

## WOODLESS CONSTRUCTION 1: AN OVERVIEW

Woodless construction: A south south technology transfer by Development Workshop over 30 years to address the environmental and construction issues of the West African Sahel region

"Woodless Construction" (Construction sans Bois – CSB) is the name attributed in the Sahel countries of West Africa to the construction of vault and dome roofed buildings using ordinary sun dried mud bricks. The name reflects the original motivation for introducing these ancient Middle Eastern techniques to West Africa – reducing the consumption of timber in construction, and therefore reducing pressure on the fragile Sahel environment. The vaulted and the domed roofs are built using techniques which have their origin in Iran and Egypt. The most important characteristic of these roofs is that they are built without any supporting shuttering, nor any wood. The bricks for both walls and roofs are formed in simple wooden or metal rectangular moulds, the mud smoothed by hand and dried in the open air on the ground - the method already used throughout the region. Thus the entire structure - walls, lintels, and roofs - is built with locally available earth.

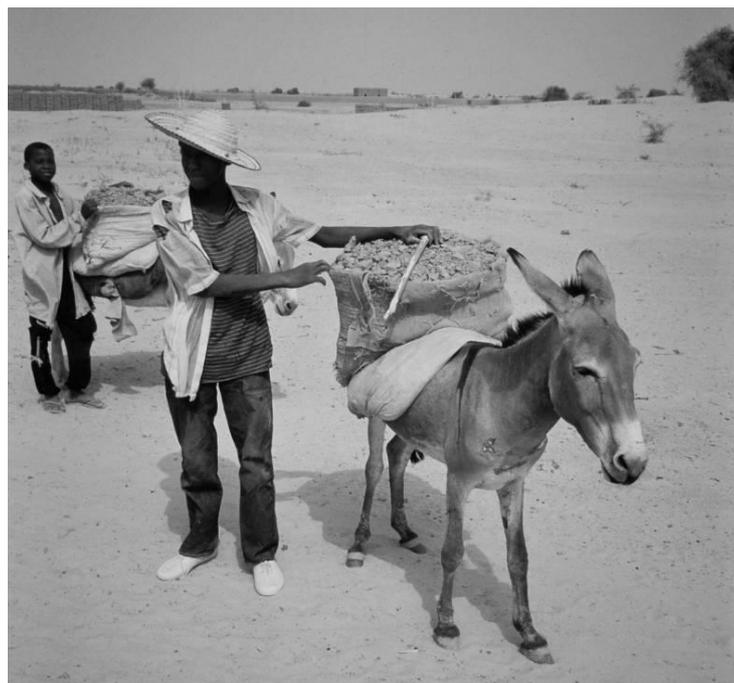


Figure 1: "Local" means the distance donkeys and carts can travel.

### Why Woodless Construction?

Although some people can afford cement blocks and corrugated iron roofing, most cannot and the majority of dwellings in the Sahel still depend on the use of organic materials for the structure of the roof, and often for the supporting walls as well. Flat-roofed buildings traditionally use large wooden beams and battens to provide the support for woven mats and then layers of compacted earth on top of the roof. Thatched roofs also use poles, branches and roots to support the grass or cereal stem thatch. Surveys have shown that for almost all such structures the availability and quality of wood or branches has deteriorated markedly in the past thirty years<sup>1</sup>. Finding good and long lasting timber

<sup>1</sup> Surveys undertaken in Burkina Faso, Niger and Mali include ongoing studies by DW and the following: Uhde, M-L ...

such as the *doum* palm (*Hyphaena thebaica*) hitherto highly favoured for their ability to resist termite attack and to provide good structural strength and durability, has become both extremely difficult and expensive, and indeed some species of trees have almost disappeared in whole regions. Now most of the wood used for building will only last a couple of years because of termite attack, and so the cutting of trees increases. Cutting trees requires a paid permit, so much of this activity is clandestine and risky.



Figure 2: The simplest round houses replace traditional organic shelters.

The Sahel has been blighted by years of drought, and there is no doubt that this has in many ways contributed to the disappearance of trees, but the biggest direct cause of degradation is over-consumption by man contributing to the loss of entire forests. The inhabitants know this and are keen to find alternatives. Woodless Construction was introduced as a viable, affordable and accessible alternative to this dual problem - how to alleviate pressure on the threatened natural resources of the region and at the same time to make building by the population easier. Woodless Construction today is about helping men and women generate revenues, manage their environment and resources, and restore pride in their abilities to build decent, durable and affordable buildings in a region where there is a rich tradition of earth building.

**Time to listen, observe, adapt**

Woodless Construction activities in West Africa started in Niger in 1980 and have evolved from an initial "one-off" demonstration and training course run by Development Workshop (DW) at the request of another NGO, ISAID, in Niger<sup>2</sup>. Thirty years later, Development Workshop operates a major programme promoting Woodless Construction in Burkina Faso, and trains hundreds of builders in Woodless Construction every year, DW also supports women potters who make ceramic products that are used in the woodless buildings, such as ceramic floor tiles and gutters, produced in fuel efficient kilns built by DW trained builders using woodless construction techniques.



Figure 3: Women potters are helped to produce fuel efficient products using CSB kilns.

<sup>1</sup> *Relations entre Habitat Humain et Ressources Naturelles*, Thesis, Grenoble School of Architecture; Development Workshop, *Évaluation des bâtiments et des techniques de construction dans le Cercle de Youvarou*, DW/IUCN, 1991; Hammer, D., Tunley P. and Development Workshop, *Iférouane - Habitat en évolution*, DW/ IUCN/WWF 1991.

<sup>2</sup> After ten years of experience using these technologies in Iran and Egypt where they have existed for centuries, Development Workshop introduced woodless vaults and domes to Niger in 1980, at the request of a small Canadian NGO, ISAID, in the context of a rural development programme in Chikal, Niger. Over the next 8 years, support from this and other projects, and notably the WWF/IUCN's project for the Conservation and Management of Natural Resources in the Air-Ténéré in northern Niger, laid the groundwork for the development of the Woodless Construction programme.

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Early in this ongoing thirty year process it was clear that whilst the idea of mud brick vault and dome building would suit the conditions of the Sahel, these roofing techniques and the way they could be both introduced and put into use, needed adaptation to suit the local conditions and habits, the experience and preferences of the population, and the specifics of local climate and soils. There was recognition that this would be a long process that could not be hurried. In each new locality time has been needed to demonstrate the Woodless Construction techniques and to allow the population to see that woodless buildings withstand the annual rains; time to listen and respond to local opinion and concerns about both shelter and the environment; time to observe how the buildings behave in the climate of the Sahel; and time to adapt techniques, building forms and above all the training methods to suit the West African Sahelian context. One example: the traditional domes and vaults of Upper Egypt are in an extremely arid region and include almost no detailing that allows for the management and evacuation of rain water off the roof. For woodless construction to be viable in the Sahel, which despite low annual rainfall does get violent rainstorms during the rainy season, adaptation has been needed to ensure rainwater run-off. This includes the careful grading of the valleys between the vaulted or domed roof shapes and the provision of wide open gutters to ensure

quick but controlled rainwater run-off. Today with climate change and changing rainfall patterns, this is increasingly important. When rainy season storms come, high winds drive the rain almost horizontally, and it is often the east facing walls that need protection as much as the roofs. Thus shape, orientation and detailing are all important. Given very localised specific conditions, issues such as the choice of surface finishes or the form of the building are influenced by local practice and therefore woodless construction is not one single type of building, but a building system that can be infinitely adapted to local needs and wishes.



Figure 4: Violent storms require good water management using graded slopes and open gutters.

### Ongoing improvement

Both training methods and working practices on building sites have been the object of ongoing evaluation and refinement in order to facilitate the way in which the masons learn and use the techniques. (See *Woodless Construction - 3: Change and. adaptation to local needs* in this series of case studies). This process reflects an approach of adapting to local realities rather than trying to impose unnecessary changes to local practices. Thus Woodless Construction aims when possible to use local brick sizes for wall building (provided they can assure good bonding and quality) rather than insist on unfamiliar dimensions for bricks where this would discourage local brick makers and push prices up. This said, DW insists on one specific brick size for use in the roof (20 \* 15 \* 6 cm), which is small and light enough to meet the requirements of roof building without shattering. Similarly, for very practical reasons, the measurement unit which determines the length of walls is



3 Figure 5: Prestige building like the Archaeological site Museum at Oursi, Northern Burkina Faso, raise the profile of CSB techniques.

the (local) brick, rather than precise metre/centimetre based dimensions. This means that the wall length is based on a number of whole bricks, and this is important because it reduces the need to cut bricks to get them to fit a specific metric length, thus avoiding bad joints in the masonry; it also simplifies laying out and ensures a good bond between successive courses of bricks.

**Gaining people's confidence**

Confidence in Woodless Construction has come with the passage of time and the example of many hundreds of woodless buildings. The wide variety of buildings, some of them large and prestigious, reinforces the demonstration of viability and quality. Large buildings complexes and quality private houses in the region have helped develop a reputation for quality which has certainly encouraged emulation by the population. But the greatest emphasis has been to demonstrate small and easily built one, two and three roomed buildings, suited both to housing and to small public facilities, and all of which are easy to build and affordable. And today practically every builder who is trained builds his own house immediately as part of his training – and gets a door and a window from the DW programme so that his house is viable and can even be rented out.

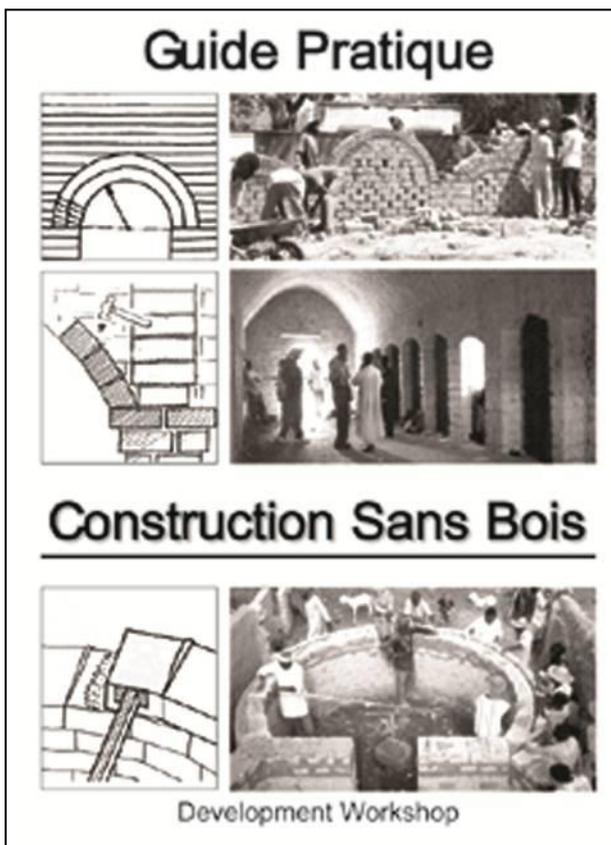


Figure 6: Woodless construction handbook for trainees, in its 11th Edition.

mixed results: the more forward builders got a lot of experience, whilst others lagged behind and often only worked on more menial tasks. It was difficult to be sure who had learnt enough of the techniques to be a safe builder. This was not a good (nor safe) way to proceed, and from 1990 onwards DW promoted the use of a structured training programme that ensures that each trainee covers the same ground and is supervised. For Woodless Construction to achieve a significant impact on local building practices, emphasis needed to be put on providing sustained and regular training opportunities, complemented by the example of many woodless buildings.

A boost to Woodless Construction came in 1993 when Development Workshop, with support from IUCN (The World Conservation Union) obtained funding from the Danish Government (Danida) for a five year, Woodless Construction Programme of training and awareness-raising in Niger and Mali;

Flexibility in design and size are important. Woodless Construction buildings range from really very cheap, single-domed, round rooms with 20 cm walls, through to numerous different combinations of round and rectangular rooms which can be adapted to suit individual tastes and specific functions. The demand for larger buildings can either be met by combinations of two and three roomed structures which can be built easily by builders after basic training and that can be developed by the owner according to needs and resources over several years, or by building larger structures such as classrooms with large roof spans. All the builders are taught to respect the ratios between roof span / the spring point height of the vault or dome / the thickness of the walls that support the roofs. DW insists that builders work within the limits of their skills and the guidelines on the span/height ratios, and to say “No” to clients who insist otherwise.

**DW's approach to training builders**

**Early opportunities to learn**

During the early 1980s, apprentice builders mainly learnt Woodless Construction techniques through 'on the job' experience. By the late 1980s it was clear that such a 'non structured' approach to 'training' gave very

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then other donors joined, including Lutheran World Relief and the Danish Red Cross. During the 1990s this support enabled regular training to take place in Niger and Mali, and as of 1995, in Burkina Faso.

Burkina Faso is today the base of the Woodless Construction programme, where DW, supported primarily by the European Union, trains hundreds of builders each year. Meanwhile, with a good base of trained builders in Niger and Mali, woodless construction continues to be used without a support programme, which is as it should be.

The key to successful training and the ability of the builders to then work on their own has been the development by DW of a very structured mason training curriculum, tested and improved through the 1990s and still subject to improvements. This is based on the Woodless Construction Trainers Guide (11<sup>th</sup> Edition), that details every step in the training process and the structures that need to be used and built during the training.

Basic training for novice builders is divided into two periods. It starts with a three week period of theoretical explanation and practice when trainee builders work on carefully designed training structures with a team of trainers and assistant trainers. The second part of training is more open ended, when each trainee builds (and pays for) his own woodless house under the supervision of an assistant trainer, which gives the trainee the complete experience of building a structure from start to finish, and just as important, provides a full scale 'visiting card' in his home locality and helps develop his future clientele. (For more detailed information on the organisation and content of the training cycles, including training for experienced Woodless Construction masons, see *Woodless Construction -2: The training of trainers and builders* in this series of case studies).

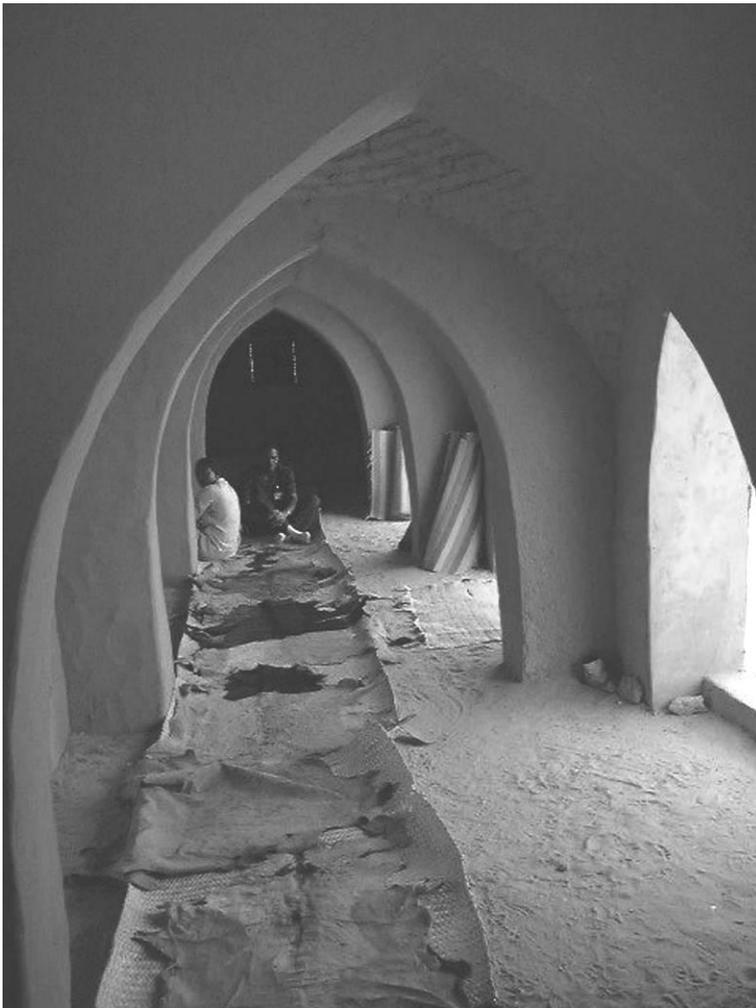


Figure 7: Spontaneous construction with no external help is the benchmark: here, a 15 dome mosque north of Zinder, Niger.

trained masons have come together to offer help to people wanting to build without wood. They know that carrying on cutting trees for building is no longer an option – and that woodless construction is not just a choice, but a necessity. Every 31m<sup>2</sup> dwelling built without wood represents a saving of about 56 linear metres of beams and 12m<sup>3</sup> of wooden battens – about 8 cartloads.

#### Impact and accessibility

Across the Sahel there are now thousands of woodless buildings, built by trained builders for themselves, for others in their community, and for private and public clients and NGOs. In some villages Woodless Construction is now the predominant roofing method. The mason Youma Karim in Kelbo village, north western Burkina Faso, has steadily been replacing all the houses and structures in his hamlet using woodless construction. In other villages the

The average cost of a woodless building is similar to that of a the flat roofed building using good quality wood, except that it is very hard to find good quality wood anymore. If a family makes its own bricks and provides its own labour one can obtain a house for almost no monetary input, and in some instance the services of a trained mason are recompensed with food, not cash. The cost of construction varies from one locality to another, depending on the local price of raw materials, the availability of water, but as well, varying ethnic attitudes about work and productivity.

Clients are attracted to Woodless Construction because it avoids the difficulty and expense of having to obtain (often poor quality) wood, needing replacement sometimes within a couple of years. They recognise that woodless buildings are much cheaper than those built with *non-local* materials. They appreciate the excellent thermal comfort in both cold and hot seasons and also value the fact that a woodless house cannot catch fire – (a common occurrence in traditional housing). Many people consider it prestigious to have a Woodless Construction house, and people are proud of what they can achieve with their own new skills and local and sustainable resources. DW organises a variety of activities to ensure that the public is aware of the potential of Woodless Construction, using the press, radio and TV and having open days for visits. But it is the local builders who play the most important role in spreading the techniques. DW provides on-going technical support after training, and helps local builders to form themselves into registered Economic Interest Groups that give them a legal base to take on contracts.

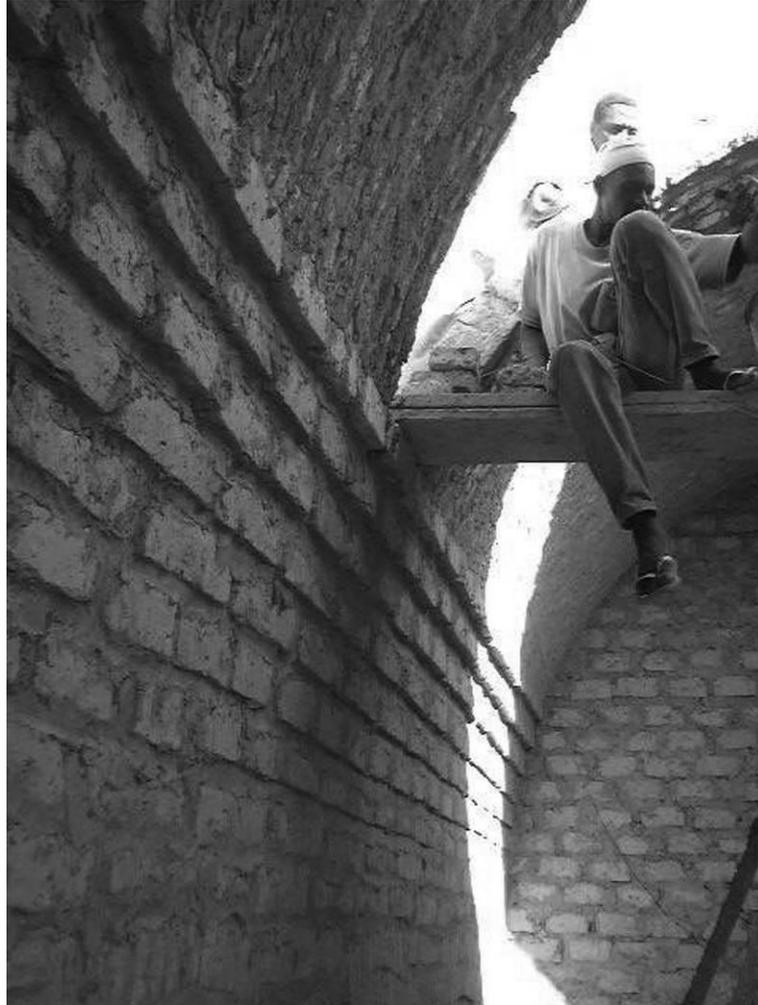


Figure 8: Vault building on corbelled supporting side walls gains time and structural safety.

***The promotion of Woodless Construction in Burkina Faso, Mali and Niger won the World Habitat Award in 1998.***

## Selected references

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