mat to fore – construction & services

Appropriate technology implementation in Ghana

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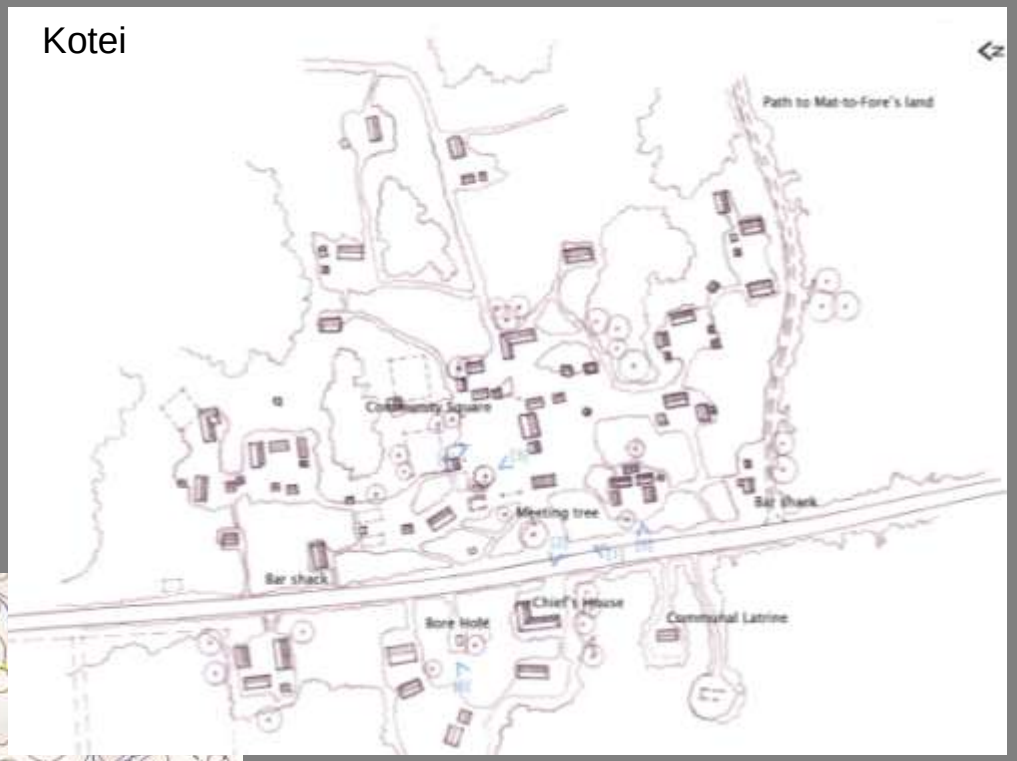
Mat to Fore Charity – Vision

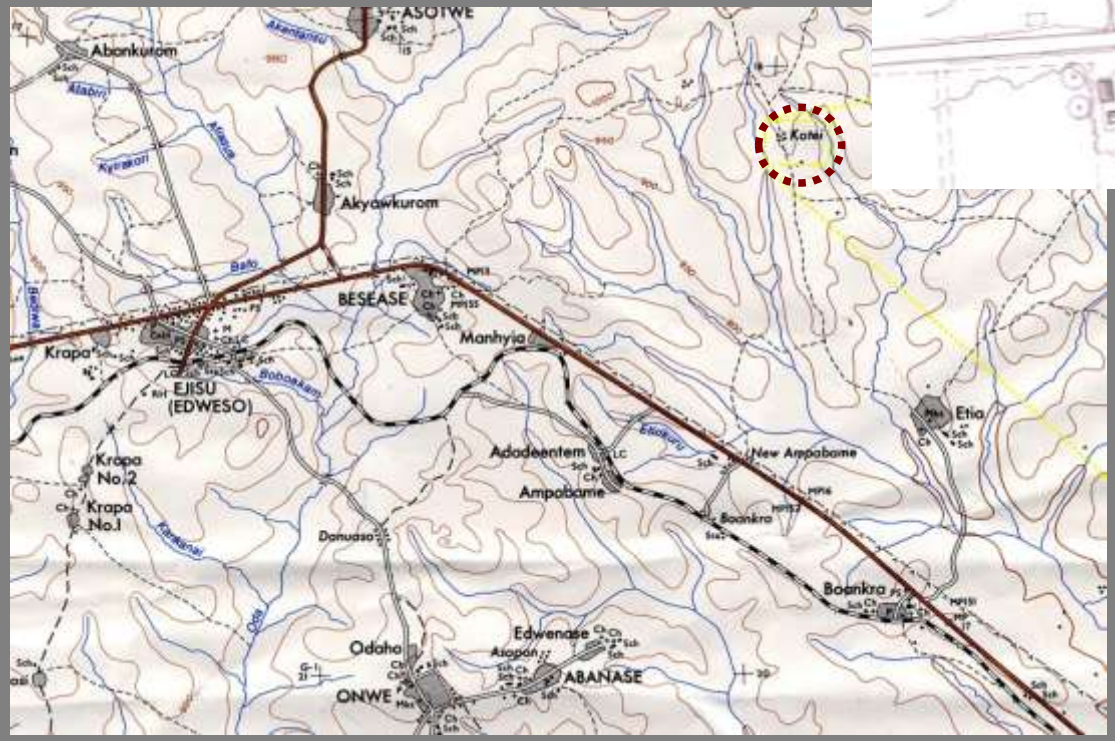
- To care for orphans
- To assist and encourage people with disabilities
- To support the disadvantaged in poor regions
- To raise awareness of the plight of orphans
- To demonstrate the love of God in every practical way possible
- To partner with any partner organisation eager to help

Mat to Fore Charity – Implementation in Kotei

- Provided a bore hole for the village
- Constructed and runs a Pre-School
- Implements child sponsorship
- Constructed admin and library facility
- Employs and trains villagers in construction
- Provided sanitation and gas supply (biogas)
- Constructing foster housing for orphans

Kotei





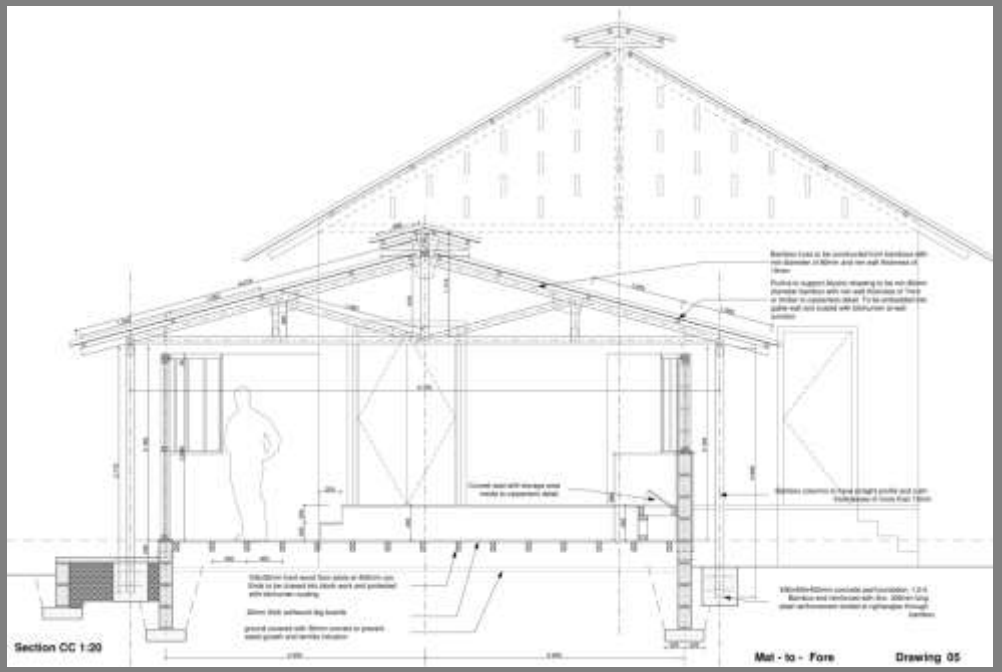
Location – Kotei Village, East of Kumasi

MAT TO FORE

Building 01 – School Building

Bamboo - Technical Details

- Based on Truss design and construction method in BRRI 'Building a School Manual'
- Treated for one week using Dursban in Open Tank Method
- Jointed with 12mm plywood gusset plates and 10mm bolts
- Max span used of 6.8m



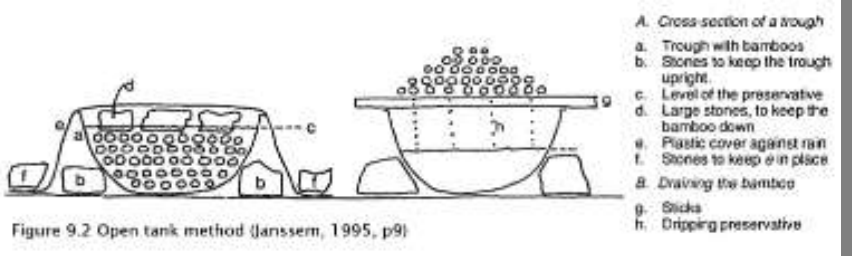


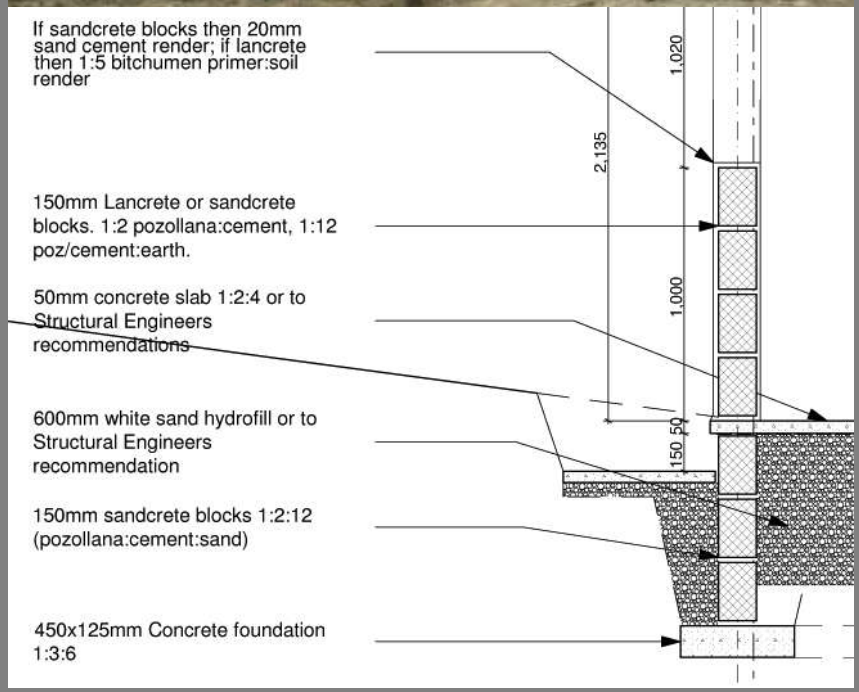
Figure 9.2 Open tank method (Janssem, 1995, p9)

Bamboo – Lessons Learned

- Bamboo was harvested essentially for free but metal bolts for joints were very costly and perhaps more than the cost of a fully timber roof
- Breaking holes in bamboo diaphragm difficult and time consuming – broken drill bits costly
- Overall the aesthetic has been well received by the villagers
- Durability is good with Bamboos at roof level. Have had some borers in a few low level columns. Plywood plates have deteriorated externally.

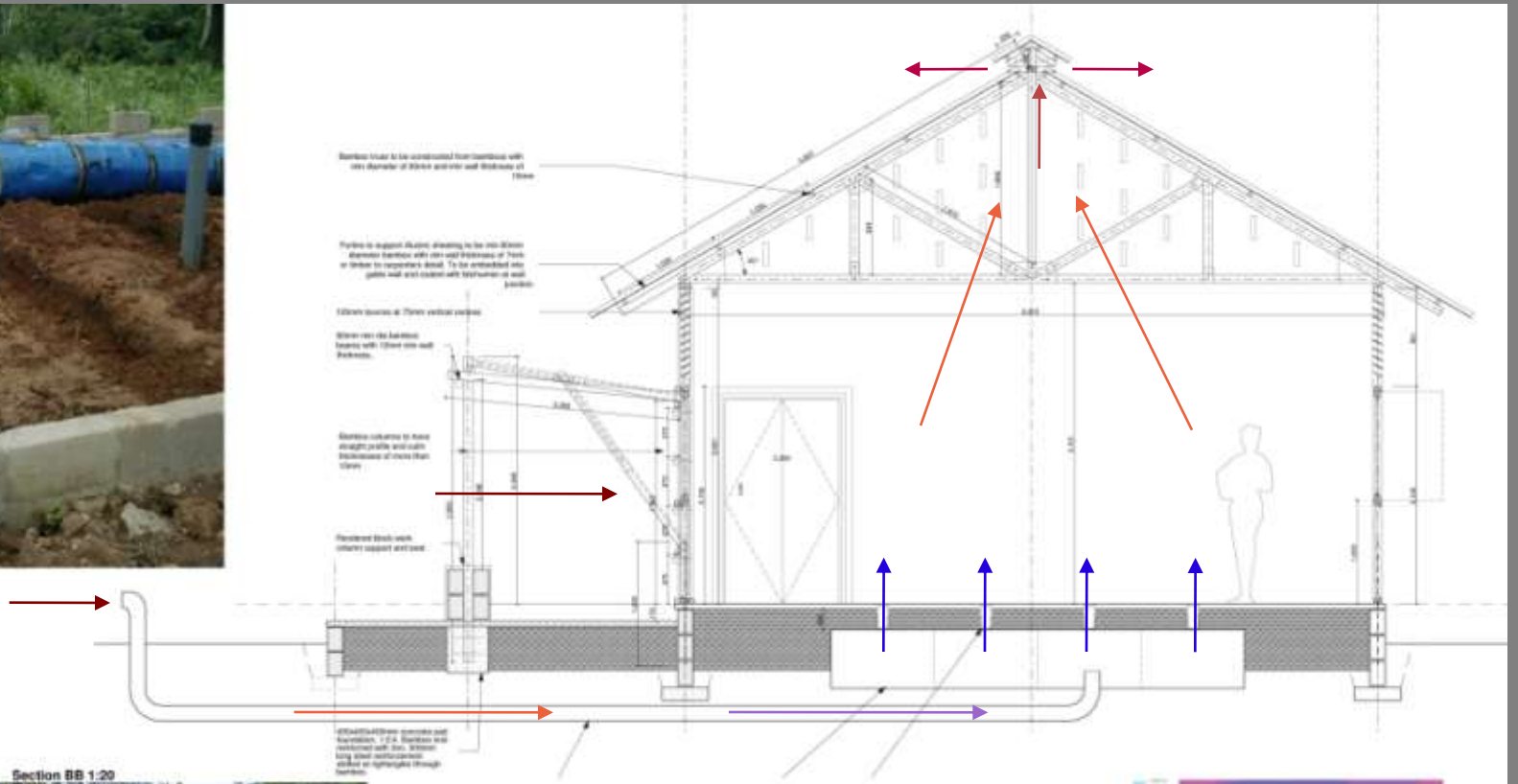
Pozollana - Technical Details

- Pozollana purchased direct from the BRRI – produced in Ghana
- Costs 1/2 the cost of cement
- Used to replace 1/3 of cement in all applications (sandcrete blocks, floor slabs etc)
- No noticeable difference between between cement and pozo/cement for workability and strength



Pozollana – Lessons Learned

- Difficult to convince the contractor at first, but now is fully convinced and always wants to use pozollana (due to cost).
- Contractor only convinced to use pozollana for blocks – not slabs, beams etc...
- Have to ensure the labourers are mixing the pozollana with cement and not using two bags of cement followed by one bag of pozollana.
- Ready supply of pozollana.
- Durability has been good.
- More costly than pressed earth bricks so now only used below ground.
- Has to be plastered and then regularly painted, which is an increased cost over bricks that are self finished.



Ventilation/Earth Duct – Details

- Earth Duct uses grounds stable temperature that is below ambient temperature level to cool the incoming ventilation air.
- Design does not require a fan but relies on wind driven ventilation as modelled with CFD.
- High level vents are used to enable buoyancy driven ventilation and to remove solar gains from roof.
- Building is positioned to take advantage of prevailing SW & NE winds.

Ventilation/Earth Duct – Lessons Learned

- Cost of plastic pipe was surprisingly high.
- Time will tell if smells develop in the earth duct – so far there are no smells
- The building is noticeably cooler than surrounding buildings.
- Builders have limited understanding of buoyancy driven ventilation and did not properly instal vents at high level
- Limited materials for floor vents means drains were used that restrict air movement

Building 02 – Admin & Library

Pressed Earth Bricks - Technical Details

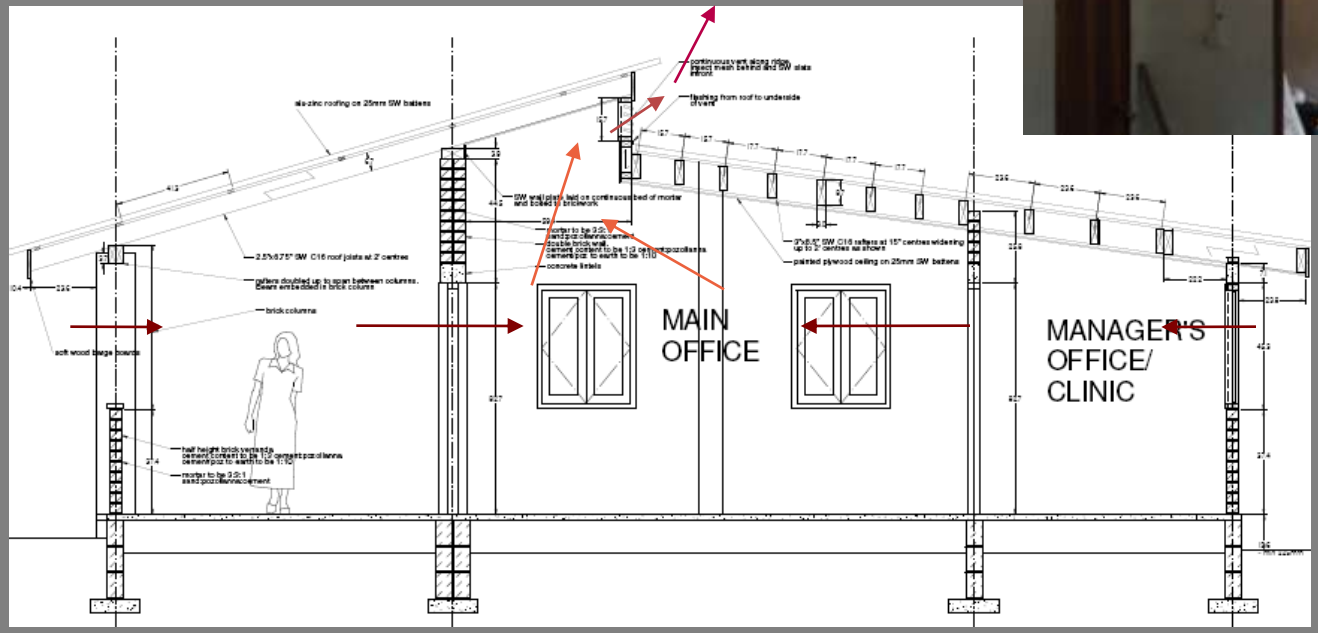
- Pressed from earth on site using the 'Tek Block Press'
- Stabilised using approx 1 bag of pozollana to 400 bricks
- Left to dry for one week (must be protected from the elements and kept off the ground)
- Should not be used below ground and be well protected with eaves, overhangs etc...
- Local labour used to produce the blocks

Pressed Earth Bricks – Lessons Learned

- Whilst the building has weathered well over the past two years, there is some surface wear at very exposed corners. Emphasises the need for good weather protection.
- Due to the cheap cost, the durability and the lack of regular maintenance required, pressed earth bricks are now also being used for the construction of the new foster housing on the site.
- Seems like a technology that has the potential as a 'cottage industry'

Ventilation Design – Details & Lessons Learned

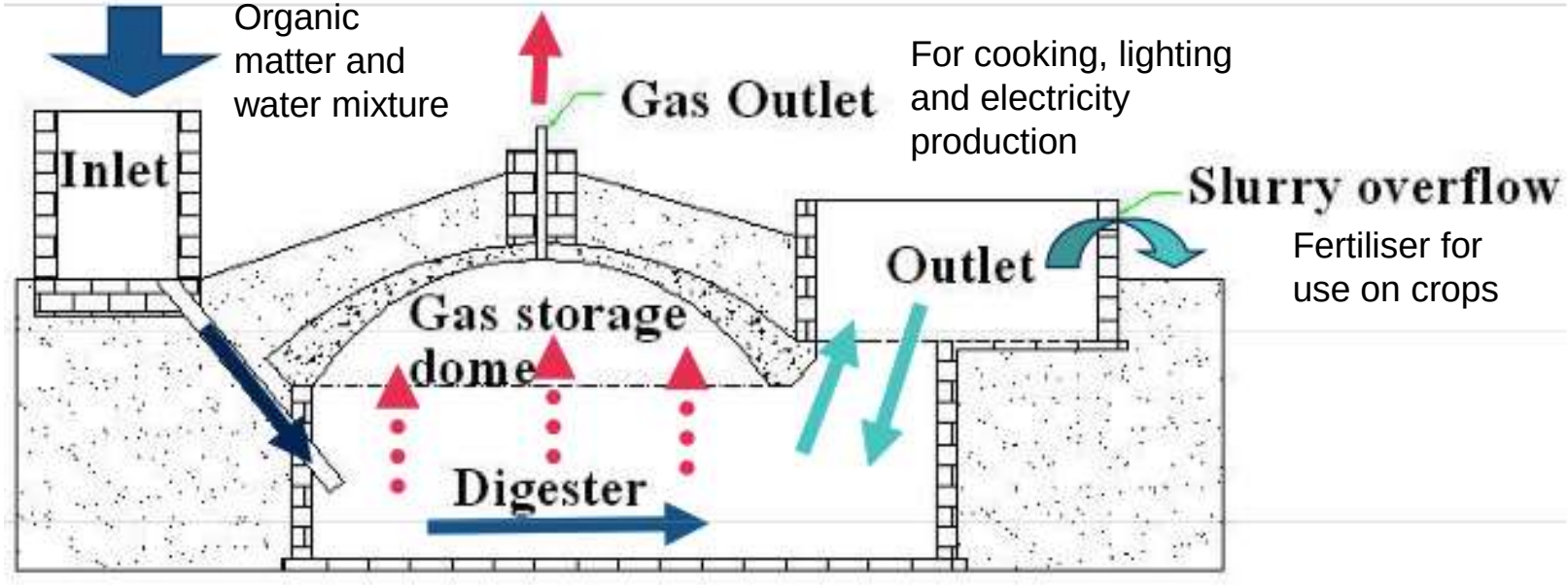
- Employs high-low buoyancy aided ventilation design.
- Again, was not properly carried through in construction. A standard sealed ceiling was installed thereby cutting off any benefit of the roof design for ventilation.

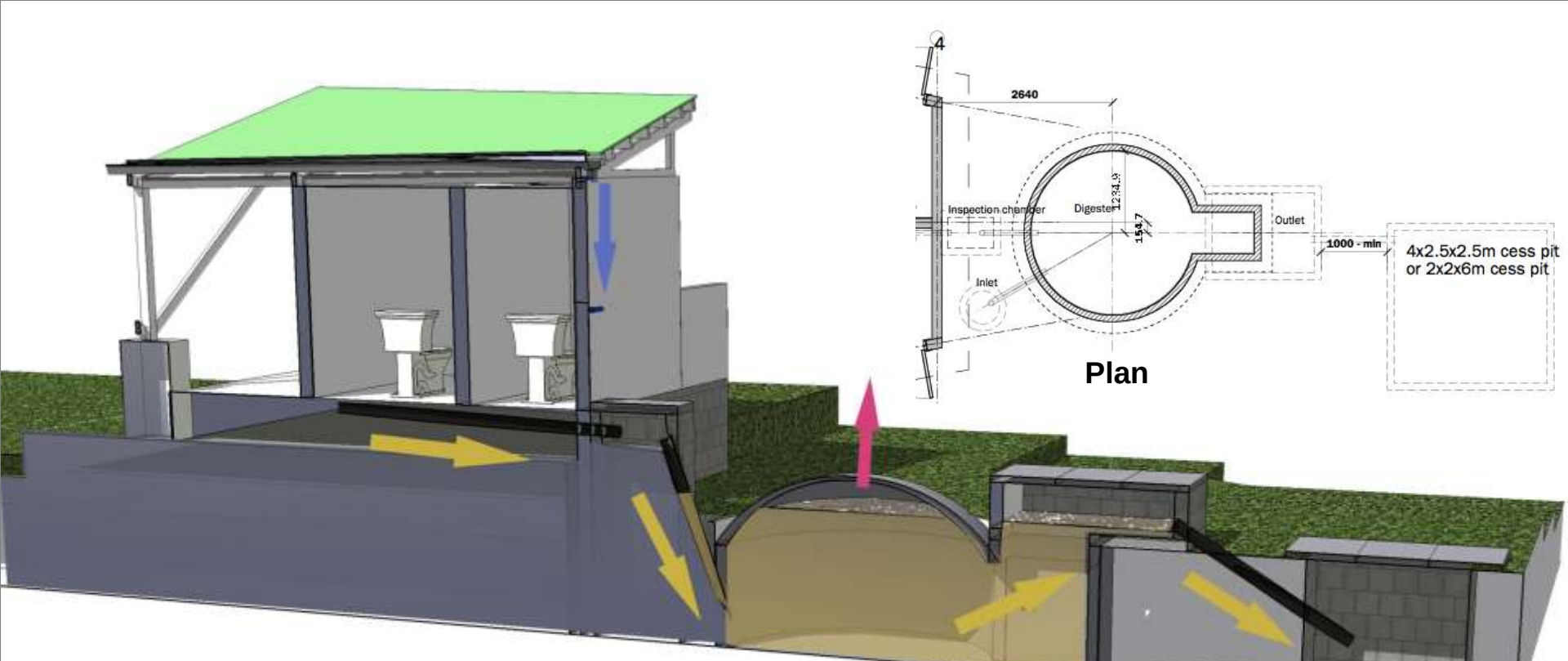


Building 03 – Biogas Digester & WC

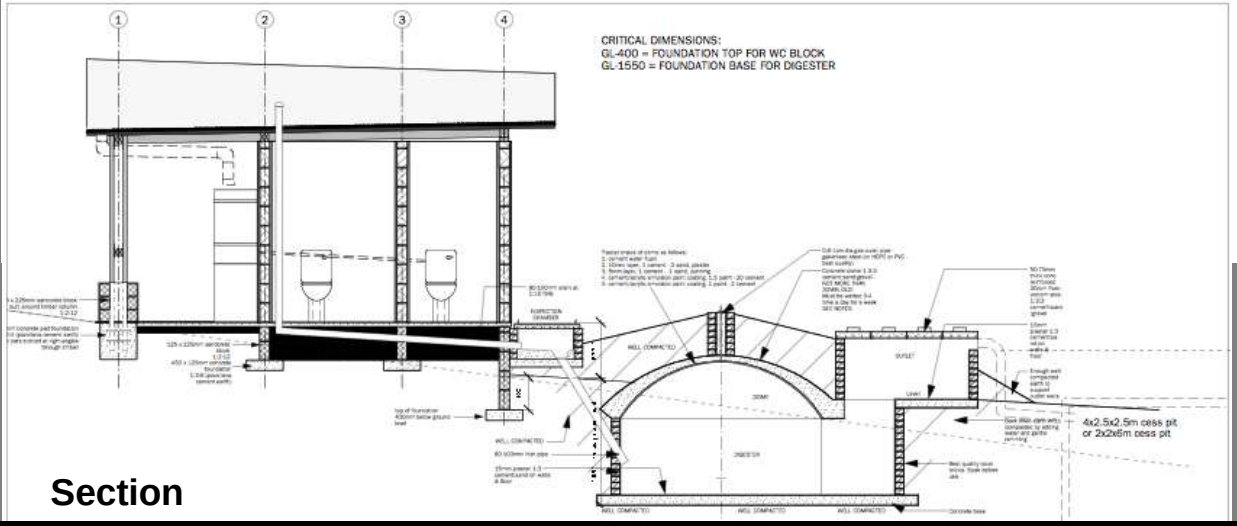
Biogas – Concept

- Organic substances when subjected to anaerobic fermentation (i.e. without oxygen) will produce 'biogas'.
- Biogas when produce from cow dung consists of approx 60-70% methane.
- Biogas can be used for cooking, lighting and electricity generation.
- A second by product is high quality fertiliser that is as effective or more effective than mineral and chemical fertilisers.





Plan

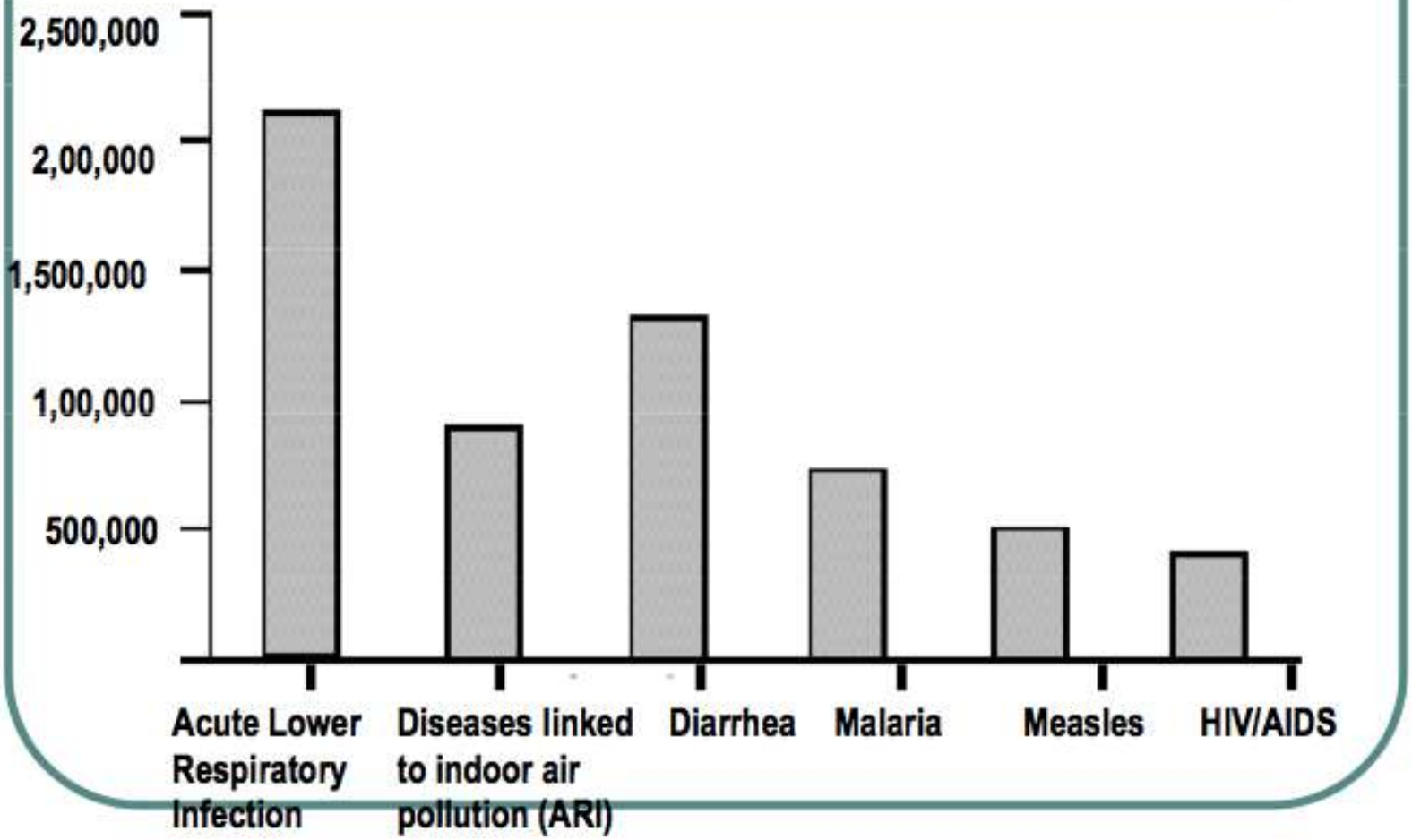


Section

Life Without Biogas

- Drudgery collecting fire wood.
- Smoky cooking environment causing poor health.
- Less effective use of land without organic fertiliser to boost production
- Poor sanitation with many defecating in the fields.

Deaths in Under fives by Various Causes



Source: BSP Nepal

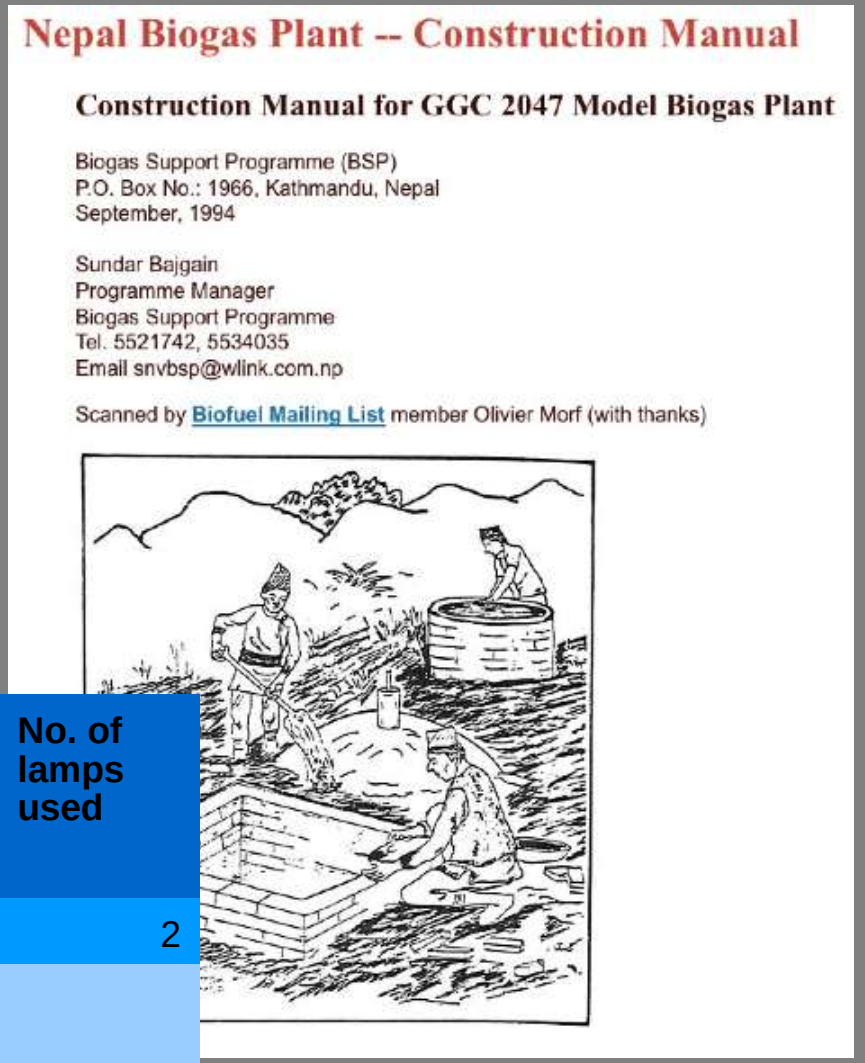
Life With Biogas

- No collection of fire wood, reducing deforestation
- FREE, renewable fuel source
- Clean cooking environment, increasing health
- Highly effective organic fertiliser produced, which can be used or sold.
- Human waste is treated when fed as a waste into the digester thereby increasing health by increasing hygiene of waste disposal.

Digester Design

Nepalese GGC 2047 Model, fixed dome, biogas plant chosen due to:

- Proven design – 264,000 in operation in Nepal
- Easy to construct from local materials
- Construction manual available (see left), with construction drawings (next slide)
- Has been rigorously tested and monitored by BSP Nepal for twenty years
- Simple sizing method when using cow dung as feed


Nepal Biogas Plant -- Construction Manual

Construction Manual for GGC 2047 Model Biogas Plant

Biogas Support Programme (BSP)
P.O. Box No.: 1966, Kathmandu, Nepal
September, 1994

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Biogas Support Programme
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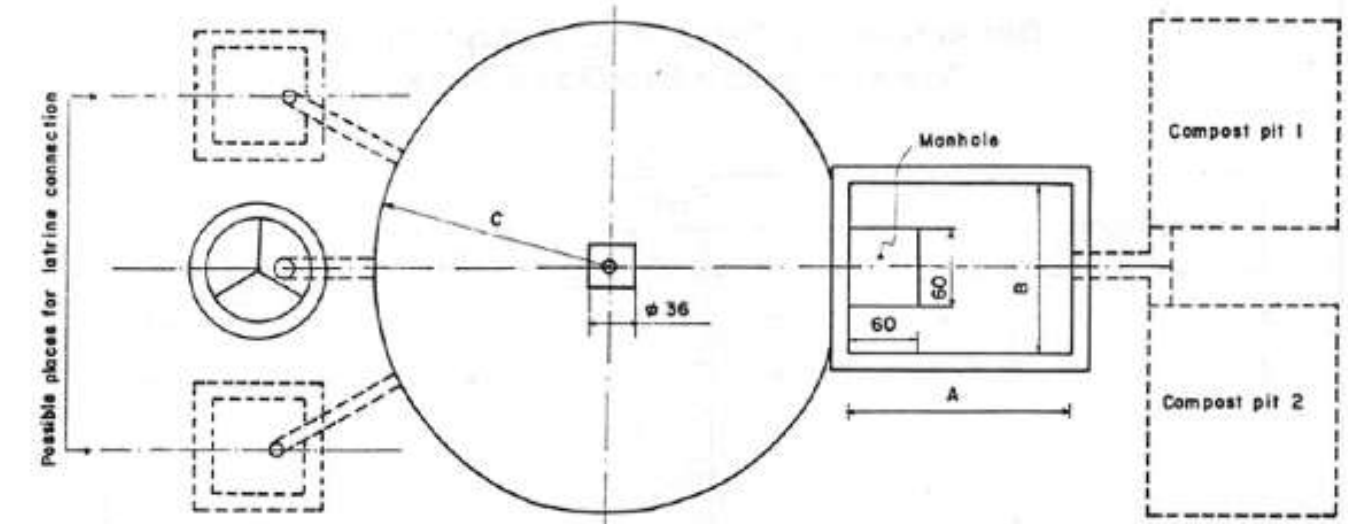
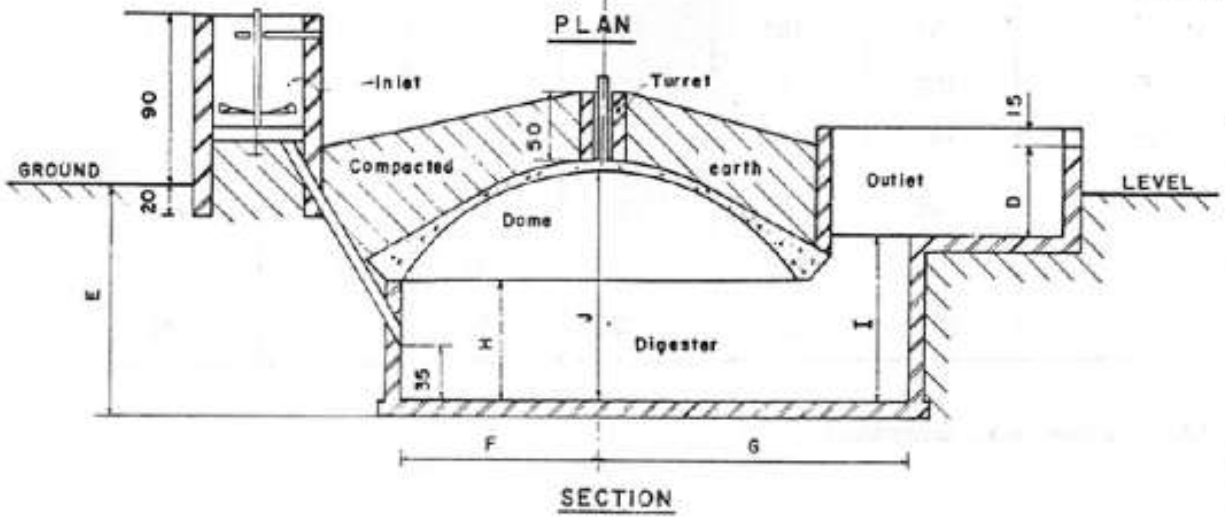
Scanned by Biofuel Mailing List member Olivier Morf (with thanks)

Plant Size (m3)	Daily Dung Feed (kg)	Daily Water Feed (l)	Approx no. Cattle Requd.	No. of people will cook for	No. of lamps used
4	24	24	2 – 3	3 – 4	2
6	36	36	3 – 4		
8	48	48	4 – 6	4 – 7	3
10	60	60	6 – 9	7 – 10	6
15	90	90	9 – 14	10 – 12	8
20	120	120	14+		

GENERAL BIOGAS PLANT



PLAN



SECTION

Dimension of Different Components of Various Sized Bio-Gas Plants

Components	Plant Size (m^3)					
	4	6	8	10	15	20
A	140	150	170	180	248	264
B	100	120	130	125	125	178
C	135	151	170	183	205	233
D	80	80	85	85	94	99
E	154	155	172	165	180	203
F	102	122	135	154	175	199
G	195	211	230	243	265	293
H	88	92	105	94	115	115
I	112	118	127	124	132	137
J	151	160	175	171	193	202

Note: All dimensions are in centimeters.

Note : The dimension of different components of various sized plant have been given in the back.


Pressure gauge
Water drain
Gas pipes

Digester – Lessons Learned

- Can reduce costs – no need for rebar in dome & can use less concrete on dome & floor construction
- Do not use low quality plastic pipe for gas outlet from dome as is almost impossible to fix if broken
- First fill is very time consuming as need to fill whole digester volume. Have ample supply.
- Ensure supply of organic matter is achievable, be realistic. Easier to collect dung from a stable.
- A caretaker needs to be fully briefed in it's operation to achieve it's full potential e.g. ensuring appropriate materials get fed into the digester.

Biogas – Ghanaian Perspective

- Offers potential for sustainable energy supply and waste management for rural development on both large or small scale
- Time savings from timber collection can be more profitably spent
- Free fertiliser will boost farm output and farmers wages
- Potential to mimic contractors training scheme operated by BSP in Nepal and create a Biogas Industry
- Potential to earn **CDM (UN Clean Development Mechanism)**. BSP Nepal is looking to achieve **3,000,000 Euro PA** on it's biogas scheme from CDM thereby making their scheme self sufficient.
- Neighbourhood schemes could be used to treat effluent and supply gas.

Contacts & Thanks to...

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Biogas: Prakash Lamichhane, BSP Nepal, bspnepal@wlink.com.np, 977-1-55 24 665 / 55 49 842

Useful References

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