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Paper

ACHIEVING SUSTAINABILITY WITH A NATURAL BUILDING APPROACH
FROM STRAW BALE TO DOME BUILDING

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While there are numerous ways of achieving some degree of sustainability within any building project, finding holistically sustainable solutions can be more elusive. This paper will take an introspective look at some of the projects undertaken over the past 5 years within the light of six broad themes for achieving sustainability:

1) Socio-Economic – socially, economically and culturally uplifting
2) Land - respectful and in symbiosis with the land.
3) Water - the protection, conservation, efficiency and reuse of water.
4) Energy - energy efficiency and use of renewable energy sources.
5) Health - healthy, non-toxic and non-polluting.
6) Holism - holistic and intrinsically recyclable.

(see "A Manifesto for Green Architecture" - by the author, Sustainability in the Built Environment Conference, Gauteng, 1998)

With increasing concern for our built environment, the design philosophy of the author is a natural building approach. This involves that we try and maximize the use of locally available natural and recycled materials as far as possible and eliminate the long distance transportation of bulk materials. All unhealthy, and polluting materials are eliminated as far as possible and buildings and their services are seen as part of an interconnected ecological web, where the waste of one input becomes the resource for another. This approach results in buildings that have very low embodied energy, whose building process can be wholly inclusive of the buildings owners and local inhabitants and which start to eliminate waste and pollution so common in the built environment.

The projects examined, cover a range of residential, educational as well as commercial building types and are located in rural, suburban and urban settings. With each of the projects, the author's design approach was to make the projects as green as possible. The results differ in most cases and so, an attempt is made to try and understand what encourages and what prohibits a greener architecture.

NEW HOUSE for Mrs. D. SALTERS **April 1999 – May 2000**

LOCATION –Tesslaarsdal – Overburg District, South Western Cape

- The setting is a rural farming village, about 20km from the town of Caledon. The site contained an existing L-shaped vernacular style thatch roof house.

CLIENT OBJECTIVE:

- To build a straw bale and thatch roof house in as environmentally sound a way as possible.

COST & TIME CONSTRAINT

- The client was on a limited budget, given that she did not want to use bank finance. The project of 96m² of internal space and 18m² of verandah space was built for ±R160 000.
- The client was prepared to build slowly within her means and wanted to be actively involved in the process. The project took 1 year to build, coming to a complete stop at one stage while the client earned more cash before the works could be finished off.

LOCAL AUTHORITY RECEPTABILITY

- Council building approval was obtained without resistance, once the official's concerned spoke with the author about the various the building systems employed.

DESIGN FEATURES

Style – The external style of the house was based on a traditional cape vernacular cottage form in keeping with the character of the area. The roof was designed asymmetrically to help reduce the scale of the house.

Gables –The more common style of building exposed parapet gables, was excluded in favour of a "jerkin-head" type hipped gable roof, to ensure protection against weathering.

Fireplace – the fireplace, built of fired clay brick, was used in a structural capacity to help brace the structure. Furthermore the position was centralized, so as to minimize heat loss.

Orientation – While the siting is in sympathy with the contours, the house was designed to create the 3rd wing of a courtyard with the existing house on the site. The lower side of the house helps deflect the unpleasant prevailing southeasterly winds, to provide a sheltered verandah space on the courtyard side of the house.

MATERIALS

Foundations – A concrete and rubble stone foundation was used, helping to save concrete. Sand was sourced locally on-site from the properties dam. However due to the poor nature of the sand it was decided to mix it with a better quality sand which had to be transported in by truck from Caledon. All the stone was gathered from on the property itself.

Floor – Given the likelihood of an extended contract period, it was decided to go for a regular concrete slab on cut and fill. A combination of oxide screeds and clay tiles were used, providing the structure with good thermal mass.

Structure – The roof support is provided by a combination of stone piers on the corners, pole supports bracketed to the stonework plinth and a few masonry bathroom walls with straw bales being used as infill only. The roof structure uses blue-gum poles, which were cut on the property and treated with a mammal friendly boron based wood treatment called "Totim B". Besides contributing to a healthy building, this helped with alien clearing, reduced transport, created more jobs for the local community as well as halving the structural timber cost.

Walling – Except for a few internal bathroom walls of clay-fired brick, the walls are straw bales. They were laid on-edge – saving on space and material - on top of a stonework plinth. The straw came from a neighbour's farm. The external plastering was done with a mix of sand, cement and hydrated lime onto a netting of chicken mesh with a homemade lime-wash to finish. The internal

walls were done in a clay plaster. The clay came from a village neighbour who had dug up the clay while making a garden pond.
Roof Construction – A thatch roof was used in keeping with the local vernacular. The verandah roof, of corrugated iron is used to help catch rainwater. The thatch ceilings are exposed while the lean-to roof is done with reeds and have 75mm of "Thermguard" (made from recycled paper) insulation.
Doors & Windows – A combination of second hand and recycled Oregon pine windows were used, avoiding the use of the typical "meranti" timber window, so as to avoid contributing to the destruction of rainforests. To protect the vulnerable sill areas, proper brick and tile sills with a damp proofing were detailed. A geo-fabric ("Kaymat") cloth was used to interface between the bales and the damp proofing. All timber was protected, using non-toxic wood oil treatments supplied by "Enviro-touch".

SERVICES
Water – An Enviro-loo, a waterless composting toilet, and rainwater tank was installed to improve water efficiency. All greywater is filtered and then lead into swales (drainage ditches dug on contour), which feed the clients newly planted grove of olive trees.
Energy – The straw bale and thatch roof provide exceptionally good levels of insulation. Water is heated using a solar water-heating panel supplied by "Solardome". The chimney flue is fitted with a simple copper coil. This acts as a heat exchanger, giving the solar water heating an additional heat source for extended cloudy winter days. It was decided that stoves and fridges would be run on gas with lanterns in the interim for lighting, until such a time as the owner could afford to install a photo-voltaic system.

PRODUCTS/DEVICES
- Heat exchanger (copper coil) and solar water heater by *Solardome @ (021) 8866 321*
- Timber Preservative "Totim B" by *Rekar Mills @ 0800 411200 (KZN)*
- Timber treatment "Outdoor" and "Table Top" by *Enviro-touch @ (021) 552 6834*
- Waterless Compost toilet – The "Enviro Loo" by *Enviro Options @ (011) 618 1350/1/2/3*
- Recycled paper insulation by *Therm Guard @ (033) 346 0111*

TERMS OF ENGAGEMENT & PROCESS
The project was built on a cost plus basis. Daily rates were used for all the labour except the thatchers and specialist sub-contractors who provided individual quotes. The author was involved in an advisory capacity with occasional site visits and maintained contact with the project as it progressed, through the client. This helped to ensure consistency with the design concept and numerous environmental considerations.

The client acted as project manager, employing a local villager to organize the laborers and act as site foreman. All work was done by hand without the use of heavy machinery or electricity except for the use of a chainsaw for the tree felling. The thatchers were sourced from a neighbouring village. The bale wall raising was lead by the author, who worked along side the client, her family and a small group of volunteers. When it came time for the labour intensive process of plastering, the client was intensively involved with the help of some local village women.

OUTCOME: From a holistic perspective, this project was a success. The client's own appreciation of environmental concerns and commitment to following the process through, undoubtedly played a big part in the success of this project.

NEW HOUSE for Ashley & Zaynoe PATIENCE March 2000 – May 2002

LOCATION – Greyton – Overburg District of the South Western Cape

- The setting is a sleepy historic country town with the nearest centre being Caledon about 40km away.

CLIENT OBJECTIVE

- To build a two story environmentally friendly, straw bale house.

COST/TIME CONSTRAINT

- Client was on a very limited budget, having to mortgage their house in Cape Town to extend their finances. The project of ±150m² internal space was built for ±R240 000.
- The client was prepared to build slowly within her means so as to be actively involved in the process. The project took 2 years from inception to completion. The building work progressed very slowly at first, before the clients were able to rearrange their lives so as to move out to Greyton on a permanent basis.
- The client's financial situation was such that they were forced to move into their house before it had been fully completed. This has resulted in many details being left unfinished.

LOCAL AUTHORITY RECEPTABILITY

- The local "aesthetics committee" insist that all new developments be done in a historical vernacular style, so as to blend in with the historical character of the town.
- Situated on an existing floodplain, the level of the house had to be above the 1:50 year flood line.
- The council approved of the method of building with straw bales, after much coercion. However, under no circumstances would they allow the proposed waterless composting toilet. Instead, given that the site is on an existing flood plain they insisted on the highly unsustainable practice of installing a conservancy tank for all sewage, which has to be pumped out by a council truck every couple of weeks.

DESIGN FEATURES

Compact form – The simple barn like structure and loft style design, allows for a double story construction, while helping to keep the scale and cost of the house within limits.

Orientation – The house is orientated north to maximize on solar gain during winter as well as maintain a street frontage in keeping with the character of the area.

Enabling framework – The idea was that the main base and roof would be done first in order to provide support and shelter once the straw baling was underway.

MATERIALS

Foundations – Stone and concrete were used. The stone came from a neighbouring piece of council land being cleared.

Floors – A concrete slab on fill was used for the ground floor, providing the structure with some thermal mass. The first floor was done with slabbed pole beams and cut timber joists, supporting a pine timber, tongue and groove floor. The flooring was ordered untreated so as to avoid the highly carcinogenic P.C.P. or T.B.T.O. treatment that is commonly supplied with tongue and groove. Preservative treating was done afterwards, using a compound supplied by "Enviro-touch," of boron-based salts called "Timber Watch" This was done just prior to the application of non-toxic floor oil also supplied by "Enviro-touch".

Walling – With the exception of a few internal bathroom walls and a fireplace of clay-fired brick, the walls are straw bales. They were laid on-edge – saving on space and material - on top of a

stonework plinth. Unfortunately the contractor neglected to build the stone plinth correctly so as to provide a proper up-stand above the level of the inside floor. This is required to raise the bales sufficiently for good moisture protection. This was not understood by the contractor or client while making cost cutting decisions. The straw came from a neighbouring farm. The timber stakes used to pin the bales together, were sourced from the area and treated on-site with the mammal friendly boron based preservative "Totim B". The external plastering was done with a mixture of clay and chopped straw and finished with a coat of sand, clay, cement and hydrated lime. The finish specified, was for a non-toxic breathable paint, called BreatheCoat. The internal walls were done in a clay plaster. The clay came from an old mud brick ruin in the neighbouring town of Genardendal, a few kilometers away. In addition to this the client experimented with a rammed earth wall for the bay window.

Structure – The roof structure is supported on a hybrid of pole supports, brick masonry (built around the bathrooms), a brickwork fireplace and large stonework piers on the corners. Poles were used for all the structural timbers except the floor joists. Poles have high strengths and require a minimal amount of processing. Unfortunately, regular CCA treated poles were used, instead of more environmentally friendly options, as the builder was unwilling/unable to do the cutting and treating of locally available blue gum poles and failed to check for available suppliers.

Roof Construction – The roof finish chosen, was a metal corrugated iron roof. Given the potential for overheating in the bedroom loft space, the ceiling was thickly insulated using "Isotherm", a non-toxic polyester blanket with a layer of "Sisilation", a layer of insulative reflective foil, above.

Doors & Windows – A fanlight window above the front door, has been made using recycled bottles. To help keep costs down and try and avoid the use of tropical hardwoods, the author had the client's source as many second hand timber doors and windows as possible. However the sizing of windows was not followed well and all fanlights above the glass doors ended up being excluded, without the author's prior approval. This resulted in the building suffering from reduced levels of natural light and a compromised aesthetic. Furthermore the client did not manage to source the dormer windows in time for the roof structure. This resulted in the builder ordering regular "meranti" (unsustainably harvested timber) type windows for all the dormers.

SERVICES

Water – Given the Council's rejection of a waterless composting toilet, a multi-flush toilet was used to help save water. In addition the shower was fitted with a water efficient showerhead. The plans allow for rainwater tanks, which will be installed when the clients have more funds available.

Energy – the straw bale walls and well-insulated roof, provide for excellent thermal insulation. While an electric cement mixer, as well as some power tools were used, most of the work was labour and not machine intensive. Unfortunately the clients could not afford the solar water heater specified. However the geyser was installed with an extra in-let and out-let, so as to easily facilitate the future retrofitting of a thermo-siphon water-heating panel. Furthermore, to cater for overcast winter months, the chimney was built with a simple copper coil heat exchanger. This is to provide the heating back-up for the solar water heater, once it is installed. The brick fireplace was not built as specified i.e. with thin layers fire-clay mortar, which has resulted in its' compromised performance. Unfortunately with the clients finishing the house themselves, they have neglected to insulate the bay window and have also not closed it off from the loft space above. This has resulted in the easy escape of heat from the main living area, compromising the energy efficiency of the structure. Fortunately, many of these problems can still be dealt with once the clients have more money available.

PRODUCTS/DEVICES

- Multi-flush toilet (retro-fitting device) by *Aqua-Smart @ (021) 855 2632*
- Water Efficient showerhead by *Aqua-Smart @ (021) 855 2632*
- Non-toxic breathing paint by *BreatheCoat paints @ (021) 852 8131*

- Insulating non-toxic polyester blanket by *Isotherm @ (021) 577 1490*
- Heat Exchanger: *Solardome @ (021) 886 6321*

TERMS OF ENGAGEMENT & PROCESS:
The building was built on a cost plus basis. Given the tight budget, the client could not afford to employ the architect to engage in the site process, other than in supplying on-site training when the straw bales were being raised. The clients did however, pay for a full written specification as well as occasionally phoning for advise. This helped to keep many of the considerations in place.

For the initial part of the construction, a local project manager – Dave Williams – was contracted to oversee the works. For the second half of the project, once the straw baling was ready to begin, the clients took over. They employing labour directly and organized for all the sub-contractors required. This part of the project saw 3 generations - the client, their children as well as a grandparent all participating in the building of their family house.

OUTCOME
Due to financial constraints, features such as; the solar water heating panel, rainwater tanks and even the painting which is essential to the good protection of the walls has been left for a future date.

A number of flaws have compromised the overall success the project, from a technical, aesthetic as well as environmental standpoint. Some of the setbacks were due to a conservative municipality, as well severe cost constraints that seemed unavoidable. However a major attributing factor to some of the problems was a lack of appreciation or knowledge by the builder and client, for some of the technical and environmental considerations, coupled with the virtual exclusion of the author from the on-site process.

On the positive side, the clients' enthusiasm for environmental issues means that in time, some of the mistakes will be corrected and a number of the environmental features will still be added.

NEW EDU-CARE CENTRE for FLOWER VALLEY CONSERVATION TRUST Dec 2001 – October 2002

LOCATION – The Flower Valley Conservancy in the Gansbaai area..

- The site is situated on a group of farms, which have been consolidated into a fynbos conservancy. Fynbos flower picking and related micro enterprises are the main activity. The farm is about 10km from the coastal town of Gansbaai in the Overstrand district of the South Western Cape.

CLIENT OBJECTIVE

- To build an environmentally friendly, community showcase building, utilizing a labour intensive natural building process.
- That the building serves as both a pre-school for the farm children as well as a community hall space.

COST & TIME CONSTRAINTS

- The project had an initial budget of only R120 000 which had been sourced from donor funds. The project of ±64 m² of internal space and 20 m² of external space was built for ± R180 000. Due to it's remote location standard current building rates were estimated to be R5000 per m².
- With the work activities of the farm being very seasonal, the idea was to make use of the off-season period, where farm workers were idle, with labour intensive methods of

construction in preference to material expensive options. Unfortunately the timing was such that the local council authorities delayed the plan approvals by about four months. This completely upset the availability of free farm labour, which lead to major compromises being made - half the walls being finished off in timber instead of the specified cob.

- Another major setback was loosing the farm director, who had been fully appreciative of the ecological considerations of the project and who the author had worked with whilst evolving the project. His post ended just as the project finally went on site. The remaining people in charge of the farm had little concern for such issues and were only concerned about cutting costs, including any costs on site involvement by the author.

LOCAL AUTHORITY/COMMUNITY RECEPTABILITY

- The local authority approved the proposal with practically no resistance. However the delays caused in obtaining land-use approval severely affected the outcome of the project.
- The farm labourer community proved to be very receptive of the natural building approach despite some initial resistance.

DESIGN FEATURES

Orientation & Form – The building was designed with an L-shaped plan to provide shelter from the unpleasant prevailing South-Easter winds, while opening up to the view across the valley onto a verandah which also provides excellent shelter from the driving rains of the north west. The roof of the main space is elevated to provide added wind protection, and good levels of natural light and ventilation.

MATERIALS

Foundations – Cement and stone, which was taken from a 100m radius of the site. The sand came from a farm road cutting about 200m from the site.

Floor – Concrete slab on cut and fill with a screeded finish.

Walling – The building was designed with a stone base, cob walls (clay/straw and sand) and some timber cladding under the eaves. The delay in approvals effectively removed most of the labour source, which resulted in a lot more timber, and much less cob than had been designed for.

Without the author's proper on-site involvement, the timber walling was completed without the any technical support and resulted in being finished with conventional toxic wood finishes.

Structure – With a few stonework supports, poles were used to hold up the roof to provide shelter while the cobbing and finishing was being done. All the poles used came from forest thinnings on the farm itself, and were treated on-site using "Totim B" However treatment instructions were not followed (that all bark be stripped and poles dipped while as green as possible) resulting in problems with the treatment method. This necessitated further treatment with another preservative; a plant extract called "Timber-Quest." All the cut timber used was sourced from some demolition work being done to one of the farm sheds.

Roof – Corrugated iron was used which was heavily insulated with a 75mm thick polyester blanket; called "Isotherm". The ceiling specified was for reeds to follow the inside curve of the ridge and edged timber off-cuts for the ceiling. Given the budgetary constraints felt towards the end, the ceiling was instead done with a draped hessian cloth.

Doors & Windows – All of the doors and windows sourced were second hand; with some coming straight from the farm shed demolition work, thus avoiding any use of tropical hardwood. However the builder neglected to follow the specifications and in doing so failed to prime the timberwork in contact with cement. This will compromise the long-term durability of the timber.

SERVICES

Water – Black water is treated with a septic tank while the greywater has a separate outlet, which is lead to a small plastic lined reed bed. However proper detailing with sand filtering and a grease trap for kitchen wastewater has not been followed. Remedial recommendations still need to be followed for the system to function properly.

Energy – The close-coupled solar hot water heater specified was not installed because of the higher up-front cost. As a result the electric geyser, which had not been allowed for in the design, makes a rather inelegant appearance within the main hall space. The good thermal properties of all the cob walling has been somewhat compromised by its exclusion especially over the roofs of the alcoves, which were replaced with, corrugated sheeting which the builder neglected to insulate.

PRODUCTS/DEVICES

- Non-toxic wood preservative *"Totim B"* by Rekar Mills, Pinetown @ *0800 411200.*
- Plant derivative wood preservative *"Timberquest LSP" from Sommerset Timbers @ (021) 845 8713*
- Insulation: *Isotherm @ (021) 577 1490*

TERMS OF ENGAGEMENT & PROCESS

The job ran on a cost plus basis, with the project manager taking control to the exclusion of the architect. Sub-contractors then quoted on piecemeal parts of the works.

Initially, while the director was still around, the author was to be involved in the site process. However, on the first site visit to inspect the building's placement, the author made the builder move the building further down the slope in accordance with the plans, as the builder had sited the building unhealthily too close to an overhead power line. With departure of the director just as the project got started, the builder – Chunky Trull – who had prior natural building as well as cobbing experience, was put in charge of project management. Given the limited budget, he chose to exclude the author from further involvement on-site. Despite his enthusiasm for the natural building process, the builder lacked a good overall technical grounding, which resulted in many flaws from a technical point of view. Luckily the author did visit the site, on his own accord at one stage and found that many basic technical issues were not handled correctly. Some of the issues encountered for instance were that the builder had sourced hay and not straw. The clay being used had not been tempered with enough sand and the cobbing was not sufficiently worked and compacted into the wall. Damp proofing under windows had also been excluded. Towards the end of the works, with there being a rush to get the building ready, and all farm laborers needed for the flower harvest, the farm management contracted another contractor to finish the works in timber cladding. This contractor had absolutely no background to the original aims and objectives of the project, resulting in environmentally unsound building practice – such as the use of normal off-gassing paints and timber finishes.

OUTCOME

While a lot of the problems stemmed from the initial delay in timing, the loss in continuity between the farm management and builders, as well as a very tight budget, some of the errors could have been avoided or corrected. However with no proper site involvement by the author, many flaws went unchecked, which has compromised both the design aesthetic as well the durability of the structure.

NEW HOUSE for MS. K. BRODIE – Febuary 2002 to May 2003

LOCATION – Scarbourgh, South Peninsular District, City of Cape Town

- A coastal suburban area near Cape Point

CLIENT OBJECTIVE

- To build a double story straw bale house with minimal means.

COST/TIME CONSTRAINT

The original brief was to build ±60 m² of internal space and 26 m² of external space for R120 000. We advised the client that this was unrealistic in an urban context, with current Cape Town building rates at about R3500 per m². We suggested that she be prepared for the building to take longer to complete and that we would try and build the entire outside envelope first, leaving the internal finishing for future.

LOCAL AUTHORITY RECEPTABILITY

The South Peninsular municipality gave no resistance to plan approval, having already approved a straw bale structure in the past.

DESIGN FEATURES

Orientation/layout – The author wanted the services to be situated to the south side of the building, both for passive design reason as well as to allow for future expansion of the house. However the client refused to accept this, wanting to pull the house as far away from her adjacent neighbour as possible.

Compact Plan – The compact nature of the house sets is a good example for higher density living, but is compromised by the difficulty of future expansion.

Shading – A deck and pergola above has been designed to provide shading to the glass double doors on the western façade.

MATERIALS

Foundations – Concrete footings with stone base walls. All the stone was sourced from the leftovers of another project, which recently built in the area.

Floor – A concrete slab was used for the ground floor and will be finished with handmade tiles (made by the client) and an oxide screed. The first floor has a tongue and groove timber floor on poles, planed on one side for a flat edge.

Walling – Both floors were done in straw bales, using the poles on edge method. All reveals and corners around the poles have been done with cob. The clay was brought in from about 10km away, leftover from some road works. A recycled bottle wall creates a feature in the bathroom. Given the extreme nature of the weather in the area, it was decided that the plaster be done with solid cob work followed by a lime sand plaster and finished in a water resistant, breathable paint BreatheCoat. The cob work was very time consuming but resulted in an extremely solid wall. Unfortunately, given very little volunteer assistance, the client started to run out of money and decided to ignore the author's specification, adding cement and oxides to the lime mixture in an attempt to save on the cost of the paint. Technically this is a disastrous decision, especially in such a harsh weather-beaten environment.

Structure – A pole structure was used with the corner brickwork fireplace adding to the stability of the structure. All the poles used were trucked in from a timber supplier and are preserved with a non-toxic boron based treatment. The poles rest on the stonework and are bolted to steel angle sections set in the stone and concrete base. The roof structure is very economical and has 3 curved "eco beams" spanned with thick 114x50 mm purlins. The structure was designed are to give additional bracing by cross nailing on an edged timber off-cut ceiling. However, not appreciative of the structural implications, the client ordered a reed roof instead. Another

interesting feature was that of a timber and cob ring beam at first floor level. This helped lift the first floor of bales above the level of first floor to give added moisture protection to the bales.
Roof – the main roof is curved corrugated iron sheet. The roof is insulated with 75mm of "Isotherm" polyester blanket.
Doors & Windows – While the big sash window is second hand, all the other doors and windows were made up from recycled Oregon pine. However without consulting the author, the client bought some planks of Zimbabwean Teak for the lintels. In all probability this timber is from an unsustainably managed source. All the timber has been treated using a non-toxic wood finish by Enviro-touch. Unfortunately the window sizes and placements were changed considerably by the client, which has affected the aesthetics and to some degree the energy efficiency, with the large sash window being shifted from the eastern to the south façade.

SERVICES
Water – The client could not be persuaded to pursue the greywater option and thus a regular septic tank with a soak away bed was used as is common to the area. A water efficient shower and multi-flush toilet system has been recommended.

Energy – The embodied energy of this house is very low. While the clients rearrangement of the windows has somewhat affected the passive thermal design, this is fairly slight, given the straw bale walls and well-insulated roof. The small footprint makes the house easy to heat and cool. Unfortunately the client could not afford a solar water heater and has opted for an instantaneous gas heater.

PRODUCTS/DEVICES
- Non-toxic Boron treated poles: Sommerset Timbers @ (021) 845 8713
- Non-toxic timber treatment: Enviro-touch @ (021) 552 6834
- Non-toxic Paint: BreateCoat Paint @ (021) 852 8131

TERMS OF ENGAGEMENT & PROCESS
The building has been done on a cost plus basis, where sub-contractors have given piecemeal quotes and labour has been hired on a daily basis. The client could not afford for the author to be involved once the building went to site. However during the initial phase of construction the stone wall builder – Dave Gaynor – did keep in regular contact with the author, which helped in avoiding potential misunderstandings. Furthermore, when the stone base was complete, the author was hired (at a hugely discounted rate) for a 3-week period to help with the straw bale wall raising and to initiate the cobbing process. This enabled the good transfer of knowledge. However despite being assured that everything was in place to start, the author found that the windows had not been prepared with lintels and neither had they been pre-fixed to the structure. This lead to inefficiencies in the baling process and difficulties with keeping the windows level. This problem had been ironed out by the time the first floor was built which was built in about half the time as the lower floor.

OUTCOME
The overall sustainability of the project has been affected by the tight budget as well as a lack of appreciation by the client for the environmental agenda and respect for the technical differences associated with a natural building.

Alterations & Additions to HOUSE GEYSER – May to September 1998

LOCATION: Vredehoek, City of Cape Town

- Located in one of the suburbs that ring the city bowl, a few minutes drive from the city centre.
- The alteration dealt with an under-utilized back north facing side of the house.

CLIENT OBJECTIVE:

- Besides the special rearrangement, the client was interested in a natural aesthetic, but was not per say particularly concerned about sustainability.

COST CONSTRAINT

The client was prepared to pay to get the job done as best as possible. The project was built for R80 000; this included 15 m² of internal space and 10 m² of decking.

DESIGN FEATURES

Planter – A planter was integrated into the extension with inward opening windows that facilitated the ease of access to a kitchen herb garden. This has helped to introduce the client to the idea of Permaculture as well as increasing urban green space.

Skylight – The extension was going to deprive the kitchen sink of natural light so the idea of a skylight was introduced.

Balustrade – The balustrade was done using poles and rope, helping to minimize the use of steel while still creating a lightweight effect.

MATERIALS

Foundations – Regular concrete foundations

Floors – The basement was done with a concrete slab on grade and finished with a cement grano. A reinforced concrete slab was used for the first floor construction with a tile finish.

Walling – A regular cavity clay brick construction was used. This was plastered and then painted with a homemade lime wash.

Structure – To avoid the use of polluting chemicals, all the SA pine timber was ordered untreated and the builder treated it himself using a pirethrin plant based timber preservative called "Timber Quest." To help avoid using hardwood timber from unsustainable sources, the decking and staircase was done with a local "Karri-gum" timber.

Roof Construction – Corrugated iron sheeting on 114x50mm timber rafter purlins. The thick roof cavity was stuffed solid with recycled paper insulation; "Thermguard". To avoid the regular PCP treated wood, which is carcinogenic, the SA pine tongue and groove ceiling was ordered untreated and treated on-site using Timber Quest.

Doors & Windows – The client was not prepared to the added cost of using timber from more sustainable sources and "meranti" timber was used. All the timber was finished with non-toxic oils supplied by "Enviro-Touch".

SERVICES

Water – Besides for the laundry, plumbing did not from part of the brief.

Energy – The extra insulation in the ceiling together with good natural ventilation has helped to keep the new dining room space nice and cool in summer, despite the very low ceiling height. The new skylight over the sink area has helped increase the level of natural light reducing the need for artificial lighting. Unwanted heat transfer through the skylight has been limited by the inclusion of a frosted glass dispersion panel of underneath the translucent roof sheet, as well as limiting the size of the skylight.

PRODUCTS/DEVICES

- Recycled paper insulation: *Thermguard @ (033) 346 0111*
- Non-toxic timber treatment: *Timberquest LSP from Sommerset timbers (021) 845 8713.*

TERMS OF ENGAGEMENT & PROCESS

A regular minor works contract was used. There were weekly site inspections, which further helped to keep the building on track with the original design.

OUTCOME:

The clients open mindedness helped the author to introduce ideas that were not part of the original brief but which helped improve the sustainability aspects of the project.

Alterations & Additions to THE BACKPACK & AFRICA TRAVEL CENTRE
March –November 2001

LOCATION – Tamboerskloof, City of Cape Town

- Adjacent to a busy road at the edge of the city centre.
- Existing buildings are all single story.

CLIENT OBJECTIVE

- To build with a natural aesthetic, and while sympathetic to sustainability ideas, were not particularly knowledgeable about it or were they prepared to pay extra for it.

LOCAL AUTHORITY/COMMUNITY RECEPTABILITY

The original design concept included a double story design, which was turned down by the Local Council who refused to consider densification, despite favorable zoning regulations, which allowed up to 7 story developments.

COST & TIME CONSTRAINT

The project had a fairly tight budget and a strict 3-month construction period time constraint.

DESIGN FEATURES

Skylights – Open able skylights help with natural ventilation.
Courtyard – The main emphasis of the design coherent courtyard space, which affords views of Table Mountain.

MATERIALS

Foundations – Standard Concrete foundations.
Floor – The new internal floor was a concrete slab on fill with an oxide screed and tile floor finish. Demolition waste was used for fill for the new raised courtyard helping to save on transport and landfill cost. A regular concrete slab was then thrown and finished with a local "Rosa" slate. This was finished with a non-toxic sealant by "Enviro-touch"
Walling – Regular Cavity clay brick construction.
Structure – An exposed pole roof structure was designed. All the poles used were trucked in from a timber supplier and are preserved with a non-toxic boron based treatment. Locally available "Poplar" timber sleeper beams were used for the post and beam construction. All external timber brackets adjacent to the courtyard were done in a durable local "Karri-gum" timber. All the timber was finished with non-toxic wood oil by "Enviro-touch".
Roof Construction – A regular corrugated iron roof was used with a reed ceiling, which is insulated using 75mm of non-toxic polyester blanket i.e. "Isotherm".

Doors & Windows – The use of recycled Oregon pine timber proved to be too expensive option for the clients. As such, regular "meranti" - in all likelihood from unsustainably managed forests - was used.

SERVICES

Water – Although not part of the brief the author persuaded the clients to retrofit their toilets with multi-flush devices.

Energy – Again not part of the brief, the author persuaded the clients to retrofit water efficient showerheads.

PRODUCTS/DEVICES

- Non-toxic insulation: *Isotherm @ (021) 577 1490*
- Non-toxic boron treated timber suppliers: *Sommerset Timbers @ (021) 845 8713*
- Non-toxic timber treatment: *Enviro-touch* (Outdoor and Table Top) @ (021) 552 6834
- Non-toxic slate floor sealant: *Enviro-touch* (Rock) @ (021) 552 6834
- Water efficient showers and multi-flush toilets: *Aqua Smart @ (021) 855 26 32*

TERMS OF ENGAGEMENT & PROCESS

The builders were Brice Construction who used a minor works contract, which involved weekly architect site visits, which helped keep the building on track.

However, with the clients on site on a daily basis, the builders overlooked the architect's specified non-toxic paint, getting the clients to choose their colours from a regular range of paints. By the time this was picked up by the author, the painting had already begun and all the paint ordered. A separate company – Rivet's & Rocket's – were chosen by the clients to handle the design and fitting of the interior bar counter and reception desk. Not wanting to be worried with extra considerations, they refused to co-operate with the author. As such, the healthy indoor air quality was further upset by their use of formaldehyde resins, chipboards, super woods polyurethane, and solvent based adhesives.

OUTCOME

Except for the paint and interior fittings Most of the sustainability features were adhered to. Furthermore the author was able to expand the brief, to include the energy and water saving fittings. This was achieved by getting the clients to see how these fittings would help save money in the long term.

Alterations & Additions to HOUSE LIGNES February – August 2001

LOCATION – Noordhoek Valley, Cape Town.

- Leafy suburban setting. The works contracted to the author, were specific to a small part of a much larger alteration job, already in progress.

CLIENT OBJECTIVE

The client already had all the plans for their house but needed the author's design and assistance as specialist sub-contractor to create a beautiful domed space forming the main entrance and dining room space. The client was not concerned about sustainability issues.

COST/TIME CONSTRAINT

The client was prepared to pay to have the dome built correctly. The entire vault and dome construction was done in 31 working days, often working overtime to get it finished before the winter rains arrived. The two 1,72 m radius vaults and 5,84m diameter dome cover 34 m² of

internal space and was built for ±R45 000 in total excluding the waterproofing which added an extra ±R15 000 to the works.

DESIGN FEATURES

Self-supporting dome construction – The dome was designed according to the precise geometry that governs a cupola structure. As such, no supporting formwork was used for the dome, as a large compass type of devise could be used.

Natural light – The arches of the dome rise above the surrounding roofs to allow circular windows into the tops of the arches to light the space together with a skylight at the apex of the dome.

Recycled Chandelier – The dome space features a recycled glass and bottle chandelier.

MATERIALS

Foundations – Regular concrete pad footings.

Floor – Matching baked clay tiles were sourced, which allowed for the retention of the existing tiled floor, which needed to be patched.

Walling & Structure – All arches, vaults and the dome were done with a variety of locally manufactured clay-fired brick. The brick cupola structure works with pure compressive forces and as such needs no steel or reinforced concrete. Furthermore the method of construction allows for careful attention and articulation of the face brickwork. In addition to the brick arching, a number of second hand Oregon pine timber lintels were used. The internal walls were painted with "Keim", a non-toxic paint. Through the proactive encouragement of the author, the entire renovation work was done with a combination of non-toxic paints, "Keim" and "BreateCoat".

Roof – The waterproofing was done with an imported non-toxic waterproof plaster and paint, called "Keim"

Doors & Windows – Both the internal and external doors used were second hand. All new windows were made up new using second hand Oregon pine. These were finished with non-toxic wood oil from "Enviro-Touch". The fanlight above the front door, has been made from old glass bottles.

SERVICES

Water – Outside the scope of works.

Energy – The bricks used were sourced from locally manufactured brickyards to help reduce the embodied energy. Furthermore, white cement was used for the mortar to help lighten the overall wall surfaces so as to help reflect more natural light.

PRODUCTS/DEVICES

- Locally manufactured Non-toxic paint: *BreatheCoat paint @ (021) 852 8131*
- Imported non-toxic paint: *Keim Coatings @ (021) 930 5304*
- Recycled glass and bottle Chandelier: by artist *Anzu Phillips @ (021) 447 0420*

TERMS OF ENGAGEMENT & PROCESS

As there was no way to predict the cost beforehand, the dome area was built on a cost plus basis. The client paid for all material and daily wages for all labour. The author was hired as specialist sub-contractor, to oversee the process on a full-time basis. This process allowed for the subtle manipulation and patterning of the brickwork and ensured that the workmanship was of a high quality. Furthermore fine-tuning was possible to get the size of the skylight just right. The alteration works outside of the domed area were beyond the scope of the authors brief. However the client did engage with the author, to seek advise on some of the more practical and aesthetic concerns of the works, which resulted in the widespread use of non-toxic paint.

OUTCOME

The project was completed to a high standard with all planned features around the dome going according to plan. In addition to the brief, the client was persuaded to take on certain environmental measures i.e. the non-toxic paints. However, other measures suggested like solar water heaters or water efficient showerheads were not appreciated, as the client was not particularly interested in ecological issues.

CONCLUSION

In part, trying to achieve sustainability can be extremely simple when one picks at the low hanging fruits. However it often involves a journey into uncharted waters that is fraught with challenges and difficulties, especially with an owner builder process. At times these difficulties can undermine a major part of what one is trying to achieve. However the challenges encountered can be seen as the inevitable birth pains of finding more sustainable solutions in an inherently unsustainable society and are lessons that will demonstrate to others where and where not to tread.

Increased awareness of environmental considerations is of vital importance to the success of a green agenda. While the architect can facilitate a greener architecture, to achieve a more holistic objective, continuity between those involved and open channels of communication between all parties, are some of the keys to success. Furthermore, the client's own attitude and ability to pay; either in time or money will ultimately determine the outcome.