ORGANIC BUILDING PROCESSES COME OF AGE — THE ROLE OF STRAW AS A BUILDING MATERIAL AT THE THRESHOLD OF THE NEW MILLENNIUM

The earliest recorded use of straw bales as structural building material was in Britain, where throughout the isles "applehouses" were built in straw for the well-ventilated long-term storage of fresh produce.

In the 1800's, with westward migration and settlement in the USA and the advent of mechanisation (steampowered baling machines),the process became more widespread. Inevitably, in the absence of abundant timber, the enormous and proud meadow haystacks of the homesteaders inspired construction — churches, dwellings, schools, animal sheds built in straw formed part of the great American "barnraising" tradition, being so much faster than sod to build. The method gained ground rapidly throughout the western states. That these "bargains" were to endure for a century without decay was surely not envisaged!

The forgotten status of straw building during the industrial revolution locates it amongst other equally neglected, timeless building techniques. These are currently gaining ground and capturing the imagination of all those who have wished for a simple, economical method of building a home and found other prospects fading. Given its aesthetic adaptability, its place in the history of the next vernacular now being created is secure.

In local patois, one of the older terms for "dwelling" is "stroois" or "struis" (grass or straw house). Indeed, our entire local repertoire of huts, hartbiehuisjes and skerms used grass, sticks and clay/sand, presages of both the well-known whitewash and peat plastered post-missionary houses of the Xhosa and the grand Cape Dutch homestead.

CURRENT STATUS: A GLOBAL INITIATIVE

Perhaps the most comprehensive data illustrating the extent of the movement to use this waste resource appear in the regular international section of "The Last Straw" - a quarterly magazine put together in Tucson Arizona, and in "Out On Bale," another regular publication. Straw building is being used in an extraordinary variety of buildings, from houses in the Ural mountains to straw vaults constructed at Frank Lloyd Wright's Taliesen West, to sod-roofed bale and cordwood buildings in the Vosges Forests of France. Articles deal with every aspect, from quality control to construction methods, innovations, varied climatological responses, building performance and development of responsive building codes.

The pressure on all governments to seriously consider, endorse and facilitate alternative building methods is increasing as population growth and urban migration put increasing pressure on inadequate resources.

The potential of straw as a cost-effective, fast, practical method of construction has gradually entered mainstream thinking. Across the globe, from high-profile buildings such as the 4600sq ft. Real Goods Solar Living Center in Hopland, California with its 12m span strawbale arched roof, to the simple Southern San - Khomani Community House at Welkom in the Mier District near the Gemsbok Park in the Kalahari, to selfbuilt people's housing in the Urals in Russia, international trends are emerging.

THE BASIC BUILDING BLOCK

Although round bales and large "three-stringers' baled with the discarded non-food parts of flax, rice, straw, rye and barley are used in other countries, the two-stringer wheat bale, measuring approx. 350 x 450 x 1000mm, will be the unit used most in southern Africa.

Straw appears to be small and light. Most people do not realise how weighty it really is. If people understood the true value of straw a human revolution could occur which would become powerful enough to substantially alter the way we think, live and contruct our buildings.

In the production of shelter, the time-honoured use of three primary building materials;

- Straw or thatch (loose, baled and bundled; the non-food stalks and stems of grasses and grains)
- Earth - pure adobe (unburnt clay brick), rammed earth, sod (turf wall/ roof), natural stone (drypacked, as masonry/ slate,

pulverized as cement/lime)
• Timber — shingle, siding, log, bamboo, cordwood, chip, sawdust.
These three basic material sources often work in reciprocity with other materials, depending on what is available locally:
• Welsh cob (straw/clay/sand mix, an all purpose structural/filler material)
• Leichtlehm — light, straw-saturated clay slip
• Rods and reeds, with undersized or off-cut units of timber, are the all-purpose go-between. These are used in various ways — weaving, screening, scaffolding, shading, supporting, spanning, holding, reinforcing. Clay coatings are usually used to preserve these structures.
Locally, striate pine or saligna vineyard stakes, 20-50 diameter poplar bolts, Port Jackson, spaansriet and bamboo are commonly used.
• The use of fibrous materials — hemp, hessian, rope, twine, burlap mesh and pulp — is still in its infancy locally, but are available off the shelf in Europe and the USA. The choice of all these materials is hemp — the strongest fibre known to man.
• Finishes are derived from animal products such as horn, bone or leather, or are made from dairy or albuminous sources.

ART OF LIFE - ART OF BUILDING

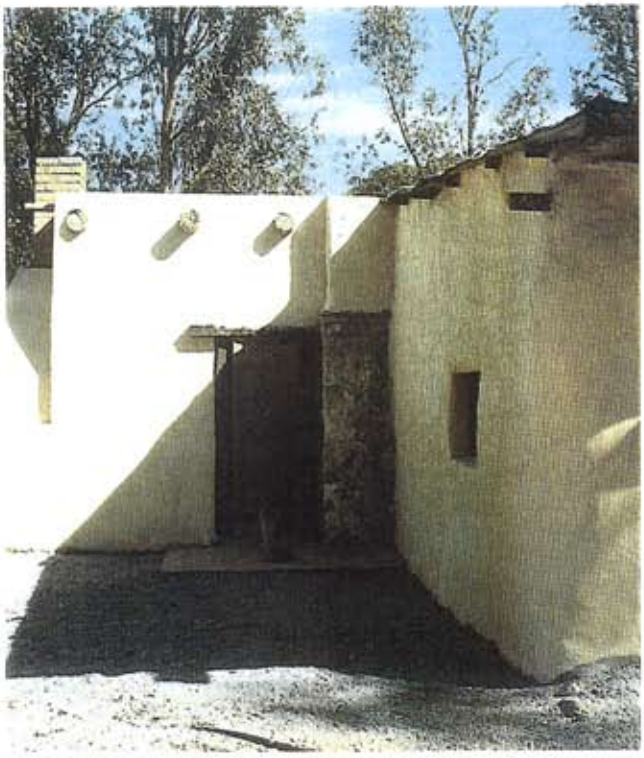
The principle of earth building is based on the concept of creating a shelter that organically harmonises with natural forces. The strength and integrity of the three part organic construction becomes evident when looking at the lower kingdoms themselves.
• Mineral — soil, clay, granite, lime
• Vegetable — grasses, seeds, reeds, rods and trees, pulp products, cottons, flax, hemp, rubbers/ bitumens for roofing, environmentally-friendly natural solvents like plant turpentine and pigments, seed and nut oils.
• Animal — leather, bone, wool, feathers, beeswax, tints, paints (cheese, milk and egg based) various silks (mopani worm) and oils (seal, whale and salmon).
Generally, the more work or industrial refinement goes into processing, the more energy would have been spent, the more fossil-fuels would have been burnt, and the greater the negative environmental impact will be. The end result will be more expensive, more soulless and less recyclable.

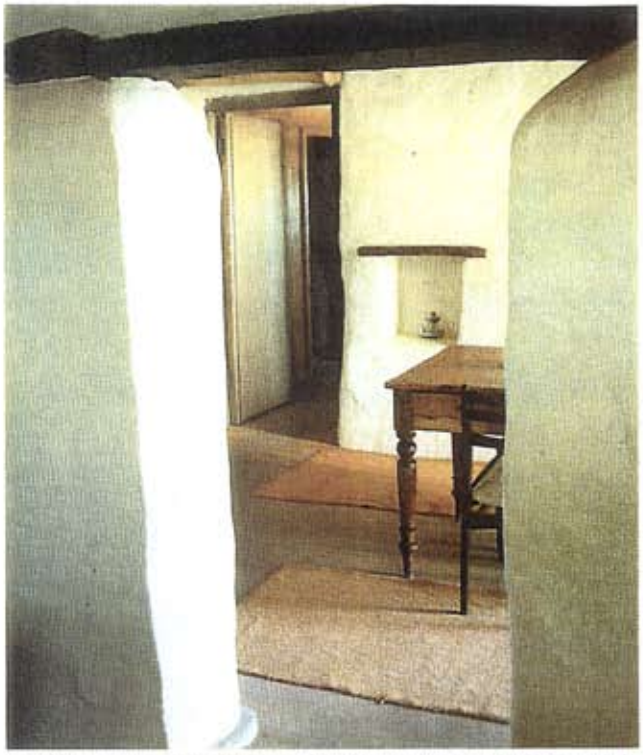
CONSTRUCTION OPTIONS

The humble bale asks only to be:allowed to stay dry and to breathe. PVA paints are not compatible, nor are tightly sealed wall units which will trap and encourage anaerobic micro-organic life.
The five typical construction methods are:
• non-structural infill
• structural bale
• mortar and bale (Canadian and French in origin)
• straw-clay (cob, tudor)
• pressed panel - heated and compressed into floor, wall and roofing panels.
• hybrid or combination
In South Africa, both the "impaling" method commonly used by the Americans and the "sosatie" or "garland" method developed here are in use.
The impalers skewer 10 mm mild steel re-bars, bamboo, or wooden stakes through a stretcher course bale wall, up to seven courses per floor (in multi-story construction the floors extend between the sections of wall as you go up), giving excellent wind resistance and rigidity.
The Sosatie-makers insert thin tubes through the bales and draw galvanised wire vertically, anchored from a lightweight foundation through the walls to the wallplates at the top, and horizontally at every bale course.
Eventually the walls may be wrapped in galvanised chicken-wire or polyprop mesh to receive soil/sand/cement/lime plasters, or be finished directly with straw-clay. The wide internal windowsills and endless sculptural possibilities provide extraordinary opportunities for individual expression.

FINISHES - A COMMONSENSE APPROACH

Good building form, shape and orientation usually emerge from sensitive cultural and architectural responses as well as





from a conscious response to the site.

In the Cape, walls oversailed by wide roofs and equipped with splash-aprons at wall bases work especially well on the northwest aspect, where the need for protection from driving rain and harsh sun coincide.

A variety of conditions occur, each calling for simple and specific approaches in finishing, decorating, fire and moisture protection.

Although totally variable in aesthetic terms, the options could be summarized in two categories:

• Earthbased — clay plasters are easiest to apply and are the most organic. They can be applied by hand, without tools. They naturally allow breathing, humidity control, reinforcement and bale protection. A wide variety of decorative or plain facings can be used. Seal oil, prickly pear or cactus gel, linseed oil, limewashes and products made of casein (cheese), milk, albumen, silicates, or less desirably, synthetics are also used.

• Cementitious plasters — these plasters are not as versatile to maintain as they set hard and mostly contain chickenmesh as reinforcement. Ordinary soil can be used. If clayfree or sandbased these are best finished in beautifully pigmented washes to provide colour. No-maintenance topcoat plasters or limewashes can be used, and if painted conventionally in synthetic polymers, at least one side should be allowed to breath by finishing with a natural facing.

CURRENT DEVELOPMENTS

Inexpensive and totally versatile, inert fibrous polyprop mesh, as a super-hightech alternative to chickenmesh, is an ideally compatible lightweight plaster reinforcement.

Over the next year ongoing small scale construction will increasingly put to trial the various methods to determine adequate regional responses, codes and guidelines: Termite control in the Transvaal, for example, will most likely lead to the introduction of codes specifying sheetmetal wallsheets above ground level, as used in Arizona. At a resort in the Clanwilliam area combination techniques (stone, thatch tiles, adding on to existing brick buildings, etc) are being tested. In the Kalahari the use of bales in low-vaulted roof construction to protect the interior from the intense heat was built and is being monitored

WHY STRAW? THE OBVIOUS BENEFITS

Organic integrity: In the light of one of the first principles of Bill Mollison's Permaculture (perhaps the most important design manual of modern times), environmental design always takes cognisance of what is at hand. Site-specific character manifests the qualities in the five elements of earth, air, fire, water and wood.

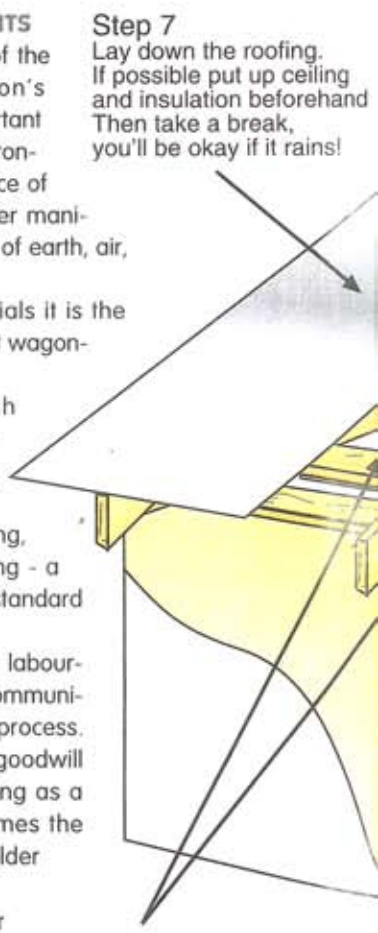
Affordable: Of all the natural materials it is the most readymade. It is literally the most wagon-to-wall product of all.

Energy saving: Any process which reduces effort in any part of production creates vast savings financially and environmentally.

Fast: No long-term storage, stockpiling, warehousing, deliveries, heavy loading - a 200 sq m house can be "baled" by a standard building team over a weekend.

Socially beneficial: Often built through labour-based contracts or as a barnraising community event, it is usually a human scale process. Community co-operation generates goodwill and neighbourly friendliness. Bartering as a method of trade potentially overcomes the usual separation between owner builder and the subcontractor.

Being designer friendly and builder friendly, it naturally becomes user friendly



PERFORMANCE AND COSTS

Relative insulation properties are difficult to show meaningfully, as wall thicknesses vary from

450mm straw to 1,6mm sheetmetal, but bale walls insulate 5-15 times better than that of any other common building material. Thermal conductivity properties outperform other materials, and average humidity levels provide good breathing. Where heating is required during winter, average savings of 40 to 50% are reported. The insulation properties are remarkable in summer and winter. At a project in arid semi-desert conditions in the Northern Cape straw bales were vaulted over a lattice of droppers, keeping the interior spaces cool in spite of the blistering daytime heat.

At a unit built in Constantia in the Cape, the noise of the freeway is reduced significantly.

BACK TO THE FUTURE - TO SURVIVE, OR TO THRIVE?

As far as provision of materials for shelterbuilding is concerned, the staggering cumulative costs of all hard, heat and pressure-dependent production processes (refined metals, cement, ceramics/ claybricks, etc) maintains the status quo of the gap between the haves and the have-nots. Monopolised industrial building-material production currently costs around R2 200 per sq m. when passed on to the ever-fewer individual owner builders. This results in devastating environmental social and economic consequences borne by all. In contrast stands Mollison's call in his Permaculture Development Guide to use "what you've got and what comes naturally."

One example of a post-industrial solution to a problem created by industrialisation provides food for thought.

In California, the annual contribution to air pollution caused by the burning of mountains of straw waste (much of it obtained from rice paddies during harvest) emits over a million tons of carbon monoxide, more than that produced by the power stations! Instead, some 10 million houses of 100sq m could be built annually!

BUILDING COMMUNITY - COMMUNITY BUILDING

Remember the adage about the good leader about whom the people said "we did it ourselves?" The best kind of development can only be fostered from without; real evolution comes from within.

If the wall material could cost R2 500 instead of R5 500, and if the first 50 owners could be trained by one trainer over four days, then they could help one another to build 10 x 100m sq shells every 5 days. Then everyone could have houses shaped to individual preferences, built by neighbours who would have every reason not to vandalize them. Neighbourhoods would arise through shared human processes born of the fulfillment of mutual needs. There would be no 25 year bonds, hence the community could invest in a mobile plant, that would pay for itself over two years, with which they would be paid to make all their own roof tiles. Eventually they would get their money back when selling the machine to the next community, who will pay them for the skills they will impart on how to build a cost-effective, well-insulated, beautiful house.

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