Training Report

Vertical Shaft Brick Kiln

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1. Introduction

Figure 1: Traditional wood fired clamps

Brick makers are faced with challenges of producing bricks of satisfactory quality efficiently and economically. Current technologies for brick production in Malawi such as clamps consume large quantities of fire wood and other biomass as fuel (Figure 1). The devastating environmental effect of this brick production with fuel wood has caused a lot of concern in the country. It is estimated that around 850,000 tonnes of fuel wood are consumed each and every year from brick production alone. Apart from the fuel consumption, the pollution caused by huge amount of emissions from the brick industry has attracted the attention of regulatory agencies who are contemplating issuing deadlines after which the polluting kilns are to “clean up or close down".

Thus a South-South Technology transfer project supported by the Knowledge Partnership Programme (KPP) of the Department of International Development, India (DFID) for introducing clean building material technologies in Malawi for commercial business purposes was initiated. This is part of a technology and knowledge partnership to step up collaboration around ideas, knowledge, evidence, accountability, technology and innovation, impacting the delivery of global public goods and services by leveraging the Indian experiences to reduce poverty in other developing countries thus forming the basis of South-South Development Co-operation. Based on the feasibility survey conducted, needs expressed by entrepreneur and long-term market and business viability, the Vertical Shaft Brick Kiln (VSBK) was chosen for adoption in Malawi (Figure 2). A commercial entity, Eco Bricks Ltd. was identified to receive the building material technologies from India.

Figure 2: The VSBK under construction

The VSBK technology is an energy efficient, environment friendly and economically viable means to produce quality bricks. It essentially consists of one or more rectangular, vertical shafts within the kiln structure. Rectangular arrays of dried green bricks and crushed fuel (coal) are carefully stacked into batches, which are loaded into the shaft from the top and finally batches of fired clay bricks are removed from the bottom end. During this process, the batches of bricks pass through the pre-heating, firing and cooling zones before they reach the shaft exit.

2. Approach and Methodology

Training and capacity building formed a very critical part of the technology transfer initiative. Training was imparted at different levels to ensure a cadre of skilled personnel was created at each level from construction to operation and firing.

To ensure quick and speedy adoption of the technologies, Eco Brick Ltd., at Salima, Lilongwe decided to sponsor two supervisors to India for an extended period of 2 months to get trained in all building material technologies. It was of a 'Training of Trainer" nature where it was expected that they will be providing on-the-job training also. This was then followed up by recruiting and training local workers in green brick moulding and firing the kiln.

In addition, masons were trained in the construction of the VSBK and the efficient use of these bricks in construction. Several masons were recruited and trained by the construction supervisor. Three months of ongoing training on the VSBK has created a pool of trained master masons, capable of carrying over the further construction of VSBK in different parts of country under guidance of construction supervisor.

2.1 Supervisor Training

An eco-friendly building material training programme on various building material technologies and commissioning techniques was held from 19th May 2014 to 14th July 2014 at TARAgram, Orchha, situated in Madhya Pradesh. This training programme was particularly for designated trainees from Malawi. The objectives of the training programme were to train the supervisors on different types of building materials technologies including machines, maintenance, operation, production, quality control etc. The major outputs for trainees were to

- Understand various technologies that use waste materials and how these materials have impacts on production and quality.
- Learn about the raw materials used for making different types building materials for housing
- Have hands on experience on making and fabricating different building materials
- Commission machines and equipments.

The approach adopted for the training workshop was participant centered, with an emphasis on practical learning. In order to bring conceptual clarity on subject matter, the training began with expert lectures followed by discussions. It included class room activity and question-answer sessions on the subject matter. Each of the technologies were demonstrated and trainees were given hands on experience to understand and implement in the near future in their respective fields. The technologies demonstrated during the training were

Vertical Shaft Brick Kiln (Week 1 to Week 5)

- Green bricks moulding and its quality
- Loading of green bricks in the kiln
- Unloading of red bricks
- Training of hydraulic system

TARA Brick Mek Machine (Week 6)

- About TARA Brick Mek
- Dry operation and quality control of product
- Trouble shooting operations and maintenance with do's and don'ts

TARA Micron – Micro Concrete Roofing Tiles (Week 7 and Week 8)

- About MCR technology
- Raw materials and mix design
- Machine and related equipments with operation and maintenance
- Production of tiles, curing
- Quality control tests and certification
- Laying of a roof with MCR Tiles

2.2 Mason Training

The construction training programme was held in Lilongwe **from** June 2014 to July 2014. The hands on training was held on the kiln site. Several local masons were involved in the construction of VSBK at Mthyoka, Lilongwe. An initial assessment to understand their ability to take over the task of critical construction gave encouraging results. The selected masons were then further trained in VSBK construction.

The objectives of the training programme were to train the masons on constructing the VSBK including precision work like laying out refractory brick liner inside the kiln. Major outputs for trainees were to

- Understand how to read plans and construct the VSBK
- Have hands on experience on the construction of the VSBK

The approach adopted for the training was participant centered, with an emphasis on practical experiential learning by doing. The key components covered in this training were

- Stone soiling - foundation of the kiln
- Setting up hydraulic pit to set up hydraulic unloading mechanism
- Setting of brick support
- Setting of C – channel
- Construction of brick masonry arch
- Refractory brick work
- Flue duct

2.3 Green Brick Making Training

The green brick making training was held from 19th November 2014 to 14th December 2014 at Lilongwe on the kiln site. This training programme was particularly for the unskilled workers from Malawi including women.

The objectives of the training programme were to train workers on different methods of green brick making including both manual and mechanized processes. The major outputs for trainees were to:

- Understand various technologies that use waste materials and how these materials have impacts on production and quality.
- Have hands on experience on the making of green bricks
- Commission machines and equipments.

The approach adopted for the training workshop was participant centered, with an emphasis on practical learning. The training was used to build a stock of green bricks for the firing. The technologies demonstrated during the training were:

- Manual Sand Moulding
- Soft Mud Machine Moulding

3. Technical Training Processes

3.1 Supervisor Training

Vertical Shaft Brick Kiln Technology

In the VSBK technology making green bricks is the most important part of producing good quality bricks. Learning manual green brick moulding is one of the important aspect considering that the whole of Malawi adopts slop moulding process. Thus sand moulding was introduced to improve the quality. In continuation mechanized brick moulding was also introduced.

Figure 3: Watering leveled moulding yard (top left); Spraying sand over levelled and watered surface (top right); Proper moulding yard (bottom left); Aging of soil and manual mixing for appropriate soil mixture (bottom right)

- *Preparation Of Moulding Yard:* The first step is to clean the moulding yard. The top soil or top 6" grass cover has to be removed from the designated moulding yard as shown in the picture. The removed grass field need to be watered after giving some time to dry the watered moulding yard (Figure 3). The upper surface then should be smoothened with sharp edge. In this picture we are using sand as sharp edge. This sand will be swapped to get almost approximately good surface for moulding.

- *Ageing of soil:* This is the process to make soil appropriate for making green bricks. Proper quantity of water to be added and kept to soak for at least 24 hours. The watered soil is then pugged manually to appropriate lump of soil paste (Figure 3). This is one of the most appropriate steps for Malawi, since it is not followed.

Figure 4: Sand Moulding

- *Sand moulding of green bricks:* The pugged soil after 24 hours are made to bricks by manual process. A lump of soil is cut by hand manually approximately required to make one bricks. The moist soil lump is rolled and kneaded into a dough and thrown in a wooden mould as shown in the picture. The excess soil is scrapped away. The filled up mould is demoulded with a releasing agent which is sand (Figure 4).

- *Loading of green bricks in the Kiln:* In this process the dried green bricks are loaded into the shaft. For VSBK firing system, bricks are loaded in predetermined pattern as per the airflow, quality required and coal size and quantity (Figure 5). Various patterns of loading of green bricks taught to the trainees were, closed loading, open loading, zig-zag loading. They were trained on the productivity based on various loading patterns and other related activities like coal weighing, distribution, spreading etc. Trainees were also trained on the consequences of wrong loading and coal distribution patterns and their effects on quality.

Figure 5: Coal distribution between bricks

- *Unloading of red bricks from the Kiln:* In this process the fired red bricks are unloaded from the bottom of the kiln. To remove red bricks from the VSBK kiln, usually an unloading trolley mechanism is used. However the screw jack system was not preferred in Malawi. Thus a hydraulic system of unloading was developed and tested (Figure 7).

  Both the supervisors were trained extensively on the hydraulic system of unloading including placing and removal of square bars. The most important lesson transferred was the slow unloading process at selected places so that bricks do not get damaged due to sudden contact with the metal parts. Training was also given on lowering various

Figure 6: Training on operation and maintenance of Hydraulic Power pack

capacities of bricks i.e. 4-layers and 6-layers. Gradual transfer of load of the entire brick shaft was the major topic of discussion and knowledge transfer.

Figure 7: Lowering of unloading trolley (left); Lowering of unloading trolley on rail (right)

- *Hydraulic unloading equipment:* Special emphasis was given during the training period on operation and maintenance of the hydraulic unloading system. The hydraulic system is an unloading device which is grouted just beneath the kiln. The hydraulic system is sophisticated mechanism which reduces the workload of the firemaster and creates better conducive environment for the workers (Figure 6).

TARA Brick Mek Machine (TBMM)

TARA Brick Mek machine is a soft mud moulding machine for making green bricks. The machine is mounted with electrical and mechanical driving system as source of power i.e the machine can be operated by electrical power or by diesel engine.

- *Dry operation of TBMM:* The pre-installation trials of TBMM were necessary to impart a new dimension of green brick making to Malawi. Normally bricks are made with slop moulding and no knowledge exists on alternate brick making process. Since this was a new technology to be introduced in Malawi, thus extensive training on assembly, operation and maintenance was planned and provided. To start with preliminary knowledge on the machine was provided. All the different component of the machine were explained to trainees with all technical details. Dry run of the machine was conducted with both forms of power supply and supervisors trained on feeding of moulds, taking them out and demoulding of bricks (Figure 8).

Figure 8: Training on soft mud moulding machine

Micro Concrete Roofing technology

- Most extensive hands-on training was provided on the MCR technology. This included not only manufacturing the product but also on process design and its relevance on the properties of the final product. During the process the importance of MCR tile, its application and its outcome was also shared (Figure 9).
- Trainees were exposed to production of various types of tiles e.g. corrugated, roman and pan type. It was understood that the Pan Type of tiles will be suitable and liked in Malawi. Based on the feedback of trainees, pan type moulds were procured for Malawi.

Figure 9: Top Row : Sieving aggregate (left), Mix preparation (centre), Making tiles in moulds (right) ; Bottom Row : Stacking tiles (left), Curing tiles in water tank (centre), Edge cleaning of tiles (right)

- Trainees took hands-on lessons on how to manufacture MCR tiles in actual production scale. They were associated with commercial production units where they took part in actual production. This gave them an idea on the production system and what are the factors that affect productivity.

- Besides the manufacturing process, the supervisors were also trained on monitoring of production systems and ensuring quality of tiles. They were exposed to various types of strength testing devices and other processes for ensuring that quality of tiles are maintained.

3.2 Mason Training

a. Stone Soiling - Foundation of Kiln

The basic of kiln foundation starts after soil leveling and compacting at the right level. Foundation of kiln can be done by brick or stone. The brick foundation is quite costly, hence stone soiling (Figure 10) is preferred. This depends on the availability of materials - locally and economically.

- Measure the outline of the foundation and mark it with pegs and strings.
- Place cut stones/boulders in CM 1:8 at the foundation outline all around and level the top.
- Place strings from one corner to another to ensure the correct height for soling.
- Start placing the soling stones/boulders in CM 1:8 vertically from one corner and work backwards to the other corner.
- Hammer or wedge the small stones into all the gaps in such a way that there is no movement of the big stones existing and that it is as solid as rock.
- Fill the voids using well graded aggregate and sand.
- Spread the sand on top of soling and sprinkle water so that the gaps between the boulders are filled
- The PCC mix ratio must not be less than 1:3:6
- The PCC layer has to be properly leveled. The maximum allowable level deviation is 10 mm.
- The concrete should be properly compacted.
- The aggregate and sand for PCC should be properly washed and free from any foreign material.

Figure 10 : Stone soiling

b. Setting of Brick Support I – Beam

These I-Beams take the entire load of the green bricks when the shaft is fully loaded. Extreme care must be taken while purchasing this material from market to check clearly for dimensions.

- Clean the places where the steel plates will be fixed. Spread a layer of cement mortar (total thickness of the cement mortar level is defined by the actual measured height). Level any difference more than 20 mm with concrete 1:2:4 (Figure 11).

- Place a clean steel plate (260x250x8 mm) into the cement mortar bed and press/hammer gently until well embedded and leveled.
- Check the level with all the opposite steel plates.
- Place the I-beams on top of the steel plates and measure the correct distance and position.
- Measure from centre to centre of the I-beam and check the correct dimensions, as well as the diagonals.
- Check the position of the I-beams from the shaft centre. Check the level (length and width) of all I-beams and make adjustments, if necessary, using metal strips.
- Transfer the centre line, using the thread stretched across the construction pillars and mark it permanently in the I-beams, using hack saw blades.

Figure 11: Setting I - Beam

c. Setting of C – Channel

The C-Channels carry the weight of the entire shaft's wall, including the chimneys. Therefore, the quality of the supporting wall, the steel-plate placing and the C Channel should be extremely good to ensure proper functioning and for an increased lifespan of the VSBK.

- Place a clean steel plate (300x250x8 mm) into the cement mortar bed and press/hammer gently until it is well embedded and leveled.
- Check the level with all the opposite steel plates.
- Place the C-Channels on top of the steel plates and measure the correct distance and position (Figure 12).
- Check the level (length and width) of all C Channels and make adjustments if necessary. Place metal strips for leveling adjustments.
- As the C-Channel is fixed, grout it with cement concrete in the ratio of 1:2:4.

Figure 12: Setting C-channel

d. Construction of Brick Masonry Arch

The brick arch masonry is constructed using first class red bricks and forms a tunnel for the unloading mechanism.

- Pile up bricks in a honeycomb pattern
- Finish the arch mould with mud until a smooth surface has been achieved (Figure 14).
- Check the stability of the entire arch mould and especially the base of piled up bricks.

Figure 13 : Constructing brick arch

- Clean the PCC arch base thoroughly and ensure that no mud is sticking on it.
- Use quality bricks after soaking them in water.
- Place the bricks on both sides of the arch and start from the front side of the arch.
- Use the “to arch centre-line” method (extended by a string).
- Use a cement mortar mixture of 1:4 for the arch construction.
- Cement mortar joints should be a maximum of 8-15 mm.

e. Refractory Brick Work

Refractory brick work is one of the most important things in VSBK construction. Refractory bricks are very costly and not easily available in the market. They should able to withstand at 12000 C and be +/- 1mm in deviation.

Figure 14: Dry refractory brick layers

- Mark the centre of the shaft on the C-Channels and the side of the shaft with the help of centre line marks on the I-beams.
- Always use the centre of the shaft as the reference point for the shaft measurements.
- Make three layers of dry refractory bricks; establish proper bonding and measure the dimensions of the cut bricks required (Figure 15).
- Prepare the cut bricks and make them available at the site before starting shaft construction.

- Tie a string on the inside of the brick line and place the refractory bricks for one layer.
- Check the level and the diagonal measurements of the shaft.
- After five layers of refractory lining, build a 470 mm thick brick wall with the ordinary red bricks in lime surkhi (1:4) mortar.

f. Flue Duct

It is considered to be most critical construction activity in VSBK. It is made of refractory bricks. The flue duct consists of 6 layers of critical laying of refractory bricks to form a tunnel for the flue gases escaping from the shaft through the chimney. It is also used to preheat the partially moist green bricks loaded in the shaft. The flue duct consists of upper and lower flue duct system.

- After completing the last refractory header course, clean the shaft walls.
- Place a layer of refractory bricks horizontally to create a total of four equal-sized flue exit holes on the short side and eight equal-sized flue exit holes on the long shaft side of the shaft.
- Place the second, third and the fourth refractory brick layers exactly on top of the first layer.
- Build up 240 mm backside of these four layers with the ordinary red bricks in lime surkhi mortar.
- The fifth refractory-brick layer is, a continuous stretcher, vertically placed, facing the inside of the shaft. This layer bridges the gaps of the four lower refractory layers (Figure 16).
- A layer of refractory or red bricks are placed in lime surkhi mortar on the backside, forming a tunnel of 80x110 mm, leaving a distance of 135 mm on the backside of the previously mentioned continuous, vertically stretcher course.
- The next course of refractory bricks is laid horizontally facing the inner wall.

Figure 15 : Building the flue duct

3.3 Green Brick Making Training

Now a days green brick are produced by manual or mechanized process. The most common method in Malawi is manual process. In manual process we have sand moulding and slope moulding. Slope moulding is considered to be inferior production process since the water content in green bricks is too high and the shape and size of the bricks deteriorates after moulding. In mechanical moulding processes the shape and size of the bricks are much better and improved strength of the bricks is achievable.

In Malawi we have introduced sand as well as machine moulding green bricks. The preparatory training is as follows.

a. Moulding Yard Preparation

Before moulding processes start, the moulding yard has to be prepared for brick demoulding. Preparation of moulding yard is just not removing upper layer of the soil of the yard but making it suitable for the brick demoulding. The moulding yard must be smooth enough to withstand the regular movement loaded trolley of bricks and sustains without damaging the moulding yard

- *Removing top soil* : The top soil i.e. approximately 6 inch of soil which consist of grass and roots are removed .

Figure 16: Sweeping of top layer of the yard

- *Watering the uneven yard:* After removing the top soil the moulding yard is watered for upper layer to be loose to carry out the next stage. Watering is done by water-can.
- *Sweeping of moulding area:* After watering the moulding yard, it is swept off by broom and any other sharp edges are removed from the top uneven surface.
- *Scrapping and leveling:* The loose upper layer is now ready to scrape off for a plane surface. Care should be taken that too much soil is not scraped off and creates pot holes. Pot holes are not desirable as the demoulded bricks will crack when placed over pot holes.

b. Sand Moulding

The mould which is used for sand moulding is either wooden or metal mould. The size of the mould decided based on shrinkage of soil by which green bricks will be made. Once the mould is finalized and made, it is ready to use for moulding of green bricks.

Figure 17: Demoulding bricks

Manual Moulding Process

- Spaying of releasing sand in the mould
- Making of dough
- Throwing of dough in the mould
- Cutting off the excess soil paste over the mould
- Spraying of releasing sand over the filled mould
- Demoulding of bricks (Figure 17)

Equipment Used

- Spade: This is used to dig the soil
- Shovel: This is used when the soil is mixed with internal fuel and also required to puss soil where ever required.
- Wheel Barrow: A cart either of metal or wood required to transport the prepared soil.
- Broom: To clean the moulding yard before and after moulding
- Scraper: This is required to level the moulding yard
- Mould: This required to make green bricks
- Cleaning tool: This is required to remove the stuck soil from the mould after few demoulding.

c. Soft Mud Moulded Bricks

A machine is used for making bricks, which is also known as soft mud moulding machine (Figure 18). These bricks are superior in quality than sand moulded bricks. There are about 13 workers required to operate the machine and the production capacity of this machine is about 1400 bricks /hour

Figure 18: Soft Mud Moulding Machine (left), Metal Mould (right)

Equipment Used

- Machine: In a soft mud moulding machine the main parts are motor driven by electricity or diesel engine. The power consumption of the motor is 7.5 HP. This machine is also equipped with a water recirculation pump whose capacity is 16litres /second .
- Stainless Steel Mould: the other component of the machine is stainless steel mould . three bricks can be made out of one stainless steel mould. The minimum no of mould provided in a machine is 24 or its depends up on the capacity of a machine

Moulding Process

In soft mud moulding process soil has to be dumped in a longitudinal way so that the machine can be moved along with the dumped soil. The design of soil deposition down the moulding yard is very important. The total distance between dumped soil, machine and demoulding yard should not exceed 70 ft to get optimum output of bricks.

- *Stage 1- Dumping of soil: D*umping of soil in the moulding yard is one of the most important job in the moulding process. Soil should be dumped in a longitudinal manner. While doing so care must be taken that the height of dumped soil should not exceed 2ft and width of the dumped soil should not increase 10ft (Figure 19).

Figure 19: Dumped soil for ageing (left), Aging of soil (right)

- *Stage 2- Ageing of soil:* Process of ageing of soil is same as for hand moulded bricks (Figure 19).
- *Stage 3- Feeding of aged soil:* After ageing the prepared soil is fed to the machine manually or mechanically (with the help of conveyor belt). In manual process 3 to 4 labour are required to feed aged soil in the machine continuously. In mechanical process 2 labour continuously shovel aged soil in the conveyor belt.
- *Stage 4- Pugging of aged soil:* This activity is done by the machine. The horizontal augur is mounted on bearing on either end of the machine. This augur has portable blades attached to it. When the augur rotates, the blades also rotates and mixes soil and ingredients are mixed in it. Thus the mixture gets pugged. This augur not only mixes the aged soil but also helps to fill up the empty mould with its rotational action.

Figure 20: Mechanical Brick Moulding

- *Stage 5 - Filling of empty mould:* The stainless steel moulds are pushed mechanically to the bottom of the opening of the barrel, designed for the mould. The moulds are filled up by gravitational force of the pugged soil and by the action of the augur. The filled up mould then are pushed in front and taken out by another action of pushing arm connected on the augur. This is a continuous process of pushing of empty mould in one end and removing filled up mould from the other end (Figure 20).
- *Stage 6- Scraping of excess pugged soil:* Excess filled soil in the stainless steel mould is mechanically scraped off by the action of scraper
- *Stage 7 - Demoulding of bricks:* Filled up moulds are then demoulded manually in the moulding yard. The mould is moved upside down and it is pushed back. While pushing back mould should come up vertically straight.

4. Trainees

Table 1: List of Trainees

Sand Moulding				
Sl No	**Name**	**Sex**	**Village**	**Age**
1	Efraim Mbdji	M	Mataka	29
2	Zulu Chiyange	M	Mthyoka	34
3	Amiton Mkomba	M	Mthyoka	30
4	Harrison Zuze	M	Sadjiwa	24
5	Josephy Banda	M	Sadjiwa	25
6	Lazolo Ganijani	M	Kawale	36
7	Limbikani Kachikwatu	M	Mataka	39
8	Nason Mbdzi	M	Mataka	44
Machine Moulding				
Sl No	**Name**	**Sex**	**Village**	**Age**
1	Agnes Mkwende	F	Mthyoka	19
2	Blender Mwale	F	Mthyoka	27
3	Mphatso Mazdi	F	Mthyoka	24
4	Diness Malizani	F	Mthyoka	22
5	Amida Kalumbi	F	Mthyoka	35
6	Emilida Zikitoni	F	Mlewa	31
7	Iness Khongo	F	Kamphinda	35
8	Richard Kombe	M	Mataka	34
9	Symon Zakalia	M	Kakuda	34
10	Welman Tembo	M	Mthyoka	39
11	Fanuel Kachikawatu	M	Mataka	44
12	Efati Kachisa	M	Mlewa	34
13	Philip Chodwe	M	Mthyoka	20
14	Samuel Fanuel	M	Mataka	21
15	Ganizani Chafukira	M	Mphanda	24
16	Jonasi Witmisi	M	Mataka	26
17	Easafu Kasaphira	M	Mataka	24
Masons				
Sl No	**Name**	**Sex**	**Village**	**Age**
1	Gavin Mwale	M	Mthyoka	29
2	Ignishij Khongo	M	Kamphinda	30
3	Francis Banda	M	Mthyoka	50
4	Thomas Kombe	M	Mlewa	28
5	James Ganijani	M	Kakuda	45
6	Masaka Mbdzi	M	Mthyoka	40
7	Kwsmna Mwale	M	Mthyoka	47
8	Rafely Banda	M	Mthyoka	39
9	Philip Zuze	M	Mataka	35
Supervisors				
Sl No	**Name**	**Sex**	**Village**	**Age**
1	**Alex Benala Zuze**	M	Mataka	42
2	**Johns Kasulira**	M	Mthyoka	37

5. Feedback

- In Malawi bricks are fired by wood. The trainees first time saw the bricks are being fired by coal. It was also learnt that coal is available in Malawi. Thus this new type of firing technology will be welcomed and adopted fast.
- Supervisors have never seen a brick firing technology that could be smokeless. The feedback provided was that this training programme will be useful to spread the message of less pollution.
- Workers can work in a pollution free environment round the year. Thus it can be a round-the-year income generating opportunities for workers.
- Trainees have learnt quite a handful of appropriate technologies and would like to get further experience at working sites. During the working process, they would also like to get further training as per Malawi conditions.
- Masons have never used plum bob as a tool to construct a building, they are now more confident to built a quality wall with better accuracy. They have learnt about the refractory bricks, their properties and construction procedure to built an insulating wall which they have never done before .
- In Malawi , small bricks size are used in construction of building and other construction activity, now the masons are happy since they are getting bigger size of bricks and what reduces their time and fatigues
- The mortar joint which used to be too thick to cover up the uneven surface ,now they have learnt how small thick mortar joint could make construction easy. Less mortar joints also reduces the consumption of cement that they have understood and appreciated.
- The training programme has provide a boost to their confidence and they are confident that with continued practice they can overcome all operational issues. They are confident that their application downtime will be reduced quite significantly due to the training that they have received. Masons are so confident that they can carry this type of construction in future any where in Malawi.
- It was requested that these type of training programmes be conducted for more colleagues from Malawi. However these should be at a higher level and not for workers. They can now train workers at site for day-to-day operation

About the Knowledge Partnership Programme

In the era of globalisation, India's strengths are its democracy, vigilant civil society, a growing economy and investment in development through policies, programmes and innovation. Considering the increased focus on South-South Cooperation development dialogue and India's experience in addressing development challenges and assisting development in various regions of the world, the Government of UK's Department for International Development (DFID) is implementing a new model of cooperation support in India through the Knowledge Partnership Programme (KPP). KPP is funded by DFID and managed by a Consortium led by IPE Global Private Limited under its Knowledge Initiative.

About Technology & Action for Rural Advancement

The Society for Technology & Action for Rural Advancement (TARA) is a social enterprise set up in the year 1985 at New Delhi, India. It is an "incubation engine" of the Development Alternatives Group which has been providing development solutions in India and elsewhere. TARA as an "enabler" is instrumental in the creation of livelihood support systems, training and capacity building for the rural poor and marginalized communities. TARA as an "aggregator" bundles support service packages, help large corporation explore new markets and also aggregate the output of local producer groups including micro, mini and small enterprises and connect these groups to market opportunities for BOP access and market development for ethical products and services. Governments, large Corporations and Civil Society networks benefit from TARA's expertise as a "manager" of large awareness creation, environmental action, community development and service delivery programmes in areas such as affordable housing, renewable energy, water management, sustainable agriculture, waste management and recycling.