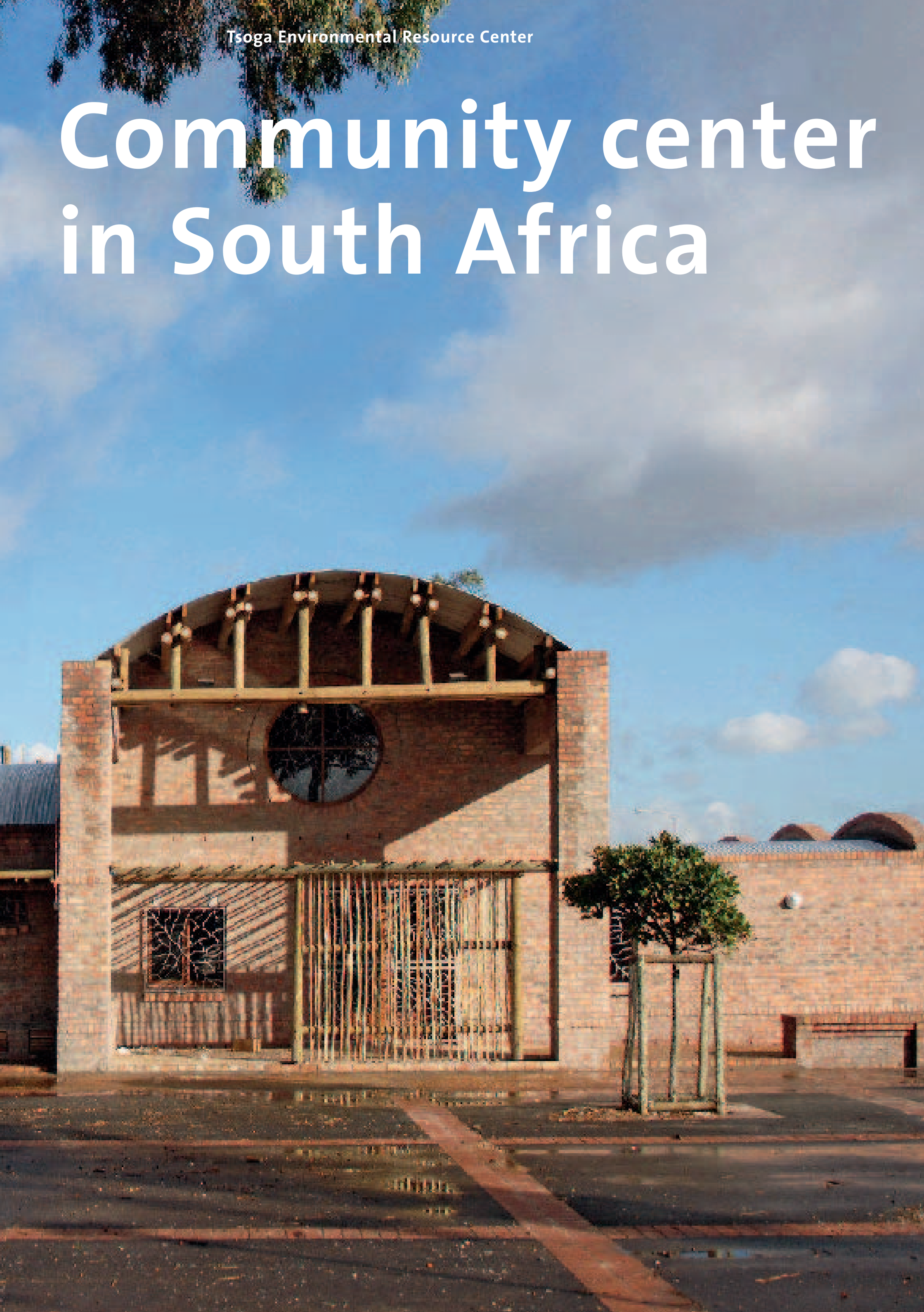
Tsoga Environmental Resource Center

# Community center in South Africa



**Building a promising future**

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- Ethical standards and social equity
- Ecological quality and energy conservation
- Economic performance and compatibility
- Contextual response and aesthetic impact

**Tsoga Environmental Resource Center**

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# Community center in South Africa


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Holcim foundation for sustainable construction

# Building a promising future

By Hans-Rudolf Schalcher, Head of the Technical Competence Center and member of the Management Board of the Holcim Foundation

Tsoga Environmental Center is a community service and recycling center in a neighborhood in Cape Town with a history of social disadvantage. In 2005 the building won the Bronze Award for the region Africa Middle East in the Holcim Foundation's first competition for sustainable construction projects. In 2007 the building received a CIA Award for Architecture from the Cape Institute for Architecture, South Africa. Within a year after being built in 2006, Tsoga Environmental Center became a standard stop on Cape Town tour itineraries of many overseas universities and international cultural and educational organizations.

The building can be seen as a model for realizing synergy between environmental sustainability and social equity. This is not only an achievement for the design team and the City of Cape Town as client, it is fully in line with the vision of Tsoga, the building tenant, a community-based non-government organization committed to improving the local environment and living conditions. The project demonstrates that the governments of South Africa and Cape Town State are taking concrete action to implement their sustainability policies.

A review of the design and construction processes through which this building was created is instructive because the building embodies thoughtful and effective approaches that can be beneficially applied to many projects around the world. The design considers the life cycle of the building and incorporates a wide range of sustainability measures. Every design decision is carefully considered to produce a work of optimum technical, social, environmental, financial, and cultural value. The project shows how these decisions not only shape the architecture and affect the environment, but also to a surprising degree enhance the social and economic well-being of people with urgent needs.

“Sustainable construction implies a strong commitment to local culture, skills, and materials.”

The design team introduces what they call a sustainable construction methodology, which applies sound principles and considers all phases of the life cycle of a building in order to select a palette of materials well suited to the function, site, context, and culture. They considered the use of materials and energy as resources, waste management, $CO_2$ reduction, environmental protection, and long-term socioeconomic development. The example reminds us of the power we have as architects, builders, investors, and consumers to achieve more with our purchases than merely obtaining goods and services.

Applying this methodology, the design team created a building that not only supports the activities of Tsoga – recycling, greening, and social support – but also trains people, creates jobs, shows how to manage waste, and improves the environment. The building incorporates sustainable materials, uses local labor and materials to stimulate the local economy, consumes little energy, and creates a strong sense of place and identity. It is a significant step toward achieving the vision of a self-supported community, equipped with construction skills and environmentally sound building materials necessary for the community to develop its own built environment over the next decades.

This is the third book in this monograph series, following the first, *Measuring up to the criteria of sustainable construction – Office building in Costa Rica*, and the second, *Eawag Forum Chriesbach – Research center in Switzerland*. This book explains how Tsoga Environmental Center seeks to improve community life. With this series, the Holcim Foundation for Sustainable Construction seeks to show the global community a wide variety of examples of responsible ways of building – so that forthcoming generations might inherit the expectation of a promising future.

# Sustainable construction

Quantum change and transferability
Ethical standards and social equity
Ecological quality and energy conservation
Economic performance and compatibility
Contextual response and aesthetic impact

Sustainable development and architecture are complex subjects that are intertwined with many other complex issues. To make sustainable construction easier to understand, evaluate, and apply, the Holcim Foundation developed a five-point definition. These five so-called “target issues” serve as yardsticks to measure the degree to which a building contributes to sustainable development. Three of the five target issues align with the primary goals of the Rio Agenda: balanced environmental, social, and economic performance. A further target issue applies specifically to building: the creation of good buildings, neighborhoods, towns, and cities. And another target issue recognizes the need for significant advancements that can be applied on a broad scale. These five target issues are explained in detail and illustrated at www.holcimfoundation.org/targetissues. Following is a summary of the five criteria and how Tsoga Environmental Center meets them.

# Quantum change and transferability

**Significant advancements in construction practice, if applied on a broad scale, can contribute much to global sustainability. Important advances must be recognized as such and repeatedly applied to achieve significant change. Practices and ideas that transfer best are those that are affordable, simple, and broadly applicable.**

Tsoga Environmental Center was planned using a formal methodology designed specifically for sustainability. This methodology is simple and universal enough to be understood and applied in any socioeconomic or geographic setting.


Preferring local independence to global dependence, artisanal to mechanized building, and elegant simplicity to complex technology, the project demonstrates viable alternatives for supporting local socioeconomic development.

With this building the designers set out to define a highly beneficial new vernacular specifically suited to the needs and resources of local poor people.

The project is designed to raise awareness, build skills, and teach people how to obtain and use recycled and renewable materials as well as sustainable materials and technology.

The project is boldly innovative, intentionally and wisely simple rather than over-designed, seeking local relevance rather than broad architectural acclaim.

# Ethical standards and social equity

**Especially in poor communities, sustainable construction means building to supply urgent basic needs such as shelter, water, schools, and access to goods and services and medical care. Furthermore, towns and buildings must respond to emotional and psychological needs of people by providing stimulating environments, raising awareness of important values, inspiring the human spirit, and bonding society. Sustainable construction also includes fair and respectful treatment of everyone involved during the design, construction, use, and recycling of buildings and cities.**

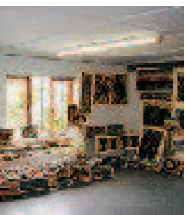
Tsoga Environmental Center was conceived as a cornerstone for building a self-supported community of people who have endured a history of social disadvantage.

By choosing to build in a sustainable way, the City of Cape Town as building owner demonstrates how government should share responsibility for the built environment.

Education of local people is a chief purpose of the center. Many people gained environmental awareness and learned valuable trade skills through the project.

The design of the building respects cultural heritage and identity; it enhances and confirms the vitality of local culture.

The building serves basic needs of the community by providing a place for meetings, educational events, and providing community services, thereby improving the quality of social life.



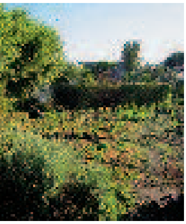

TSOGA
O.D

# Ecological quality and energy conservation

**Sustainable buildings conserve finite resources and minimize greenhouse gas emissions to counter global warming. Good built environments are healthful for humans, animals, and plants. Green buildings help keep the natural environment and ecosystems healthy by reducing waste, controlling pollution, and treating land, air, and water as precious resources.**

Tsoga Environmental Center fosters environmental stewardship, demonstrating ecologically sound construction practices, supporting non-wasteful community practices, and educating people accordingly.

The building incorporates many environmentally beneficial features and functions such as rainwater harvesting, composting, farming, and recycling. These benefit the local environment and the entire city.



The building is designed for low energy consumption and emissions during every phase of the life cycle, using hand-processed natural materials, non-mechanized construction methods, and passive heating, cooling, and lighting systems.

Construction materials are chiefly recycled waste or renewable materials, locally sourced in order to minimize transport and the associated energy consumption and greenhouse-gas emissions.

As part of its concept, the community center establishes environmentally sound enterprises specializing in farming, composting, recycling, and other beneficial activities, and is working to green the city, which supports local ecosystems and biodiversity.


TSOSA

# Economic performance and compatibility

**Every building must be financially feasible to build, operate, maintain, and ultimately remove. Sustainable buildings can help balance the distribution of wealth by supporting the disadvantaged. This can be achieved by establishing long-term new bases for livelihoods, stimulating local economic activity, and paving the way to broader economic integration.**

Tsoga Environmental Center promotes economic self-sufficiency in the community by establishing physical resources and by creating and supporting local sustainable jobs and small businesses.

Locals were trained daily as part of the construction project; unskilled workers learned marketable skills from tradesmen, creating a chance for people to escape poverty.

Local people and local materials were used to build the structure; this kept as much money in the community as possible, giving the public-private partnership the maximum return on its investment.

Labor-intensive construction methods were used instead of mechanical methods and highly processed materials, allowing twice as many local people to be employed and trained.

The building is cost-effective to maintain and operate because it consumes little energy and it is built of durable materials that age gracefully, or simple renewable materials that can be easily replaced by local workers.


TSOSA

# Contextual response and aesthetic impact

**Sustainable architecture is durable and adaptable. It provides an attractive, comfortable, and functional indoor environment, and it enhances its surroundings, fitting functionally and aesthetically into the community setting. It provides culturally relevant indoor and outdoor spaces.**

The architectural vocabulary of Tsoga Environmental Center exemplifies a new vernacular that draws strongly on tradition and can help local people achieve self-sufficiency and advancement over future decades.

The building skillfully knits together strands of suburban fabric in the neighborhood, establishing hierarchy in the local urban structure. It fills the gap so naturally that it seems as if it has always been there.

The community center radiates pride of place. It is truly of the neighborhood – built by local hands, serving neighboring families, and accepted by everyone.

Incorporating ample greenery, natural and recycled materials, and many benefits for the local people, the building faithfully expresses the identity of the tenant, Tsoga, an environmentally active community organization.

The building is designed for flexibility over the years; floors can be added, the workshop can be easily partitioned, even the recycling yard can be converted into office space.

# Tsoga Environmental Resource Center

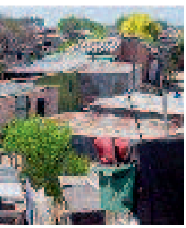
**By Daniel Wentz**

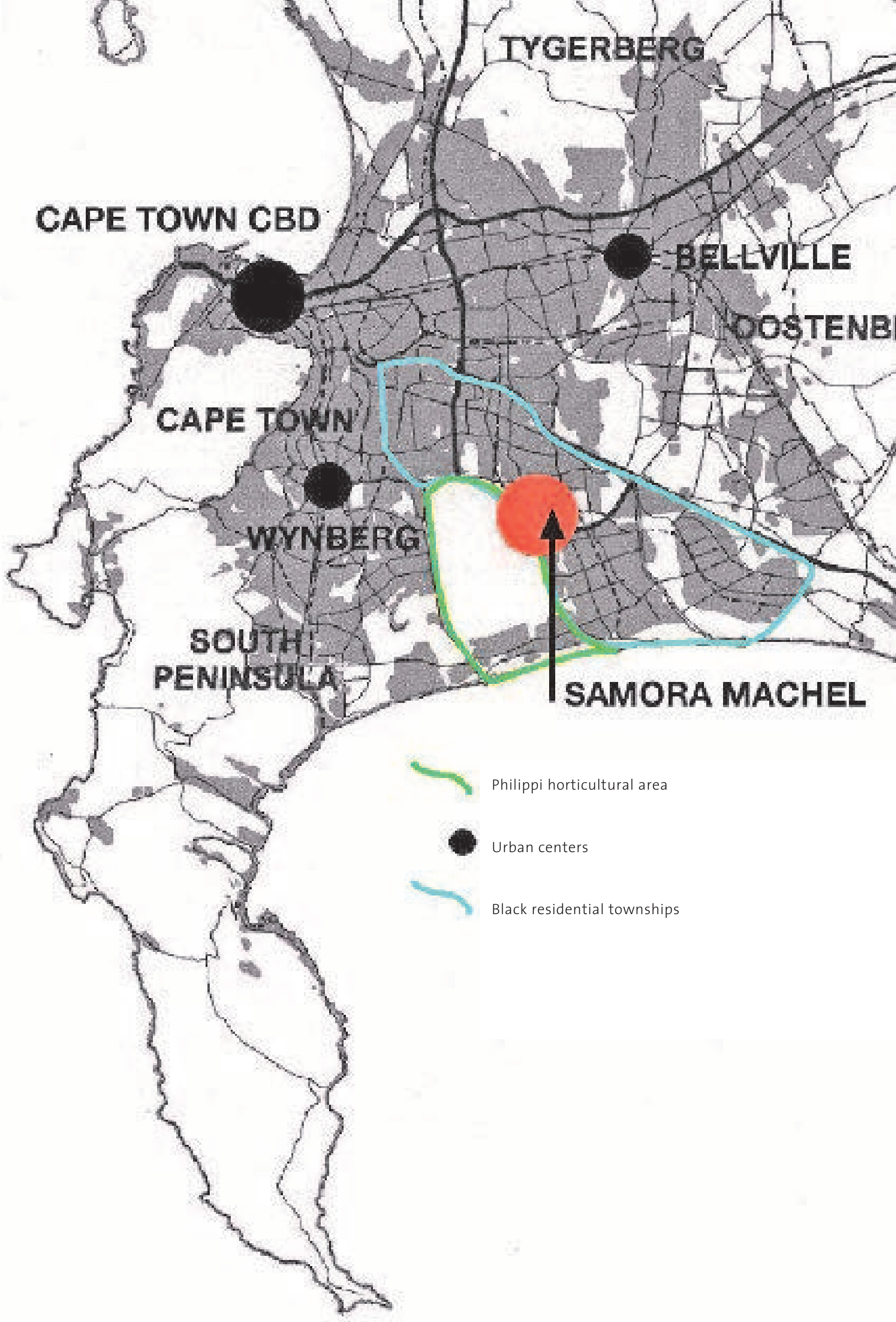
# Tsoga and the informal settlements

Tsoga is the Xhosa word for wake up! It is also the name of a donor-funded, community-based NGO founded in South Africa in 1990 to aid the environment, fight local poverty and unemployment, and improve social conditions and quality of life for residents of the townships. Tsoga is present in a number of South African communities, represented by nearly 800 volunteer members, mainly women.

In 1999 some 200 Tsoga volunteers were moved 20 kilometers from Langa to government-subsidized housing in the community of Samora Machel in the Philippi township, a suburb of Cape Town. Tsoga volunteers in this new community asked the city for an environmental education center from which they could conduct their activities. Being committed to sustainable development, the City of Cape Town provided land and funding, and Tsoga was eventually granted use of three municipal sites.

Tsoga Environmental Resource Center in Samora Machel was erected on one of these sites in 2006. The building is owned by City of Cape Town and is rented by Tsoga. The project was funded by the City of Cape Town and the South African Department of Housing through the Human Settlements Grant. It was also supported by the Western Cape provincial departments of Public Works and Environment and Planning.

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WYNBERG
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Urban centers
Black residential townships


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# A dreary suburban site

Samora Machel is crowded and has a relatively poor infrastructure and few amenities. Nearly all residents are poorly educated and unskilled. Many are unemployed, most are poverty-stricken, and a shocking number are sick with tuberculosis or AIDS. The average household income is less than USD 200 per month. This segment of the population with an ongoing history of social deprivation suffers from a myriad of economic and social disadvantages that are endemic in the community.

The physical neighborhood is a bleak cluster of shacks, shanties, and social housing, aligned along depressing streets. The Tsoga site was a leftover parcel in this grid, a dusty field surrounded on two sides by housing and on the other two by Oliver Tambo Drive and Washington Street, two major streets that intersect far from the suburb center. Aside from the streets, the only significant feature marking the site was a grove of mature Australian blue gum trees, standing far to the east.

**1** Tsoga site

**2** Oliver Tambo Square

**3** Starter and informal housing

**4** School playground

**5** Stormwater detention pond

**6** Subsidized housing

# Program of indoor spaces and outdoor uses

The small site was to be developed to optimally support the many activities of Tsoga. The grounds were to be developed to support gardens. The new building was to illustrate intelligent use of local materials at a small or domestic scale. The brief called for a project that meets high standards of environmental and social responsibility and breaks new ground in sustainable design in Cape Town. The room program called for a meeting hall, exhibition space, dividable workspaces for production and training, two offices, a reception area, kitchen, toilets, and covered recycling yard. Outdoors, a demonstration garden was requested.

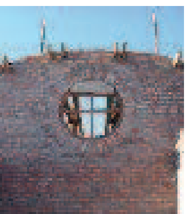
Activities conducted at or from the center include waste collection and recycling, composting, organic fruit and vegetable farming, tree farming, a food program for poor families, local craft sales, educational programs, job creation, landscape contracting, guided township tours, youth programs, life-skills training, environmental lobbying, environmental education workshops, and courses on recycling, reading, and fruit and vegetable gardening. The center provides a workspace and meeting space for approximately 200 volunteers who plant gardens in the community and collect domestic waste for recycling. These people had been operating from their homes for six years.


THIS IS A
HARD HAT
AREA
By Order
DANGER
BUILDING SITE
KEEP OUT
LUMKA INGOZI
KUYASETYENZWA
UNGANGENI

# An all-encompassing approach

The project objectives, site, budget of 2.5 million rand (later raised to 4 million, roughly equivalent to USD 550,000), and socioeconomic context presented the design team an unusual challenge. How does one go about building a community center in an impoverished neighborhood where people need food, education, and jobs more than a new building? Clever design without social and economic benefits would fall miserably short. How can a building improve people's lives or their future – or even fit into a neighborhood of shanties? Would the local people accept it? By asking these critical questions, the team formulated the intention to effect significant and lasting change through the project. The building was to provide a community service that goes beyond mere architectural utility – to sustainably improve environmental and socioeconomic conditions. The project was conceived as a stepping-stone on a new path toward a self-sufficient and ecologically healthy community.

By considering every design decision in terms of environmental and social impact, the designers aimed to achieve far-reaching benefits. They sought to heighten residents' awareness of ecosystems and energy conservation, heal the social network, mend the urban fabric, establish lasting bases for livelihoods, and demonstrate a viable way to build in the poor community – in short, they set out to give people not a building, but hope for the future.



# A structured design tool

The design team adopted a structured approach to design and construction; they call it a "sustainable construction methodology." It treats the built environment as part of a cyclical process of regeneration rather than as a consumer of materials. This innovative methodology is simple enough to be understood by users and observers, and it can be applied anywhere in the world. The methodology produces local benefits by systematically applying environmental, socioeconomic, cost-management, and technical principles such as using waste and renewable materials, minimizing $CO_2$ emissions, conserving energy, and using local resources. Through an iterative process, the methodology considers all phases of the life cycle of a building. A palette of materials and a language of forms emerge that suit the local cultural, technical, and environmental context.

**Using waste as a building material**

Cape Town's landfills will overflow by 2010 unless the waste stream can be curbed or new landfills are opened. The building industry can help solve the problem by using suitable waste as construction material. The Tsoga building uses materials from three of the city's four waste streams – domestic waste, industrial waste, and building waste, but not toxic waste. In the preliminary design phase the team identified local waste materials that could be used as construction materials. These included brick, scrap metal, demolition rubble, and discarded sheet metal roofing, ceramic tile, stone, sand, and soil.

**Using renewable materials**

Throughout the pre-industrial centuries, civilizations built shelter using local renewable materials; hence vernacular architecture can offer clues to the design of sustainable buildings. Using renewable materials is a proven way to reduce the energy footprint of a building. Renewable local materials used to build Tsoga Environmental Center include wood and reeds in a variety of forms and applications.

**Minimizing $CO_2$ emissions**

Worldwide, the construction and operation of buildings is a chief contributor of greenhouse-gas emissions. In many countries buildings produce significantly more greenhouse gases than both the transport sector and industry do. To significantly reduce $CO_2$ emissions, builders can use materials with the lowest possible gray energy. At Tsoga, these include waste and reclaimed building materials, natural materials, local materials, and materials processed by hand rather than by machine.

**Conserving energy**

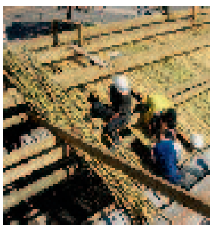
Buildings are ravenous energy consumers throughout their life cycle, from the manufacture and transport of building materials to installation of the materials on the site; from heating, cooling, and lighting the building, to demolition and removal at the end of the life cycle. Energy consumption can be lowered by using renewable resources and waste materials instead of highly processed materials, by using local materials instead of those sourced farther away, and by using passive instead of mechanical systems. The design of Tsoga center considers energy consumption throughout the life cycle of the building, including gray energy. It employs passive systems. At the end of its service life, the structure can easily be dismantled and virtually all of the materials recycled or reused.

**Using local resources to produce local benefits**

Buildings can be designed to heavily rely either on prefabricated elements, which are typically produced in other cities, or on manual labor, typically performed on site. Tsoga center is a perfect example of the latter – maximizing local benefits. It was designed and built to demonstrate locally relevant principles of sustainable construction and to develop the associated skills among local workers. The workers gained hands-on experience and received formal on-site training. The building was designed so that local people can repair and maintain it using locally grown materials.

Like natural systems, these five principles of sustainability reinforce each other – or synergize, if you like a bit of jargon. For instance, the use of local waste and renewable materials simultaneously reduces resource consumption, saves energy, generates less greenhouse gas, and generates local jobs.

From this approach evolves an ethic: (1) operate locally – make full use of the site and locality in every respect, and draw on immediate surroundings before looking beyond, (2) prefer craftsmanship to mechanization, and (3) prefer natural materials to processed ones. This ethic is practicable and most beneficial where unemployment is high, income is low, labor rates are low, or resources are plentiful – but it offers advantages anywhere.



# Master plan

**1** Thirteen gum poles per homestead every five years; lath every year

**2** Reeds, bamboo, thatch, bananas, pawpaws in water detention pond

**3** Orchards, plants, medicinal trees offer shade and wind protection

**4** Orchards and community vegetable gardens

**5** Detention pond and recreational site; thatch-making

**6** Tree-lined avenues provide windbreak and harvestable materials

**7** Brick, scrap metal, wood, tiles, stone, sand, soil; boron treating

● Material collection yards on railway reserve; employment program

With such an ambitious set of objectives, which intends more than the mere assembly of materials into a building, it comes as no surprise that the design team drew up a master plan that extends far beyond the site itself. Visionary thinking produced a master plan of outreach, wholly in line with the philosophy of Tsoga. This plan brings urban integrity into the monotone suburban context, ties together several neighborhood activities related to the center, and serves many people in many ways, on and off site, today and tomorrow.

A glance at the master plan reflects the scope of outreach. Tsoga's three sites are only 100 meters apart, but the plan encompasses a radius of 250 meters. The chief elements are plant materials: trees, bushes, and crops – simple materials that appreciate in ecological, economic, and aesthetic value. The master plan proposes 5,000 new trees in this dusty suburb where greenery is sparse.

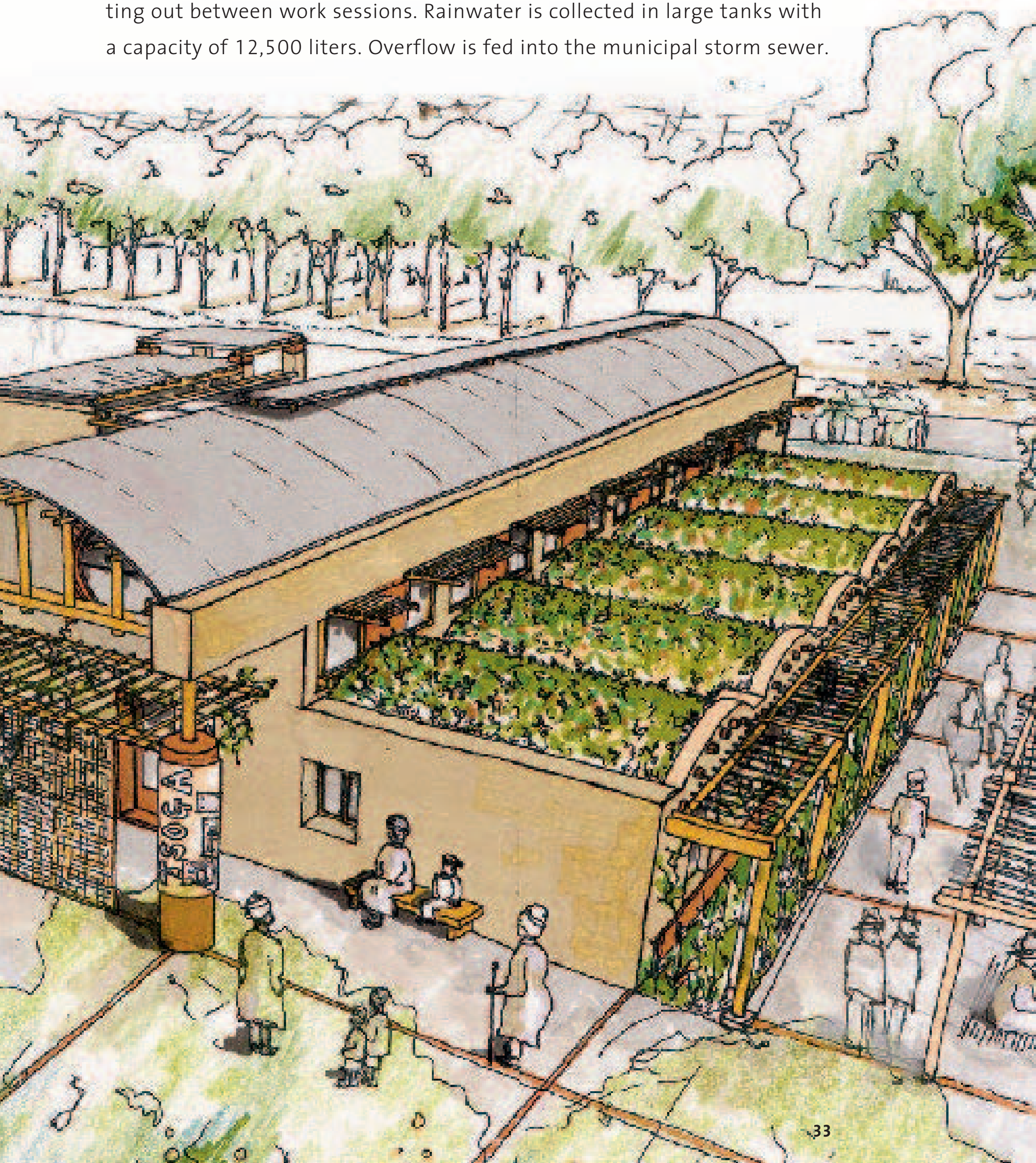
In the plan, trees radiate from Tsoga center in all directions. This impromptu "forest" helps define a neighborhood with a distinct center, a place with identity. Oliver Tambo Drive and Washington Street become densely tree-lined alleys as one nears Tsoga Center. The greenery climaxes at the center, creating for the visitor an unmistakable sense of arrival. The rows of trees modulate the street, define edges between elements, and beautify the neighborhood. The strands tie together the neighborhood, lending coherence, physically and semantically integrating the center into the community. The trees morph into veritable orchards to the south and west of the building.

The tree, which represents nature and growth, is the ideal symbol for Tsoga. That the project introduces trees far beyond the site boundaries


demonstrates Tsoga's embrace of the community. The trees offer beauty, shade, wood, and fruit, including apples, apricots, and pawpaws. Greening is a simple means of improving the townscape and quality of life. Simple means are typical of this project, but simple means conceived for multiple effects – what might be called sophisticated simplicity, the economy and elegance of achieving much with little.

# Site design

The site is flat, measuring approximately 900 m². Erosion is not a problem because the site is almost entirely covered by the building and by the recycling yard. The walks, two parking spaces, and the recycling yard are paved. The only unpaved ground is planted with the demonstration food garden or grass in the courtyard, and plant beds along the northeast facade. The courtyard includes a sheltered walkway with benches for sitting out between work sessions. Rainwater is collected in large tanks with a capacity of 12,500 liters. Overflow is fed into the municipal storm sewer.



# Urban design

The design is an instructive example of how to fill a void in urban or suburban fabric. It enhances the surroundings, develops new resources, bridges gaps, and knits together the fabric, functionally and physically. The building and adjacent park form a duo that introduces the beginning of urban spatiality. The volume defines public space as much as it occupies space itself. The form fits the geometry of the surrounding streets and park. The volume is not set back, but built on or very near to the property lines on all four sides. This urban characteristic contrasts with the typical suburban development pattern of the area, wherein each house is an isolated volume on a plot with narrow perimeters of underused or essentially wasted leftover space. Building to the boundary maximizes the use of the small site and makes possible a sheltered central courtyard, another urban element. Street edges are designed to create a range of modulated and well-defined outdoor spaces, public and semi-private.

The building carefully touches its surroundings on each side. The high southeast facade, with main entrance and meeting hall entrance, has enough visual weight to anchor the large square which it abuts and to which it is oriented. Not only does this positive edge give form to the square, it gives the square an additional function as a large public forecourt to the building. The wide doorway of the meeting hall opens generously onto this plaza, so the building and square function together for large events. The building and park are physically and functionally integrated indoor and outdoor public spaces.

A different type of stitch is used for the fabric to the northeast of the building. Here, a market pergola stretches along Oliver Tambo Drive, with perfect exposure to the main street and proximity to the bus stop. The longitudinal space between the building and street connects to the square but has a more intimate scale. The pergola invites people to rest in the shade, to talk, to see what wares the traders are selling. The two-story northwest facade, along Washington Street, displays a more formal street presence. Entrances to the recycling yard and garages are located at the west end.

On the southwest side, a walkway only three meters wide separates the building from a row of small two-story houses. Here, so as not to overshadow its neighbors, the building steps down to single-story height. The facade opens into a green courtyard visible from the walkway and the houses. Situated at a major intersection, near a school, and adjacent to Oliver Tambo Square, the Tsoga building creates a neighborhood center. It derives from its surroundings – completing, complementing, infilling – and in turn, it enriches its suburban context as a focal point, and attractive place, even a landmark. This center should grow as a vital node of activity and base of local opportunity. Although this public structure is situated at a major intersection, it is not a typical corner building. The architecture does not acknowledge the corner because the intersection is for cars. The building is in fact oriented to other sides, sides for people, and this is a key to the urban integrity of the building and site. Urban quality suffers when buildings are oriented toward parking lots, the typical suburban pattern. Tsoga center requires no parking lot because users arrive by foot (the center does have parking for Tsoga's vehicles). This example invites planners and architects to think again about cars in suburbs. Instead of designing every site for vehicles, why not restrict cars to municipal parking lots or garages within walking distance, and design urban and suburban places for people?

# Socioeconomic benefits

Tsoga's mission to redress social inequity is central to the design team's approach. Tsoga, and the center itself, seeks to fight poverty in a holistic and sustainable way by establishing self-sufficiency and gradually integrating the poor into the broader economy and society. This requires extensive effort and multiple measures because the mechanisms that perpetuate poverty are intertwined and deeply rooted. The capacity of a

**1** Eucalypts planted to form a living, productive, sheltering fence

**2** Five-meter poles for harvesting

**3** Branches for lath

**4** Lath sunscreen

**5** Fruit, fragrant, or sacred trees along street

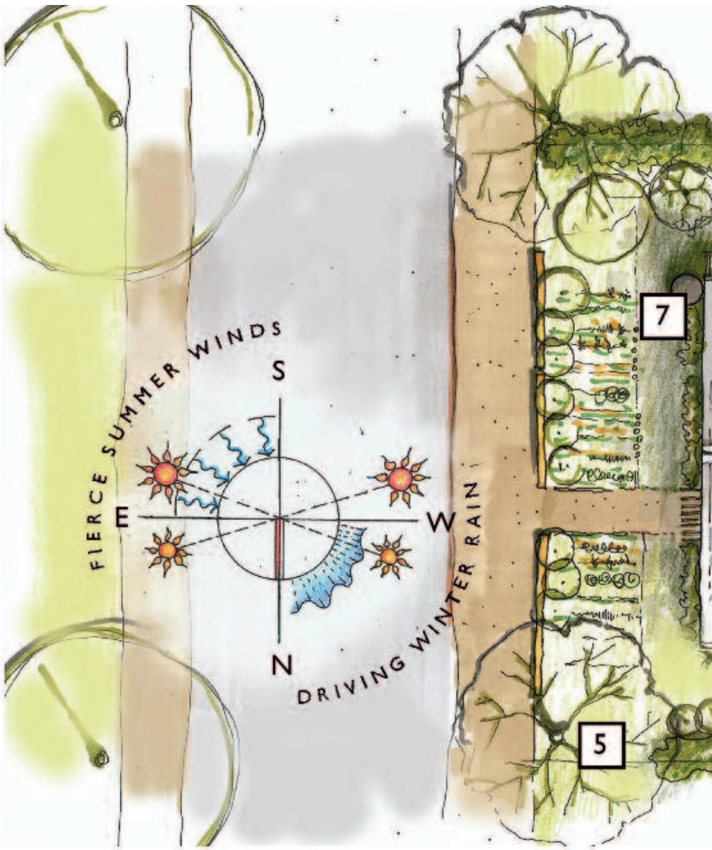
**6** Garden as hedge: corn, beans, etc.

**7** Rainwater tanks

**8** Stacked tires form potato beds

**9** Vegetable gardens

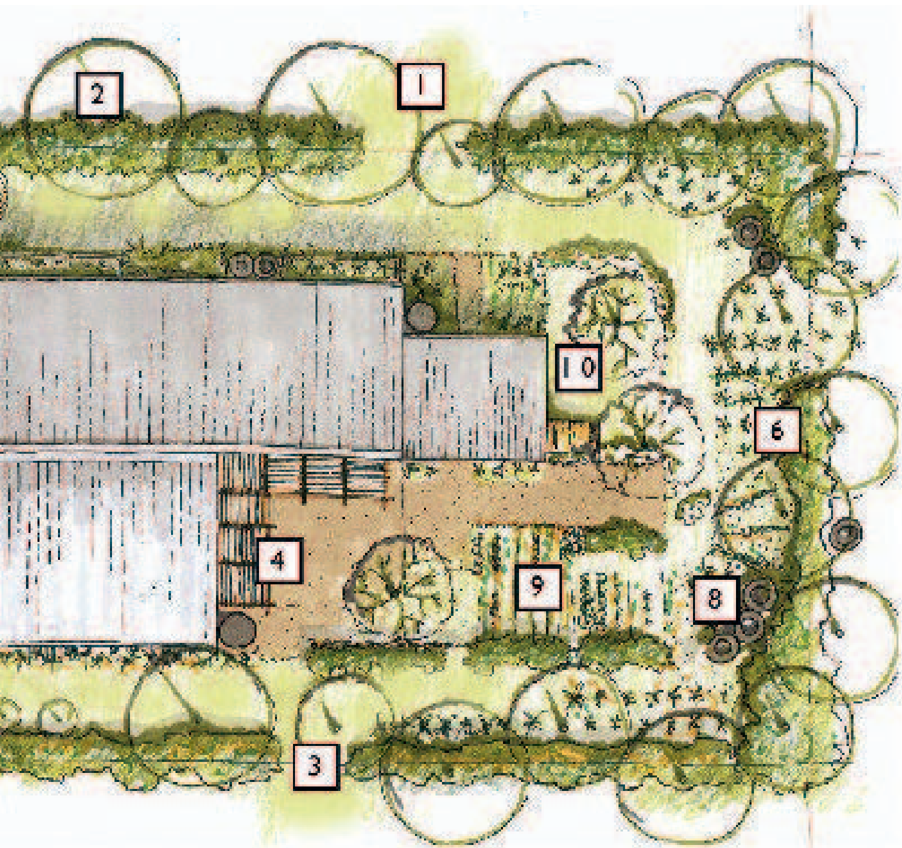
**10** Chicken yard



single building or small NGO to effect change is limited, but Tsoga is dedicated and is making progress – one person or one family at a time.

Establishing self-sufficiency and social equality among the poor requires education, marketable skills, employment, resources, markets, and a humane physical environment. The team designed the project to provide all these assets to the greatest extent possible, especially to empower people during the construction phase and beyond.

The socioeconomic development that Tsoga seeks and the project advances will take decades to realize. The steps can be roughly outlined as follows:



1. Sustenance – food donations, homestead support, beginnings of a local subsistence economy

2. Education and training – imparting marketable skills

3. Resource development – establishing local material sources

4. Producing, not buying – to meet its needs, the neighborhood produces using its own resources instead of relying on outside support

5. Supplying local markets – starting locally and expanding; proximity to solvent markets allows the people to supply goods and labor beyond the neighborhood; money flows into the neighborhood through normal economic exchange

6. Neighborhood improvement – residents locally apply their construction and farming skills and resources

7. Socioeconomic integration – the neighborhood becomes an asset to the greater community; the people become integrated into the city's activities; the city is ultimately relieved of its social, financial, and moral burden

Tsoga Environmental Center contributes to each of these steps as follows:

**1. Sustenance**
A vegetable garden and orchard are planted on the site, providing food for fifty very poor families. The demonstration garden is used in Tsoga's program to teach local families how to establish and maintain their own organic vegetable gardens and productively use domestic land. Under the project, fifty fruit trees for public benefit were planted in the neighborhood.

**2. Education and training**
The construction methods used in the project were highly labor intensive, chosen in order to teach people, use and develop local skills, and build local knowledge. As many local people as possible were hired as construction workers and trained on site. Construction techniques were regularly



explained and demonstrated. A scale model of the building was used to explain the construction principles. Daily meetings were held, and workers were encouraged to propose ways of handling particular tasks. Thus, the workers learned not only trade skills, but how to think, design and build for themselves in a practicable way. They learned practicable methods of rainwater collection and techniques of passive design that can be applied at home.

A Building Support Center was established at the center. It disseminates to the community local knowledge gained in constructing and using the building. To monitor its effectiveness, the center maintains a scoreboard of local sustainable building projects and livelihood practices.

**3. Resource development**

Besides teaching skills, the project places resources in the hands of the people by establishing local sources of materials such as wood and waste. Trees are an economical and renewable source of wood. New trees are planned in the neighborhood for use by the community, establishing suburban forestry. Each tree is to be coppiced and to produce a new pole every five years. A yard for recovering demolition materials was created in the neighborhood, establishing another valuable and plentiful resource. Materials collected here include brick, scrap metal, roofing, stone, and wood.

**4. Producing, not buying**

Prefabricated systems, mass-produced products, and mechanized production technologies have revolutionized building and construction, and most other industries. Artisanal building approaches provide opportunities to address issues of high unemployment and low availability of capital.

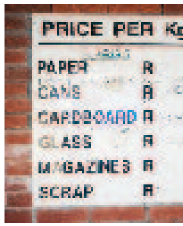
To promote local self-sufficiency, the architects engaged local workers and businesses as much as possible rather than to import industrialized building materials. The benefits are twofold: (1) as much money as possible is injected into the local economy in the form of wages (over half of the construction budget – over 2,000,000 rand – flowed directly into the local community), and (2) once local skills and resources are established, people can begin producing instead of buying, and a local economy can emerge. Tsoga Environmental Center was conceived to catalyze this process.

### 5. Supplying the solvent local market

Once the neighborhood can meet some of its own needs, it can begin selling goods and services beyond its borders. Potential export goods include handcrafted wares, clothing and accessories, furniture, and local services. Two advantages that Samora Machel can exploit are cheap labor and proximity to more affluent districts of Cape Town. Tsoga Environmental Center also draws international tourists to the neighborhood, people who come to see the noteworthy progress that Tsoga is achieving. This is another source of revenue for the local economy.

### 6. Neighborhood improvement

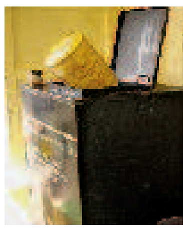
In this phase the neighborhood begins to take control of its situation. With many basic needs covered and resources in hand, locals can begin to improve their homes and neighborhood. As a physical, social, and learning hub, Tsoga Environmental Center should play a central role in this process. In this phase one can begin to imagine an acceptable quality of life in the neighborhood.




### 7. Socioeconomic integration

The Cape Town suburb will have become a civic asset and a global example. This improvement in the conditions for residents will address long-term structural disadvantage, and is the vision of Tsoga and the center.

In fact, this phase has begun. Tsoga is showing Cape Town one way to handle its waste problem. The greening of the city envisioned in the master plan is another contribution. Tsoga envisions ultimately millions of trees throughout Cape Town.



# Social merit

Besides the extraordinary socioeconomic merits, the project displays many other forms of social benefits. It was funded and carried out by the local government at the request of Tsoga, and it meets government policies and guidelines for social responsibility. Material suppliers were screened for fair labor practices and support of historically disadvantaged persons. The designers specified materials and methods that exclude toxic or dangerous substances, and compliance was monitored on site.

The project was planned with the participation of community stakeholders in workshop sessions and discussions to determine the requirements and expectations for the building. Their involvement was important because previous projects that were imposed without community consultation met with both overt and passive resistance. The stakeholder groups included Tsoga volunteers, Tsoga trustees, Cape Town city officials, local councilors, and many local workers, skilled and unskilled. The project also promotes the aims of the Environmental Justice Networking Forum, a locally active NGO that seeks to coordinate environmental and social endeavors.

# Economic value

The economic value of the project exceeds by far the real estate value. As a development project by the local government, the building is a sound investment. The construction cost was below average and operating costs are very low, which allows most of the available funding to go into wages and projects instead of overhead. The center is a catalyst for the local economy, and the building provides an economic base for local people, small businesses, and Tsoga volunteer workers. The project shows how to cost-efficiently reduce the municipal waste stream. It also points out that cities should not rely too heavily on developers, who as investors primarily seek private financial gain. Sustainable development seeks a higher form of profit – benefit for all citizens. In developer-speak, one could say that investment in human capital is the highest and best use of public funds.

The 816-square-meter building was built at a total unit cost of USD 800 per square meter. Comparable buildings of conventional design in Cape Town cost from USD 900 to 1,000 per square meter. The cost of a doubled construction crew was less than the cost of trucking in the standard amount of prefabricated materials.

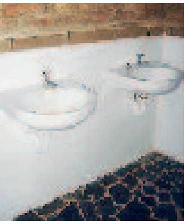
Operating cost comprises the costs of water and power supply, sewer use, phone service, and maintenance. These costs were carefully considered in the design of the building. Durable, low-maintenance materials, passive design, and rainwater collection keep operating expenses low. The only regular maintenance required is periodically oiling the wooden windows and doors and repainting the window grills.

The building employs passive means of heating, cooling, and ventilation instead of mechanical systems. Daylight illuminates all spaces, so artificial lighting is required only at night. The boiler for hot water in the kitchen is used only occasionally. The electricity bill averages USD 29 a month.

Employing local suppliers and labor optimized the direct benefit to the local economy. The project injected USD 380,000 into the Cape Town economy over a nine-month period. Over half of it went to local people, in contrast to the usual twenty to thirty percent. The construction project provided 8,420 person-days of work, or employed an average of 42 people every day for nine months at a rate of USD 38 per day. Because twice as many people were employed as in a standard project, the effect of the training program was doubled.

Small enterprises were contracted to harvest and treat wood, erect the framing, make doors and windows, and weld window grills and balustrades. These contracts comprised over ten percent of the total contract sum of USD 550,000. The contracts for the ceilings, floors, and metalwork included training clauses to benefit community members. Unskilled local workers cleaned salvaged brick for use in the building, helped make and install reed ceilings, and executed the landscaping work.

# Environmental performance



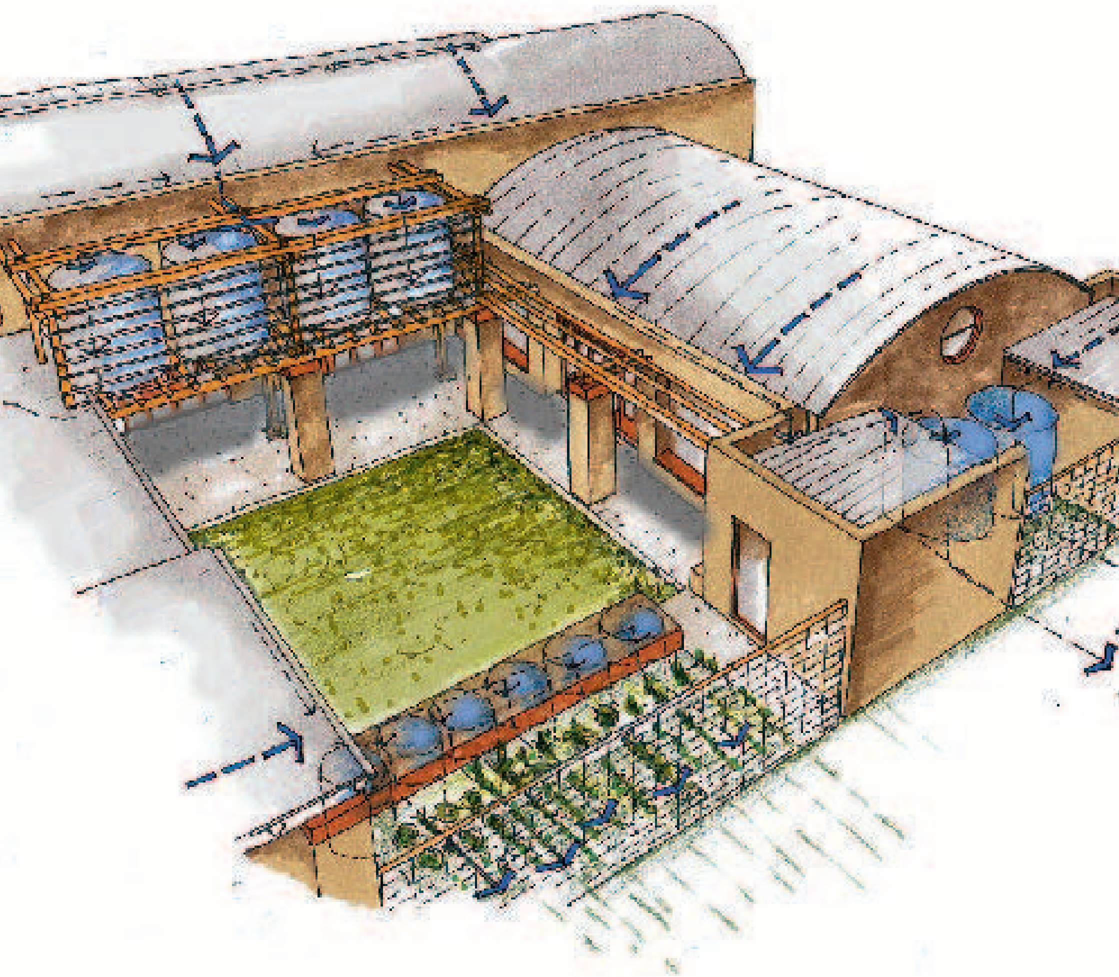
As one would expect from its name, Tsoga Environmental Center sets a good example of raw materials management, energy conservation, and environmental stewardship – and not only because the building houses a recycling center where local waste is collected, sorted, and bundled. The design supports cyclical, regenerative systems instead of urban throughput systems.

Applying its sustainable construction methodology, the design team selected a palette of environmentally friendly materials for the building. These materials are largely natural, nontoxic, non-polluting, renewable, locally abundant, and low in gray energy. Salvaged materials are extensively used. They offer many benefits: reducing waste, providing local jobs, conserving raw materials and fossil fuels, and avoiding greenhouse gas emissions of manufacturing. This sets an example for Cape Town, indeed for every city. Many materials need not go into landfills.

Waste created during construction of the building was recycled. Scaffold planks were later incorporated into the building as seating, and scaffold poles as structure for water tanks and pergolas. The "wasting nothing, use everything" mentality is part of the set of suburban survival skills the center teaches.

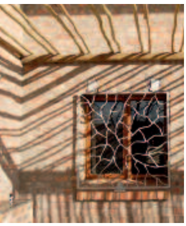
The building was designed to minimize the input of mechanical energy and maximize the input of human energy. The most energy-intensive tool used on site was a power drill. All other work was done by muscle and hand tools. At the end of its service life, the building will be simple to dismantle, and most materials then can be reused. Weak mortars and unplastered and unpainted walls were specified so that bricks can be easily cleaned later.

The project promotes responsible resource management. It shows the local people how their land can yield building materials and food (gum pole, lath, reeds, fruits and vegetables), how materials can be recycled and obtained cheaply, how rainwater can be easily collected, and how passive design can provide comfort without energy costs. The project not only built environmental awareness among local people, it taught them practical ways of applying ecological principles.



# A new vernacular

With this building the designers sought to define a new vernacular architecture that local people could adopt, one that is economically and technically viable and will remain so, one that respects local tradition and culture, and one that can be used to create a fitting and dignified environment. The vernacular utilizes natural materials and cheap and plentiful modern industrial waste materials. It employs traditional and simple building methods so that poor people can build structures themselves. It responds to the climatic, social, cultural, urban, economic, and environmental contexts. Industrialized systems characterize mainstream construction worldwide. The engineering, fabrication, transport, and installation of these systems excludes the poor. Artisanal building can include the poor in the value chain. In 1949 Siegfried Giedion proposed that "Mechanization Takes Command"; but little more than half a century later, the new vernacular retorts, "mechanization takes the back seat."



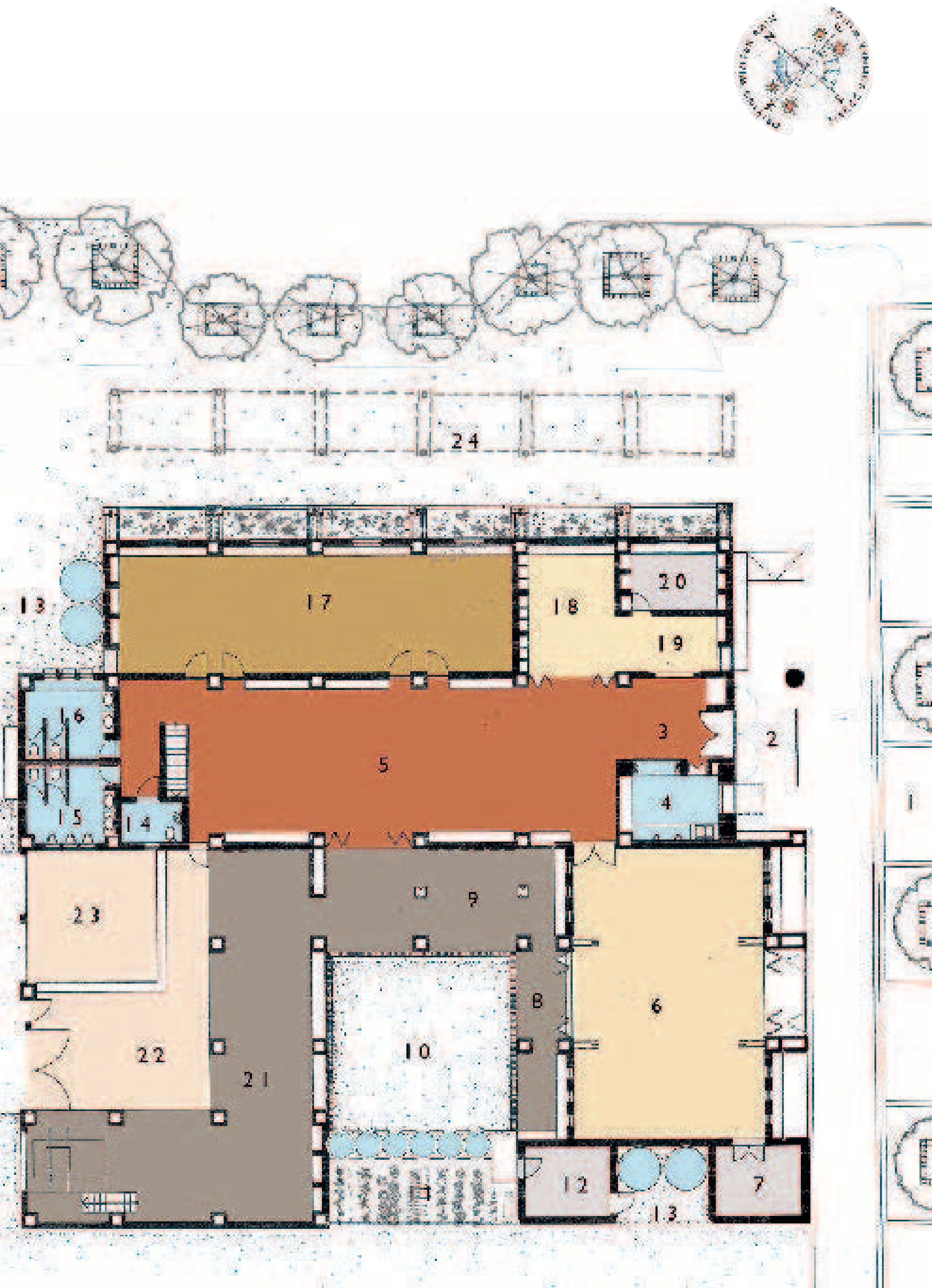
This architecture is rustic and African, and it speaks to the people. Polished elegance would be out of place here, doomed to rejection by the community. The need is for appropriateness, not flashiness, and this is one reason Tsoga enjoys enthusiastic acceptance by the community. The locals appreciate that most of the construction budget went into lasting socioeconomic benefits instead of highly processed materials. Another reason locals strongly identify with the center, is that it was built with pride by local hands. During one of the workshop sessions, a Tsoga volunteer said, "We want a place that we can be proud of with jewels on the roof." The spring flowers on the earth roof are the living jewels. In a broader context, this state-funded municipal building demonstrates that the government of Cape Town supports the use of recycled and alternative materials in carefully designed buildings. This statement elevates the status of recycled and non-conventional building materials from substandard to the material of choice preferred by responsible builders.

# The architecture

Formally, the building comprises four main volumes, which are simply combined to form a rectilinear floor plan. Three of the volumes are arranged in a U-shape to form a courtyard. The volumes vary in height according to a formal hierarchy, the central two-story volume being flanked by one-story volumes. The massing is orchestrated to mark the main entrance with visual weight and to achieve human scale where the building edges step down to the adjacent houses and the market pergola. Separate roofs cap each building volume, accentuating the formal expression of the building as a composition of volumes.

The original design shows a round column and Tsoga sign marking the entrance. The design of the column was changed during the construction phase, and the sign will be installed when Tsoga fully takes over the building. The entrance leads into the lobby (labeled “foyer” on the drawing). This lobby is the largest volume in the building, a two-story longitudinal circulation, meeting, and presentation space. It is flanked on both sides by single-story spaces – offices, workshops, and workrooms – and the meeting hall. The lobby ceiling traces the curve of the vaulted roof, reinforcing the spatial unity of the room, which is reminiscent of a

**1** Oliver Tambo Square
**2** Covered entrance
**3** Entrance foyer
**4** Kitchen
**5** Double-height foyer with mezzanine level
**6** Hall
**7** Storage
**8** Outdoor walkway
**9** Water storage above veranda
**10** Courtyard
**11** Vegetable garden
**12** Storage
**13** Water storage tanks
**14** Handicapped-accessable toilet
**15** Male toilets
**16** Female toilets
**17** Workshops
**18** Open-plan office
**19** Reception
**20** Office
**21** Covered recycling yard
**22** Recycling yard
**23** Parking
**24** Market pergola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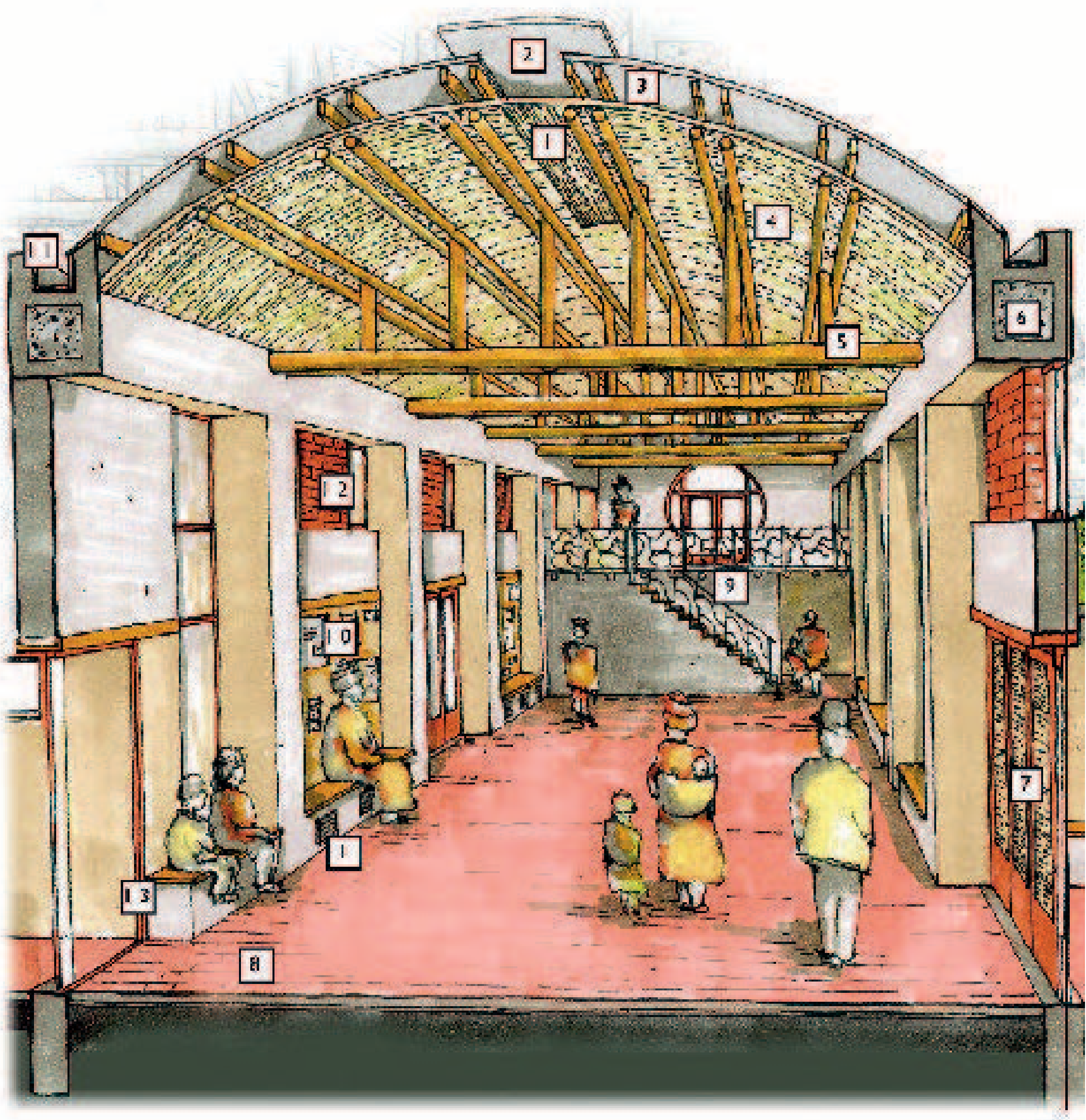
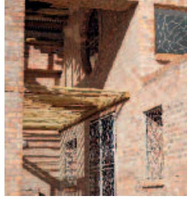
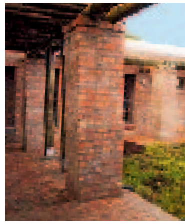
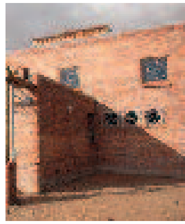
Roman basilica. A gable or shed roof would have been simpler to build, but would not have the uplifting and embracing character that the vaulted ceiling adds to this main public space. The barrel vault is not a traditional local roof form; the pitched roof is. The barrel vault distinguishes the structure as a significant public building.



Tsoga serves its community generously, and the building reinforces that endeavor. It offers outdoor drinking fountains, trees that bear fruit for public consumption, shade, shelter from rain and wind, and outdoor seating in various niches where people can relax. The flexibility of the building is also generous, allowing incremental conversion and expansion as programs and partners grow and change. The gallery, workspaces, and hall can be used simultaneously or interchangeably for a variety of meetings, craft activities, and exhibitions. The workspaces can easily be subdivided in various ways. The waste-recycling court can be converted into offices after the waste-handling business outgrows this location.

The structural elements of the lobby and hall are designed to carry loads of a second floor, which could be added in the future. If a second floor were added to the lobby, then the roof would have to be replaced because it is flammable; it meets code only because the building is considered single-story.

**1** Adjustable vents for summer cooling

**2** Fixed roof vent

**3** Ventilated roof cavity

**4** Reed ceilings

**5** Boron-treated gumpole roof structure

**6** "Rubble-crete" beam – all structural members consisting of recycled reinforcing bars, strong mortar mix, graded and cleaned broken bricks, and mortar from recovered bricks

**7** Reed infill panels

**8** Recovered brick flooring

**9** Decorative metalwork made by local artisans and linked to job creation program

**10** Pinboard walls

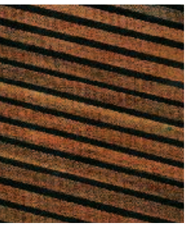
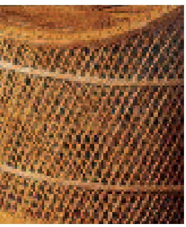
**11** Purpose-made gutters to rainwater tanks

**12** Decorative brickwork panels

**13** Eucalyptus maculata seating made from wood obtained through alien-tree eradication program

# Building materials



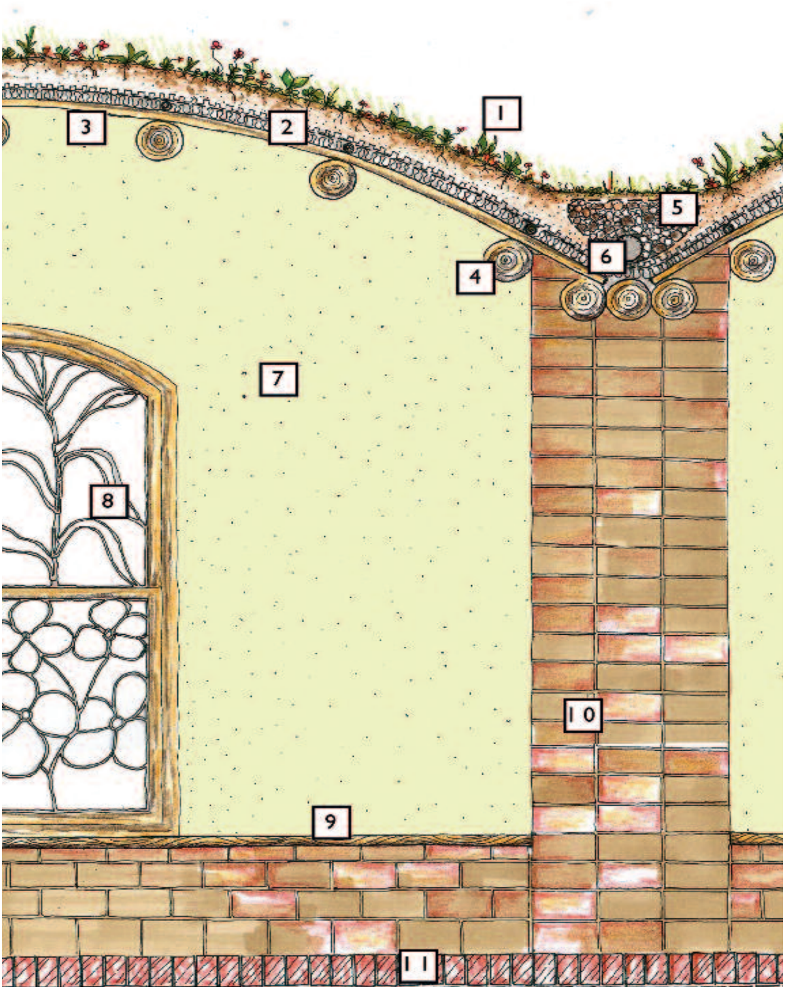




Central to the new vernacular is economy and resourcefulness in the use of materials and construction methods. Locally available, salvaged brick is the main material used in the building. Brick is durable, robust, and attractive. Masonry walls throughout the building are fair faced. Reclaimed brick in exposed applications is not to everyone's taste, but careful cleaning, selection, and workmanship produced adequate results at the center. The beauty lies beneath the surface.

Wood is locally plentiful and renewable, and thus plays strongly in the new aesthetic. Most of the wood for the building comes from invasive alien trees cleared from local forests. Poles and logs are used instead of surfaced timber; the wood was treated with boron on site and finished naturally. Wooden windows were fabricated locally. Wood lath for screens and fences was harvested from local trees.

Reeds are an indigenous building material in South Africa, and were used here to make attractive ceiling mats and divider screens. Reeds regenerate rapidly, but the material has become expensive and scarce, as wetlands have been swallowed by development. Given the large number of detention ponds on the Cape Flats, it should be possible to revive the use of this renewable building material. Reed mats must be replaced relatively frequently, but because they are made by hand from renewable material, the ecological profile is favorable. Sustainability does not always equal durability.

Crushed demolition rubble was used as aggregate in the concrete foundations. The sod roof is planted with indigenous mountain plants that require no care. Rejected polished stone along with reclaimed brick was used for mosaic floors. Discarded steel reinforcing bar was used to fashion decorative security grills for windows. Rejected industrial rubber matting was used as insulation. Recycled polystyrene packing material was crushed and used as cavity-wall insulation. New corrugated metal sheets were used for roofing. Although the rooms are simple rectangular spaces, the variety of room heights and proportions, and the textures and colors of the palette of natural materials, create a visual richness. The building displays craftsmanship and beauty of natural materials as opposed to machined precision and highly finished materials. The handsomely textured floors, walls, and ceilings are part of the new vernacular – fitting for the neighborhood, and by no means second rate.




**1** Diverse range of succulents on 70 mm well-composted soil

**2** Polyethylene insulating layer from industrial waste stream, 40 mm thick neoprene waterproofing on hessian layer

**3** Rent 40–50 mm Ø lath under waterproofing

**4** Gumpole beams

**5** Gravel wrapped in woven geotextile for drainage

**6** 75 Ø agricultural drain

**7** Limewash wall finish

**8** Recycled metal security grills

**9** Timber seating

**10** Brick recovered through employment program

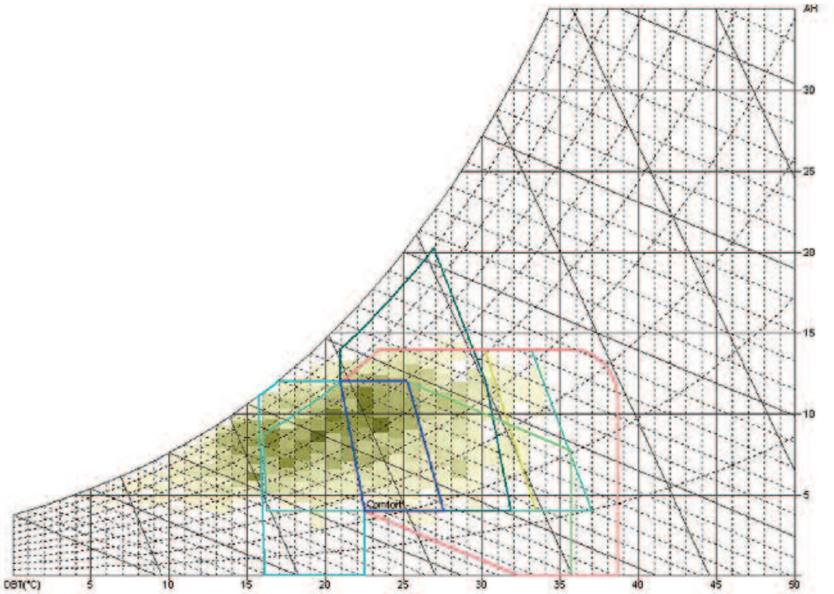
**11** Recovered brick; vapor control membrane on well-compacted sand; below, crushed demolition rubble was used as aggregate in the concrete foundation

# Passive climate control

The indoor climate is controlled by passive heating and cooling, shading and ventilation systems, insulation, and thermal mass of the floors and walls. Several passive energy concepts using various roof assemblies and insulated cavity-wall designs were modeled and studied. Simulations included all heat sources. The design was optimized to minimize the hours of indoor air temperature above 26˚C in summer and below 18˚C during working hours in winter.

Psychometric chart

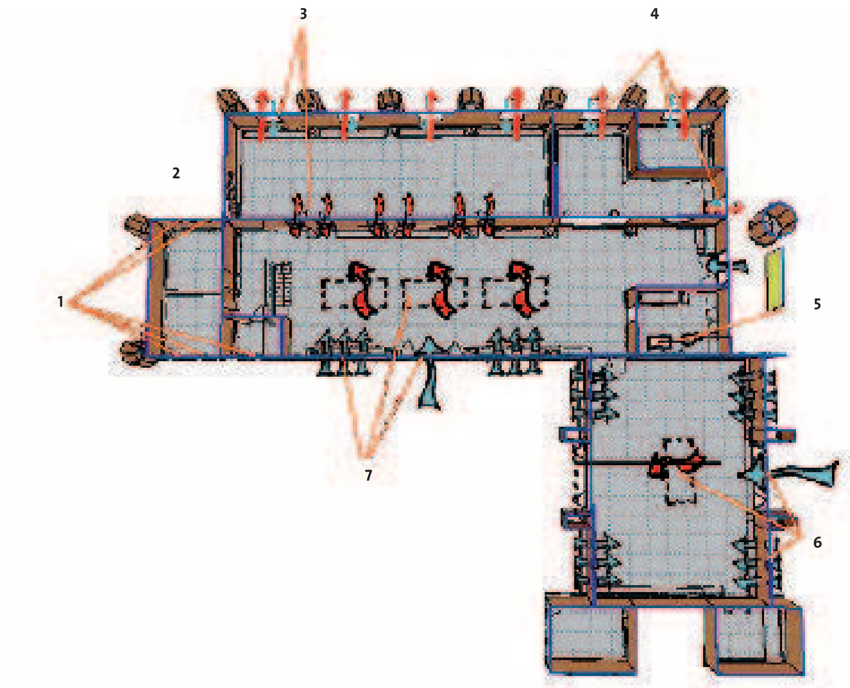
- Passive solar heating
- Thermal mass effects
- Exposed mass plus night-purge vent
- Natural ventilation
- Direct evaporative cooling
- Indirect evaporative cooling




A basic aspect of passive design is the placement and shape of spaces in the building. The layout considers the necessary level of comfort required for each space, taking into account heat generated by indoor activities during all seasons. Offices and workshops are situated on the northeast side of the building, the coolest side. These spaces are regularly occupied, and therefore situated for maximum comfort and productivity. They are covered by a green roof that shades, insulates, provides high thermal mass, and cools by evaporation.

Other roofs are insulated and ventilated. The central vault roof is insulated with a 75 mm polyester blanket, and the build-up includes a 3 cm air space for ventilation in summer.

Ventilation is manually controlled using a pole to operate a wooden flap. The assembly of external insulated cavity walls comprises 270 mm brick (inside for thermal mass), 50 mm insulation (recycled polystyrene packaging chips), and 110 mm brick veneer.




Ventilation strategy in plan

**1** Toilets ventilated by windows

**2** Future vents for mechanical vent. of equipment (e.g. kiln)

**3** Workshops – sliding sash windows ventilate into exhibition space

**4** Offices – sash windows

**5** Mechanical ventilation in kitchen

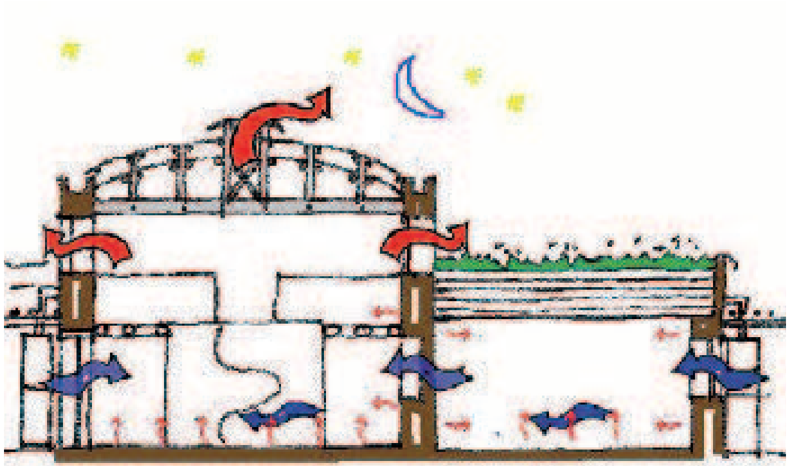
**6** Cross ventilation of hall via doors; low vents and roof vent

**7** Cross ventilation of exhibition space; low vents and roof vent

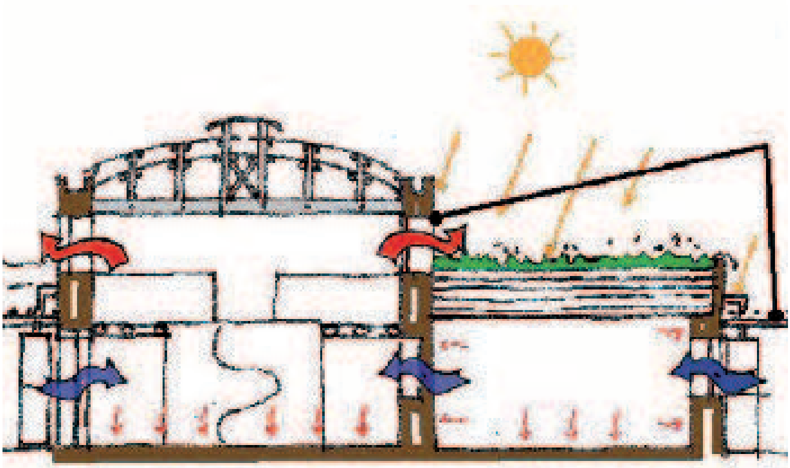
In summer the outdoor temperature varies by about 15°C daily, from 18° to 33°, and indoor temperature fluctuates between 20° and 25°. Heat conduction from the outside is prevented by insulated cavity walls and the insulated and ventilated roof assembly. Solar gain is reduced by shading. During the day, most windows and vents are kept closed to reduce infiltration of warm air; only those needed for fresh air are opened.

The massive brick walls and concrete floor absorb heat from the indoor air. At night, windows are opened, and vents in the roof and at ground level are opened to induce natural airflow, extracting warmth from the thermal mass. The hall and foyer are cross ventilated. Nighttime cooling is used nine months of the year.

In winter the building is heated by solar gain, building occupants, electric lights, and equipment such as PCs. Shading is adjusted to maximize solar gain. To retain heat, walls and ceilings are insulated and windows and vents are kept closed at night. Indoor temperature drops below 18˚C

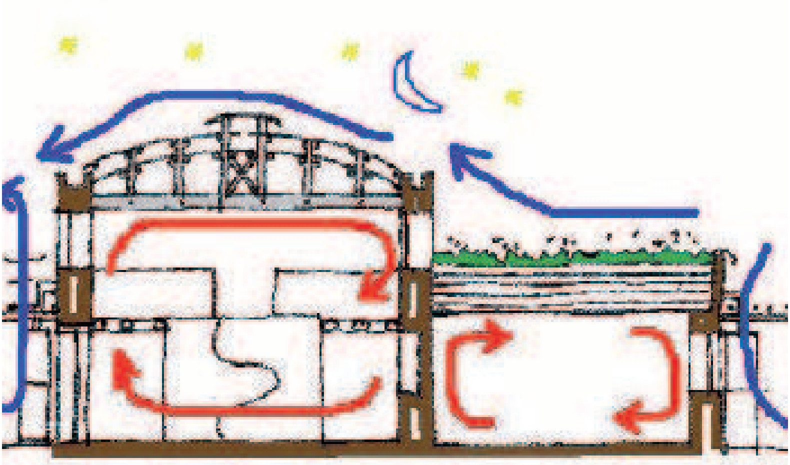


Summer thermal strategy: night ventilation removes heat stored in thermal mass

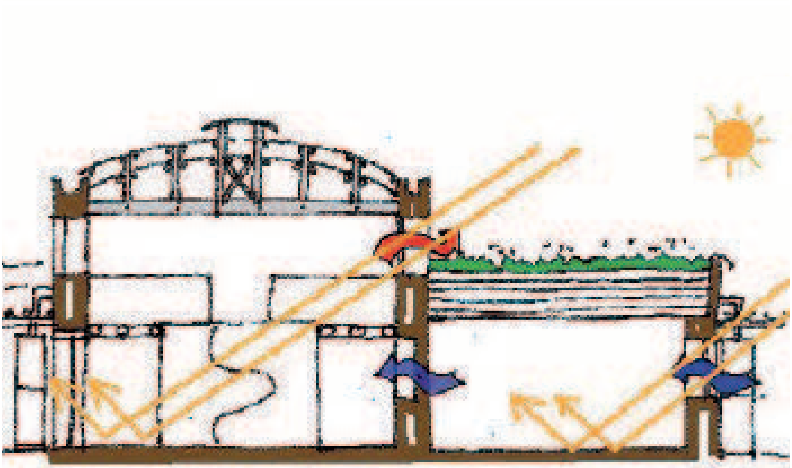


At day: internal heat gains moderated by thermal mass. Shading reduces solar heat gains during 16% of the working hours in winter. This is tolerable because occupants can dress warmly in winter. By accepting this fluctuation, the building can do without artificial heating.

Controlling the climate in the lobby (circulation and exhibition space) is difficult because occupant loads vary and the main entrance opens onto the space. The lobby is never occupied for more than thirty minutes at a time, so slight discomfort of the indoor climate is considered acceptable. The hall is the main assembly space, and it is designed to provide a comfortable climate even when fully occupied for two hours. Indoor climate in the building has not been measured.



Winter thermal strategy: insulation and wind barrier retains heat at night; no night ventilation

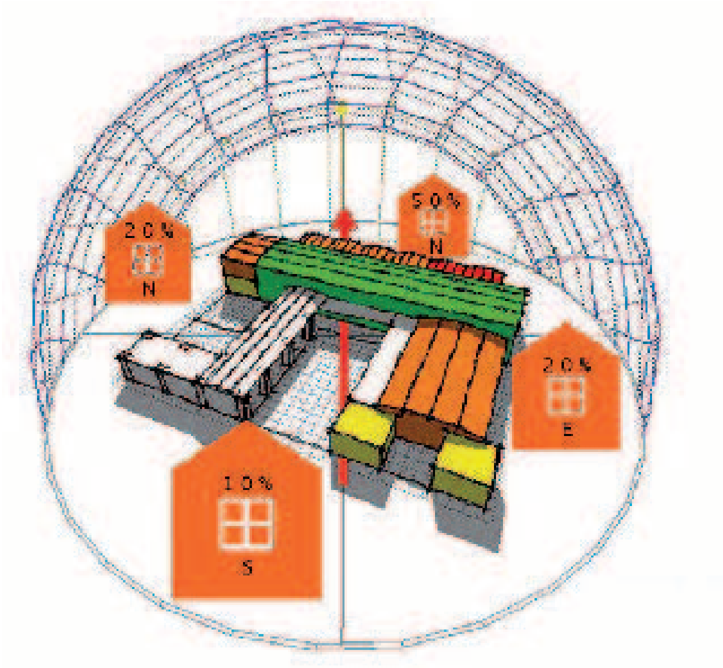


At day: internal heat gains and solar energy stored in thermal mass and released when temperature drops. Shading designed to allow low-angle winter sun to enter

# Window orientation and sizing

Windows and shading are oriented and sized for passive heating, cooling, and lighting. On the northeast facade, fixed horizontal shading made of simple 5-cm-diameter lath allows the low winter sun to enter but blocks the high summer sun. Vertical shading is effective on the southeast and northwest facades, and fixed shading blocks unwanted solar radiation all year round. Operable shading permits winter sun and blocks summer sun.

Windows permit diffused and direct sunlight. Diffused light reduces the need for electric lights all year round and reduces heat gain from electric lights in summer. Direct sunlight heats spaces in cold seasons; in warmer months it is blocked to keep the building cooler. Window sizes relate to orientation. Daylighting design utilizes rules of thumb and simple modeling instead of detailed calculations.



# Mechanical, electrical, and plumbing systems

The building has no mechanical heating, cooling, or ventilation systems, except for an exhaust fan in the kitchen. The original design called for a wind generator on site; this was deleted due to costs. Power is supplied from the municipal grid. Wiring is installed in chases, integrated inside columns, to accommodate future modification of electrical and electronics systems. Photovoltaic panels were not installed due to the cost; solar power generation is three times more expensive than power from the grid. Hot water is needed only occasionally in the kitchen. Drinking water is supplied from the municipal system. Rainwater is collected from all roof surfaces and used for flushing toilets and for on-site irrigation, supplemented by well water. Low-flow faucets and toilets are used. The building is connected to the municipal sewer; a septic system was not technically feasible because of the high water table.

# Building a future

The building suggests a new indigenous aesthetic, valid for the time and place. The project developed new artisans and taught them the associated skills and principles. It established local resources. It teaches people to value their own handwork over industrial materials. It strives to create a micro-market, to spur a local economy that can develop and become self-sustaining. While the integration of the building into the community takes time, one already anticipates that this seed will germinate, develop and generate future changes – for instance a kiosk or a small market building on the square, or replacement of neighborhood shanties with new owner-built houses, built with the newly gained skills and an artisanal perspective.

# A “wake up” that resonates beyond “Tsoga”

*The designers of Tsoga* Center relied extensively on logic, proven practices, documented experience, and rules of thumb instead of precise calculations. Simple methods and thoughtful design are practical approaches, well suited to the cultural, technical, and economic context.*

*The project invites us to reconsider the merits of applying human energy – the cleanest and healthiest form of energy – instead of electromechanical energy. This approach equates with more jobs and it distributes wealth. It promotes pride of workmanship and pride of place. The project is a reminder of the often-overlooked option of deindustrialized building.*

*The designers show great concern for local disadvantaged people. With acute awareness of indirect and future ramifications – social, environmental, and economical – of building projects, they shaped the project to achieve far more than the construction of a community center. Every material and method was chosen to provide the fullest benefit, in the broadest sense, to the local community. Such awareness is valuable in any context. As the name Tsoga says, this is a call to “wake up!”*

*The first three books in this series show an office building in Costa Rica, a research center in Switzerland, and a community center in South Africa – three buildings that vary in function, size, technical scope, and context. Each is specific to its context and would be out of place in the other contexts. Yet the similarities are striking. All three projects show that the creation of sustainable buildings requires extraordinary commitment of the owner or client. They show that designers must apply sensitivity. They show that passive systems for heating and cooling can replace mechanical systems, that recycled materials can be incorporated into new buildings, that passive lighting is often feasible, and that buildings can always be* *designed to respond to the full range of critical issues. The three buildings use passive systems for climate control. Fluctuations of temperature, humidity, and lighting are greater than those in buildings with mechanical heating and cooling, but acceptable.*

*This invites observations and questions. How much comfort is necessary? At what cost? Sustainable buildings can be built anywhere, so what is the best way to ensure that they will be built? Will the voluntary approach suffice, or are regulations needed? Or will we wait until fuel and material costs rise so high that we have no choice? Building codes and standards ensure safety, but they fall pitifully short of addressing the full range of issues, especially social and environmental requirements. Can sustainability clauses be added? Would it be reasonable to require that every building with mechanical systems must also include passive systems? Or that every building with air conditioning must also include shading and passive cooling systems? Should governments be required to build only exemplary buildings, to set an example? How can such advancements be transferred to the urban scale?*

Daniel Wentz

* Tsoga is the Xhosa word for wake up!

# Team approach to sustainable construction

Bronze Award
Winner 2005
Holcimawards
for sustainable construction
entre
1. Site Establishment
2. Foundations & Masonry
3. Timber Work & Roof
4. Service Systems

"Tsoga was a chance for us to seek a sustainable solution in a context with great poverty, limited material resources, and enormous human potential."

Interview with the Tsoga project team (from left): Alastair Rendall, Gita Goven, Anne Cowen, and Vernon Collis.

**Tsoga Environmental Center was designed and built using your sustainable construction methodology. Please explain this approach.**

**Alastair Rendall:** The team developed the methodology as a formal means of designing sustainable buildings. The methodology is held in place by a design philosophy and the underlying design principles. All interventions emerge and are guided by this philosophy. The methodology is designed to create synergy between natural systems, technology (or manmade systems), and consciousness. The principles for praxis serve as a filter that guides the design process to ensure both ecological quality and appropriate energy responses.

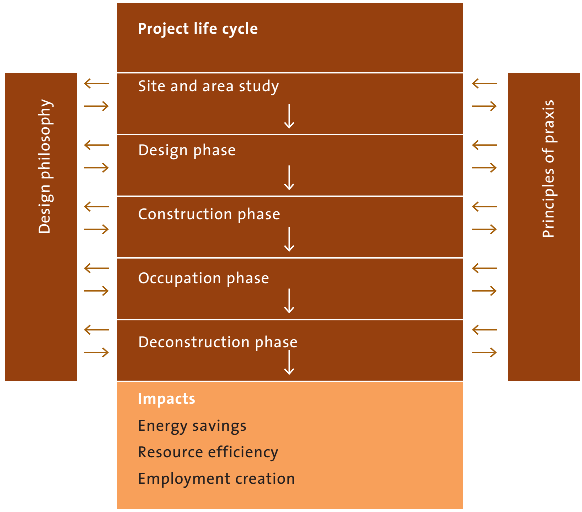
The approach assumes that each site goes through a life cycle. In an iterative process, a multidisciplinary design team considers each phase of the life cycle in reference to the design principles. For example, when one considers construction, one must also consider deconstruction. Ultimately, a balance or best fit across all five steps emerges. The outcomes vary from site to site, and are always appropriate to each context. Tsoga Environmental Center found its specific form through application of this general methodology, which can be applied universally. We hope it will help inspire a new way of approaching construction projects and will become common practice.

**Tsoga Environmental Center embraces a range of concerns that originates and radiates far beyond the site. Presumably, these are identified in the first step, site and area study.**

**Gita Goven:** Yes, once the project has been defined and the site identified, a thorough information-gathering process begins. This is informed by the design principles. The site-area study involves consideration of manmade systems, in particular the potential waste streams generated by the construction and manufacturing industries. By studying the availability of both conventional and unconventional materials in the area, a palette of local construction materials emerges. With respect to the natural systems, the area will reveal natural building materials which are either abundant or are well suited to the area because of its unique environmental, socioeconomic, or technical context.

**What are the five steps of a building's life cycle?**

**Gita Goven**: Site and area study, design phase, construction phase, occupation phase, and deconstruction phase.




**In this methodology, how does the design phase differ from a conventional design phase?**

**Anne Cowen:** The evolution of the building tectonic harmonizes architectural ideas, expertise, local knowledge, and the palette of materials. The form evolves by considering ways of reducing the energy footprint during the construction phase. Considerations include ways of absorbing daily construction waste, as well as the energy inputs required during construction, such as tools and cranes. Wherever possible, human labor is preferred to power tools. Depending on prevalent skills in the community, construction technology is chosen to fit local conditions. Simultaneously, the building is designed with deconstruction in mind. For example, the sizes of columns and beams not only facilitate a multiplicity of function, but also allow using weaker mortar. Full-strength mortar hinders full recovery of building materials when a building is deconstructed. For the same reason plastered buildings are not encouraged. Wooden and metal elements are bolted or screwed into place so that they can be unbolted and reused.

**How did the methodology affect the construction phase at Samora Machel?**

**Anne Cowen:** The entire construction process is designed to minimize mechanized energy inputs and to maximize human energy inputs. Scaffolding consisted of poles and planks, bolted together. When the scaffolding was no longer required, it was dismantled and the materials were incorporated into the building. The poles became trellises and the planks became seating. Residual mortar was always put into the building rather than being carted away. Thus, we conserved materials and reduced transport energy.

**The building is now in the occupation phase. What is critical in this phase?**

**Vernon Collis:** Primarily, long-term energy consumption. The further energy is transmitted, the greater the loss; hence the inefficiency of electrical power grids. We should attempt not to rely on municipal power grids, but generate as much power as possible on site. We had designed this project with a wind generator, but had to strike it because of budget constraints. To keep energy consumption low, the occupants must properly use the passive systems designed into the building. Gray and soiled wastewater is considered for processing and use on site, while all solid waste tends to be naturally reprocessed. Plants are used for shading of the building and must be cared for. The earth roofs are planted with a range of indigenous and medicinal plants. These roofs reduce heat reflection, absorb $CO_2$, and generate oxygen.

**How was deconstruction of the building considered during the design phase?**

**Vernon Collis:** The amount of energy required to build the structure relates directly to the amount of energy required for its deconstruction. Given that the building utilizes human power and that weak cement and lime mortar mixtures are used, near full recovery of materials will be possible. The building has been designed so that the entire structure can be unbolted, deconstructed, and even re-erected elsewhere with the least possible effort. Designing for sustainability takes more care and more time because many more factors must be considered, including deconstruction.

**Architects learn from every project. How did this project contribute to your development or change your way of thinking or designing?**

**Alastair Rendall:** Tsoga Environmental Center was a chance for us to seek a sustainable solution in a context with great poverty, limited material resources, and enormous human potential. As we tackled the paradoxical complexities of this challenging terrain, we found ourselves opening up. Sustainable design calls for interdisciplinary teamwork. The challenge and joy this involves exposes one to an enriching and stimulating diversity of perspectives. The quest for sustainability challenges us to constantly question ourselves and soberly consider our world. As we heal the earth, we heal ourselves.

# Technical data

| | |
|---|---|
| **Construction period** | March 2006 to April 2007 |
| **Building type** | Community center |
| **Building volume** | 2,345 $m^2$ |
| **Maximum number of occupants** | Seating for 120 in the hall, 200 in the exhibition space, 5 in offices, and 20 at workplaces. |
| **Gross usable floor area** | 513 $m^2$ |
| **Number of finished floors** | One, plus 36 $m^2$ mezzanine |
| **Number of basements** | None |
| **Construction** | Masonry load-bearing structure, wood frame roof. |
| **Mechanical systems** | None. Passive heating, cooling, and ventilation |
| **Construction cost** | USD 550,000 (at 1 USD = R7) |

**Design team**

Alastair Rendall, Architect, Urban Designer, ARG Design, Cape Town
Gita Goven, Architect, ARG Design, Cape Town
Anna Cowen, Architect, Anna Cowen Associates, Cape Town
Vernon Collis, Structural and Sustainability Engineer,
Vernon Collis Associates, Cape Town
Abby Street, Quantity Surveyor, Cape Town
Paul Carew, Passive and Low-Energy Design Engineer, Cape Town
Tarna Klitzner, Landscape Architect, Kala Landscape Architects, Cape Town
Penny Marguerite Unsworth, Landscape Architect, ARG Design, Cape Town
Shane Vernon Stewart, Architectural Technologist, ARG Design, Cape Town
Martin Firer, Architect, ARG Design, Cape Town

**Contractor**

Clive Drude, Drucon Building and Roofing, Cape Town
Tino Sangiorgio, Site Foreman, Cape Town

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**Author's note**

Grateful acknowledgement is due to the Holcim Foundation for Sustainable Construction for making this publication possible and coordinating the production, to Alastair Rendall, Architect at ARG Design, for providing information on the project, answering my many questions, and fact checking, and to Christopher Barbour, Humanities Bibliographer & Coordinator of Special Collections, Tisch Library, Tufts University, for proofreading the text. I take all responsibility for any errors I might have added after proofreading.
*Daniel Wentz*

## Books in this series


2006


2007


2008

# Holcim Foundation

**The Holcim Foundation for Sustainable Construction promotes innovative approaches to sustainable construction. The objective of the Holcim Foundation is to encourage sustainable responses to the technological, environmental, socioeconomic and cultural issues affecting building and construction, regionally as well as globally – through a range of initiatives, including Holcim Awards, Holcim Forum, and Holcim Projects.**

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www.holcimawards.org

* The partner universities of the Holcim Foundation are the Swiss Federal Institute of Technology (ETH Zurich), Switzerland; Massachusetts Institute of Technology (MIT), Cambridge, USA; Tongji University, Shanghai, China; Universidad Iberoamericano (UIA), Mexico City, Mexico; and University of the Witwatersrand, Johannesburg, South Africa. The Universidade de São Paulo (USP), Brazil, is an associated university of the Holcim Foundation.

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for sustainable construction

A series of symposiums for academia and practitioners to encourage discourse on the future of the built environment. The Holcim Forum supports sustainable construction in the scientific field, among experts in the construction sector, business and society.

In addition to renowned specialists from around the world, promising international students from leading technical universities are invited, to represent the next generation and to share their visions.

The first Holcim Forum was held at the Swiss Federal Institute of Technology (ETH Zurich), Switzerland, in 2004 under the theme "Basic Needs." The second Holcim Forum was held in 2007 at Tongji University in Shanghai, China, under the theme "Urban_Trans_Formation."

www.holcimforum.org

## Holcim grants
for sustainable construction

Seed funding for building initiatives and grants for research projects to accelerate progress and promote sustainable construction.

Within the framework of Holcim Projects the Holcim Foundation provides USD 1 million per three-year cycle to support research in sustainable construction and the implementation of building projects. Projects nominated for seed funding are evaluated according to the target issues for sustainable construction, and must be endorsed by a local Holcim Group company.

The Holcim Foundation acts as an enabler for both research projects and building initiatives so that, whatever their origin, exciting and important new ideas can be more widely implemented and tested by a broader audience of specialists.

www.holcimgrants.org

Holcimfoundation
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This publication can be downloaded as a PDF file at
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Published by Holcim Foundation, Zurich, Switzerland
Layout by Schadegg Grafik, Zurich-Gockhausen, Switzerland
Printed in Switzerland on FSC paper by Stäubli Druck AG, Zurich
Stäubli Verlag AG, Zurich, Switzerland

ISBN 978-3-7266-0082-2

Holcimfoundation
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