General Assumptions

All the suggested designs in the proposal have certain assumptions which are listed below:

- All design dimensions are in mm
- Drawings are not up to scale
- House drawings with Air Cavities are suggestive. For optimal cross ventilation, decision has to be taken by on-field operative.

Mosquito free homes

Introduction

Malaria is high risk disease in tropical & sub-tropical countries across the world. Specially affected are large parts of Africa and Indian sub-continent. Many solutions with regards to addressing reduction in spreading of malaria have been developed over period of years.

My proposed solutions for this challenge focuses on simple aspects. All these aspects include simple and easy changes in existing homes, which can be achieved with minimal cost and implemented easily without requirement of many sophisticated tools.

Proposed Solution

a) Introduction of Air cavities in homes that have no or small windows
b) Using redesigned mosquito net with different color scheme, material & fitting technique
c) Using lighter colors to paint outside/inside of homes

All these solutions will be discussed in details in the next pages.

Mosquito free homes – Air Cavities

Air Cavities

The basic idea is to introduce Air cavities in homes that have no or very small windows. Air cavities along opposite sides provide perfect ventilation. They reduce heat and provide comfort.

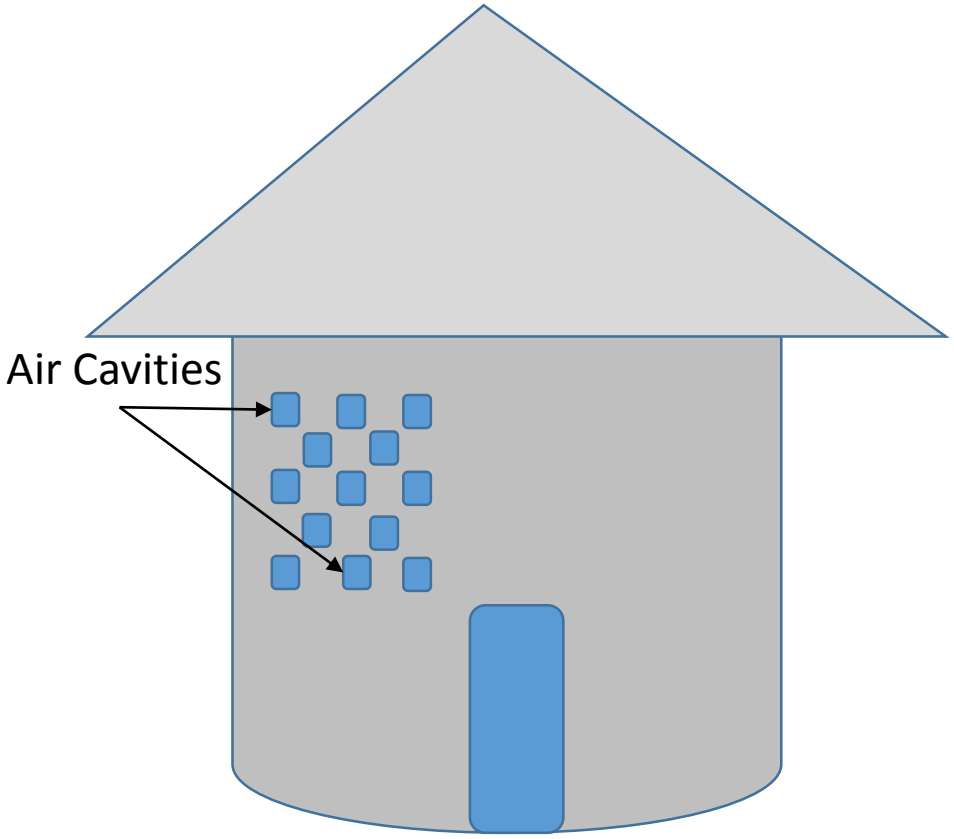
I am proposing 200mm X 200mm Air cavity design (suggest making 13 such air cavities spread over 5 rows covering effective area of 1000mm x 1000mm & at a minimum height of 1500mm from ground – See diagram on next page). These can be rectangular or circular in shape. In case the shape is circular, it is really easy to insert hollow white PVC pipes of 200mm dimension as inserts into these cavities. These can be glued with “holed” surface. Once the pipe is inserted, PVC caps can be used to close it from inside. Since PVC pipe dimensions are pretty standard, pipe caps will be easily available. These pipe caps can be glued with an adhesive in the pipe from inside. These pipe caps will have small holes (small enough to filter out mosquitoes) to allow air to flow in and out. While the pipe cap will restrict some air flow, but it will help in reducing the heat. Please remember one side of the pipe will remain open.

Air cavities are very cheap to make. In an existing houses made of mud/straw etc. these air cavities can be made with very little effort and can be made in less than a day. The thickness of air cavity (and length of pipe) will depend on thickness of wall. Usually mud walls can have thickness anywhere between 150mm to 400mm.

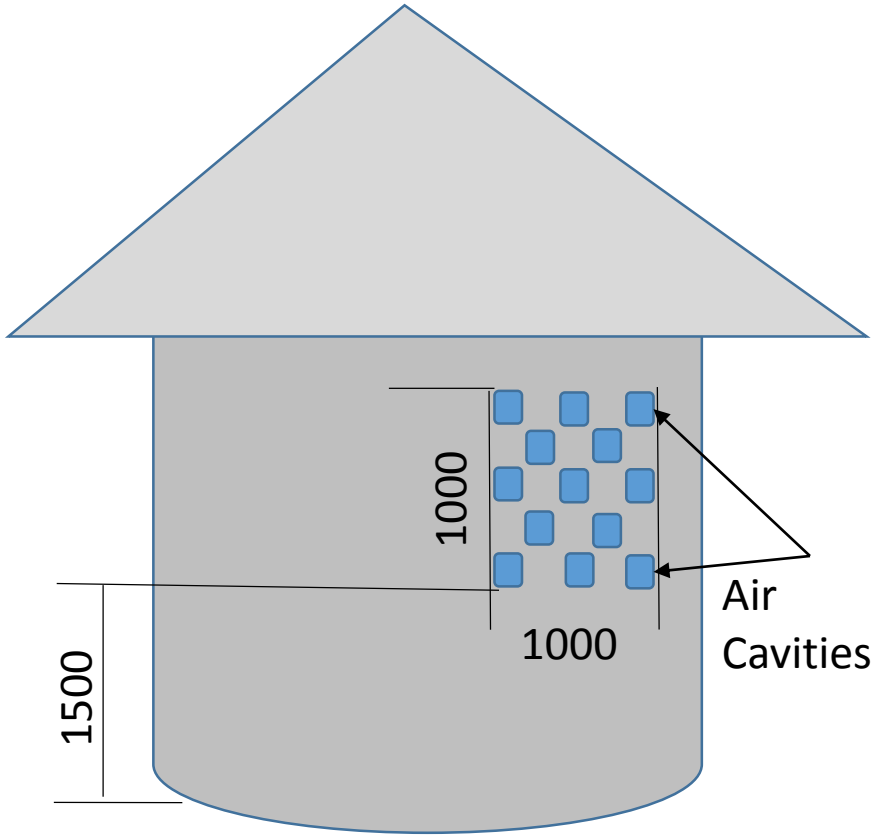
Air cavities must be designed in such a way so as to allow cross ventilation. The exact location can be decided by on field operative.

All dimensions in mm

Air Cavity – Design - 1



Front side of house with no windows



Rear side of house with no windows

Air Cavity Design

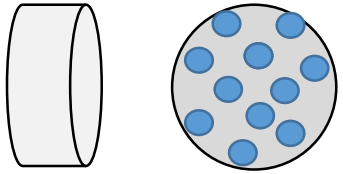
- Rectangle/Circle of 200 mm x 200 mm (Height x Width) [Depth will be based on thickness of existing home wall.
- Total 13 cavities
- Cavities will be spaced out evenly or in a pattern
- All cavities will be located at height of 1500 mm from base of floor.
- Air cavities will be painted white.
- PVC pipes of White color of 200mm dimension could be used as inserts after cutting in right length.

All dimensions in mm

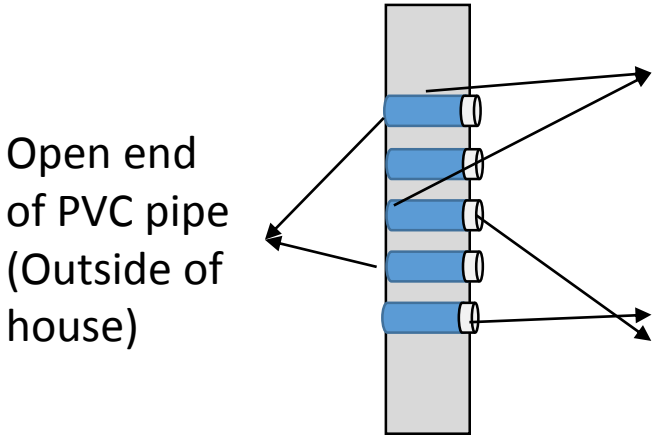
Air Cavity – Design - 2

200 mm diameter
White PVC hollow pipe

200 mm diameter
White PVC hollow pipe with pipe cap and one side open



PVC pipe cap –
Side View & Top View



Mud Wall of the home – Side View
Thickness of wall envisaged anywhere between 150 mm to 400 mm

Mosquito free homes – Net color/pattern/material

Black & White Striped Mosquito Net

It is quite well known that darker color attracts mosquitoes. But apparently stripes (thin black and white stripes) attract even lesser mosquitoes (See Reference – 1). Mosquito nets have been the go to solution to avoid spread of malarial diseases. Hence the basic idea here is to design a mosquito net with thin stripes of black and white (just like Zebra Stripes). The stripes must be in range of 20-50 mm width of either color (See diagram on next page).

PVC Net having High Gloss/Sheen

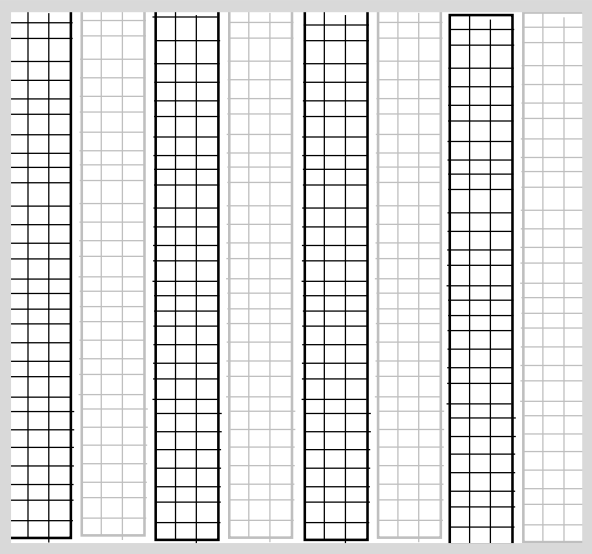
My proposal is to use a PVC based hard (or semi-soft) fine net (which restricts many other small insects apart from mosquitoes). This is suggested to be used on Windows, Eaves & mud homes with functional doors. The PVC net along with Black and White Stripes must have a glossy sheen.

“Mosquitos are attracted to low reflectance wavelengths. As the luminous reflectance of an object decreases so too does the number of mosquitos attracted to that object. This means glossy satins are less attractive than matt and khakhi clothes” (See Reference – 2). Shiny/Glossy objects have high reflectance wavelengths that repel mosquitoes.

Finally, PVC net is quite easily available, cheap and long lasting netting solution.

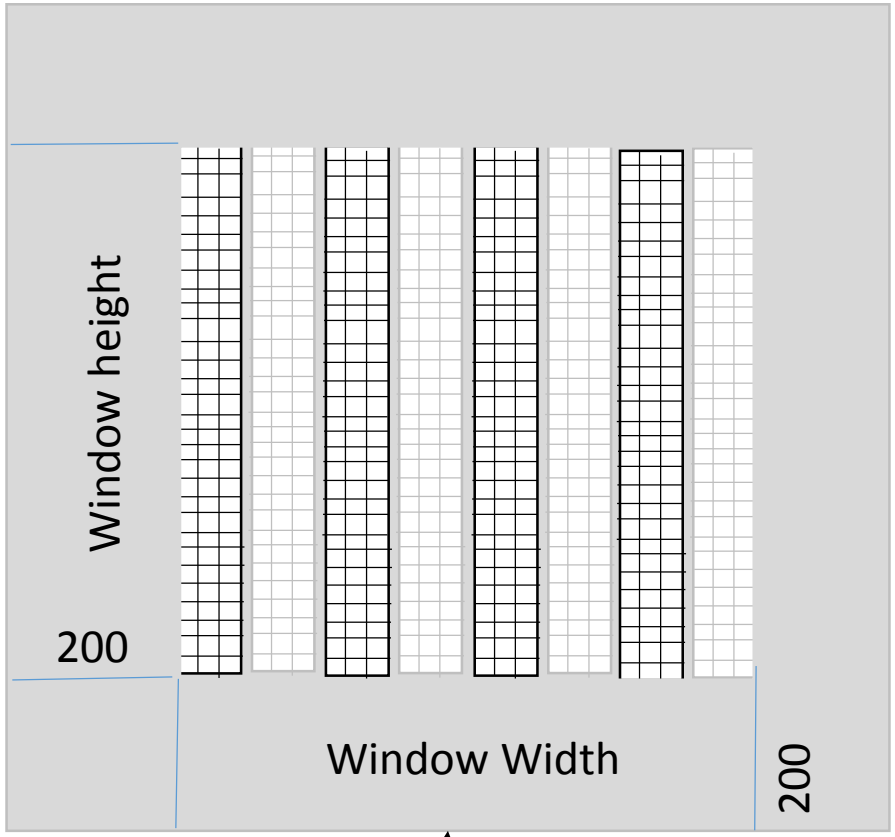
All dimensions in mm

Mosquito Net – Black & White Stripes



Mosquito Net Pattern

- Black & White Stripes
- Made of polyester/PVC
- Must be Glossy (have high sheen)
- Black & White Stripes must be in range of 20-50 mm in width



Painted Border across the actual window. The border must be at least 200 mm thick in all directions. The border must be painted white (Have depicted light gray here for visualization purpose)

All dimensions in mm

Mosquito free homes – Net Setup using Velcro

Mosquito Net using Velcro

Mosquito nets have been the go to solution to avoid spread of malarial diseases. My proposal is to use a PVC based hard (or semi-soft) fine net (which restricts many other small insects apart from mosquitoes). This is suggested to be used on Windows, Eaves & mud homes with functional doors. The basic idea is to use a Velcro based system to put up the net on Window frames, Eaves & Doors (see diagram in the next page).

The following process will be followed to install a Velcro based mosquito net:

- First the net will be cut in the appropriate length (based on the dimension of window frame, eave size or door frame).
- In the second step one side of the Velcro strip will be hammered onto the wall (whether it is door or window, in case of eave one side will be hammered on the wall and the other side
- Finally, the other side of the Velcro strip will be sewed on the hard (semi-soft) mosquito net, in the shape & length that is required.

Advantages of using Velcro:

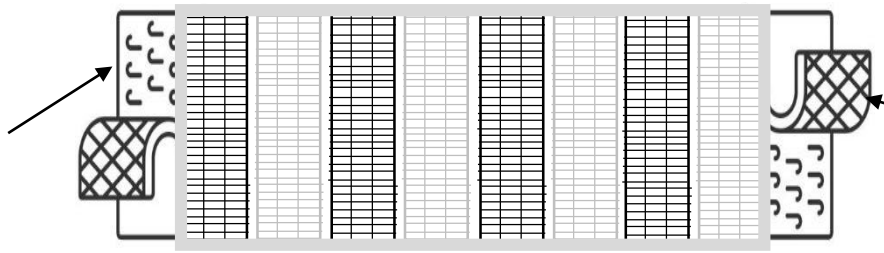
- Cheaply & Easily available & can but cut in any sizes as per requirement
- Long lasting, Weather proof & easy to maintain (can be removed easily & washed using normal water)
- Very good holding strength

All dimensions in mm

Mosquito Net Setup using Velcro

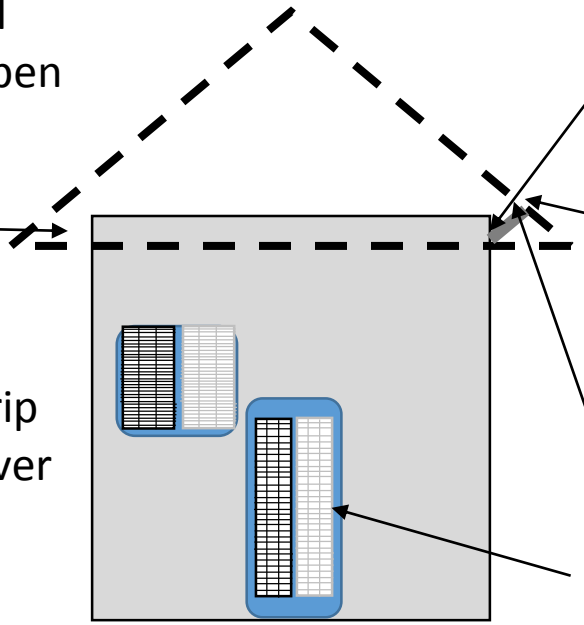
Hard / Semi-soft Mosquito Net

Velcro Strip – Side to be hammered in Wall



Velcro Strip – Side to be sewed in Mosquito Net

Eaves in typical mud house (Open part for ventilation)



One Velcro strip will be hammered in wall.

On the other this Velcro strip will be either hammered in wooden frame for thatched roof or just sowed into the thatched roof.

Mosquito Net, with Velcro strip can be used over windows from inside

Mosquito Net, with Velcro strip sowed into the net.

Mosquito Net, with Velcro strip can be used on Door frames.

Mosquito free homes – Inside/Outside Color

Inside/Outside Color

Many studies (see References 3 & 4) have found out that mosquitoes are attracted towards darker colors like Dark Blue, Black, Brown and less attracted towards lighter colors like White, Pink, Beige etc.. Hence my proposed solution is to use lighter color paint scheme around windows and doors to restrict attraction of mosquitoes.

The following must be done outside the houses:

- At least 200mm thick border around a house window from the outside must be painted in a lighter pastel color like White or light yellow. Ideally an Eco-friendly White paint must be used to paint these borders around windows and doors.
- For homes made out of mud use natural materials like lime to color window/doors. The only drawback of using lime is that it has to be painted quite regularly.

The following must be done inside the houses:

- Paint the inside with light colors having high sheen
- For homes made out of mud use natural materials like lime to color window/doors. The only drawback of using lime is that it has to be painted quite regularly. Avoid Khaki colors.

Mosquito free homes

Conclusion

My proposed solutions:

a) Introduction of Air cavities in homes that have no or small windows
b) Using redesigned mosquito net with different color scheme, material & fitting technique
c) Using lighter colors to paint outside/inside of homes

All these solutions proposed are relatively cheaper to implement, require no sophisticated tools nor do they require too much expertise to implement and use cheap and easily available material (PVC Net, PVC pipes, lime, eco-friendly white color, nails, hammer etc.). All these materials are available in Kenya (even in rural areas) relatively easily.

What would definitely require is some awareness campaign on using lighter paints and convincing people to make larger windows or create air cavities so as to reduce inside heat in homes (heat is the real attraction for mosquitoes).

References

1) https://www.sciencemag.org/news/2019/02/zebra-stripes-confuse-biting-flies-causing-them-abort-their-landings

2) https://scienceoxford.com/are-you-an-insect-magnet/

3) https://www.color-meanings.com/what-colors-attract-repel-mosquitoes/

4) https://www.fivestarpainting.com/blog/2019/may/color-a-better-outdoor-bird-and-bug-repellent/