environmental impact, since they are essentially a waste product. Furthermore, this type of raw material increases energy efficiency, providing

thermal comfort and minimising energy costs. Other features related to the performance of straw bale, are the capacity to absorb noise, increasing the acoustic quality of the space, as well as the reliability in case of seismic events. The construction

of walls was done using straw bales. All joints and corners around the poles were constructed with cob. To further the use of local

materials, the project acquired leftover clay from some road works some 10km distance to the project site.

It was decided to furnish the bathroom wall with plaster made from solid cob and to paint it with a non-toxic and water resistant paint to provide a natural environment inside.

The house was made in a way that robustness and simplicity were equally embraced. A pole structure made of locally provided and non-toxic treated timber was used with a corner brickwork fireplace adding to the stability of the structure. Another feature of interest is a timber and cob ring beam at the first floor level. This

House Brodie is a low energy consumption structure with straw bale walls and well-insulated roof. The small footprint makes the house easy to heat and cool. After completing construction of the house, Eco Design concluded that an understanding and commitment on the customers' part toward environmental aspects in the planning and construction phases is important to guarantee sustainability of the project.



helped lift the first floor of bales above ground level to protect against moisture penetration.

The roof was made of curved corrugated iron sheets and was insulated with 75mm of "Isotherm" polyester blankets. Both doors and windows were made of recycled Oregon pine.

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Embracing African traditions (Voûte Nubienne)

Limits of traditional construction and disadvantages of “modern materials”

Roofing in the dry areas of sub-Saharan Africa traditionally has been made out of timber supported by mud walls incorporating load bearing timber posts. In recent years, this traditional construction method has become more and more difficult due to population growth, widespread desertification and the loss of forest areas. Consequently, many people in rural areas are switching over to the use of corrugated iron sheets and sawn timber beams for their roof construction. This method of roof construction has several disadvantages. Corrugated iron sheets are inadequate in terms of their thermal, acoustic and aesthetic properties and the use of sawn timber beams is accelerating deforestation in the region.

Learning from other developing countries

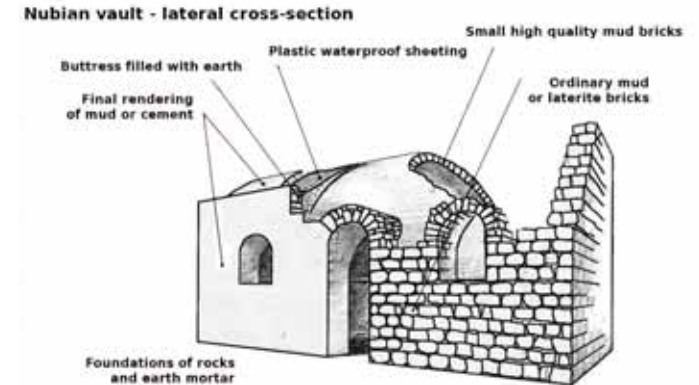
The Association for Voûte Nubienne (AVN) has established a Programme called “Earth roofs in the Sahel”, which enables households in sub-Saharan Africa to build comfortable, sustainable and affordable homes. The programme was launched in Ouagadougou, the capital of Burkina Faso and recently expanded to Mali, Senegal and

Togo. The association promotes a roofing technique called “la Voûte Nubienne” (VN), which is an ancient architectural technique for the construction of timberless vaulted roofs in Sudan and central Asia. The programme enables villagers to train to build houses with vaulted roofs using basic, readily available local materials and simple, easy to learn procedures.

Constructing climatically suitable roofs using local materials and techniques

The VN technique uses earth as a raw material to form dried mud bricks and mortar. The dried mud bricks constitute both walls and vault roofing of the structure. By using this construction method timber is not

required to support the vault. In contrast to its traditional use in Sudan and central Asia the VN technique has been simplified and adapted to provide protection during the short but heavy rainy seasons in Burkina Faso and Mali. The mud vault is supplemented by



Interest in the Voûte Nubienne technology is growing with every year in West Africa. Originally coming from Sudan and central Asia this roofing technique offers an effective and environmentally sound solution for recent challenges of construction in dry and hot climate zones in West Africa.



plastic waterproof sheeting in order to repel penetrating rainwater. In order to construct larger buildings, the vaulted roofs can be reinforced with concrete pillars and beams providing much wider open building interior spaces. Unlike the corrugated iron

sheets, houses using the VN technique will stay cool in the heat of the day and radiate the heat back during the colder evening time. The labour element as well as the raw material that are locally available and ecologically sound contribute to a sustainable construction technique feasible for rural development in dry African countries. Since the launch of the programme in 2000, 858 houses with mud vaulted roofs have been constructed and more than 150 bricklayers have been trained in Burkina Faso, Mali, Senegal and Togo.

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Water and waste in Tiholego Ecovillage

Challenges

Water is highly precious and, particularly in dry and hot African regions, its sustainable use is of central importance to development. Nevertheless, the potential for good water management is not often considered in African housing. One aspect of sustainable water management is the economic use of water as a first priority followed by the provision of water recycling opportunities through the use of grey and other “waste” water.

Basic is effective

Tiholego Ecovillage features sustainable water and waste water management



concepts and illustrates an example for sustainable management of water and waste in rural areas in Africa.

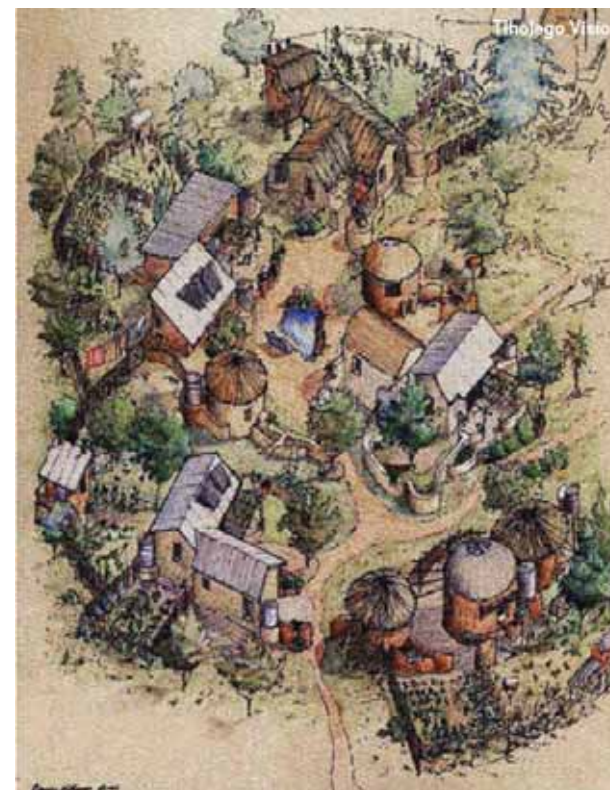
Catching water for drinking and irrigation

Another element of houses in Tiholego is the harvesting of water to improve household food and water security. The first level of water catchment takes place on the rooftop through a gutter system which flows into a storage tank as high-quality drinking or irrigation water. During the rainy season water can be collected and stored in

The Tiholego Ecovillage demonstrates how African communities and households can sustainably manage their water and waste resources. The village promotes basic, inexpensive and effective water and waste management methods that can be easily adopted by other households in African countries to improve food security and hygiene.

underground tanks. The same water can be later used for irrigation of trees, food and plants during the dry seasons of the year. Next to the collection of rainwater, wastewater is another available source of water that can be harvested at the household level.

The houses of the Tiholego village incorporate a grey water filtration system for water from bathrooms and kitchens for irrigation applications.



Composting to manage human waste

The ecovillage integrates on-site waste treatment for safe management of human waste. The main system used in the Tiholego ecovillage is an Earthway Composting Toilet. Advantages of this system are its low costs and the simplicity of its operation. This makes it an ideal system to be copied by other rural communities with limited means. It relies on the process of aerobic decomposition, which enables natural bacteria to decompose the waste material.

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Constructing social and environmental sustainability

Saving the Fez River

Recognising the need for action to save the Fez River, Extramuro LLP and Urban Studio developed an urban renewal strategy that proposed city and site scale intervention projects to treat polluted river water. At the city-scale, the project suggested a master plan that included measures for improving regional water quality. At the site-scale, the project aimed to develop strategies in three areas: the improvement of water quality, the remediation of contaminated sites and the creation of open spaces for community leisure activities.

In cooperation with the City of Fez Department of Water and power, which is developing a new sewer system to channel sewage towards two treatment plants, Extramuro LLP and Urban Studio were tasked with proposing a rehabilitation plan for the river and interventions along the river banks. To systematically approach their task they developed strategies to work at the city and site level to address the ecology of the river and the social and economic

Through the construction of sewage channels, public transit paths, community recreation spaces and renewed places to work leather in more environmentally friendly ways, this project made a significant contribution to the rehabilitation of the river which makes its way through the city of Fez, Morocco. For many years the river was used to deposit waste, earning it that honour of being named the "River of Trash".

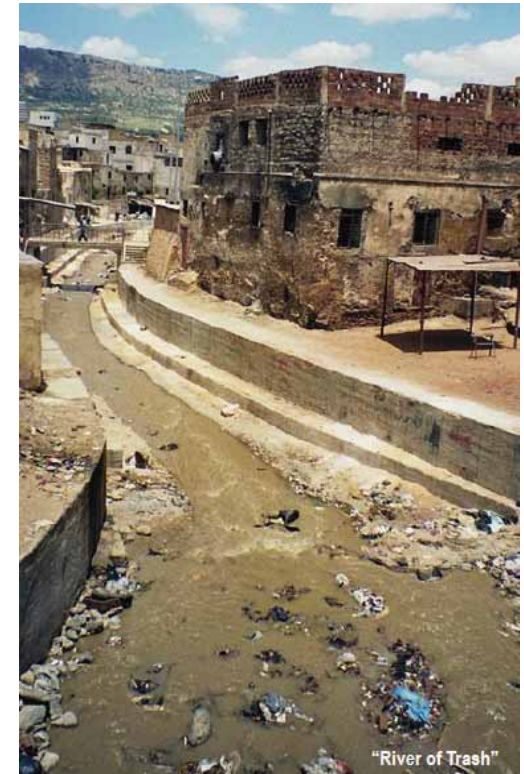
concerns of the city.

The project took community-supported programmes into consideration such as a leather-craft centre (currently the leather industry is one of the largest contributors to industrial pollution in developing countries

because of releases of chromium), water-purifying wetlands, recreation facilities for children, and botanical gardens. These actions are a response to the lack of open public spaces in

the city and are intended to enable the interaction of inhabitants with their restored ecosystems.

Construction projects will be use traditional techniques and local labour. The materials are mainly baked clay bricks and white plaster, which are energy efficient and are sourced from locally produced raw materials.



"River of Trash"



Remediation of contaminated sites

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Eco-friendly holidays

Unsustainable use of water

In African tourist facilities waste and especially water and wastewater is often not sustainably managed. Large swimming pools, continually flushing toilets and ineffective showers are common, even in dry and hot regions of the continent. In addition to travel related energy consumption, tourism also imposes additional burdens on the environment through measurably greater production of waste.

Caravan Site Upgrade

Nieuwoudtville is a small village situated 350 kilometres north from Cape Town in the Northern Province of South Africa. The place is famous among tourists for flower viewing opportunities owing to the region being one of South Africa's biodiversity hotspots. Rainfall is just 300 to 400mm per year, which is very low for this region. In 2005, Nieuwoudtville Caravan Site was upgraded by Andy Horn, an architect from Cape Town, to become a showcase for the use of sustainable construction and applied ecodesign in South Africa. The design aims to reduce the environmental footprint of the caravan site through the use of local materials and the introduction of ecological sanitation systems to increase the sustainability of the water and waste treatment system.

Economical water usage

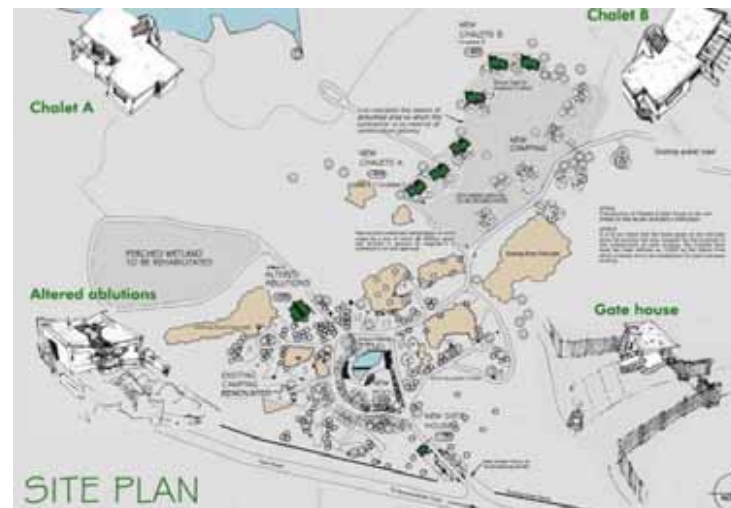
Flush toilets use about one third of the overall water consumption of an average household. The ecological upgrade at Nieuwoudtville Caravan Site introduced waterless compost toilets, which are manufactured in South Africa, to its chalets as a water efficient, ecological and low-cost solution. However, the flushing toilets of the ablution block have been replaced with multi flushing devices that reduce water consumption by 60%, saving 5 to 6 litres per flush. Additionally, old continual flushing

urinals were replaced with waterless models, which are also produced in South Africa. Showers of the ablution block have also been retrofitted with water and energy efficient showerheads reducing water consumption by 50% to 11 litres per minute while still providing acceptable shower performance.

Benefiting from human waste



The upgrade of the Caravan Site in Nieuwoudtville shows the potential for cutting water usage and management of waste in African tourist facilities. Tourist facilities can also promote and drive exemplary water and waste management in Africa's building and construction sector.



Caravan site

Since the compost toilets do not produce any waste water, the ecological upgrade of the chalets focussed on using grey water coming from the kitchen. To make this water useful, grease traps are used in every kitchen and the de-greased grey water is then directed through a simple drainage system made of recycled materials such as buckets or used pipes. Water is discharged at a subsurface level and then used for

tree irrigation. Biodegradable dish washing liquids are provided to each guest in the chalets and signs, made by a local artist and community members, provide instructions and information about environmentally sound usage. The ablution block uses a septic tank for waste management. Thus human waste and grey water are treated with anaerobic digestion. Despite being installed in over 10 million locations in China (Agama Energy) this robust and simple technology has not yet found widespread use in Africa. The methane gas produced through the digestion process is used as an energy source for one of the chalets at the caravan site.

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Towards more sustainable retail buildings

Reducing environmental burden

Woolworth distribution centre is situated in Midrand, South Africa. Completed in 2007, the centre consists of a warehouse and an office building. The structure is 600 meters long and 120 metres wide. The Woolworth distribution centre has a number of interesting solutions related to water and waste management, energy efficiency and indoor environmental quality.

Energy and indoor environmental quality

A “centre of gravity”-study was conducted in order to identify the optimal site for the building in respect to distances for suppliers and deliveries to reduce energy burden from the transportation of goods. A Building Management System controls the warehouse at all times. When natural light is sufficient the system reduces artificial light inside the building to reduce energy consumption. Moreover the building is divided in different sections that are lit accord to occupancy and time of the day requirements. Energy is also saved by an efficient refrigeration system. Heat from the refrigeration plant is recycled and used in the heating system for other areas of the

building. Thirty solar panels attached to the building generate 59% of the buildings onsite hot water needs.

Sustainable water management solutions

A water management system ensures that the use of potable water is minimised in the building. Water meters monitor the quantity water used at strategic locations such as the main washrooms, evaporative cooling systems, top-up grey water storage and so on. In a nearby location three gravity fed ponds have been established that can hold 8500 m³ of rainwater and filtered grey water that is used mainly for irrigation purposes.

Rainwater that is harvested on the building's roofs, roads and parking areas is piped to these ponds.

On a daily basis a grey water system recovers 10 m³ the refrigeration plant, 7 m³ from fan coil condensation, 5 m³ from washing basins and 12.5 m³



Ponds

Woolworth distribution centre is characterised by its sustainable use of water and waste during construction and use phase. A grey water system recovers grey water from refrigeration plant, fan coil condensation, hand washing basins and showers for reuse in toilet flushing or irrigation after its filtration.

from showers. Recovered grey water is either used for toilet flushing, which ensures that no potable water is required for toilet flushing, or channelled to filtration ponds to be used to irrigate the surrounding landscape. The

energy required to circulate water to the ponds is delivered by the means of farm windmills. The Building Management System monitors and controls the entire facility's

irrigation, optimising its function in accordance with weather conditions. Calculations of architects involved indicate that the extra costs imposed by the installation of these sustainable building features will be recovered in roughly 12 years.



Distribution centre

More Information

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Old car wheel rims as ventilation holes: Refisque Women's Centre

Providing social space

The Refisque Women's Centre is located in the suburbs of the Senegalese town of Rufisque. It is the result of a project that aimed to construct a sustainable building that will bring women together and help women support each other to prevent poverty and malnutrition and provide security against external threats. The building combines different sustainability dimensions by providing women space for social and economic activities and by using recycled materials which promotes sustainable waste management.

The Building

In 2001, the building concept was developed by several women's groups collaborating with the Finnish Non-Governmental Organisation "Tekniska Foren i Finland". The frame is a cast-in-place column and beam structure, with concrete block walls cast in a mould and dried on site. The roof is corrugated metal sheeting supported by a system of steel beams, with thick woven straw matting forming an insulating ceiling structure; the space between the roof and ceiling insulation is ventilated, which ensures that indoor air is kept pleasantly cool. The

structure is grouped around an internal courtyard with simple street facades that adapt the building to its surroundings. The corner faces a road crossing which forms a small public square where facilities reserved for trading purposes are located. The building's red colour gives the house its own identity amidst the general grey tone of the city blocks.

Promoting Recycling

All materials used in the construction were sourced locally which avoided negative environmental impacts arising from long transportation distances and

The Refisque Women's Centre is an example of sustainable social housing promoting acceptance and harmony within its surrounding. It also is a sound example of how sustainability can be applied to serve social issues such as gender empowerment.

at the same time supported the local economy. The importance of re-used materials was highlighted by installing old car wheel rims as ventilation holes, bottoms of old glass bottles for windows and the reinforcement iron derived from recycled metal. The use of materials such as wood,

which is related to significant environmental burden in the region, were used only where no alternative materials were available.

Supporting social inclusion

The building, being designed on the basis of suggestions and recommendations of a variety of the women's organisations, adds a significant value to the local community. Moreover, it offers space for independent schooling initiatives and literacy courses, while also giving assistance women who are facing significant changes in life by relocating from the countryside to the city. From the economic standpoint the centre is self-sustaining since the organisations produce an income stream by selling home made food and needlework.



Suggestions and recommendations



Space for social and economic activities

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Part Three

Organisations working on SBC in Africa

Public and private capacity in Africa for Sustainable Buildings and Construction (SBC)

Organisations, their activities, programmes, projects and initiatives are important drivers for Sustainable Buildings and Construction (SBC). Sometimes actions taken by organisations enable the generation of scientific outputs and outcomes that can suggest guidelines for policy and decision makers to develop frameworks for SBC. These results are used by other organisations to produce tangible projects that reflect SBC in practice. This section presents some important organisations working on SBC in Africa. The purpose of this short description is not only to illustrate how experienced organisations are approaching SBC on the African continent, but also to encourage other existing and future organisations to become more deeply involved in the movement towards sustainability in the building and construction sector.



Capacity building for sustainable building professions

Council for the Built Environment (CBE)

The CBE is a South African public sector organisation in the city of Pretoria that was created by the Minister of Public Works in the year 2000. The underlying concept of the CBE is the creation of a forum for interaction and participation of professions, sectors and government institutions associated with the built environment.

The main focus of the CBE agenda is on the development of strategies to enhance professionalisation and understanding of the concept of a sustainable built environment in South Africa. This is possible through activities and projects like traineeships, policy documents or audits, which are based on standards for health, safety and environmental protection, and training and ongoing human resource development standards for the built environment.

For more information about the activities of CBE see www.cbe.org.za

Sustainable construction through leadership

Construction Industry Development Board (CIDB)

The CIDB was established in 2000 by the South African Parliament to provide leadership for stakeholders and to stimulate sustainable growth, reform and improvement of the construction sector. In 2002, CIDB supported the elaboration of the Agenda 21 for Sustainable Construction in Developing Countries together with UNEP, CSIR and CIB. This document sets the basic framework highlighting sustainability challenges and opportunities for actors involved in the construction sector. In order to encourage sustainable practices and assure sectoral growth, CIDB applies tools such as capacity development and empowerment, promotion of industry performance and best practice, as well as advising on consistent and ethical procurement practices in the construction sector.



For more information: www.cidb.org.za



Encouraging sustainable architects for the future

School of Architecture and Planning- University of the Witwatersand in South Africa

This School was originally established in 1922 as the Department of Architecture of the university, but in 2001 grew to become the School of Architecture and Planning. This progression was based on the commitment to face present and future challenges of sustainable development. The department belongs to the Faculty of Engineering and the Built Environment and now currently undertakes research and academic activities to educate students and professionals on issues such as the current energy crisis in the city of Wits. Working in fields such as housing, urban design and wider urban studies, the school supports the quality of its degrees through engagement in research and professional work.

For more information:

<http://web.wits.ac.za/Academic/EBE/ArchPlan/ArchitecturePlanning.htm>

Creating a space for SBC learning

Faculty of the Built Environment - Uganda Martyrs University

Promotion of sustainable construction and building practices among current students, and future architects and designers is the main goal of this academic and research institute in the city of Kampala. The mission of the faculty is to educate outstanding men and women with design creativity, technical competence and entrepreneurial skills. The teaching basis of the Faculty of the Built Environment is the concept of sustainable development. For this reason, most courses in the faculty are taught through a project-based integrated teaching approach that integrates design with construction techniques and practices, structures, materials and building services within a theoretical and historical context of place, taking into account the fundamental goal of fulfilment of human needs (social, physiological and cultural). The academic programme focuses on programmes that include a Bachelor of Environmental Design, Bachelor of Architecture, Master of Landscape Architecture and the Master of Science in Environmental Design.



For more information: www.fiuc.org/umu



New potentials for energy efficient construction

The Renewable Energy and Energy Efficiency Partnership (REEEP)

REEEP is an active, global public-private partnership that builds policy and regulatory initiatives for clean energy and facilitates financing for energy projects. Some of those projects focus on the installation of energy efficiency systems in buildings, houses and other physical structures.

For more information:
www.reeep.org
www.reeep-sa.org



Construction and sustainability: hand-in-hand through learning

Department of Building - Faculty of Environmental Science University of Lagos

Understanding the importance and need to adapt construction education systems to environmentally friendly learning processes, between 1980 and 1981 the Faculty of Environmental Sciences of the University of Lagos in Nigeria introduced a number of professional academic programmes in response to this challenge. These programmes are integrated into the departments of Architecture and Design, Building, and Estate Management and Urban and Regional Planning. In accordance with its strong academic commitment the faculty undertakes sustainability-oriented research and produces scientific documents and publications.

For more information:
http://www.unilag.edu.ng/index.php?page=about_departmentdetail&sno=19



Deepening the debate on environmental buildings

Promoting Renewable Energy in Africa (PREA)

PREA is an international cooperation project between the architecture and engineering faculties of universities in Uganda, Tanzania, South Africa, Germany, France, Greece, UK and the International Solar Energy Society (ISES) to promote the effective use of energy in construction. Aspects including building design, encouragement for the use of environmentally friendly materials and building management are core to the work of PREA. By organising workshops and bringing together African experts PREA contributes to deepening the debate and demonstrating the benefits of environmental architecture and the integration of renewable energy in buildings. More information about the work of PREA and their workshops can be found on their internet website.

For more information: <http://prea.ises.org/index.php>

Certification and rating of buildings and construction

Establishing Standards and Benchmarks in the Sustainable Building Sector

The South African chapter of the World Green Building Council, GBC, uses market-based approaches to promote sustainable building in the South African property and construction industry. This approach includes capacity building, diffusion of information between actors of the building sector, and the development of a sustainable building rating system named Green Star SA.



For more information: www.gbcsa.org.za

Awarding SBC practices in the continent

The Holcim Foundation

The Holcim Foundation is located in Switzerland and has worked to advance the commitment to sustainable development of the Holcim Group since 2003. The Holcim Group is one of the leading global suppliers of cement aggregates and, since 1999, a member of the World Business Council for Sustainable Development. The increase of awareness and the encouragement of sustainability-based practices in building and construction activities is the main purpose of this organisation. The Holcim Foundation achieves this through the selection and support of initiatives that combine sustainable construction solutions with architectural excellence in the provision of developing and industrialised country housing and infrastructure.

More specifically, the Holcim Foundation recognizes outstanding and innovative projects developed by individuals, research institutes and private or public initiatives. Projects are rigorously analysed and evaluated by regional SBC experts. Since 2005 African projects in countries like Egypt, Morocco, South Africa, Botswana and Kenya have received awards and were profiled by the foundation as among the best practices in the industry. Three main activity areas represent the mission of the Holcim Foundation, specifically the organisation of professional and academic seminars and symposia, the award of research grants for PhD level work in the field of SBC, and finally the provision of financial support to enable sustainable construction projects that offer a benefit for disadvantaged communities.

For more information: www.holcimfoundation.org



Making sustainable construction possible

Programme: The Emerging Africa Infrastructure Fund (EAIF)

Through the “Emerging Africa Infrastructure Fund (EAIF)” programme, the Department for International Development (DFID) aims to provide USD and EUR lending to private companies for greenfield projects or for refurbishment, upgrade or expansion of existing facilities. EAIF was established in January, 2002 and is a US\$365 million fund that aims to address the lack of available long-term foreign currency debt financing for infrastructure projects in sub-Saharan Africa.

For more information: www.emergingafricafund.com



Carving new sustainability pathways

The Council for Scientific and Industrial Research (CSIR)

The CSIR is one of the leading scientific and technology research, development and implementation organisations on the African continent. It was enacted as a formal institution in 1945 by the South African Parliament, and has a strong relationship to the national Minister of Science and Technology. Fundamentally, the CSIR undertakes transdisciplinary-oriented research, linking industry with scientific work to develop strategies and sustainable projects that support welfare and quality of life of people working in and for SBC. In this respect, the CSIR unit's research agenda has been focused on a number of key projects related to areas including planning support systems, infrastructure engineering and systems, professional human resources development, construction and architectural sciences, rural infrastructure and services.

For more information: www.csir.co.za

Sustainability-oriented research and development

Habitat Research and Development Centre of Namibia (HRDC)

The HRDC was created by the Ministry of Regional and Local Government and Housing and the National Housing Enterprise and the City of Windhoek, where it is located, as a research centre in the housing sector. Its aim is to be the focal point for research and development in the Namibian housing sector and its work includes promoting sustainable housing, focusing on environmental suitability. This is carried out through promotion of indigenous building materials and designs, engagement of multi-disciplinary teams in basic research, and adaptation of existing knowledge and applied research.

In order to promote SBC practices, the HRDC carries out activities that are linked to topics such as the design of affordable and sustainable housing systems and provision of a central information resource centre for sustainable housing and networks between different actors. The HRDC integrates activities that promote energy and material efficient design practices in the Namibian construction sector. Beyond the scope of these services, the HRDC also works on citizen education, promoting sustainable housing issues and principles, as well as the evaluation of national building and standards and regulations.



For more information: www.interact.com.na/hrdc/index.htm

Brief list of other organisations working on SBC in and for Africa

1) **University of Jos Faculty of Environment- Department of Building (Nigeria)**

Academic and research centre offering programmes and consultancy services on the built environment in Nigeria. See www.unijos.edu.ng/academics.php

2) **South African Institution of Civil Engineering (SAICE)**

SAICE promotes sustainable practices among its professional membership through consultancy and accountability. See www.civils.org.za

3) **University of Dar Es Salaam - College of Engineering and Technology (CET)**

Sustainability education and training programmes for students in the Tanzanian construction industry. See www.coet.udsm.ac.tz/faculties.htm

4) **The Sustainability Institute**

The Sustainability Institute is a non-profit trust, founded in 1999. An international living and learning centre focussing on studies and experience in ecology, community. It forms a part of the wider Lynedoch EcoVillage, an emerging community that offers a unique African setting where creative work and learning can be inspired by the joys and challenges of sustainability in practice. See www.sustainabilityinstitute.net

5) **African Union for Housing Finance**

Association of 27 mortgage banks, building societies, housing corporations and other organisations involved in the mobilisation of funds for shelter and housing, in 15 countries in Africa. See www.auhf.co.za

6) **InfraCO**

InfraCo aims to stimulate greater private investment in African infrastructure development by acting as a principal project developer. See: www.infraco.com

7) **The EcoCity Trust**

The EcoCity Trust is the custodian of the EcoCity Concept. The project seeks alternatives for communities and their settlements supporting sustainable development. See www.ecocity.org.za

8) **International Council for Research and Innovation in Building and Construction (CIB)**

The CIB stimulates and facilitates international sustainability cooperation and information exchange between governmental research organisations in the building and construction. Its activities cover technical, economic, environmental, organisational and other aspects of the built environment during all stages of its life cycle. See www.cibworld.nl



Part Four

Literature and online resources on SBC in Africa

Publications, speeches and conference papers, virtual resources and forums on Sustainable Buildings and Construction (SBC) in Africa

The purpose of this section is to present relevant information (scientific documents, conferences and workshops speeches and presentations, books, etc.) about promoting sustainable practices in the African building and construction sector. The information is presented in different categories respecting different fields of analyses. It is important to mention that the list does not present a complete list of resources but rather a representative sample of material compiled over the last 8 years for the purpose of explaining and contextualising the debate on sustainable buildings and construction in the African continent. In this section the reader will find further resources on sustainable buildings and construction in Africa. The internet websites provide information related to research in the field, initiatives, forums, and construction companies working in Africa.

Agenda for sustainable buildings and construction in Africa

The debate surrounding SBC in Africa has deepened since the publication of Agenda 21 for sustainable construction in developing countries: a discussion document in 2002 (Source: www.cidb.org.za/Documents/KnowledgeCentre/a21_sustainable_construction.pdf). The objectives of the project were to identify constraints and challenges facing sustainable construction in the developing world and the opportunities for practitioners and to set a research agenda for SBC in developing countries and a stimulate debate. Thus, the document sets the conditions and a provides general framework for encouraging SBC in Africa.

1) **Sustainable construction practices in Kenyan construction industry: the need for a facilitative regulatory environment by Watuka, J. Aligula, EM. (2000).** **Topic:** This document explains the causes for the lack of awareness of sustainable practices in the construction industry in Kenya. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries, 11 to 13 November 2000, Stellenbosch, South Africa, http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.

2) **The creating of a sustainable building industry in the housing sector of Lusaka, Zambia by Mususa, PN., and Wood, B. (2000).** **Topic:** This paper explores possibilities to create a sustainable building industry in Lusaka, the capital city of Zambia. The paper focuses on the housing construction industry, investigating a range of housing strategies that have been used in the city including state built housing, site and service, squatter upgrading and the concept of self-help. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.

3) **Agenda for Sustainable Construction in Africa by Irurah, D. (2002).** **Topic:** This article remarks on the importance of linking environmental, social and economical issues in construction in Africa. Source: Fraunhofer Informationszentrum Raum und Bau. The International Construction Database: <http://www.irbdirekt.de/daten/iconda/CIB661.pdf>.

4) **Sustainable Construction In Africa by Adebayo, A. (2002).** **Topic:** The author highlights the importance of setting and developing strategies that take local context into consideration rather than implementing strategies from developed countries. Two aspects of 'culturally traditional methods and the built environment', and 'energy efficiency and environmental protection', are at the forefront in this paper. These issues must be addressed in fields like housing, transportation networks, the tourism industry, and also concerning traditional architecture. Source: Sustainable Settlements; http://www.sustainablesettlement.co.za/docs/a21_adebayo.pdf

5) **Sustainable Construction in Sub-Saharan Africa: Relevance, Rhetoric, and the Reality by Ebohon, OJ. (2002).** **Topic:** General description of the current situation of the built environment in Sub-Saharan countries. Source: Sustainable Settlements; www.sustainablesettlement.co.za/docs/a21_ebohon.pdf



6) **The transition to sustainability in the planning, construction and management of the built environment in South Africa by Richard, H., Pienaar, J., Bowen, P., Küsel, K., and Kuiper, S.(2002).** **Topic:** This document highlights sustainability aspects at all the stages of the life cycle in the construction process. Source: International journal of environmental technology and management, 2002, vol. 2, no1-3, pp. 200-224.

7) **The built environment and climate change in South Africa by Du Plessis, C. Irurah, D. Scholes, R. (2003).** **Topic:** Impacts of climate change on the construction sector and contributions of the built environment in South Africa in the light of adaptation and mitigation strategy development. Source: Building Research & Information (2003) 31 (3 – 4). 240 –256.

8) **Malawi experience in sustainable building by Maclean, A. (2004).** **Topic:** This paper describes the contributions of he Department for International Development-UK in the development of SBC in Malawi. Source: The SB'04 - Africa conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

9) **Urban environmental sustainability: a challenge to effective landscaping in Nigeria by Fadamiro, J., and Atolagbe, A. (2004).** **Topic:** This study discusses environmental problems and concepts of sustainability, particularly within the built environment. It looks into the principles and indicators for sustainability and the implications for the urban landscape in Nigeria. Source: Sustainable Building 2004 Africa Conference; <http://puslit2.petra.ac.id/ejournal/index.php/ars/article/viewArticle/16456>

Community participation and other social aspects of SBC

Employment generation and community participation are relevant components of SBC when one considers that physical structures are created by people and communities in order to provide shelter or comfortable spaces. The following publications deal with these topics from different perspectives.

- 1) **Community-based maintenance and environmental management partnerships: a model for more sustainable local governance by Krone, A. (2000).** **Topic:** The document describes a project which developed a model or approach to good governance at a neighbourhood level in response to the maintenance and environmental management needs of newly completed low-income housing projects in Africa. Source: Proceedings: Strategies for a Sustainable Built Environment, Pretoria, 23-25 August 2000; <http://www.sustainablesettlement.co.za/event/SSBE/Proceedings/proceedings.html>.
- 2) **Community-based strategies for a sustainable built environment for future settlements in Qwa-Qwa by Van Niekerk, E. (2000).** **Topic:** Qwa-Qwa is a region located in the eastern part of South Africa, where a lack of sustainable development in the built environment has led to environmental degradation. This document mentions the importance of developing strategies for an action programme with local communities -including environmental awareness programmes, as well as training programmes for companies, NGOs and other relevant organisations to cope with these problems. Source: Proceedings: Strategies for a Sustainable Built Environment, Pretoria, 23-25 August 2000; <http://www.sustainablesettlement.co.za/event/SSBE/Proceedings/proceedings.html>.

3) **Impact of migrant labour on the local construction industry: a case of Botswana by Mselle, P., and Kgaue, T. (2000).** **Topic:** This paper discusses the effects of migrant labour in the development of the Botswanan Construction Industry. It also discusses general attitudes towards migrant workers, and laws regulating their use. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.

4) **Participatory strategies in community development projects by Khan, Z. (2000).** **Topic:** This paper is a summary of a literature review done for a Masters thesis and outlines briefly how participation has emerged and is starting to influence project approaches to community development projects in South Africa. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.

5) **The expansion of employment opportunities in the building construction sector in the context of structural adjustment: some evidence from Kenya and Tanzania by Wall, D., and Wells, J. (2003).** **Topic:** The implementation of structural adjustment programmes in many countries of sub-Saharan Africa has had repercussions for the construction sector in a number of ways (e.g. a shift in production from the public to the private sector; the liberalisation of markets and break-up of monopolies in the building materials industries). Presenting evidence from Tanzania and Kenya this document argues that these changes have led to a fall in the volume of work passing through the more formalised systems of production and an increase in activity in the 'informal' systems. Source: Habitat International, Volume 27, Issue 3, September 2003, Pages 325-337.

6) **Land Excision Policy in Nigeria as a sustainable tool for physical developments in developing countries by Ogundana, O. (2004).** **Topic:** This document addresses the issue of Land Excision Policy as a tool for physical development. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

7) **People, livelihoods and values is the basis on which sustainable communities are built by Sugrue, A. (2004).** **Topic:** This paper describes the social achievements of the EcoCity Trust, in partnership with the Ivory Park community and the City of Johannesburg to integrate sustainable local economic development with a focus on livelihoods and quality of life. Source: Sustainable Building 2004 Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.



Use of natural and local raw materials

To undertake construction in a more sustainable way raw materials used in the process should harmonise with the physical and functional characteristics of local ecosystems. Natural and local raw materials play an important part in achieving this goal, if they are managed properly without jeopardising the functionality of other species and elements of the natural environment. The following documents put the benefits and advantages of using natural raw materials into context.

1) **The Future of indigenous building materials by Fisk, P. (1982).** **Topic:** The document illustrates the potential advantages and opportunities of using natural and local raw materials in building and construction. Source: The Centre for Maximum Potential Building Systems; http://www.cmpbs.org/publications/AD4.1-Indig_Building.pdf.

2) **Towards a sustainable construction procurement: Timber supply chain approach in Tanzania by Shayoh, H., Udeaja, CE., Tah, JMH. (2000).** **Topic:** The purpose of this paper is to explain how broad sweeping economic, social and environmental changes associated with sustainable development are impacting the timber supply chain in Tanzania. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.

3) **Bamboo housing: market potential for low-income groups by Paudel, S., and Lobovikov, M. (2003).** **Topic:** Bamboo has been identified an excellent building material due to its versatile characteristics. In addition, its ecological and economical characteristics have made it a sustainable building material. Few development organisations have initiated large-scale bamboo building programmes to build

houses for low to middle income groups. This paper presents successful stories of three housing projects using comparative assessments of cost and technical aspects. The ultimate objective of the paper is overview the applicability and market potential housing projects for low-income groups in other regions of the world. Source: J. Bamboo and Rattan, Vol. 2, No. 4, pp. 381 – 396 (2003).

4) **Butabu: Adobe Architecture of West Africa by Preston, S. (2003).** **Topic:** The book describes experiences, advantages and techniques for working with adobe in West African countries. Source: Publisher: Princeton Architectural Press; 1 edition (September 1, 2003), ISBN-10: 1568984138.

5) **The contribution of zinc coated steels to sustainable construction in South Africa by Cook, M., and White, R. (2004).** **Topic:** This paper explores key sustainability aspects of interest to designers using steel protected with zinc. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

6) **The role of low impact building materials in sustainable construction: The potential for hemp by Wooley, T. (2004).** **Topic:** The paper outlines some of the research and development work and investigates the best ways to use hemp while raising the possibility of hemp construction as a solution to sustainable construction in Africa. Source: Sustainable Building 2004 Africa Conference; <http://www.sustainablesettlement.co.za/event/SBE2004/papers/SB014.pdf>.

7) **Report on adobe brick construction at Lynedoch by The Sustainable Institute. (2005).** **Topic:** Experiences learned from the use of unfired (adobe) clay brick building systems adopted at the Lynedoch Eco-Village, Stellenbosch in South Africa. Source: Sustainability Institute; http://www.sustainabilityinstitute.net/index.php?option=com_docman&task=doc_details&gid=198.

8) **Sustainable construction in South Africa –Theoretical and practical analysis of sustainable infrastructures in the case study of the Hawequas Straw Bale Accommodation by Bruelisauer, M. (2007).** **Topic:** This document analyses the extent to which materials like straw bale can contribute to improve energy efficiency in the construction sector in South Africa within a LCA approach. Source: Department of Civil, Environmental and Geomatic Engineering Federal Institute of Technology (ETH), Zurich, Switzerland; <http://www.ivt.ethz.ch/docs/students/dip71.pdf>.



Human Resources and Capacity Building

Knowledge and skills development are fundamental requirements for enabling sustainable construction and building practices. For this reason, there is a need for professionals who understand the problems, challenges and opportunities of the construction sector in an holistic and trans-disciplinary manner. The following documents explore this concept:

- 1) **Construction deconstructed: Value systems and the teaching of technology in architecture by Irurah, D. K., Stone, J., and Kammeyer, H. (2000).** **Source:** S. A. Architect. July/August 2000. 67 - 9.
- 2) **Performance improvement in South African construction by Smallwood, JJ. (2002).** **Topic:** The article provides a range of best practice programmes in the construction sector which include benchmarking, ease of design construction, worker skills training, implementation of quality management systems (QMSs), security of / timely payment, and foreman / supervisor development. **Source:** RICS – The Royal Institution of Chartered Surveyors; http://www.rics.org/site/scripts/download_info.aspx?fileID=2595&categoryID=450
- 3) **Sustainability and Building Performance in Education and Community Buildings in South Africa by Gibberd, J. (2002).** **Topic:** This project holistically contemplates the integration of sustainability issues in SBC through education. **Source:** CSIR Building and Construction Technology; http://www.buildnet.co.za/akani/2002/nov/gibberd_hongkong.pdf.

4) **Towards interoperability: ICT in academic curricula for sustainable construction by Mourshed, MM., Matipa, WM., Keane, M., Kellihe, D. (2000).** **Topic:** Information and Communication Technologies (ICT) might be good instruments for linking sustainability between academics and actors of the construction sector. Even though this paper has an international scope, its recommendations could be applied in the African context. **Source:** CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; www.buildnet.csir.co.za/cdcproc/docs/.../mourshed_mm_matipa_wm.pdf

5) **Are South Africa's built-environment professionals embracing green building practices? by Van der Merwe, C. (2007).** **Topic:** The author analyses the role of

practices. **Source:** Engineering News; http://www.engineeringnews.co.za/article.php?a_id=111643.

6) **Building research for sustainable housing development in Nigeria by Kuroshi, P., Anigbogu, and N., Bala, K. Topic:** This paper gives a general review of academic research on building production. It appraises the extent of the application of sustainability principles in research on building construction conducted by scholars in Nigeria. **Source:** International Association for Housing Science (IAHS), Miami-USA; www.fig.net/pub/proceedings/nairobi/ajanlekoko-CMWS1-1.pdf



construction sector professionals to implement SBC

Financial considerations

SBC is a holistic approach that demands innovative conceptions (techniques, technologies, materials, performances) but also financial resources for making innovation possible and accessible. Financial issues include not only funding but also institutional frameworks to enable access to funding. The following documents describe financial fundamentals that should be considered by policy makers and other actors to foster and increase accessibility to SBC in Africa.

1) **Sustainable housing development in Nigeria –the financial and infrastructural implication- by Ajanlekoko, JS. (2001).** **Topic:** Analysis of barriers and opportunities for financing sustainable housing projects in Kenya. Source: The International Federation of Surveyors; <http://www.fig.net/pub/proceedings/nairobi/ajanlekoko-CMWS1-1.pdf>.

2) **The potential of South Africa's saving and credit co-operative movement to deliver "Green Finance": A Feasibility Study by Gichia, S., and Bannister, S. (2006).** **Topic:** This study examines the issue of finance for eco-efficiency in the low-cost housing market, and considers whether South Africa's Savings and Credit Co-operatives (SACCOs) would be suitable vehicles for delivering this type of finance. Source: Sustainable Built Environment Conference 2006 in South Africa; <http://www.sustainablebuiltenvironments.com/SBE/Secondary%20Pages/2006%20Papers.htm>.

3) **A Literature review on housing finance development in Sub-Saharan Africa by Mary R Tomlinson (2007)** – commissioned by FinMark Trust-. **Topic:** This document focuses on describing the state of housing access to citizens of Sub-Saharan Africa, as well as economic and financial

constraints. The author develops a literature review with respect to the development of housing finance in Sub-Saharan countries. Four categories are highlighted: 1) Macroeconomic conditions and how they affect the financial sector and the housing finance environment in Sub-Saharan countries; 2) Land issues and how they affect housing delivery and the ability to collateralise credit; 3) Mortgage finance delivery; 4) Microfinance for housing delivery. To foster access to housing finance the author suggests that technical assistance should be provided to commercial banks to develop mortgage lending systems and to governments to develop policies, legislation and regulatory frameworks, e.g. to restructure their land titling systems. In countries where the financial sector is relatively more advanced, the development of a secondary market may be considered and guarantees can be made available to lenders to expand

http://www.housing.gov.za/amchud/content/2008%20updates/Amchud_2/Annex_1_Literature_review_of_housing_finance_in_Africa_May_2007.pdf

Other Documents related to the topic Housing Finance by country case are documented by The Department of Housing Republic of South Africa, Source: www.housing.gov.za/Content/2008%20updates/Amchud_2/Conference_Papers.htm and by FinMark Trust, Source: <http://www.finmark.org.za/HMF.aspx>



housing finance. Source: The Department of Housing Republic of South Africa;

Institutions and Governance

Drivers like stable institutions and strong governance schemes enable sustainable buildings and construction by providing trust, suitable environments and possibilities for innovation to actors involved in the sector. In order to achieve this goal, the commitment of public institutions to establish guidelines that promote ethical behaviours, manners and cooperation between actors is needed. The following documents address this issue:

- 1) **African construction industries in Turmoil? The Implications for NEPAD by Rwelamila, P. (2000).** **Topic:** This paper draws from the results of a number of research projects in East Africa and the Southern Africa Development Community (SADC) construction industries. It explores problems facing African construction industries and their ability to embrace New Partnership for Africa's Development (NEPAD) objectives. Finally, the paper makes recommendations to African construction industries to better confront the challenges facing their viability. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.
- 2) **Global drivers of change: their implications for the Zambian construction industry by Shakantu, W., Zulu, S., and Matipa, W. (2000).** **Topic:** This paper suggests social, technical and business changes the Zambian construction industry should be making to realign itself to meet the demands of change. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; http://buildnet.csir.co.za/cdcproc/docs/3rd/shakantu_w_zulu_s.pdf
- 3) **Institutional aspects of construction industry development: a poignant dilemma for Sub-Sahara Africa**

by Ebohon, J. (2000). **Topic:** This study shows that necessary and appropriate institutions are crucial to a functioning construction industry, without which efforts at evolving an effective construction industry in sub-Sahara Africa is an exercise in futility. The conclusion from the study indicates that unless urgent steps are taken to develop the institutions necessary to facilitate the development of a modern and sophisticated construction industry, sub-Saharan Africa will remain a net importer of construction materials and services. Source: CIB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa; http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.

4) **Project procurement systems in the attainment of sustainable construction by Rwelamila, P., Talukhaba, A., and Ngowi, A. (2000).** **Topic:** The article focuses on the growing lack of focus on construction sustainability in the Southern Africa Development Community public building sector. Source: Sustainable Development; Feb2000, Vol. 8 Issue 1, p39-50, 12p.

5) **Furthering the development of a SBC agenda for the African continent – a development funding institution's (DFI) perspective by Havemann, G. (2004).** **Topic:** This paper refers to criteria of the Development Bank of Southern Africa that should be considered based on an institutional approach to achieve SBC. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

6) **Governance and accountability - who sets the standards for the built environment? by Gilham, A., and Ebohon, J. (2004).** **Topic:** This paper provides an interim report on an international study to produce a governance and

accountability model for sustainable development in the built environment. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

7) **Built Environment Decay and Urban Health in Nigeria by Ahianba, JE., Dimuna, KO., and Okogun, G. (2008).**

Topic: This paper examines the decay of the Nigerian urban built environment and its impacts on the health of city dwellers. The paper identifies the problems that have contributed to the decay including: inadequate basic infrastructural amenities, substandard housing, overcrowding, poor ventilation in homes and work places, poor sanitation and non-compliance with building bye-laws and regulations. Source: Journal of Human Ecology 23(3): 259-265



Life Cycle Thinking: techniques and performance

SBC is a Life Cycle Thinking approach that considers all aspects of the construction and building life cycle, beginning from the supply of the raw materials, and passing through construction, use –including refurbishment- and demolition of physical structures. To practise this approach, methods, strategies, techniques and technologies must be developed in fields like supply, design, construction and demolition. The following documents explain some of these tools and hint at detailed aspects in order to consider construction and building in a more holistic way.

1) **The identification and measurement of performance indicators for the South African construction industry by Van Huyssteen, S., Van Heerden, L., Perkins, P., and Gyimah, O. (2000).** **Topic:** This paper reviews some of the international and local experience in monitoring technical aspects of construction. Source: CSIR Building and Construction Technology; http://buildnet.csir.co.za/cdcproc/docs/3rd/vanhuyssteen%20_vanheerden.pdf

2) **Building Materials & Engineering Design Low-Income Housing Projects Port Elizabeth-South Africa by Cortés Ballerino, C. (2002).** **Topic:** This study attempts to cover most of the factors influencing the use of building materials and engineering design, the focus being to investigate the impact of processed building materials for wall systems in urban areas. Source: Master programme Environmental Engineering and Sustainable Infrastructure at The Royal Institute of Technology, Stockholm, Sweden; <http://www.infra.kth.se/bba/MASTER%20THESISSES/msc%20thesis%20camila.pdf>.

3) **The sustainable building assessment tool (SBAT) assessing how buildings can support sustainability in developing countries by Gibberd, J. (2002).** **Topic:** This paper describes the SBAT and shows how this can be used to integrate sustainability into the design, construction and management of buildings. Source: CSIR Building and Construction Technology; http://www.buildnet.co.za/akani/2002/nov/gibberd_sandton.pdf

4) **Technology alternatives: Harnessing cutting-edge technology to achieve SBC goals by Van Wyk, L. (2004).** **Topic:** This paper reviews the development of technology from an ecological, anthropological, and architectural perspective, and culminates in a synopsis of contemporary cutting-edge technology that supports ongoing research work in future construction technologies. Source: Sustainable Building 2004 Africa Conference; <http://www.sustainablesettlement.co.za/event/SBE2004/papers/SB047.pdf>

5) **Innovative construction technology for affordable mass housing in Tanzania, East Africa by Mehta, R., and Bridwell, L. (2005).** **Topic:** Building affordable housing with adequate structural safety is very important in developing countries. New technology, specifically the Terra Block Fabricator, has the advantage of using local soil and labour to create high quality building blocks. This paper analyses how using environmentally appropriate technology can foster local sustainable economic growth by stimulating market demand for improved housing and how this can improve the standard of living in a low-income country like Tanzania. Source: Construction Management & Economics, 23 (2005), 1, 69-79.

6) **The application of permaculture design concepts for sustainable housing environments by Gori, E. (2005).** **Topic:** This paper uses permaculture design concepts to show how sustainable and holistic greenfield housing developments can be designed to cater for more functional

and safer housing with greater opportunities for urban agriculture, open space systems and community facilities. Source: Sustainable Built Environments Annual Conference Series 2005 -South Africa; <http://www.sustainablebuiltenvironments.com/sbe/Documents/2005/2005%20-%20Gori.pdf>.

7) **Thermal behaviour and ventilation efficiency of a low-cost passive solar energy efficient house by Makaka, G., Meyer, E., and McPherson, M. (2008).** **Topic:** Low-cost houses in South Africa are characterised by poor craftsmanship and design, with no regard to energy efficiency. This results in high electrical energy consumption, an uncomfortable indoor thermal environment and poor ventilation. Incorporating energy efficiency passive solar design strategies and correct material choice can significantly reduce energy consumption in buildings. This paper presents the effects of fly ash to brick properties, thermal comfort analysis and the impact of the ventilation components to the indoor environment of a low-cost energy efficient passive solar house constructed using fly ash bricks. Source: Renewable Energy, Sep 2008, Vol. 33 Issue 9, p1959-1973, 15p



Energy Efficiency Approaches in SBC

Energy efficiency and conservation is a component of life cycle thinking for sustainable buildings and construction. In order to reduce CO₂ emissions and improve energy efficiency in construction, it is necessary to identify, quantify and interpret the energy flows during the entire life cycle of the construction project, and to develop technologies that rely on the use of renewable energy sources. The following documents indicate pathways to understanding energy efficiency issues in buildings and construction:

1) **Application of the Input-Output method of energy analysis in estimating process energy intensities by Holm, D., Irurah, D., and Ströh, A. (2000).** **Topic:** This document demonstrates a process to identify, quantify and interpret the internal energy flows between the sectors of an economy based on an Input-Output method with the building construction sector as an illustrative example. The approach yields data, which can be applied in detailed sectoral energy studies and analysis, especially for policy making and sectoral energy conservation initiatives. Source: Journal of Energy in Southern Africa, 11(1). 161 - 5. (2000).

2) **Energy efficient housing to benefit South African households by Klunne, W. (2002).** **Topic:** The author highlights technical aspects to be considered by implementing energy efficiency housing strategies for low-income groups in South Africa. Source: HEDON Household Energy Network; <http://www.hedon.info/EnergyEfficientHousingToBenefitSouthAfricanHouseholds.pdf>

3) **An end-user based assessment of a low energy building in a predominately hot and dry climate by Douglass, G., and Frew, M. (2004).** **Topic:** This paper outlines the building design of The Botswana Technology

Centre (BOTEC) headquarters and presents preliminary results from performance monitoring. The document aims at highlighting sustainable design principals applied to medium sized buildings with modern aesthetic appeal. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepled_papers.html.

4) **Providing the basis for developing energy efficient housing design tools through the use of diurnal temperature swing and the difference between indoor and outdoor temperatures by Roberts, E. (2004).** **Topic:** This paper sets standards for architects and designers for aspects like indoor and outdoor temperature to improve energy efficiency in housing construction. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepled_papers.html

5) **Quantifying benefits of energy efficient house design through monitoring of specified air quality and household energy activity by Wentzel, M. (2005).** **Topic:** This project measures the indoor air quality of six energy efficient houses in two project areas as well as energy activity and potential benefits related to energy efficient housing design. It concludes that a small reduction in CO₂ is achieved in an energy efficient house. However, the reduction achieved is dependent on the type of fuel used for space heating. Overall, the energy efficient houses were more comfortable for occupants and households spent less on space heating requirements. Source: Institute for Technological Innovation Faculty of Engineering, Built Environment and Information Technology University of Pretoria; <http://www.erc.uct.ac.za/jesa/volume17/17-2jesa-wentzel1.pdf>.

6) **Building Energy Labelling for Commercial Buildings in Africa by Reinink, M., and Irurah, D.(2006).** **Topic:** Exploration of Ecolabelling systems for the African building

sector. Source: Speech given by the authors at the PREA International Workshop Sustainable and Energy Efficient Building in Africa 13 October 2006, Kampala Uganda; http://public.ises.org/PREA/2_Presentations/3_Tech_Strat_Edu/8_Reinink_BuildingLabelingSA.pdf

7) **South African energy efficiency standards for buildings by Reynolds, L. (2007).** **Topic:** The author comments on the progress of two standards for energy efficiency in the building sector proposed by the Energy Steering Committee of the Department of Minerals and Energy (DME) in South Africa: Standard for Energy Efficiency in Naturally Ventilated Buildings; Standard for Energy Efficiency in Artificially Controlled Buildings. Source: Cape Peninsula University of Technology; http://active.cput.ac.za/energy/web/du/papers/2007/09L_Reynolds.pdf.

8) **Low cost energy efficient housing by South African housing associations by Jongeling, R., Klunne, W., Maathuis, S., and Suurenbroek, Y. (2007).** **Topic:** The authors highlight the importance of housing associations as instruments to spread and implement low cost energy efficient housing in South Africa. Source: Renewables4Africa; <http://renewables4africa.net/klunne/publications/SB02.pdf>.



Human settlements

SBC aims at the efficient realisation of human settlements that enhance the quality of life of urban and rural communities and that contribute to the eradication of poverty. The following documents indicate the importance of addressing this issue by policy makers and other actors in the construction sector.

1) **Climate change impacts and human settlements in Africa: Prospects for adaptation by Magadza, C. (2000).**

Topic: This paper is a call for energy efficient housing use to cope with climate change. Source: Environmental Monitoring and Assessment, Vol. 61, no.1, March 2000, pp. 193-205(13).

2) **Report on sustainability analysis of human settlements in South Africa by Du Plessis, C., and Landman, K. (2002).**

Topic: This is a description of a human settlement policy framework that provides strategic guidance for the development of human settlement policy. Source: CSIR Building and Construction Technology; <http://www.buildnet.co.za/akani/2002/nov/09.html>.

3) **An interpretation of sustainable development and urban sustainability in low-cost housing and settlements in South Africa by Irurah, D., and Boshoff, B. (2003).**

Source: In Harrison, P., Huchzermeyer, M. and Mayekiso, M. Confronting fragmentation: Housing and urban development in a democratising society. Cape Town. UCT Press. pp. 244 – 262. Juta Academic, ISBN-10: 1919713735- ISBN-13: 978-1919713731.

4) **Building sustainable South African communities: Learning from the Lynedoch Case by Swilling, M., and Annecke, E. (2004).**

Topic: The Lynedoch EcoVillage is a significant case because it is the first intentional socially mixed ecologically designed urban development. Source: Sustainable Building 2004 Africa Conference;

http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

5) **Sustainable settlements in the remote rural areas of South Africa and the smart townships that could eradicate poverty by Formington, G. (2005).**

Topic: This document describes the opportunities to apply photovoltaic solar cells in South African townships to assist with poverty eradication and to establish sustainable human settlements in remote rural areas. Source: Sustainable Built Environment Conference 2005 in South Africa;

<http://www.sustainablebuiltenvironments.com/SBE/Documents/2005/2005%20-%20Formington.pdf>.



Construction industry role and commitment

Issues such as corporate social responsibility, customer satisfaction and the promotion of community participation are relevant topics to the role of the construction industry. In general, the following documents indicate pathways that the construction industry and businesspeople in the sector should follow to implement social responsibility and respond to the expectations of customers and communities.

- 1) Causes of, and solutions to client dissatisfaction in the South African Building industry: The clients perspective by Nkado, R., and Mbachu, J. (2000). Topic:

The South African building industry is reportedly beset with dissatisfied clients. Considering that client satisfaction is the crucial variable underpinning current and future prospects in the building industry, it is necessary to investigate the causes of, and solutions to, client dissatisfaction from the perspectives of the clients themselves. This paper presents the results of an exploratory study carried out for this purpose. Source: IB W107 1st International Conference: Creating a sustainable construction industry in developing countries 11 to 13 November 2000, Stellenbosch, South Africa;
http://buildnet.csir.co.za/cdcproc/3rd_proceedings.html.

- 2) Finding the tin man's heart –social responsibility in the construction sector by Du Plessis, C. (2002). Topic:

This paper examines how the requirements of sustainable development are shaping the social responsibility agenda, how businesses both inside and outside the construction sector are implementing social responsibility, and finally provides some suggestions on what the construction sector can do to meet these requirements. Source: CSIR Building and Construction Technology; <http://www.buildnet.co.za/akani/2002/nov/08.html>.

- ### 3) Contractor development models for promoting sustainable building – a case for developing

management capabilities of contractors by Dlungwana, S., and Pantaleo D. (2004). **Topic:** This paper briefly reflects on past and current contractor development programmes in South Africa and other African countries. A part of the research work done by the CSIR is discussed to illustrate the use and benefits of contractor development models. Source: CSIR Building and Construction Technology; <http://researchspace.csir.co.za/dspace/handle/10204/1936>.

- 4) **Implementing a participatory approach in a building sustainability assessment model by Kaatz, E., Root, D., and Bowen, P. (2004).** **Topic:** This paper advocates the

implementation of a participatory approach to the specification of building sustainability assessment tools by actors involved in the sector performance. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

- 5) **Enabling community empowerment for sustainable assets: examining the contractor's role in the processes and structures by Saidi, M., and Karuri, G. (2005).**

Topic: This paper analyses the role of building contracts and contractors in enabling community empowerment and asset management regarding roles, processes and structures in asset delivery. Alternative models of apportioning the risks of community participation regarding quality and time to delivery are given. The models suggest that role players like the contractor need to play not only a facilitating role to ensure community capacity building and empowerment, but also to ensure that unreasonable risk or accountability is not apportioned to contractors for aspects over which they have no direct responsibility. Source: Frauenhofer Informationszentrum Raum und Bau The International CONstruction Database;
<http://www.baufachinformation.de/aufsatz.jsp?ul=07061000260>.



Brief list of additional publications on SBC in Africa

1) **Sustainability and sustainable construction: the African context by Du Plessis, C. (2001).** **Topic:** This document argues that the context of poverty and rapid urbanisation suggests that sustainable urban development should be the focus of sustainable construction in Africa. Source: Building Research and Information, Volume 29, Number 5, 1 September 2001, pp. 374-380(7).

2) **A contract to integrate built and natural environment imperatives by Datta, M. (2005).** **Topic:** This paper attempts to portray an overview of the relationship between architecture and environment. It also tries to identify the formal potential of environmentally sustainable design. Source: Sustainable Built Environments Annual Conference Series 2005 -South Africa; <http://www.sustainablebuiltenvironments.com/SBE/Documents/2005/2005%20-%20Datta.pdf>. 2005, pp. 405-415(11).

3) **Green planning processes and products for the built environment by Brink, B. (2006).** **Topic:** Taking as an example South Africa, the author highlights notions of sustainability and unsustainability, including the five-capital models' of sustainability to provide a planning context for green building and development. Source: Sustainable Built Environments Annual Conference Series 2006 -South Africa; <http://www.sustainablebuiltenvironments.com/SBE/Secondary%20Pages/2006%20Papers.html>.

4) **Natural Building in West and North Africa by Black, V. (2006).** **Topic:** This paper illustrates some images of buildings using earth and other natural building materials that the author visited in Ghana, Mali, Benin, Togo, Burkina Faso, and Morocco, which all have a long tradition of natural architecture. Source: Sustainable Built Environments Annual Conference Series 2006 -South Africa; <http://www.sustainablebuiltenvironments.com/SBE/Secondary%20Pages/2006%20Papers.htm>.

5) **Rules for the built environment in 19th century Northern Nigeria by Hakim, B., and Ahmed, Z. (2006).** **Topic:** An historical review of the traditional construction techniques in Nigeria in the 19th century. Source: Journal of Architectural and Planning Research, 23(1): 1-26.

6) **Defining a Strategic National Agenda on the Theory of Construction for Development by Van Wyk, L., and Knoetze, T. (2007).** **Topic:** This paper reviews concepts of theory and theory formulation, contextualises optimal developmental modalities, describes the role of construction within the context of the social contract, and explores postmodern research approaches. Source: CSIR Building and Construction Technology; <http://researchspace.csir.co.za/dspace/handle/10204/1035>.

7) **The contribution of zinc coated steels to sustainable construction in South Africa by Cook, M., and White, R. (2004).** **Topic:** This paper explores key sustainability aspects of interest to designers using steel protected with zinc Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

8) **A study of plant materials used for house construction around Kibale National Park by Kakudidi, E. (2007).** **Topic:** Analysis of the relationship between construction materials and longevity of traditional houses in three parishes adjacent to Kibale National Park in western Uganda. Source: African Journal of Ecology 45. p. 22-27 (2007).

9) **The application of natural fibre composites in construction: a research case study by Van Wyk, L. (2007).** **Topic:** The objective of this research is to establish the applicability of natural fibre composites (NFCs) as sustainable construction materials. The research identified four construction

elements: load bearing elements, non-load bearing elements,

solid section and hollow tube. Source: Sixth International Conference on Composite Science and Technology, ICCST/6, 22-24 January 2007, Durban, South Africa; http://researchspace.csir.co.za/dspace/bitstream/10204/1034/1/Van%20Wyk_2007.pdf.

10) **MUD - Building with Mud by Baker, L. Topic:** Characteristics and advantages of mud building-based techniques are exposed. Source: Sustainability Institute; http://www.sustainabilityinstitute.net/index.php?option=com_docman&task=cat_view&gid=11&dir=DESC&order=name&limit=5&limitstart=25.

11) **The sustainable building assessment tool (SBAT) assessing how buildings can support sustainability in developing countries by Gibberd, J. (2002).** **Topic:** The paper describes the SBAT and shows how this can be used to integrate sustainability into the design, construction and management of buildings. Source: CSIR Building and Construction Technology; http://www.buildnet.co.za/akani/2002/nov/gibberd_sandton.pdf.

12) **Sustainable low cost housing – Needs, possibilities and attitudes. A proposal for a research project with focus on the Kambaata region in Ethiopia by Hjort, B., and Sendabo, T. (2004).** **Topic:** The paper is about the development and tests new, sustainable, low-cost, house building technologies intended for ordinary people. Source: Sustainable Building 2004 Africa Conference; http://www.sustainablesettlement.co.za/event/SBE2004/accepted_papers.html.

Sustainable Settlement in Southern Africa

www.sustainablesettlement.co.za/events.html

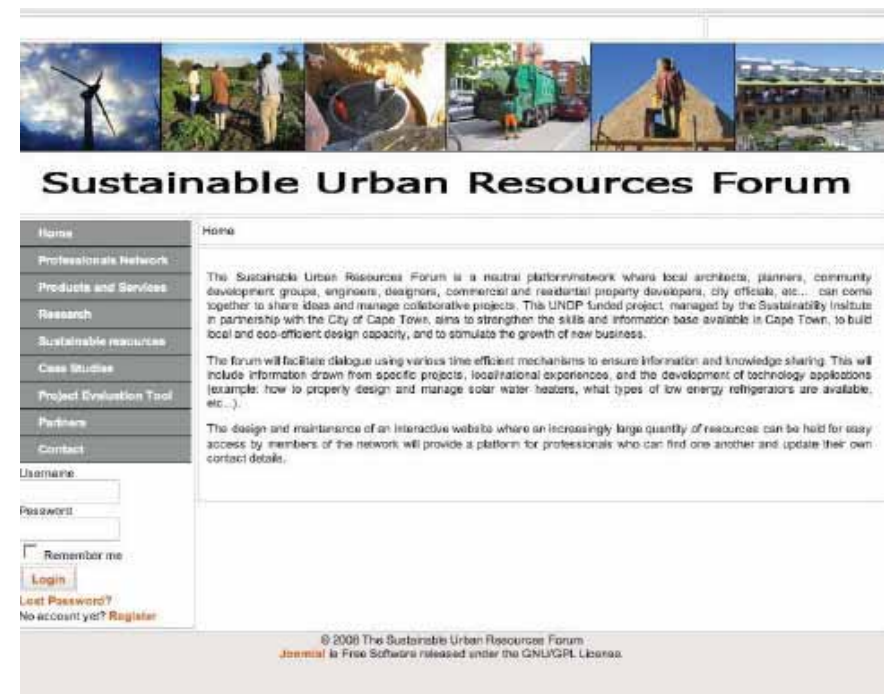
Launched by the CSIR, this webpage contains information from conferences (documents, speeches) produced since 2000 on sustainable building and settlements. Topics including policies to foster sustainable buildings, innovative technologies and methods are presented.



Sustainable Urban Resources Forum

<http://sustainableneighbourhoods.co.za>

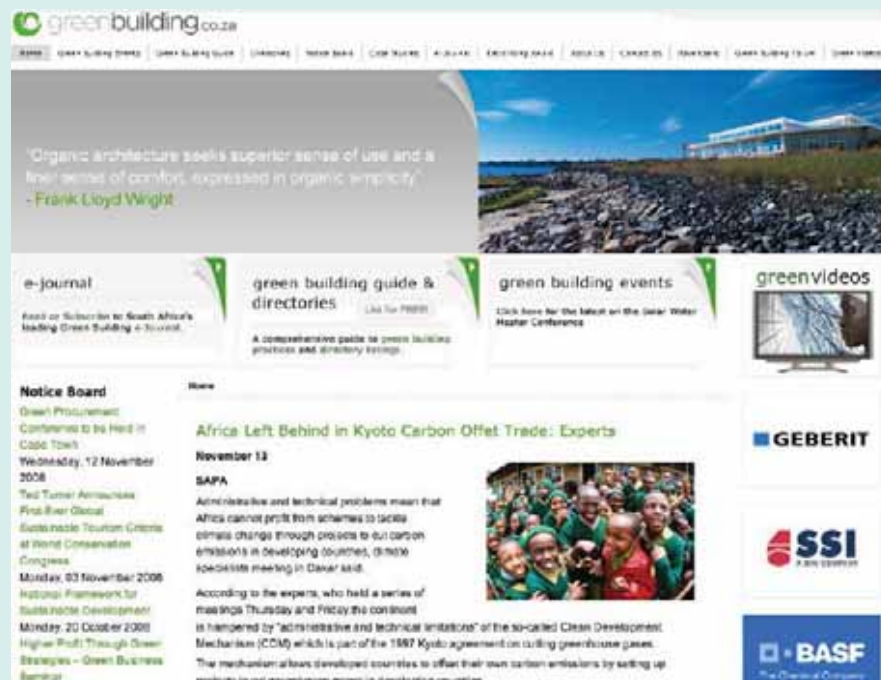
Founded by UNDP, Sustainable Urban Resources Forum is a platform where local architects, planners, community development groups, engineers, designers, commercial and residential property developers, city officials can come together to share ideas and manage collaborative projects.



The e-Journal of Green Building

www.greenbuilding.co.za

Information platform aiming at encouraging architectural and environmental knowledge among construction-related professions, including the fields of design, history, built environment, cultural studies, technology, theory, and practice related to Sustainable Buildings and Construction (SBC) activities.



Going Green Directory

www.goinggreen.co.za

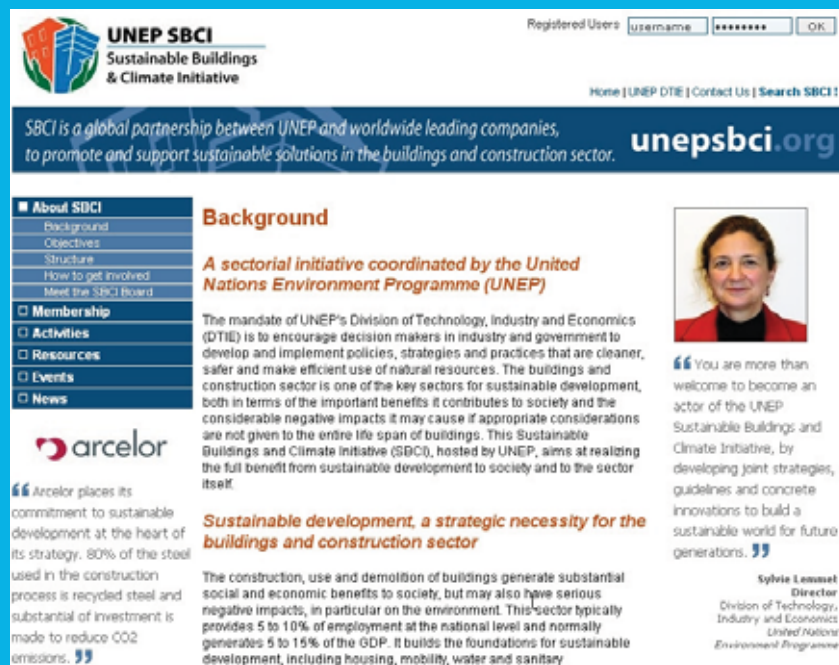
Database platform gathering information on green products, organisations and practises in several fields in South Africa. Building and construction is integrated in one category offering over 100 useful links.



UNEP Sustainable Buildings & Climate Initiative (SBCI)

www.unepsbci.org

The website of the SBCI provides industrial and construction companies, real estate developers, financiers, architects and local authorities with a common platform to promote the adoption of sustainable construction practices. It highlights information about the initiative and its activities, news, events and resources related to sustainable buildings as well as members, partners and organisations and networks linked with SBCI.

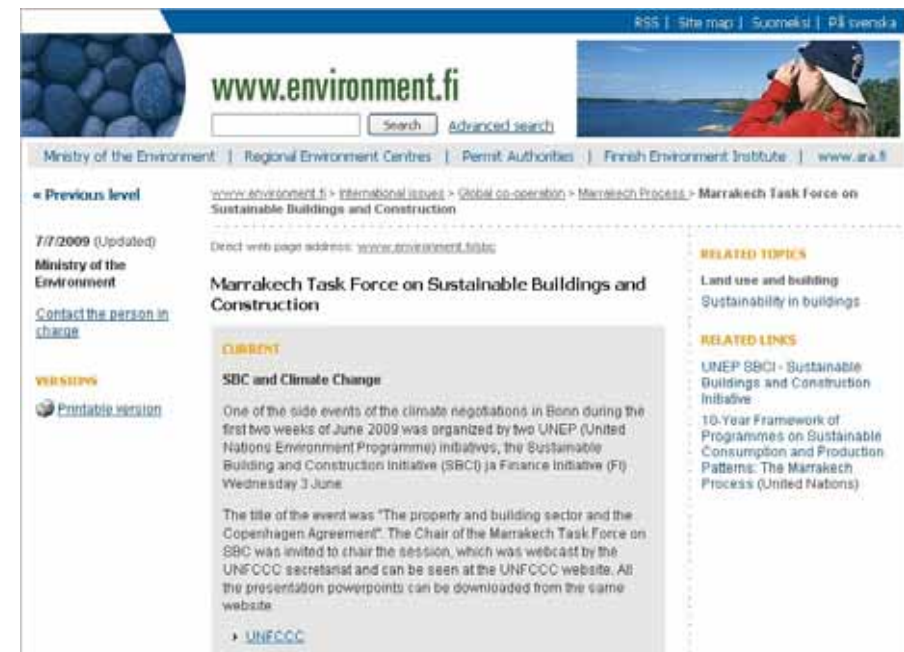


The screenshot shows the UNEP SBCI website. At the top, there is a logo for UNEP SBCI Sustainable Buildings & Climate Initiative. Below the logo, there is a navigation bar with links: Home | UNEP DTIE | Contact Us | Search SBCI. A search bar is also present. The main content area is titled "Background" and features a quote from Sylvie Lemmet, Director of Technology, Industry and Economics, United Nations Environment Programme. The quote states: "You are more than welcome to become an actor of the UNEP Sustainable Buildings and Climate Initiative, by developing joint strategies, guidelines and concrete innovations to build a sustainable world for future generations." The text also mentions that the SBCI is a sectorial initiative coordinated by the United Nations Environment Programme (UNEP) and aims at realizing the full benefit from sustainable development to society and to the sector itself. A sidebar on the left contains a menu with links: About SBCI, Membership, Activities, Resources, Events, and News. At the bottom, there is a quote from Arcelor about its commitment to sustainable development.

The Marrakech Task Force on Sustainable Buildings and Construction (SBC)

www.environment.fi/sbc

The website of the Marrakech Task Force on SBC compiles background information about policy practices, policy recommendations, research projects and news related to SBC.



The screenshot shows the website of the Marrakech Task Force on Sustainable Buildings and Construction. The website is in Finnish. At the top, there is a logo for www.environment.fi. Below the logo, there is a navigation bar with links: Ministry of the Environment | Regional Environment Centres | Permit Authorities | Finnish Environment Institute | www.ara.fi. A search bar is also present. The main content area is titled "Marrakech Task Force on Sustainable Buildings and Construction" and features a quote from the UNEP SBCI. The quote states: "One of the side events of the climate negotiations in Bonn during the first two weeks of June 2009 was organized by two UNEP (United Nations Environment Programme) initiatives, the Sustainable Building and Construction Initiative (SBCI) ja Finance Initiative (FI) Wednesday 3 June." The text also mentions that the title of the event was "The property and building sector and the Copenhagen Agreement". The website also features a sidebar with links: Previous level, 7/7/2009 (Updated), Ministry of the Environment, Contact the person in charge, and a printable version. At the bottom, there is a quote from the UNEP SBCI about its commitment to sustainable development.

Urban Sprout

www.urbansprout.co.za

Urban sprout is a growing blog-style online community, featuring daily green blogs, events and a directory that focuses on eco-friendly products in buildings and construction in South Africa.



Environment (iiSBE)

www.iisbe.org

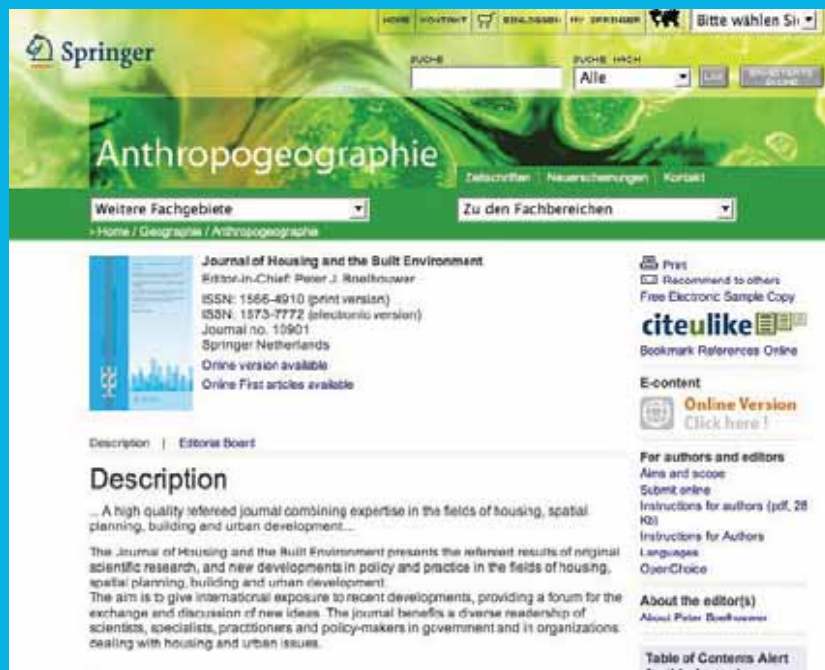
International non-profit organisation whose overall aim is to actively facilitate and promote the adoption of policies, methods and tools to accelerate the movement towards a global sustainable built environment.



Journal of Housing and the Built Environment

www.springer.com/geography/human+geography/journal/10901

Published by Springer Netherlands, this journal provides scientific research, and new developments in policy and practice in the fields of housing, spatial planning, building and urban development.



Terra 2008: 10th International Conference on the Study and Conservation of Earthen Architectural Heritage in Mali

<http://whc.unesco.org/en/events/395>

Conference held in Mali in February 2008 with approximately 300 specialists in the fields of conservation, anthropology, archaeology, architecture and engineering, scientific research and sustainable development of earthen architectural heritage.



Glossary

10-Year Framework Programmes

At the UN World Summit in Johannesburg in 2002, governments called for the development of a 10-year framework of programmes in support of regional and national initiatives to accelerate the shift towards Sustainable Consumption and Production (SCP) patterns. The 10YFP is meant to be an international framework of programmes and actions that support regions, countries and a range of stakeholders, to accelerate the shift towards SCP.

Aerobic decomposition

Aerobic decomposition refers to the breakdown of a molecule into simpler molecules or atoms by micro organisms under favourable conditions of oxygenation.

Biomimicry

Biomimicry is the science and art of emulating Nature's biological ideas to solve human problems.

Butterfly roofs

A butterfly roof is formed by two adjacent gables sloping inward toward the middle, so that they dip to create a central valley

Carbon dioxide (CO₂) emissions

CO₂ is a colourless, odourless and non-poisonous gas formed by combustion of substances that contain carbon and in the respiration of living organisms. It is a greenhouse gas, because it contributes to greenhouse effect and thus to climate change. CO₂ emissions refers to the release of CO₂ greenhouse gases and/or their precursors into the atmosphere.

Clean Development Mechanism (CDM)

The CDM allows emission-reduction or emission removal projects in developing countries to earn certified emission reduction (CER) credits, each equivalent to one tonne of CO₂. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol.

Compact fluorescent lamp (CFL)

CFL is a lamp that produces visible light by emitting electromagnetic radiation. CFL lamps usually consist of a glass tube filled with argon, along with krypton or other inert gases. CFLs can replace incandescent lamps that are roughly 3–4 times their wattage, saving up to 75% of the initial lighting energy.

Energy Efficiency

Energy efficiency refers to the situation when products or systems use less energy to achieve the same or better result than conventional products or systems.

Environmental Impact Assessment (EIA)

An environmental impact assessment (EIA) is an assessment of the possible impact—positive or negative—that a proposed project may have on the environment. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts to decide whether to proceed with the project.

Evaporative Condenser

An Evaporative Condenser is a heat exchanger in which a refrigerant is condensed by a combination of air movement and water that is sprayed over its surface.

Greenhouse Gas Emission

Greenhouse gases refer to carbon dioxide, nitrous oxide, methane, ozone and chloro-fluorocarbons occurring naturally as well as those resulting from human activities, and contributing to the greenhouse effect and thus to climate change.

Indoor Air Quality (IAQ)

IAQ is a term referring to the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants. Factors which contribute to IAQ include moisture, temperature, air circulation, ventilation, the presence of toxins, and moulds. Some common effects of poor indoor air quality are discomfort, difficulty to breath and even cancer.

Indoor Environment Quality (IEQ)

IEQ encompasses all aspects of the indoor environment including air quality, ventilation, thermal comfort, lighting and noise.

Integrated design approach

Integrated design approaches view a building as a system and allows the discovery of synergies and potential tradeoffs or pitfalls with design choices. An integrated design approach helps maximize synergies and minimize unintended consequences.

Life cycle thinking

Life Cycle thinking is an approach to evaluate the environmental burdens associated with a product or service by identifying energy and materials used and wastes released to the environment, and to evaluate and implement opportunities to gain environmental improvements. Positive and negative impacts can be measured and assessed for each stage of the lifecycle reaching from resource extraction to the disposal phase.

Local/Regional Materials

Local/regional materials are extracted, manufactured and/or processed within a certain radius of the construction site. Use of regional materials is considered a sustainable building strategy due to the fact that these materials support local economies and require less transport, reducing transportation-related environmental impacts.

Marrakech Process

The Marrakech Process is a multi-stakeholder platform to support: 1) the implementation of projects and strategies on Sustainable Consumption and Production (SCP) and 2) the elaboration of a Global Framework for Action on SCP – the so-called “10-Year Framework of Programmes on SCP” (10YFP). The Marrakech Process was initiated at the UN World Summit in Johannesburg in 2002. UNEP and UN DESA are the lead agencies in the process, with an active participation of national governments, development agencies, and civil society.

Marrakech Task Forces (MTF)

Within the Marrakech Process, seven Marrakech Task Forces (MTFs) have been established as voluntary initiatives led by governments. The MTFs are committed to carrying out a set of activities that support the implementation of specific projects of the Marrakech Process. So far, the following Task Forces have become operational: Cooperation with Africa

(Germany), Sustainable Products (United Kingdom), Sustainable Lifestyles (Sweden), Sustainable Procurement (Switzerland), Sustainable Tourism (France), Sustainable Buildings and Construction (Finland), and Education for Sustainable Consumption (Italy).

Marrakech Task Force on Cooperation with Africa

The Marrakech Task Force on Cooperation with Africa was established by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and is chaired together with the African Roundtable on Sustainable Consumption and Production (ARSCP). The main aim of this Task Force is to support African countries to implement the African 10-Year Framework Programme on SCP.

Marrakech Task Force on Sustainable Buildings and Construction

Finland is contributing to the Marrakech process by hosting a Task Force on Sustainable Buildings and Construction (SBC). The main aim of the MTF is to develop local and national policies and legislation to secure the sustainability of construction, and of the use, maintenance and refurbishment of the built environment. Among key activities are: compiling background data to map out the baseline condition, publishing best policy practices, drafting policy recommendations and initiating research projects.

Noise abatement

Noise abatement is an activity to reduce noise or vibration from a given source, or to protect persons and built—up structures from exposure to noise and vibrations.

Passive solar principles

Following passive solar principles means designing a building's architectural elements to collect, store, and distribute solar resources for heating, cooling, and day lighting.

Pollution Prevention

The use of materials, processes, or practices to reduce, minimise, or eliminate the creation of pollutants or wastes. It includes practices that reduce the use of toxic or hazardous materials, energy, water, and/or other resources.

Rainwater Catchment/Harvest

On-site rainwater harvesting and storage systems used to offset potable water needs for a building and/or landscape. Systems can take a variety of forms, but usually consist of a surface for collecting precipitation (roof or other impervious surface) and a storage system. Depending on the end use, a variety of filtration and purification systems may also be employed.

Recycled materials

Material that would otherwise be destined for disposal but is separated from waste and reintroduced into the manufacturing process as re-useable material.

Resource Efficiency

Resource efficiency refers to the situation when products or systems use fewer resources to achieve the same or better result than conventional products or systems.

Rooftop rainwater catchments

In the most basic form of this technology, rainwater is collected in simple vessels at the edge of the roof. Variations on this basic approach include collection of rainwater in gutters which drain to the collection vessel through down-pipes constructed for this purpose, and/or the diversion of rainwater from the gutters to containers for settling particulates before being conveyed to the storage container for the domestic use.

Sustainable architecture

Sustainable architecture seeks to minimize the negative environmental impact of buildings by enhancing efficiency in the use of materials and energy. The issues considered in the field include the quality of indoor air, the amount of energy used for heating and air-conditioning of buildings, waste management, durable and environmentally sound building materials.

Sustainable Consumption and Production (SCP)

Patterns of consumption and production that allow social and economic development within the carrying capacity of ecosystems by addressing and, where appropriate, de-linking economic growth and environmental degradation through improving efficiency and sustainability in the use of resources and production processes and reducing resource degradation, pollution and waste.

Sustainable Buildings and Construction (SBC)

Sustainable buildings and construction works fulfil their performance requirements with minimum adverse environmental impacts, while encouraging improvements in economic, social and cultural conditions at local, regional and global levels.

Sustainable development

Sustainable development refers to development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Systemic approach

A systems, or systemic, approach promotes analysis and action across the whole of a system rather than just one part of it.

Thermal Mass

A mass (often stone, concrete, or brick) used to store heat and reduce temperature fluctuation in a space, by releasing heat slowly over time.

List of literature

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