REPORT 11

THE SOUTH AFRICAN REPORT ON SUSTAINABLE DEVELOPMENT AND FUTURE OF CONSTRUCTION

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NATIONAL REPORT

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1. INTRODUCTION

This study was undertaken by the Division of Building Technology (Boutek) of the Council for Industrial and Scientific Research (CSIR), South Africa. It is an interim country report and reflects mainly the views of a few people within Boutek. If feasible, it will be expanded through a national workshopping process in the year. The report forms part of an international pilot study done under the auspices of the International Council for Building Research Studies and Documentation (CIB) and specifically the Working Commission 82 that deals with the future of construction.

1.1 Aim

The aim of this document is to investigate the meaning of sustainable development in the South African context and what impact it would have on the built environment and with it the construction industry by the year 2010.

1.2 Methodology

While drawing heavily on research done by the author in the course of postgraduate study, the report is mainly a synthesis of two in-house CSIR reports, a conference paper prepared by CSIR researchers in conjunction with academics at the Universities of Cape Town and Pretoria, a conference paper delivered by the author, and the government White Paper on Environmental Management. Due to time constraints it was not possible to workshop the report, but it was sent for comment to members of the Sustainable Development Forum within the Division of Building Technology at the CSIR and to selected academics at the University of Pretoria (see acknowledgements).

The following documents were used to inform this synthesis. The nature of the synthesis is such that referencing each phrase taken from these documents would have resulted in a very difficult to read document. However, where substantial amounts of text were quoted, the normal referencing procedure was followed. The author would therefore like to acknowledge the authors of these documents as co-authors of this report:

Boutek - CSIR. 1998. *2020 Technology Foresight: The Built Environment and the Construction Industry*. Report no. BOU/I103, March 1998. Pretoria: CSIR.

Shuttleworth, L. 1998. *Sustainable Construction*. Unpublicised internal draft report. CSIR-Boutek.

Hill, RC, Kusel, K, Pienaar, J and Bowen, P. 1998. *The transition to sustainability in the planning, construction and management of buildings and settlements in South Africa*. To be presented at the 1998 CIB conference at Gâvle, Sweden.

Du Plessis, C. 1997. *The Meaning and Definition of Sustainable Development in the Built Environment*. Proceedings: 1997 CAA Conference on Urbanisation and Housing, Goa, India.

South African Government Gazette (1997) *White Paper on Environmental Management Policy*. Pretoria: South Africa.
hhtp://www.polity.org.za/govdocs/white_papers/envir.html

1.3 National concerns, constraints and issues

1.3.1 Context

In many ways, South Africa represents a microcosm of the developmental and environmental issues facing the world economy. The country manifests both the environmental problems of the affluent, industrialised world, and those of poverty and underdevelopment.

The South African economy extends from the agricultural (rural) society, through the industrial society, to the information society. Economic attitudes vacillate between seeing the newly democratic country as a land of opportunity and a growth point in Africa, and seeing it as another African country full of uncertainties and a high risk investment area. Developers look for quick returns and low risks and are not willing to take the long term view that sustainable development will bring its own rewards in good time. Unless significant economic growth is achieved, economic growth alone will not be a significant driver of construction activity in the country.

Establishing social and economic equity will be the biggest driving force in South Africa over the next ten years. Social equity is as high on the agenda as environmental concerns, and therefore more thought is given to the impact of construction on social and economic sustainability. The construction industry is thus geared towards job creation and more labour intensive practices. Entrepreneurship is encouraged, with construction companies outsourcing to previously disadvantaged contractors and obtaining building materials from small, local businesses. Emphasis is also placed on skills transfer and capacity building.

Having suffered many years under the development policies of an autocratic government, South Africans are very aware of the need for public participation as part of sustainable development and have well-developed skills in this regard. For any development, a public participation process is as important as an environmental impact assessment.

The problems with building stock in South Africa centres more around the provision of housing and new infrastructure, than upgrading the existing infrastructure, although this is also a concern.

The opportunity therefore exists to create sustainable settlements from scratch, instead of having to fix existing problems. However, the pressure for delivery is such that sustainable development principles may be sacrificed in the short term and quality falls by the wayside.

South African society is very fragmented and there are vast disparities in income and educational levels, as well as complex ethnic and cultural differentiations resulting in much tension across racial, cultural, tribal and political lines. Furthermore, the conflict surrounding the country's transition to full democracy has created a development arena that is fraught with gatekeeping, political power struggles and mistrust. This calls for sensitive public participation programmes and intricate negotiations and tradeoffs.

1.3.2 Key issues and constraints

Ensuring equity

The major focus for the South African government over the next ten years will be to redress the inequalities of the past. While most of the work will lie in the field of socioeconomic development, the political ideology of apartheid also influenced the built environment. Separation of the races and oppression of the majority resulted in cities with unsustainable settlement patterns that were deliberately designed to keep a large percentage of the population poor, with no means to better themselves. Cities have no equitable distribution of facilities and employment opportunities and millions of people are housed in sprawling dormitory suburbs on the periphery of the city with grossly inadequate public transportation to where the shops, schools and job opportunities are.

One of the biggest challenges for planners, designers and the construction industry lies in reducing the imbalances in the spatial development of the apartheid cities to create more equitable city structures.

Poverty alleviation

It is estimated that 39 per cent of South African households live under the nominal poverty line. Apart from contributing to social problems such as crime and low education levels, this translates into a very small tax base. Emphasis is therefore not on social security programmes, but on job creation, entrepreneurship and capacity building. As one of the largest employers in the country, the construction industry is being geared towards job creation and more labour intensive practices, as well as skills transfer and capacity enhancement. Entrepreneurship is encouraged, with construction companies outsourcing to previously disadvantaged contractors and obtaining building materials from small, local businesses.

Catering for a young, growing population

Thirty seven per cent of the South African population is under the age of 15. It is estimated that the population of South Africa will reach 56 million in 2010 and will double within the next 30 years. The requirements of the young population will be a key driver for the demand of construction products in South Africa. Apart from education and training facilities, the youth also needs sport and recreation facilities. The growth in population will demand more health and commercial facilities and put further pressure on housing and infrastructure delivery.

A factor that may change the above population estimates is AIDS. Although the statistics are unreliable, evidence points to a large percentage of the young population being HIV positive. It is uncertain how this will affect population growth, but it will increase a demand in health facilities and care centres.

Urbanisation and housing provision

Two of the most important issues for the South African construction industry will be the construction of new settlements to house the predicted population growth, and the upgrading of old apartheid townships and the informal settlements surrounding the existing cities.

By 2010, more than 60 per cent of the population will live in metropolitan and urban areas even though the pace of urbanisation has slowed due to a lack of jobs, high levels of crime and violence and the huge backlog of housing and other services. The existing backlog stands at more than a million houses and it is estimated that an additional 150 000 houses need to be built per year to provide for the increase in population.

Political pressure for short-term volume delivery of land, housing, services and facilities, is resulting in the old pattern of low-density mass housing on the urban periphery reemerging as the only significant form of urban development right now. This is supported by personal aspirations created by liberation ideology and a popular demand for the one house one plot model of development.

Solving the problem of informal settlements is hampered by the fact that this is not a homogenous, generic type of urban form for which a model solution can be found. Each settlement has a different population profile with different allegiances and a different reason for coming into existence. Approaches will be flexible, customised and based on a proper study of the context and dynamics of each settlement.

Conservation of scarce resources

Past development has not only neglected the development of the country's people, but has also largely ignored constraints arising from the finite character of non-renewable natural resources and the ecological cycles that sustain renewable natural resources.

The most important conservation issues at the moment centre on water, land and indigenous knowledge.

Water

South Africa is classified as a semi-arid country. About 64 per cent of the country receives less than 500 mm of rainfall a year. Around 60 per cent of the country's water is used to irrigate farmlands, while 17.8 per cent goes towards domestic use. Of that, 20 per cent is attributed to systems loss because of inadequate and badly maintained systems and illegal tapping into water mains, while 35 per cent goes towards gardening. Industry uses 11.3 per cent of the country's water with power generation and mining using 4.3 per cent and 3.3 per cent respectively.

The Ministry of Water Affairs and Forestry have instituted a major water saving campaign. This campaign entails information drives on waterwise gardens and domestic water saving, and a countrywide drive to eradicate alien vegetation like Australian Hakea, Black Wattle and the Port Jackson along waterways. The upgrading and maintenance of existing water reticulation systems and the rethinking of other water-based services like sewerage and storm water collection will directly influence the construction industry.

Inadequate sanitation is a particular concern because of its impact on water quality. It is estimated that 21 million people in South Africa do not have adequate sanitation. Ill placed informal settlements have already polluted the aquifers around the large cities, and both industry and informal settlements have polluted the country's rivers.

Land

Only about 11 per cent of the country's land is arable. A large percentage of the arable land is found around cities and towns. Urbanisation and industrialisation therefore contribute to the loss of high potential agricultural land. The ever increasing needs for energy, provided mainly by coal burning power stations, are responsible for further loss through strip mining and the emissions changing the acidity in the ground.

A further concern is the scarcity of natural aggregates. Uninformed planning has resulted in many of the existing sources disappearing under township development, but this remains a largely unknown issue.

Indigenous knowledge

History has seen deliberate suppression and dismissal of indigenous knowledge on agriculture, medicinal plants, building technology and social organisation. This dismissal came from both the colonial attitude that indigenous people have little to offer in the way of technology, and from a populist movement to discard 'backwards' living models and materials in favour of the high technology of the First World. Because most indigenous knowledge was verbally communicated from generation to

generation, and the younger generations were actively discouraged from continuing with traditional practices, indigenous knowledge is fast being lost to the world. The importance of this knowledge is now being re-evaluated and attempts are made to capture it on more permanent databases. It could assist with identifying drought resistant indigenous crops suitable for small scale farming, developing new medicines based on traditional herbal remedies, designing more sustainable settlement patterns and encouraging the use of appropriate technologies.

An important aspect of traditional African social relationships is the concept of *ubuntu.* This sees all people (including the people of the animal and plant world), their ancestors and their descendants as part of one organism, and all actions must be done with the good of the whole in mind. The saying that underlies the concept - *umuntu wabantu ababantu*- literally translates as ‘a person is a person because of other people”. *Ubuntu* lies at the heart of sustainable development.

Improvement of public transport systems

Little provision was made for public transport systems in the planning of South African cities, despite the fact that only a minority of the population can afford private transport. Public transport is mostly road based, even though an extensive rail network exists. Badly maintained vehicles contribute significantly to air pollution and one of the highest road accident rates in the world. The largest existing public transport system in South Africa, the minibus taxi industry, is mostly in the hands of unscrupulous entrepreneurs and is characterized by unacceptable safety standards, high prices and territorial violence.

The lack of affordable public transportation is contributing to increasing poverty levels, as it is not uncommon for a worker to pay more on transport than on food, shelter and clothing combined. It furthermore prevents equitable access to health and educational facilities, as well as social services.

2. SUSTAINABLE DEVELOPMENT

2.1 Meaning and definition

The concept of sustainability is not a new one. For thousands of years it has been practised by indigenous people world wide who lived by the principle that one should take from nature only that which is necessary for survival, always leaving enough for the next seven generations. However, few, if any, have managed to couple sustainability with what the Western mind set terms "development". Those cultures who have lived the most sustainable lifestyles were often also the ones considered extremely "backward" or "underdeveloped" and regarded as subhuman (consider the treatment of the Australian Aborigines, the Native Americans and the Southern African Khoi-San)

While the origins of "sustainability" lie with the traditional societies and indigenous people, the origins of sustainable development lie in science. The whole idea that a protocol for sustainable development can be defined, harks back to the ideas of the Enlightenment that Man can control nature and through science and technology address the problems imposed on human society by the "external limits" of nature.

The most popular definitions (see Box 1), such as those of the Brundtland Report (1), caring for the Earth (2) and the International Council for Local Environmental Initiatives (ICLEI)(3), are often vague and ambiguous, giving no agreement on what sustainable development may mean in practical terms.

Box 1: Definitions of Sustainable Development

1. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987, p.8)

2. Sustainable development means improving the quality of human life while living within the carrying capacity of supporting ecosystems. (IUCN/UNEP, 1991, p.221)

3. Sustainable development is development that delivers basic environmental, social and economic services to all residences of a community without threatening the viability of natural, built and social systems upon which the delivery of those systems depends, (ICLEI, 1996, p.4)

The weakness of the above definitions lies in their reliance on vaguely defined concepts such as ‘basic needs’, ‘quality of life’ and ‘basic services’. These are qualitative dimensions and very difficult to quantify. It is this very need to define and measure the qualitative dimensions of sustainable development that is the biggest obstacle to its successful definition. What is happening instead is that the requirements for sustainable development are turning into an ever-growing wish list for an ideal society, instead of concentrating on the practical implementation of the sustainable development philosophy within a given context.

The generally quoted prerequisites for sustainable development, such as peace, democracy, human rights, equality, efficient use of energy resources, local community involvement, fair distribution of wealth and participation in all sectors of decision making (International Institute for Sustainable Development, Youth Source Book, 1995), are actually doing the concept a disservice. It creates the impression that sustainable development is only possible in an ideal society.

The concept of ‘basic human needs’, for one, is very controversial, especially in the current consumer society where human ‘needs’ are determined by market forces and not actual survival.

The quality of life that sustainable development aims for, has little to do with the quality of life propagated by consumerism. Before sustainable development can really become accepted practice, there will have to be a redefinition of ‘quality of life’. In the end sustainable development may simply mean that the rich must live simply so that the poor can simply live.

There is as yet no universally agreed-upon definition of sustainable development that can be used by all the various interested parties in the development arena, and perhaps no such definition is necessary. The International Institute for Environment and Development (IIED), one of the first organisations to propagate the term ‘sustainable development’, admits that it has never felt a need for a rigorous, theoretically consistent definition beyond the notional ‘handrail’. (Holmberg, 1992, p. 23) Instead, it might be more useful to define this ‘handrail’ that will guide the various disciplines in spirit, while allowing them to set individual requirements.

The main criteria for sustainable development seem to be agreed on as follows:

1. Development that will not do irreversible damage to the earth's natural systems, that avoid using non-renewable resources, does not pollute, uses energy efficiently, takes the ‘embodied’ energy of building materials into account and fits into natural cycles, not change them.
2. Development that involves the community in decision making, does not destroy social structures, does not endanger health and does not diminish quality of life.
3. Development that does not destroy livelihoods, does not reduce the value of property, does not make a community reliant on one form of income, but provides entrepreneurial opportunities, supports local business and uses true-cost pricing.

These are the common criteria to be found in all the sets of requirements, principles and strategies examined and can be taken as the basis for the criteria of sustainable development in the built environment.

The above criteria can be used as a ‘handrail’ for the establishment of guidelines that are specific to the time, place and culture within which the development is to take place. Given the diversity of human life and the different ‘needs’ of each specific society, it would be impossible to establish a set of fixed, universally relevant guidelines for sustainable development. The more so because it becomes a complex issue of negotiated takeoffs and priorities that are community and project specific.

Clearly, sustainable development in the built environment is about more than ‘green’[1] construction and urban planning. It is a process that:

- evaluates not only the environmental impact of projects, but also their social and economic impact;
- integrates technical, environmental, economic and social criteria in the design and construction process;
- prioritises needs and solves conflict through discussion with the community;

- informs and educates the community about the pros and cons of each requirement;
- is transparent in its decision making; and
- has entrenched feedback loops to constantly evaluate viability, sustainability and acceptability.

2.2 Sustainable development in South Africa

As manifested in the concept of *ubuntu,* sustainable development is in harmony with deep-seated African cultural values concerning the continuity of the dead, the living and the yet unborn. South Africa has taken sustainable development as a key priority and entrenched it in legislation, various policy papers and the Bill of Rights. (See Box 2).

Box 2: Section 24, South African Bill of Rights

" Everyone has the right... to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures... that.secure ecologically sustainable development and use of natural resources, while promoting justifiable economic and social development "

White Paper on Environmental Management

The most important of these policy documents is the White Paper on Environmental Management published by the Department of Environmental Affairs and Tourism (DEA&T) in 1997. For the first time it gave South Africa national guidelines on sustainable development, and firmly established it as part of government policy.

The Minister of Environmental Affairs and Tourism, Z. Pallo Jordan, stated the importance of sustainable development in a media briefing:
"This White Paper sums up government thinking on environmental management based on an integrated and holistic management system for the environment. The concept 'sustainable development' is the centrepiece of our new policy thrust." (9 Sept 1997)

Adopting the Brundtland definition (See Box 1) of sustainable development, the White Paper states that sustainable development focuses on maintaining and improving the quality of life of all South Africans by meeting their basic needs, rather than on the quantity of economic activity. Growth and development needed to improve quality of life must be reconciled with the sustainability of natural resources so as not to compromise the ability of future generations to meet their needs. Sustainable development also requires that particular attention be given to addressing the needs of previously disadvantaged communities.

The vision of the environmental management policy is one of a society in harmony with its environment. The policy seeks to unite the people of South Africa in working

towards a society.

Box 3: Criteria for Sustainable Development

The new model or paradigm of sustainable development is based on integrated and coordinated environmental management that addresses:

- people's quality of life and their daily living and working environments;
- equitable access to land and natural resources;
- the integration of economic development, social justice and environmental sustainability;
- more efficient use of energy resources;
- the sustainable use of social, cultural and natural resources; and public participation in environmental governance.(White Paper on Environmental Management, 1997)

where all people have sufficient food, clean air and water, decent homes and green spaces in their neighbourhoods that will enable them to live in spiritual, cultural and physical harmony with their natural surroundings. Short term solutions to alleviate immediate demands are cautioned in the context of sustainable development.

The White Paper also defines environment as broader than just the natural environment.[2] (See Box 4: Definition of Environment)

Other government policies

The Development Facilitation Act, Act 67 of 1995 (DFA) and the Local Government Transition Act, Act 209 of 1993 (as amended by Act 97 of 1996), both compel local government to follow bottom up planning, and include active local participation and environmental impact assessments. Both these acts are of critical importance towards attainment of social sustainability in development projects.

Box 4: Definition of Environment, DEA&T, 1997

Environment refers to the conditions and influence under which any individual or thing exists, lives or develops. These conditions and influences include:

- the natural environment including renewable and non-renewable natural resources such as air, water, land and all forms of life.
- the social, political, cultural, economic, working and other factors that determine people's place in and influence on the environment;
- the natural and constructed spatial surroundings, including urban and rural landscapes and places of cultural significance, ecosystems and the qualities that contribute to their value.

The Reconstruction and Development Programme, centrepiece of government policy, is a vision for the fundamental transformation of SA by, inter alia, creating a "...sustainable and environmentally friendly growth and development plan".

The Housing Subsidy scheme recommends that, where developers build for a community, the project must be underpinned by a social compact (National Housing Forum). A regular stipulation of such a compact focuses on the maximum utilisation of local materials and labour. (Dalgliesh, CD and Hill, RC, 1997)

The newly released White Paper on Local Government (March 1998) presents a vision of a developmental local government which centres on "working with local communities to find sustainable ways to meet their needs and improve the quality of their lives". The White Paper places the provision of basic household infrastructure as the responsibility of local government and exhorts the use of affirmative procurement policies and linking municipal contracts to social responsibility. The main importance of this White Paper is that it represents a shift in planning philosophy from physical planning to planning for economic development.

The Land Reform Programme is addressing the dense rural and peri-urban settlements, especially in the former homelands, where land tenure must be clarified before development can occur. Current tenure requirements for finance (whether state subsidies or through the private sector) prevents development on, for instance, the communal land that forms part of African tribal land ownership and that forms the bulk of land in the former homelands.

The Gauteng Provincial White Paper on Urban Regeneration and Integration addresses urban decline and underdevelopment, as well as the integration of cities, towns and townships. It outlines as principles the setting up of cooperative partnerships between the public and private sectors; putting in place strategies for conserving existing resources and energies; developing strategies that are specific and appropriate to local situations; balancing growth and development between centres and, ensuring the process is driven by full community participation.

Despite the incorporation of sustainable development in general government policy, there is little effort to coordinate the various initiatives to promote sustainable development in the country. This might soon change as, at the Rio +5 conference in 1997, the Minister of Environmental Affairs and Tourism committed South Africa to having a national policy on sustainable development in place by 2002.

The construction industry

Sustainable development in the construction sector, including manufacturing of construction products, requires that the construction process be optimised to reduce the consumption of materials and energy. Within the context of sustainable development and growth of the South African economy, environmental issues must be balanced with durability and economic viability (the Life Cycle Cost) of construction, as well as its social impact and viability. It must be kept in mind that durability and attainment of service life are environmental, economic and social priorities as poor quality will be paid for at some stage during the service life of a building, and therefore has an impact

on the quality of life. The cost of poor quality can be monitored financially (initial investment and asset management) and environmentally (resource consumption).

This wider understanding of sustainable development (beyond environmental issues) is already being explored by the construction industry and other big businesses. Large companies who belong to the Industrial Environmental Forum of Southern Africa are engaged in a voluntary process which is turning from only addressing the environmental impacts of new developments in 'greenfield' sites, to a more holistic view in which the environmental and social impacts of their activities are targeted for improvements in performance.

3. ANSWERS TO THE MAIN QUESTIONS

1. What kind of cities and settlements will we have in 2010 and what does this entail for city planners and the built environment?

It is not expected that the type of cities and settlements will change much over the next 12 years, because the existing spatial patterns are extremely well entrenched and the economic power base that influences development is still concentrated in specific areas. However, their expansion, maintenance and management will see some definite changes.

Integrated spatial planning will become very important to ensure that valuable agricultural land and aggregate resources are protected, that aquifers and rivers are protected from seepage and pollution, that there is an equitable distribution of community facilities and economic opportunities and that the real needs of the people are heard through public participation programmes. Combining integrated spatial planning with integrated design methodologies and environmental management results in the identification of the 'optimum sustainable design', which can be translated as durable construction which meets the objectives of sustainable development.

Rural communities will become empowered through participatory processes that enable them to realise their own opportunities and solutions, thereby solving identified problems. Once they have neem through this process, they will be in a position not only to set their own development programmes, but also implement them in consultation with appropriate stakeholders.

Various collective approaches in the spirit of 'ubuntu' will be developed, as these will enable rural communities to utilise their own skills and time to build homes and other community projects, thereby effecting monetary savings and developing local capacity. Savings instituted by the use of local people can be used to generate other economic enterprises, which will help in achieving sustainable local social and economic systems.

The following are the major issues city planners and local authorities will have to deal with:

Compact development

Current urban design policy calls for compaction and the location of low income residential areas within the developed city limits, close to existing job opportunities, and more easily serviced by public transport, as opposed to peripheral developments with little access to job opportunities and urban amenities. Higher density residential development is proposed in all areas, whilst the focus of high density development is on points of high accessibility and high intensity of activity. This will aid in slowing down urban sprawl and shorten travelling distances.

In practice, low income residential areas would remain peripheral because of cheaper land costs, availability of land and opposition from already established communities. Aspirations towards the idealised model of 'one house, one plot', will continue to hamper drives for higher urban density. Furthermore blue collar employment is moving towards the periphery, bringing the jobs to where the workers are, but furthering inner city decline.

Integration

This is a specific concern for South Africa where cities are markedly separated on racial and economic lines, often with buffer strips of industry or undeveloped land between the rich and poor. The biggest problem confronting planners here is the eradication of this spatial segregation and the integration of the various apartheid townships in the city structure and its economy. At the same time, these undeveloped tracts of land presents major opportunities for development.

Integration on city level would, however, call for more than racial and economic integration. Factors that will have to be explored in the future are the spatial integration of employment and residence, and with it, the integration of multiple land uses; the integration of strategic, operational, sectoral and spatial planning; and the integration of various developmental processes such as planning, management, implementation, community interaction, monitoring and review.

The integration of various townships and local authorities into one metropolitan management structure will even out service delivery. This would inevitably mean a drop in standards of service delivery in the more affluent neighbourhoods, but would improve the service delivery in the previously disadvantaged neighbourhoods. Apart from contributing to social sustainability, improved service delivery would mean less direct pollution through sewerage seepage, wood fires and litter, as well as a reduction in systems water loss through water theft.

On a more physical level, activity spines and development corridors will be used to

integrate the various areas. These elements are also used to intensify certain areas in order to create viable economic opportunities, as well as to spread the economic activities more equitably.

Sustainable land use

There is a definite move towards a greater mixture of land use that will allow for compact communities where housing, work, services, facilities and public transport are all within walking distance. Home-based enterprises, 'teleworking' or 'nearworking' will reduce commuter traffic and the need for high traffic roads. Mixed land use will also enhance the viability of new development on the urban periphery.

Undeveloped land like road and rail reserves, as well as abandoned military and industrial land, will be recycled and optimally used. Inner city renewal will be generated by the re-introduction of a residential component through infill development of vacant land, redevelopment of derelict areas, and conversion of unused or partly occupied commercial buildings into residential flats.

Due to the loss of agricultural land through urbanisation, urban agriculture will be actively encouraged, especially on vacant land that is not suitable for construction.

Emphasis will be placed on recycling and reuse of waste to minimise the use of land for landfill and dumpsites.

It is possible that some new settlements will be ecologically closed-loop systems in which all waste is transformed into food and recycled products, and in which food systems and settlement systems will be closely integrated. There are already some pilot eco-villages [3] in South Africa, most notably the Tlholego Village and Kuthumba Eco-village (See Chapter 5). The community of Orange Farm has also started a prototype eco-village.

Given the links between traditional African community and settlement patterns and the eco-village idea, the fact that communities will increasingly take ownership of the process of service delivery and that people will become more responsible for providing their own services and shelter as government dedicate money to education and the stimulation of economic growth instead, eco-villages provide a sustainable solution to especially rural and peri-urban development and it can be expected that there will be a number of them in South Africa by the year 2010.

Improvement of public transport

It is inevitable that the state will have to take some control over the taxi industry, probably in the form of a national taxi cooperative that can regulate and maintain safety standards, ensure vehicles are maintained to reduce emissions, control route allocation and negotiate price increases with commuters.

There will be an increase in the use of vehicles not using fossil fuels, like buses running on earth gasses or hydrogen, and the rail network might be augmented by light rail transport systems.

City planners will actively plan for the provision of non-road based public transport and its integration with road based transport to achieve a seamless network of public transportation that complements the integration of the city.

Crime

Unacceptably high crime levels are turning South African cities into a conglomeration of fortresses. The fastest growing development product is security villages that sometimes even provide schools, shops and offices within their fortified perimeters. There is little likelihood that crime levels will decrease significantly in the immediate future and the fear of crime will continue to shape South African cities and towns well into the next century.

Recent government initiatives have launched a study on crime prevention through environmental design[4], but it will be some time until its recommendations will influence the design of cities and neighbourhoods.

2. What kind of buildings will we build in 2010 and how will we adapt existing buildings?

Given the expected population growth, the backlog in housing and services and the youth of the population, it can be expected that building types will concentrate on affordable housing, educational and recreational facilities, and commercial and industrial development to provide employment opportunity.

New community buildings will be multi-functional with one building serving several purposes during the course of a day or week. This will do away with the need for several dedicated buildings, saving building costs and land and contributing to safer neighbourhoods, but will require re-education and an efficient strategy for dealing with the logistics. Money saved by designing multi-functional buildings can then be used to make that one building durable and energy efficient.

Commercial premises will be built to be highly adaptable, with a durable skin and recyclable internal divisions and fittings. Buildings will be designed with life cycle costing in mind and the constitutional right to live and work in a healthy environment will force many developers to opt for healthier climate control measures and building materials.

Industrial complexes will be rethought to allow for zero emissions manufacturing, greywater use and recycling of waste. Emphasis will also be placed on healthier working conditions, reduced pollution, resource efficient processes and energy and

water savings. This will impact on the built form and materials used.

Affordable housing will either be self-built, using improved forms of indigenous construction technologies and local materials, or incremental housing based on small, mass-produced units using high-energy building systems. Although the latter is not always desirable, the technology will still be used because of pressure to deliver, perceptions on quality and entrenched interests.
The use of upgraded traditional technologies will be encouraged, where appropriate, as this will enable impoverished communities to build homes that give them greater value for money than more expensive conventional building methods. This use of local materials and methods will undoubtedly lead to cost effective and appropriate buildings being built using local materials and methods.

In general, housing sizes will decrease as families become smaller and materials more expensive. Existing large houses will be subdivided into separate living units. Cluster units in security villages will remain a popular option for those who can afford it.

Existing buildings will be retrofitted with more environmentally friendly services to produce 'healthier' buildings, and, in inner cities, many will be turned into residential units.

3. How will we design and construct them and what does this entail for initiating, designing, constructing, maintaining, operating and demolishing buildings?

Designing, manufacturing, construction, facilities management and demolition processes will in future be strongly focussed on decreasing the impact of the construction of facilities and infrastructure on both the natural and social environment.

Initiating and designing

The choice of site and development product will consider its social and environmental impact, as well as the impact on the local economy, and will be influenced by public consultation and prescriptive legislation. Both an environmental impact assessment and public participation programme will have to be conducted on most proposed development before the design can be finalised.

The design will adapt to its environment by considering the climate, the culture, soil conditions and the aesthetic impact of the building.

In building design, all free natural resources will be effectively utilised. This includes the maximal use of natural lighting, gravitation-based ventilation and the utilisation of passive and active solar energy, wind energy and the thermal capacity of the ground. The design would also allow for efficient water use.

Construction

Conditions on site will be improved to be less ecologically destructive and noise, dust and vibration on construction sites will be reduced. Water and energy consumption of construction methods will be monitored and reduced. The environmental impact of transportation to the site will be minimised. Where possible, work will be outsourced to small, local contractors and local materials will be used.

Working conditions on site will be made safer and healthier, with robots performing some of the more dangerous tasks. Where appropriate, labour intensive construction methods and improved indigenous building technologies will be used.

Maintenance and operation

The main issues for the maintenance of buildings are durability of materials, energy use and water savings. Durable finishes and fittings that are easily cleaned and repaired will be the order of the day. Smart systems will control the energy use and adjust it according to temperature, time of day and occupation levels. Water saving devices, regular maintenance of taps and toilets and drought resistant landscaping will control water use.

Demolition

Demolition techniques will be refined to allow the extraction of re-usable components with little or no damage. The already existing market in recycled components like window and door frames, structural timber and roofing material, will be expanded to include crushed concrete aggregates, recycled plastics and insulation material

4. What kind of materials, services and components will we use then and what does this entail?

Materials

It should be emphasised that materials by themselves are not sustainable, only the use of materials can be sustainable.

Knowledge about the environmental properties of new and improved construction materials will be increased. This would include information on embodied energy, noise-absorption potential, the potential release of dust and toxic substances and recyclability. The use of energy, non-renewable raw materials and other resources in the production of construction materials will be minimised. The objective is towards zero-emission manufacturing, where all by-products will also be utilised, possibly by other industries working in a network. In addition to recycling, the use of renewable raw materials will be encouraged.

Construction industries will increase the use of environmentally non-detrimental materials. New construction materials and applications will be developed utilising different by-products from other industries. The use of materials produced by the vitrification of domestic or chemical waste will be increased in secondary structures. Composite materials and products made from recycled materials, offer numerous promising new opportunities. Biotechnology will also produce new building materials, or genetically engineer existing natural materials, e.g. wood, to provide a better product that provides more value for the resource use of its production.

Box 5: Future construction materials

Future construction materials will be characterised by the following features and properties:

- full recyclability;
- resource-saving manufacture
- the increasing use of local renewable raw materials and resources;
- enhanced strength, toughness and ductility;
- enhanced durability and service life;
- increased resistance to abrasion, corrosion, chemicals and fatigue;
- initial and life-cycle cost efficiencies;
- initial and life-cycle energy and CO_2 efficiency;
- improved response in natural disasters and fire;
- ease of application and installation;
- ease of use and maintenance;
- zero emission;
- non-toxic and zero radiation;
- moisture-safety;
- tailor-made materials; and
- the ability for self-diagnosis, self-healing and structural control (CSIR Report no. BOU/I103, 1998)

Two opposing criteria will influence the choice of building material. For components that can easily be re-used, the first priority is durability and long service life. For components that are difficult to reuse the requirement will be easy biodegradibility or recycling. The reuse of components will be preferred, thereby cutting out the energy costs of recycling and further manufacture.

Capital-intensive high technology production systems, materials with high embodied energy coefficients and poor thermal (energy-saving) attributes will still be in use, especially in the mass housing market.

Guidelines for the use of indigenous building technologies and found local materials will have been developed which will allow their use in urban areas. The life expectancy of these technologies will also have been improved through the development of easy-to-implement design principles and protective technologies.

Components

Components will be re-usable, easily extracted during demolition and designed with the saving of energy and water in mind. New technologies in building services offer major opportunities for energy saving with systems optimising the use of energy according to the actual needs of the occupant and systems recovering residual heat and recycling energy within the building. Light fittings and electrical devices like geysers will also be designed to minimise energy consumption. The use of photo-voltaic cells and solar heating will increase as these technologies become affordable.
Water-saving devices such as low flow shower heads, dual flush toilets and greywater irrigation systems will be common practice and the use of self-composting toilets that use no water and do not seep into groundwater reservoirs will be acceptable. New systems will be developed in high density urban areas to utilise collective organic waste as energy source.

Services and tools

Environmental life-cycle analysis tools will be developed to evaluate designs at an early stage and present the environmental impact of different design alternatives. These would take into account the entire environmental impact of a product from its cradle to its grave, including the energy used and the waste created by, for example, the acquisition of raw materials and demolition. This portfolio of tools will also assess the life-cycle cost of construction from a technical, economic and environmental perspective and assist with sustainable development.

Although the focus to date of assessment systems has been on assessing the impact of buildings on physical environments, the focus will increasingly shift to developing an assessment tool that includes the assessment of buildings and environments from a social and economic point of view, with the aim of achieving social sustainability in developments.

Integrated project databases will provide a seamless flow of information in electronic format that will be updated during the life of the project to provide a continuous feedback loop. Such a database will provide an integrated design model consisting of both spatial and other information, enabling all project participants to work together, exchanging design information, and applying advanced design tools to optimise the design and construction process.

Facilities Maintenance and Management Systems (FMMS) will become a necessary tool for the integration of strategic and operational management. FMMS systems provide strategic planners with updated information and enable holistic strategic reviews and appropriate pro-active maintenance of a facility. They represent a key tool for ensuring optimal use of available resources and for assisting with the attainment of sustainability in buildings.

5. What kind of skills and standards will be required and what does this entail for human resources and skills needed in the construction industry?

Skills

Information technology will impact on all aspects of planning, design, construction, operation and the maintenance of construction. In briefing and planning, sophisticated computer-based, multi-criteria, multimedia, three-dimensional space simulation and virtual reality tools will routinely be used to enable the making of more informed choices. During construction and operation IT will be used to provide as-it-happens information on design changes, logistical performance, running costs and environmental feedback. It would be vital for all players in the building industry to have the skills necessary to cope with this level of information transfer.

The emphasis on public participation in a complex society calls for skills in negotiation and facilitation, knowledge on different cultures and political sensitivities and skill in creative problem solving. Building professionals will have to be skilled in combining public participation with the design process.

A further necessary skill will be the ability to interpret environmental assessments and apply life cycle thinking,

Standards

It would be necessary to keep a fine balance between quality and cost. The recent past has shown that rigorous quality standards have served to discourage the building of affordable housing. Standards will have to be adapted to suit local perceptions and environmental conditions, and should include indigenous building technologies.

4. STRATEGIC RECOMMENDATIONS

4.1 Environmental sustainability

Land

Sustainable development starts with the choice of a product and a site. Both should be chosen not only according to environmental factors, but also according to the impact it will have on the local community in terms of socio-economic factors. This would range from respecting local values and areas of cultural significance to the impact on small local businesses through, for instance, altered transport patterns, as well as the sustainable job opportunities and opportunities for capacity building that will be provided.

Environmental factors that should be included in the choice of site are the presence of scarce resources like natural aggregates or clay and the potential agricultural use of the land.

Even in small settlements, development should aim for compact land use, thus creating communities which are less reliant on mechanised transport, can provide better passive surveillance and hence safer neighbourhoods[5] and can pool resources for alternative energy production and waste recycling.

Energy

It is necessary to address the issue of energy provision for the poor. In South Africa, affordable and sustainable energy provision for cooking and heating presents an enormous challenge. Most of the fuel currently used is either firewood (which has caused major deforestation and concomitant soil erosion and changing rainfall patterns) or fossil fuels like coal or paraffin. Energy efficient design of low cost housing, using site orientation, materials that provide thermal mass and suitable insulation can reduce the need for heating. Design of houses should allow for the incorporation of solar water heating and cooking systems.

Where large housing developments are planned, the use of photovoltaic cells and methane gas as energy sources should be considered. A linked system of photovoltaic cells, placed on the roofs of houses and feeding into a communal battery bank, can provide for most of the electrical needs of a community, in effect turning the entire settlement into a power station. Likewise the organic and sewerage waste of the settlement can provide methane gas for heating and cooking.

Materials and construction technologies should be chosen for the amount of embodied energy - that is the energy used in the extraction of raw materials, manufacturing, transport, construction, maintenance, operation and demolition - they represent.

Water

With most of the world facing a global water crisis, it would be prudent to install water-saving devices in both new and existing buildings. Buildings should be designed to capture rainwater and paved surfaces should use materials like porous brick pavers that reduces run-off.

Apart from watering the garden, the biggest household use of water is flushing the toilet. Especially in arid countries serious thought should be given to using waterless sanitation systems where possible. Systems such as composting toilets had developed to the point where they can be installed inside the house and present a closed system with no seepage into the groundwater.

Grey-water should be kept separate from ‘black’ water so that it can be used to flush

the toilet and water the garden..

Landscaping should reduce water run-off through contouring and ground covers. Drought-resistant, indigenous plants will also reduce water use.

Materials

More research should be done to increase the life expectancy of indigenous construction materials, codes of practice should be developed for these materials and their use actively promoted where appropriate.

Incentives should be put in place for developing new environmentally friendly building materials and improve the environmental performance of existing materials. Likewise, incentives can be created to limit the use of environmentally detrimental materials..

4.2 Economic sustainability

Basis for Competition

The basis of competition must be quality (defined as satisfying the clients needs), profitability and sustainability. These can be viewed as indicators of the construction industry's contribution to sustainable development. The 'real' benefits of innovative technologies and materials must be substituted for perceived benefits (or lack thereof) to demonstrate that innovation and sustainable development initiatives are not in conflict with competitiveness. Once real benefits are substituted for perceived benefits, and responsibilities for environmental management are mandated, the drivers of competitiveness will be life cycle cost, quality, environmental performance and social responsibility. Demonstration of the benefits of innovative solutions which meet the criteria of sustainable development can be achieved using integrated modelling techniques and virtual reality technology.

Quality indices and service life prediction must be applied in the building design and construction process. Prediction of service life is a prerequisite to all further life cycle analyses as this establishes the boundary conditions. The 'cost' of construction must be justified in terms of mandatory technical performance. 'Cost' embraces economic, environmental and social implications of construction. Trade-offs between competing objectives must be 'managed' at the design stage using established criteria as costs to the environment and can be counted as benefits to the economy.[6]

Poverty alleviation

Where appropriate and viable, labour intensive construction methods can provide much needed jobs. The majority of jobs created in this way are project dependent and thus not sustainable in the long term, but if they are combined with skills transfer, they provide a much needed opportunity for self-improvement and entrepreneurship.

Outsourcing to small, local contractors and suppliers, instead of importing manpower, materials and equipment, will provide a boost for the local economy and promote the social sustainability of the project. In return, local support will make the development more economically sustainable.

Finance options

When dealing with development for the poor, creative finance solutions are called for that allow for different tenure options, development on communal land, mechanisms like 'stokvels' and the cooperative use of housing subsidies.

4.3 Social sustainability

Public participation

It is necessary that a methodology for true public participation be developed. The current system of identifying stakeholders and community representatives often cast doubts on the authenticity of the representation and marginalised groups are often not heard. A major problem with current public participation processes is that they are largely driven by consultants and existing power structures and are prone to hijacking by political pressure groups. It is often difficult to identify the real needs of a community amongst all the needs identified by 'experts' and politicians. The Orange Farm community (see Chapter 5) is one of the few who managed to sidestep the political minefield and as such can provide a model for the identification of representatives in public participation.

Despite the problems created by public participation, the involvement of local communities in delivery systems is crucial if a project is to receive community acceptance. A greater degree of community participation, community contracting, and dependency avoidance is needed if a proposed development aims towards social sustainability.

Gender equity

The construction industry needs to work towards greater gender equity. In South Africa, a large percentage of self help builders, especially in the rural areas, are female, yet their skills are generally being ignored on conventional building sites. While there is a definite move towards equality at the professional level, the blue collar employment opportunities are still relatively closed to women.

Cultural acknowledgement and spiritual well-being

Acknowledgement of spiritual well-being and cultural diversity in development projects creates a sense of self-determination and ownership for the intended users and promotes social sustainability (Hill, RC et al, 1998)

Environmental management policy in South Africa is already experiencing a shift from an ecological bias towards including people and their culture and accommodating diverse cultural needs, but more research needs to be done on the spiritual well-being of people. In this regard the field of environmental psychology has been long neglected amongst design professionals, but can offer valuable insights into the effect of the environment on the human psyche.

The construction industry in South Africa should consider how it can include the concept of 'ubuntu' in its decisionmaking and operation and what this can contribute to sustainable development.

Education

There is a need for education on sustainable development at all levels. This would include the adaptation of tertiary curricula to accommodate sustainable development thinking and basic knowledge on environmental design and public participation; continuous re-education of building and construction professionals; raising awareness of the benefits of sustainable development in clients and educating the end-user on sustainable living and how to use and maintain new technologies and services.

4.4 Technical sustainability

Decision support

It is necessary to create a coherent construction development profile which matches technological choices and approaches with broader socio-economic objectives for sustainability. An inventory of all life cycle costs should be made and suitable indices for measuring technical, economic, environmental and social performance should be identified.

To assist with this, it would be helpful to create a bench marking programme which evaluates best practices and examine how they can be improved or adapted to different conditions.

Decision support systems and tools should be flexible enough to accommodate a continuous feedback mechanism that informs the design and construction process.

Indigenous technology

Methods to improve the life expectancy of indigenous technologies and materials should be developed and the use of these materials encouraged where appropriate.

5. BEST PRACTICES

SA Wildlife College (Kruger National Park)
Denis Moss Partnership Inc.

The college is claimed to be the most advanced example of sustainable architecture built in South Africa to date. Much of the design is determined by energy and resource efficiency considerations. The protection of natural systems was a high priority, given the pristine natural environment that surrounds the college. The design and construction processes involved local communities as much as possible, to ensure the equitable sharing of the social and economic benefits ensuing from the construction of the college. Locally obtained materials that can be sustainably harvested and managed (e.g. thatch) were used.

Most of the building work was contracted to the Bushbuck Ridge Builders Association, a consortium of Murray and Roberts (one of the largest construction firms in South Africa) and local builders and artisans. As far as possible local suppliers, craft workers and manufacturers were supported by the development. Unskilled labour was recruited from 11 surrounding villages.

Over the 18 month construction period, the project provided employment for an average of 200 people, of whom 40% were women.

Energy efficiency was a key criterion in the siting and design of the college. Great care was taken to shape the college around natural features, such as trees, thereby utilising existing shade to cool buildings. The buildings were carefully orientated and designed to minimise sun penetration and heat gain. Planted pergolas were provided on the north side of buildings to provide shade in summer. Natural cross-ventilation has been enhanced through the provision of raised roofs with openings; other features include seep roof overhangs and thick walls.

The College uses a ground water source according to a strict management plan that aims to ensure a sustainable yield of water. Consumption levels are managed through the use of water-saving devices and reusing grey-water and sewerage effluent for irrigation.

A number of the buildings were designed to be multi-purpose and adaptable for future uses, thereby negating the need for new buildings to house new functions.

Novalis - Ubuntu Centre (Kenilworth, Cape Town)
Johnson Murray Architects

The centre is to function as a training facility for teachers in the Waldorf system of education. The structure is to be a *building for the human soul*, and thus the main

emphasis in the design was the quality of the spaces and indoor environment that are created in the building.

Physical and spiritual well-being was an important issue for the Novalis-Ubuntu Centre as part of their whole educational philosophy. A 'geomancer' was commissioned to identify 'geopathic stress spots'. These are points of adverse or negative energies that usually originate from underground water sources, magnetic grid lines and radiation, amongst others. Where buildings are sited above them, these forces become confined within the buildings and are said to cause stress and illness in people working within these buildings. Organic forms and human scaled designs further contribute to the well-being of occupants of the centre.

The client's brief also stipulated that training of local workers on site was compulsory, and labour intensive construction methods were used.

The Barn, Kuthumba Nature Reserve, Plettenberg Bay
Natural Architecture

The Barn is to provide accommodation for visitors to this private nature reserve, while further cottages are planned. The architects advocated the use of clay construction techniques, organic building forms and the use of natural materials to create buildings that are environmentally sensitive, as well as being sensitive to the surrounding landscape. A gum pole structure was used with wattle and daub infill panels.

The wattle, an alien plant, was harvested from the surrounding indigenous forest. Other materials used for the infill panels were locally-sourced clay, and straw that had been treated with old motor car oil. Thatch was used as a roofing material.

Provision was made for the reuse of grey water and a wetland sewage system is used.

The Barn also addressed the issue of deconstruction as the main construction materials used, clay and wood, are recyclable after demolition.

A 'clay building festival' was organised for the local community and friends to do most of the clay mixing and panel infill work. Local workers were trained in clay construction during the building of the Barn.

The Klein Constantia Wine Cellar
Gabriel Fagan

The Cellar provide an example of the way in which conventional building materials and methods can be used to create energy efficient and biophysically sensitive design solutions. It features passive design measures that involve orientating buildings and using materials in such a way as to make the most of natural energy for lighting, ventilation and temperature control. The cellar is partly buried, thereby making use of

the insulating properties of soil. The roof is built of brick vaults filled with high mass concrete, which adds to the insulating properties of the building. These and other design features allow natural regulation of temperatures within the building and have eliminated the need for mechanical systems to maintain required temperatures. The cellar won an Eskom Design Award for energy efficiency in 1990.

The choice of site avoided damage to vulnerable farmland and vegetation that would have resulted from using the initially proposed site. The alternative site chosen was an old 'grey' site that had been used in the past to support farm sheds and other buildings. These old ruined buildings were demolished and the new cellar built on the site. Thus, no new land had to be cleared or damaged by the construction process.

House of Mr. Justice HA Fagan, Cape Town
Gabriel Fagan

Apart from design measures involving the orientation of the building and using materials in a way that makes the most of natural energy, lighting and temperature control, the Fagan house also uses passive solar design to regulate internal air temperatures. This building uses a combination of a large skylight on a north facing roof, situated above a heavy concrete floor finished in terracotta tiles. The tiled floor acts as a heat sink, absorbing the heat entering via the skylight, and releasing it at night or in winter months. The rooms were designed to maximise the flow of heat from this heat sink throughout the house. Large, adjustable blinds below the skylight prevent excessive heat gain in summer.

(First five references from Drager, L. and Hill, R. 1997, 'Sustainable Architecture in South Africa: A Review of Selected Case Studies', Architecture SA, July/ August 1997, pp.33-38)

Orange Farm Informal Settlement, **Johannesburg**
Orange farm Creative Action Development Forum
The Centre for Lifelong Learning: TECHNIKON Southern Africa

This settlement is an example of entrepreneurial self-governance. Lacking any formal municipal structure, the community embarked on a creative approach to develop the area. The community identified the leaders in the community, people known for resourcefulness and community concern. A self-governance structure, the Orange Farm Creative Action Development Forum was formed - an acceptable local structure for community development to improve the management and delivery of essential services. The community has since mobilised and channelled development funds through this forum and successfully developed schools and other services for the community. Several people in the forum have received national honours for their endeavours. The Centre of Lifelong Learning of the Technikon Southern Africa has made the principles established by the forum the basis for a special Integrated Community Building Programme, which encourages communities to be more self-

reliant and self-responsible in their planning, decision-making and actions. (Hill, RC, et al, 1998)

Tlholego Development Project, Rustenburg[7]

The Tlholego Development Project (TDP) was established in 1991, in order to pilot research and development into sustainable technologies for rural development. These technologies include: ecological building, household food security, natural waste management, permaculture and education/training on these subjects.

The project is situated on a 120 hectare farm in the rural area 16 km west of Rustenburg in the North West Province. At present, Tlholego consists of three components:

- Tlholego Institute - the management, training and development centre for the project.
- Tlholego Village - a socially and economically sustainable model for village settlement.
- Tshedimosong School - a farm school for 300 students from the surrounding community..

The Tlholego village pilot is an important demonstration in the replacement of sub-standard housing with high quality, affordable houses which use modern techniques of unburned brick and appropriate technologies of rainwater collection, compost toilets, grey-water irrigation, solar collectors and permaculture gardens, to provide communities with food security and a foundation for the production of surplus.

One of the main objectives of Tlholego is to establish a rural settlement model, which demonstrates to South Africans real options for living sustainably in the 21st century. TDP is a pioneer for Permaculture training in South Africa, and works together with international and local networks of development specialists in housing, food security, training and village settlements.
The TDP is currently working with Brian Woodward, from Earthways, Australia, a world leader in low cost owner build housing, to develop a sustainable housing system for South Africa.

The Tlholego Building System combines the principles of sustainable building systems with natural waste treatment and the Permaculture approach for designing food self reliance to produce a high quality, low cost sustainable housing system for South Africa. Although the system was conceived as a solution to the low end of the housing market, it is in fact applicable to all sections of the housing market. It is also flexible enough to accommodate conventional building materials. The building system has succeeded in producing houses that far exceeds the size and comfort levels of those provided by the government and construction industry on the R 15 000 (± 5 000 US$) government housing subsidy. (Personal communication, Paul Cohen, Tlholego Trust)

Green Buildings for Africa Programme
Division of Building Technology at the Council for Scientific and Industrial Research (CSIR),

This is an assessment system that was developed to encourage and reward building owners who voluntarily implement profitable energy-efficiency upgrades in their buildings, i.e. to go beyond the normal requirements and to ensure sustainable development through the optimal use of non-renewable resources and the sustainable use of renewable resources with the minimum damage and risk to the environment and human health, whilst maintaining a healthy economy.

It uses the Green Buildings Environmental Assessment, the first such system in South Africa for existing commercial and industrial buildings. The system specifies a range of environmental issues covering the design, maintenance , operation and management of existing office buildings. Credits are awarded where the said issues have been addressed and satisfied. The system will be tested and refined in the 'Green Buildings for Africa' showcase programme.

Although the initial thrust of the programme is on energy efficiency, it also has the scope to address many other environmental dimensions that are reflected in the assessment system. It covers both global and local issues. These issues are approached firstly from the perspective of the Building and its services and secondly with regards to the operation and management of the building.

Facilities Management and Information System (FMIS)
Facilities Planning and Management Programme, Division of Building Technology, CSIR

The system allows detailed information to be captured on capacity, condition, suitability and the likely cost of ensuring continued functionality in existing facilities. A graphic visualisation language component enables people from different disciplines to understand and interpret data quickly, and to make informed decisions.

6. CONCLUSION

Achieving 'quality of life' and 'quality of the built environment' does not necessarily go hand in hand with sustainable development if such 'quality' is linked to gross consumerism and the use of environmentally and socially suspicious processes and materials. Pressurised by a constituency that demands quick delivery at all costs, the temptation is great for developing countries to follow the unsustainable development pattern of the industrialized world in order to achieve economic growth and First World development standards.

It must be emphasised that economic growth alone cannot ensure a sustainable future unless it is accompanied by environmental and social sustainability. Thus, while it is vital to catch up with the backlog in housing and infrastructure provision, it may be more cost-effective in the long term to provide more sustainable options to begin with.

The construction industry is traditionally conservative and loathe to adapt to new technologies, but there is a groundswell in favour of sustainable development practices that will become hard to ignore and the industry would do well to support it.

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[1] Green construction can be defined as construction that considers only the environmental issues like energy efficiency, toxic materials and sustainable use of materials, but do not address the socio-economic issues engendered by the construction process.

[2] For the purposes of this study, the more generally accepted meaning of environment as dealing with nature and ecological systems only will be used.

[3] The term 'eco-village' includes more than just an ecologically closed loop system. There are various levels or degrees of eco-villages ranging from the ecologically closed loop, agriculture based village to a completely self-sufficient community with shared values and spiritual beliefs. For more information on eco-villages, visit the Global Eco-village Network at http://www.gaia.org

[4] Napier, M, Du Plessis, C, Lieberman, S, Kruger, T, Shaw, M, Louw, A and Oppler, S.1998. *Environmental Design for Safer Communities in South Africa*. Pretoria: CSIR - Boutek

[5] See Napier, M, et al, 1998.

[6] I am indebted to Lianne Shuttleworth of the Construction Technologies programme in the Division of Building Technology at the CSIR for this section.

[7] For further information on the Tlholego Development Project, visit the following websites: http//:www.gaia.org/thegen/genoceania/newsletter/december_97/safrtlholego.html and http://dx.gaia.org/features/africa97.html