



Wall Building Case Study



The Vertical Shaft Brick Kiln: A Problematic Introduction into Pakistan

Introduction

This is a case study of a technology transfer and focuses on how it was conducted in Pakistan between 1993 and 1996. It is not really a success story and because of this is worth telling. There are many lessons that already have, and are still to be learnt from a technology transfer such as this. Poor project management and a lack of technical expertise combined with no initial knowledge of the prevailing brick production and firing technologies, all played a part in the problems connected with this transfer. It was also never monitored or evaluated. This could have redirected the technology away from what became a confrontation between the new and old brick firing methods in the country.

The vertical shaft brick kiln

The vertical shaft brick kiln (vsbk) represents a relatively low cost, energy efficient, low pollution method of firing bricks.

With the global focus on energy efficiency and more environmentally friendly industries, the vsbk is an ideal technology for global dissemination. This is especially relevant when the technology used to fire bricks in most developing countries from the environmental and fuel efficiency standpoint still leaves a lot to be desired.

The technology that was transferred is not a new one, though it is quite revolutionary in that no one had thought of firing bricks in this way before. It was developed in China in the late 60s during the cultural revolution or "great step forward". It was a period when the cities of China were emptied of people who were sent to the countryside to work on the farms, or to labour on large construction projects. There was a great demand for fired bricks in the rural areas and this brought about the development of the vsbk. The kiln is ideal for the wide-

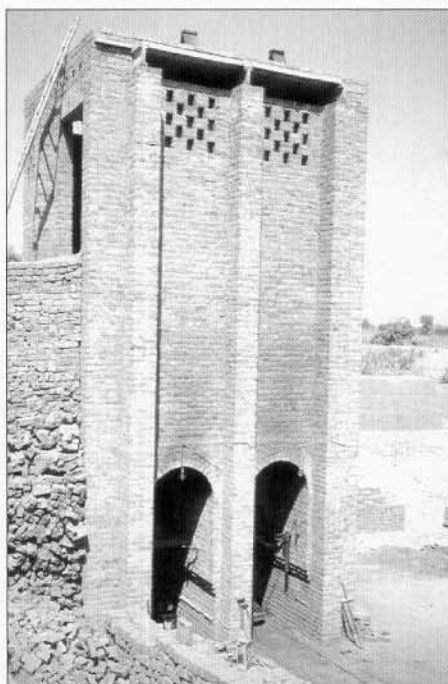


Figure 1 The first prototype vsbk built in Peshawar

spread small scale (4,000 to 7,500 bricks per 24hrs) brick production and is to be found in China usually on the edges of agricultural land near a canal or river.

The vsbk is similar in principal to a lime kiln, where limestone and coal are loaded into the top of a shaft, and ash and lime are removed from the base. In the vsbk green bricks and coal are loaded at the top of a rectangular shaft and fired bricks removed at the base. Temperature in the shaft is controlled by the amount of fuel added and the speed at which the fired bricks are removed. It is a simple efficient process and there are tens of thousands of this type of kiln currently operating in the rural areas of China. Many more are presently being built each year to meet the large demand for building materials during the country's current "free market" expansion. (For more information on the vsbk, refer to "The Vertical Shaft Brick Kiln", 1995, Technical Brief of this Wall Building Series).

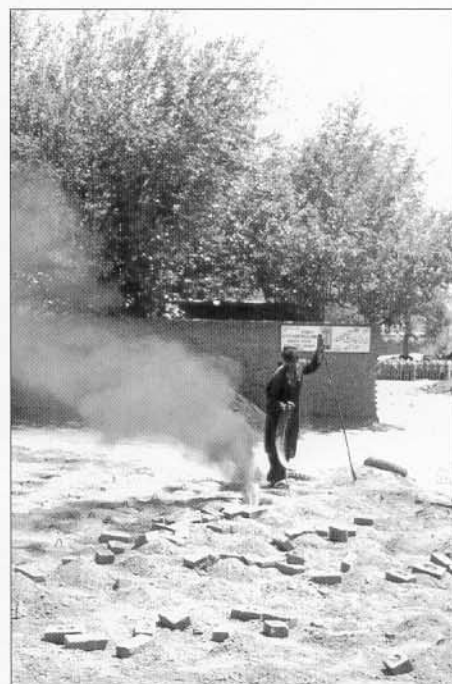


Figure 2 Fuelling a large Btk with rubber (old tyres)

Firing bricks in Pakistan

Pakistan produces more bricks per head of the population than any other country in Asia. It was, therefore, an ideal choice for the introduction of a brick firing technology that is so successful in China.

Peshawar in the North West Province of Pakistan, because of its low annual rainfall and large deposits of clay, is surrounded by brick producers supplying the Northern areas of the country. In Pakistan the bricks are handmade by slop moulding, then sun dried and traditionally fired in a Bull's trench kiln (Btk). This kiln was developed in 1873 by a Mr Bull near Delhi in India. It is a low cost version of the Hoffmann kiln that was used extensively in Europe at the time. The Btk can be built in a variety of sizes and configurations to produce from 7,000 to 28,000 bricks a day. (Ref.: Technical Brief "Bull's Trench Brick Kiln", 1995).

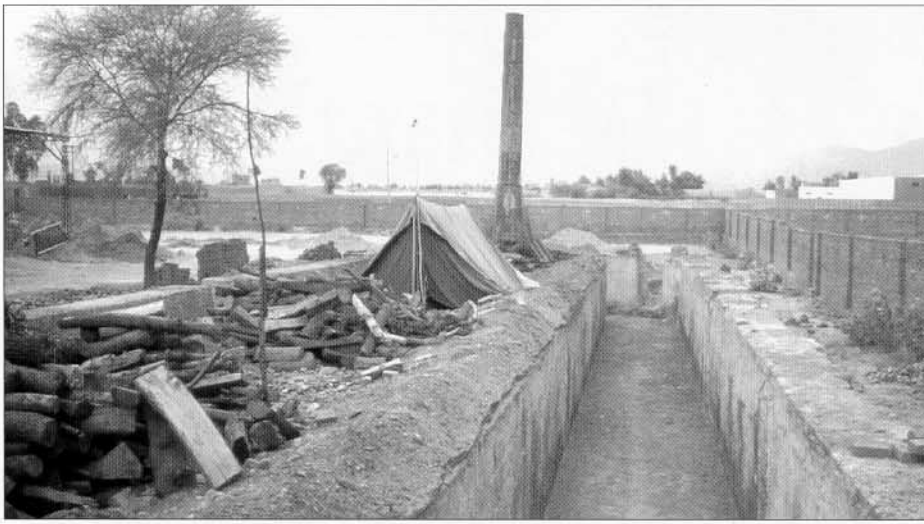


Figure 3 A small single chimney Bull's trench kiln

Its advantages are that it is relatively simple and cheap to build especially when its large firing capacity is fully utilized to obtain the economies of scale. All loading and unloading unlike the vsbk can be conducted during the day with only the firemaster and his crew remaining to stoke the kiln during the night. It is a tried and tested technology and despite its drawbacks its operation and the bricks it produces have been the accepted norm in Pakistan for over 100 years. Disadvantages are that the Btk burns large quantities of wood and also rubber in the form of old tyres and also used engine oil. The wood, which is becoming an increasingly scarce resource, is used to move the fire through the bricks as it provides a long flame length. The rubber and oil are used as a cheap fuel substitute to boost the low heating power of poor quality coal. The Btk can run without the rubber and oil on the superior qualities of coal that are available, but this is more expensive. At the moment in Pakistan the prevention of air pollution by industries such as brick making is, despite being on the statute books not enforced.

The Btk though is not very efficient as a considerable amount of heat is lost through the roof and walls and floor of the firing chamber as the fire moves through the kiln. This type of kiln takes up a lot of space which is now becoming more of a problem. Smaller models of the Btk use one or two metal chimneys which are manually moved along the kiln as the firing progresses, these chimneys are expensive and are replaced every 3 to 5 months as they quickly burn out. Otherwise construction and maintenance costs are low. It is not difficult to run a Btk badly by over stoking, and unfortunately most of them around Peshawar are. Where this is the case, profits drop as brick wastage increases, and the air pollution from an excess of poorly combusting fuel becomes horrendous.

The introduction of the vsbk

It was in competition to the Btk that the vsbk was introduced into Pakistan in Peshawar in 1991. Things did not go well for the vsbk from the start. Three Chinese engineers from the Energy Research Institute Henan came to build the prototype kiln. For some reason they built an older design that had prior to their arrival in Pakistan already been improved upon in China.

The latest model developed in China has a larger firing shaft and is both more energy efficient and economical as it produces more bricks with less fuel for a lower initial outlay. Unfortunately the Chinese engineers also spent too short a time in Pakistan, leaving soon after constructing and running the kiln for only a few weeks. This turned out to be a mistake and was due to the overconfidence of the local brickmakers, and their desire to have control of the kiln as soon as possible, coupled with the decision of the management to save money by returning the Chinese as early as possible.

The project was therefore left with an older type kiln, that had been run for too short a time and some partially trained local brickmakers. The kiln was then run for several short periods over a couple of years. There were continual staff changes during this time, so no experienced kiln management or operating team was established. Apart from a very short period, when external consultants managed the kiln, it never came near expectations. The kiln was very difficult to control, producing a high percentage of overfired, underfired or broken bricks. This was due to the poor and inconsistent management, lack of any in-house technical know-how, and the wrong kiln operating technique. This as well as the low quality of the coal and the poorly handmade bricks resulted in big problems.

Despite the obvious operational failure of the first vsbk, a dissemination programme was instigated without a prior evaluation and another 4 vsbks were built around Peshawar. Although these kilns were expensive to build and failed to work properly, the dissemination went on. But it had already become obvious that the vsbk was not an economical proposition for the local brickmakers, when compared with the existing Btk.

Why the vsbk technology did not transfer

In China the kiln is used by small scale entrepreneurs who produce up to 7,500 bricks a day, usually as an addition to their farming activities. The vsbk was designed to replace the old brick clamps and very simple intermittent updraught kilns found in the rural areas. It was never designed to replace the large Hoffmann kilns built on the outskirts of major Chinese cities or the Btk of Pakistan, where the daily yield is far higher (Ref.: Technical Brief "Hoffmann Kilns", 1995).

The clay in the areas where the vsbks are used in China is of a very good quality for producing bricks. It comes straight out of the ground and is fed into small portable diesel brick extruders. There is no souring, no mixing, no crushing, and no sand or grog added. If any additional water is required, it is dripped onto the clay and mixed in the extruder. The size of the bricks produced are smaller than those in Pakistan, requiring less firing time. All the green bricks are smooth and regular in size, of even consistency and a lot stronger than those found in Peshawar. This also applies to the bricks used in the vsbk now being introduced into India, which are also handmade, but to a much higher standard. Chinese coal is of a much better quality than that found in Pakistan and the coal fines can be purchased for less than lump coal, so the extra expense of crushing the coal is not required.

In Peshawar the quality of fired bricks is poor. This is because the clays available are not very pure, containing stones and other impurities, such as limestone. Also the method of manufacture does not help. The clay is not mixed correctly, is not allowed to stand long enough and the majority of stones and dry clay lumps are not removed. Too much sand is used to release the bricks from the mould and this gets unevenly mixed into the bricks, making them weaker. The result is a low quality often unevenly dried and shaped green brick. The coal is of poor quality containing as much as 25% impurities in the form of stones and clay soil.

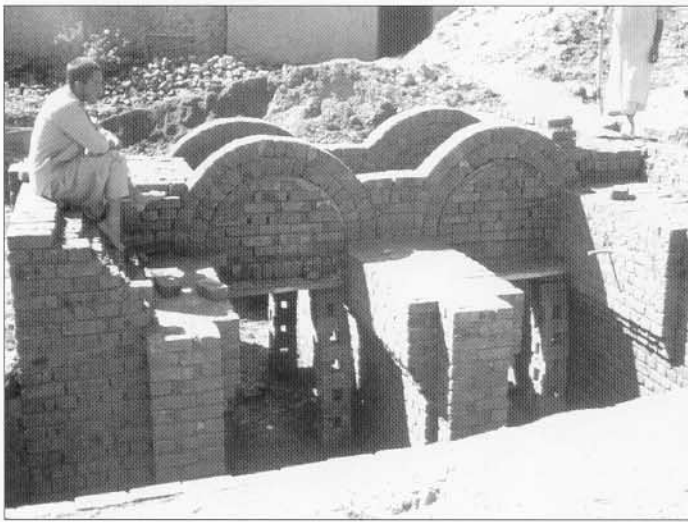


Figure 4 Construction of the third prototype vsbk in Peshawar

Figure 5 The fourth prototype vsbk in operation

To build a four shafted vsbk capable of producing the 7,000+ bricks a day that a small Btk is capable of would cost 50% more than the equivalent Btk. This is due to the extra cost of the supporting iron work, trollies, rails, screw jacks or chain pulley blocks needed. A very skilled and therefore more expensive mason is required to build a vsbk as the construction has to be accurate, or problems within the firing shaft will be experienced.

Despite the poor coal and quality of green bricks they are still successfully fired in the Btk resulting in an 8 to 10% breakage. In a Btk the bricks are fired a lot more slowly taking days rather than hours. In the vsbk the bricks are stacked a lot higher than in the Btk, this is not a problem with the superior green bricks made in China, Nepal and India, but in Peshawar the vsbk breakage rate never fell below 12%, with far too many bricks being underfired.

The breakage rate and underfiring was considerably reduced and the uneven firing corrected on a research and development vsbk built in Peshawar with ODA funding after the problems which occurred in the 5 previous kilns. The main technical problems were sorted out and the kiln ran well.

However, the vsbk is still not an economical proposition when put in competition with the Btk in Pakistan under present conditions. The construction costs are higher for the equivalent yield and this outweighs the fuel savings.

If the air pollution in Peshawar is to be reduced and the laws enforced, it would mean that 4 or 6 shafted vsbks would be an option. The trouble is that, apart from reports from Herat in Afghanistan that five 6 shafted vsbks are being successfully used to replace brick clamps, the vsbk has never been developed for the large scale produc-

tion of bricks. If the Btk were ever phased out for a less polluting and more economical kiln in Pakistan, the vsbk would then become an option if it was scaled up. At the moment it remains a fuel efficient and less

polluting technology, highly suitable for replacing brick clamps in the small scale production of bricks, especially in rural areas.

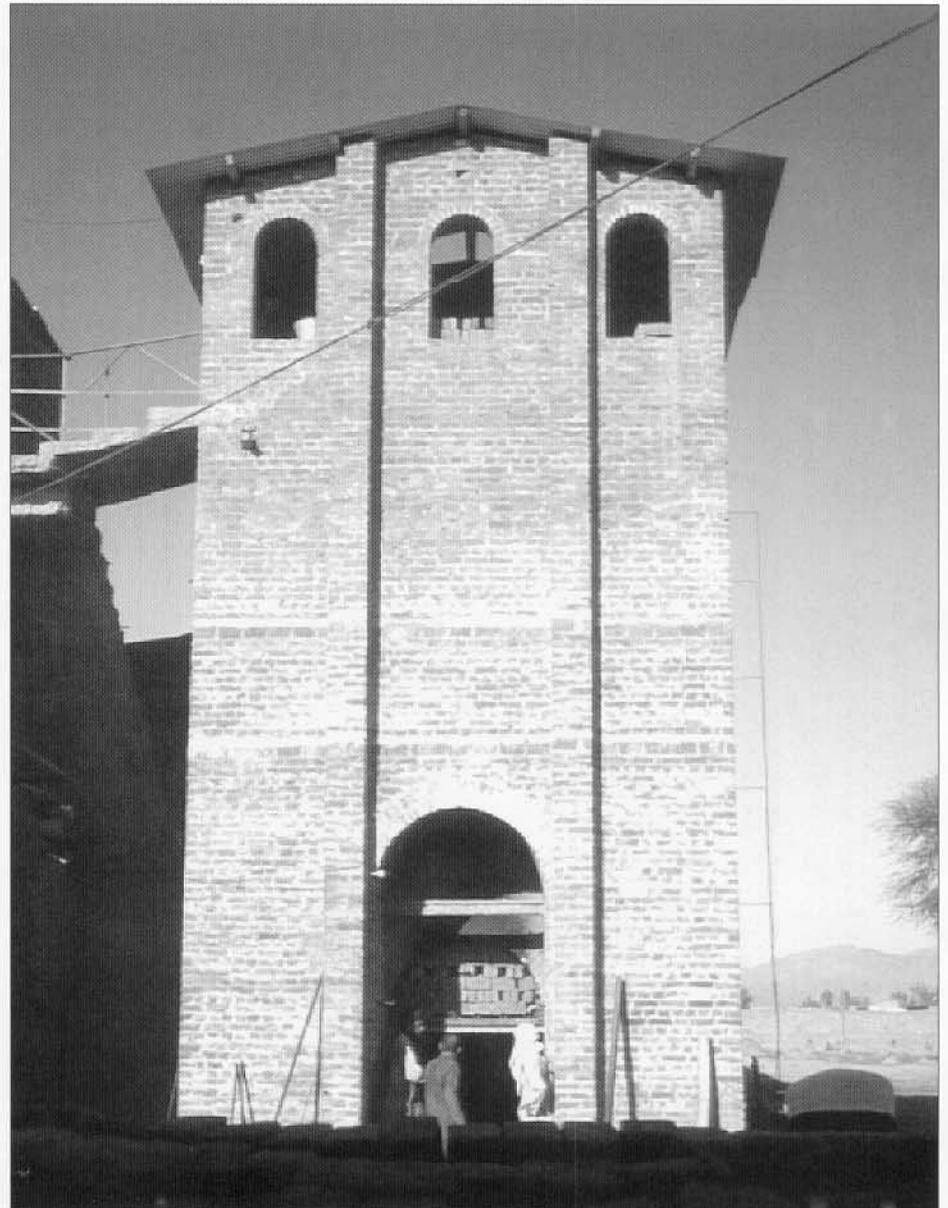


Figure 6 The research and development vertical shaft brick kiln built in Peshawar with ODA funding

What are the problems with this technology transfer

1. The first model of vsbk built in Pakistan was not the latest developed in China.
2. The Chinese engineers did not stay long enough to run the kiln correctly or to complete the necessary training required for a successful hand-over.
3. The problems with the kiln's operation and output were never satisfactorily solved before dissemination.
4. Continual staff changes meant that an experienced dissemination team was never established.
5. Failure to fully evaluate the Btk when compared with the vsbk early on. The vsbk was never designed to replace the Btk. It does not have the daily capacity in its present form and is more expensive to build.
6. Informing the local Brick Makers Association that all the Btk's had to be replaced with vsbk's as soon as possible caused a lot of bad feeling, resulting in the brickmakers' reluctance to accept the vsbk.

The vsbk technology now has a rather poor reputation in Pakistan. The opportunity for a better planned and executed vsbk introduction has not been used.

Lessons learnt

Despite the problems experienced in Pakistan, the lessons learnt there have contributed to the kiln's recent successful introduction into India. There the Chinese engineers and firemaster spent six months building the latest model of vsbk, and fully trained the Indians to operate it. The efficiency of the kiln is up to and in some cases beyond expectations. The pollution produced by the kiln is very low and work is being done to reduce it still further. Brick breakage is down to acceptable and economic levels, and the bricks produced are highly marketable. The kiln is being aimed at small scale brick entrepreneurs, who are currently using brick clamps or scove kilns, not Btk's. There is no question of disseminating the vsbk technology until a second kiln has been built and tested under different conditions in another area.

The technology transfer into Pakistan was problematic but the vsbk technology moves on. There are plans for its introduction into Bangladesh and Zimbabwe which will benefit greatly from the Pakistan experience. The technology involved in a technology transfer will not be successfully adopted in isolation. Careful planning and sensitive management, combined with suitable technical know-how, are also vital for sustainability of the technology.

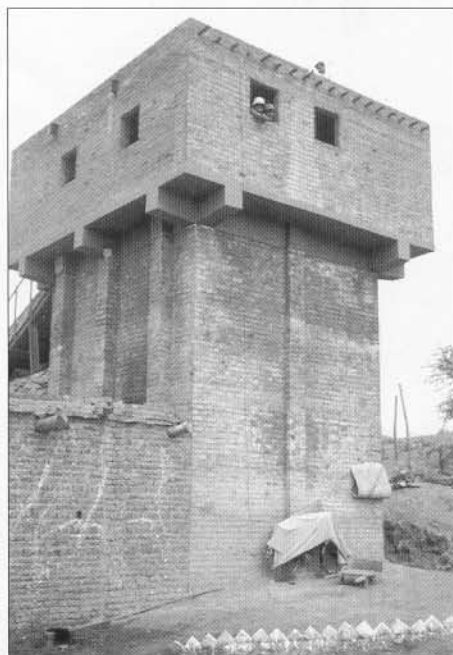


Figure 7 The second prototype vsbk built in Peshawar

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(1997)

What is BASIN?

Building materials and construction technologies that are appropriate for developing countries, particularly in the low-income sector, are being developed, applied and documented in many parts of the world. This is an important prerequisite for providing safe, decent and affordable buildings for an ever-growing population.

But such new developments can do little to improve the building situation, as long as the information does not reach potential builders. The types and sources of information on standard and innovative building technologies are numerous and very diverse, making access to them difficult.

Thus, in order to remedy this drawback, Shelter Forum, GATE, ITDG, SKAT and CRATerre are co-operating in the Building Advisory Service and Information Network, which covers five principal subject areas and co-ordinates the documentation, evaluation and dissemination of information.

All five groups have a co-ordinated database from which information is available on Documents, Technologies, Equipment, Institutions, Consultants as well as on Projects and Programmes. In addition, printed material or individual advice on certain special subjects is provided on request. Research projects, training programmes and other field work can be implemented in co-operation with local organizations, if a distinct need can be identified and the circumstances permit.

BASIN is a service available to all institutions and individuals concerned with housing, building and planning in developing countries, but can only function efficiently if there is a regular feedback. Therefore, any publications, information, personal experiences, etc. that can be made available to BASIN are always welcome and will help BASIN to help others.



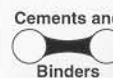
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