Low cost fencing project 2013 Funding Proposal / Report Engineers without Borders (EWB) – University of Cape Town

Compiled by: Mashudu Makhado (project leader)

Mufarisi Manyuha

Abhilash Alex

Stephane Masamba Ma-Kiese

Damian Naidoo

Alexa Bessinger

Mashudu Muridili

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1.Abstract:

This proposal outlines a request for project funding for the EWB UCT's low cost fencing project.

The aim was to design and build a low cost fence for a playground at a pre-school in a Cape Town community based in a low income area. Facing the challenges of material theft in the area one of the objectives was to provide an alternative to the wood fencing that is currently being used such that this new design does not lure thieves. Moreover, the aim is to provide a safe and reliable design for fencing the playground that is durable and comes at a low cost.

Plastic netting (supported with concrete poles) was suggested as potential replacement for the traditional wooden fence.

2.Background and Problem statement

This project is being facilitated by the UCT Knowledge Co-op. This institution is aimed at collaborating with community partners in the Western Cape. A pre-school fence material which is low cost is to be investigated. The following criteria were set for the material:

- The material is to have no fuel usage value such as wood, which can be burnt for space heating;
- The material is to have no scrap metal value such as steel and wire fencing material as this easily gets stolen;
- The material is not to block visibility which may harbour criminal activity in the area. Fences such as concrete slabs and brick block visibility.

The school has previously installed fences which were stolen or vandalised for reasons stated above.

3.Proposed solutions

The fence is to be built for a pre-school, it is therefore important for it to be safe for children to play around it. If possible, the fence should contribute to the mental stimulation of the children. Colour and interesting shapes would be advantageous in the overall design of the fence.

The fence should have no domestically usable fuel value. Materials such as wood are not to be used as they have a fuel value which can be used in the households. Low-income communities tend to use wood for heating even when electricity is available.

The fence should have no material value. Common engineering materials such as steel and aluminium have a recycle value. The scrap metal industry provides an easy way to exchange stolen metal for money.

4.Introduction

The aim of this report is to provide a low cost fence design that will be able to secure a playground in a preschool. Following that the current fencing may be durable, factors such as material theft decrease the effectiveness of the fence. It is therefore necessary to present a design that can counter these challenges that the preschool is faced with.

The following are the objectives for the design:

The design should be:

- Safe for children;
- Inexpensive and preferable eco-friendly;
- Composed of non-valuable materials i.e. not metals;
- Able to provide visibility to the surrounding area (Not enable criminals to hide behind it);
- Easy to erect, but hard to remove once installed.

Bearing in mind that materials such as metals and wood lure criminals, the following design has been made.

5. Fence Design

5.1 Poly Vinyl Chloride (PVC) pipe with concrete compressed in its column

The PVC pipe column design is simple and easy to erect. A PVC hollow pipe with a circular cross section may be purchased and will become the frame of the column. The PVC pipe will be buried to a depth where the soil is dense. Concrete will be poured into the PVC pipe and should be compacted.

Once the concrete cools it will stick to the PVC pipe, therefore theft of the PVC pipe will be avoided. The required height of the column was unspecified. Much load is not expected to be applied onto the column therefore a small pipe diameter may be used, for example 50 to 100mm. Small stone aggregates may be mixed with cement and sand to further strengthen the column.

Plastic straps may be used to secure the fence to the column, by connecting the fence with the wire and taking the wire around the column. The reason for using the plastic straps is for its high strength and low price.

PVC pipes are the cheapest kind of recycled plastic pipes; together with concrete (cement and its aggregates) that can be easily prepared they provide a suitable structure for the project. Plastic straps (used to attach the netting to the poles) are cheap and also easily obtainable and the least amount of straps will be used which will not have any significant economic value to attract criminals**.** Below is a figure of the type of PVC pipe that can be used in this design:

Figure1: Example of PVC Pipes

5.1.1 Specifications of PVC pipe proposed are:

- PVC has a high mechanical strength
- 40mm or greater diameter pipe will be used

5.2 Netting material

5.2.1 Plastic wire netting

Plastic netting is much more expensive than traditional wire netting but they are an ideal solution for our problem. The material does not have a high scrap value and thus it is less likely to get stolen than wire netting. The high cost of plastic netting can be justified by the amount of time the fence will remain in position compared to other types of fences which are vulnerable to crime. Plastic fences also look more appealing and safer to children who would be running around the playground.

Below is a figure of plastic wire netting:

Figure 2: Plastic wire netting

5.2.2 Cricket netting

The net is usually manufactured in a synthetic polymer such as polyethylene; this is a hard wearing and relatively economical material. This type of netting can provide a safe environment for children to play around. They cannot be used as fuel, provides clear vision for children when playing, criminals cannot use it as a hiding place. The only possible drawback it can be stolen to be sold to other willing cricket clubs but proper installation can make it hard to steal while it is in place. Below is a figure of cricket netting that can be used in the design.

Figure 3: Cricket net in tension on metal bars.

The netting will be used to cover the distance between the PVC pipes. Both cricket netting and plastic wire netting can be used in the design as they both satisfy the objectives listed in the introduction.

Specifications of polyethylene netting proposed are:

- 42 mm mesh and 2.5 braided thread
- UV stabilised against radiation giving a product that can withstand the harshest of outdoor elements.
- Life span of the fence is between 4-5 years [2] .
- Life span can be influenced by level of use , treatment of the product and extreme weather conditions;
- It is resistant to acids, alkalis, salt solutions, water, alcohol, oil and petrol.

5.2.3 Plastic straps

Figure 4: Plastic straps

Specification:

1. Materials: nylon 66, 94V-2 certificated by UL.
2. Heat-resisting, acid &
3. Erosion control,
4. Insulate well and not apt to age.

5.3 Complete Design

Below is a figure of the complete design incorporation the netting and the PVC piping.

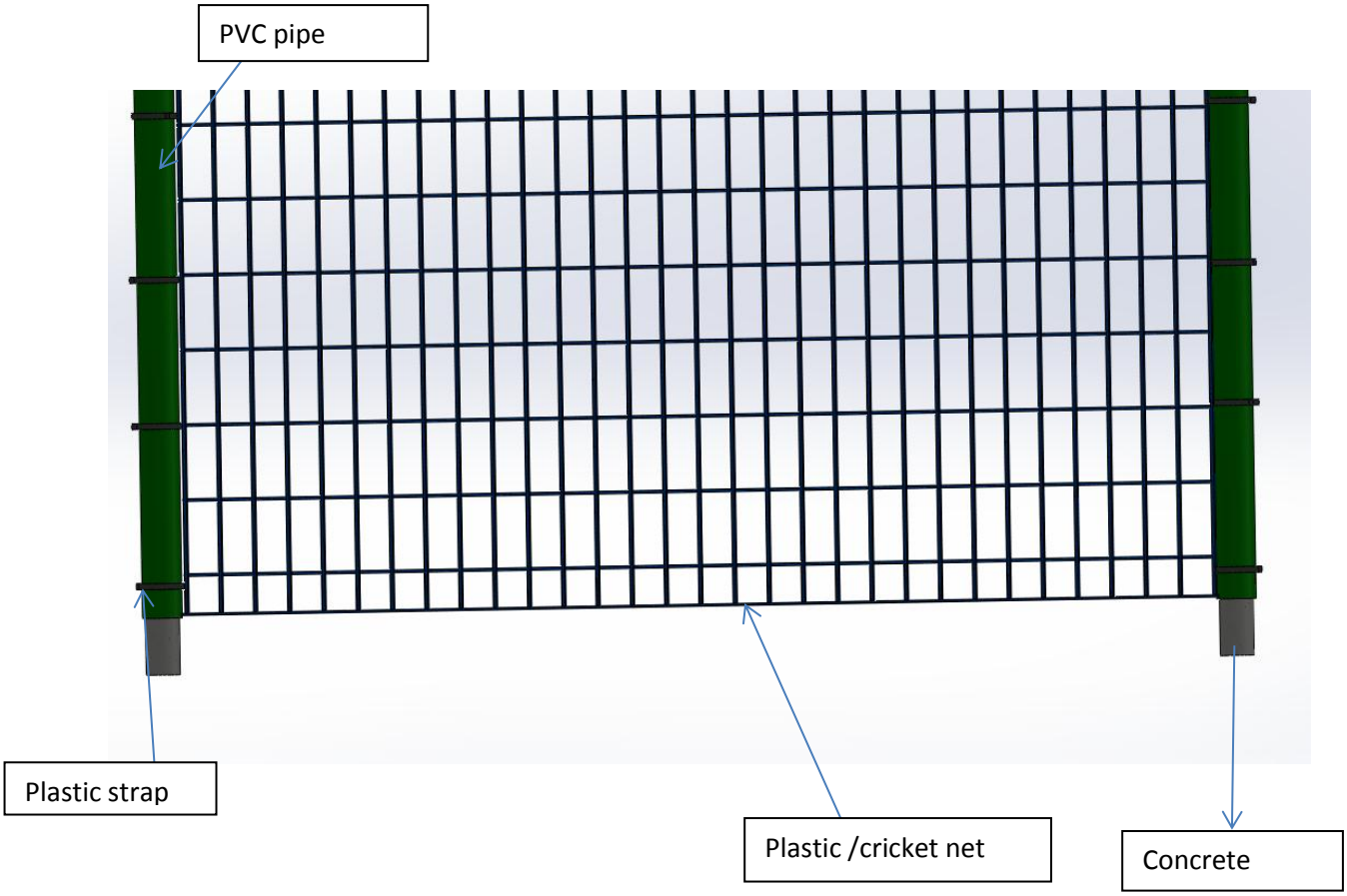

Figure 5: fence design

5.4 Interaction with plastic and concrete

Experiments were conducted by Kurt (1978) on commercially available plastic pipes filled with concrete. An interaction was observed with the plastic and the concrete, with a corresponding increase in strength of the concrete core (Kurt, 1978). Kurt (1978) concluded that the concrete filled plastic shows promise for structural applications. Concrete is known to be weak under tensile load; therefore any lateral load applied onto the column may compromise it. Generally plastic pipes have low load bearing capacity, it will inevitably deform once it reaches its yield strength (Oldhand, 2013). With concrete filled plastic pipes, the two materials complement each other; the concrete may be the load carry material and the plastic may absorb the tensile stress applied onto the column. For the advised 1.2m height column for a pre-school fence, high durability is not necessary as the major loads applied on the columns may be wind load and variable load applied by the public.

5.5 Previous projects with similar column material

Common fencing posts dimensions used are diameters ranging from 75mm to 100mm. The post height requested was 1.2m. The following figure illustrates a similar design located on Main Rd in Rondebosch and is exposed to the similar climatic environment as required. The concrete filled plastic pipe does not show any type of premature deterioration.

Figure 6. PVC pipe filled with concrete

6. Cost estimations

6.1 PVC cost estimate

- The price of PVC pipe 40mm is approximately R 12 per metre
- For a 30 m fence approximately 16 poles of 1,5 metre each will be required resulting in a total cost of **R 288.**

6.2 Concrete cost estimate

- Concrete cost will include cement, sand and stones
- Price of bag of cement is approximately R110
- Approximately 14 bags will be required to a total of R 1540
- The equivalent sand needed will cost at about R 500
- Additional gravel for strength can be collected in nearby construction waste sites.
- Total price for concrete is **R 2 040**

6.3 Netting and Fastening cost

- The plastic net is R52 per metre at retail price
- The total price for 30 metres is R 1560
- The plastic strap used to fasten the net to the pole is R 120 for a bag of 100 straps
- Approximating 10 straps would be required per pole resulting in in the total of 160 straps.
- Two bags will be required at a price of R 240.
- Total price for netting is **R1 800.**

6.4 Total estimated price

- The total price will depend on the total cost of PVC, concrete and fencing material which is equal to **R 288 + R 2040 + R 1 800= R 4 128**
- The total cost does not include transport cost and any labour coat that can be incurred.
- 30% is added to account for increase in prices during the duration of the project.
- Then the total cost price **R 5 366.**

7. Site execution plan

The concrete pole can be made on site with the help of trainees which are at the new world foundation. EWB UCT has a membership of more than 400 students that have the potential to volunteer in the installation of the fence. After installation the school together with the sponsor will asses the work and report on its quality and satisfaction of their expectations.

8. Conclusion

It is concluded that the combination of PVC with cement is mechanically suitable and financially feasible. This analysis shows that the composition of plastic in the design is more favourable in comparison to the wood that is currently being used, as it does not contain attractive materials. Life span ranges from four to five years which is worth the investment.

9. References

1. Kurt, C. E. (1978). Concrete filled structural plastic columns. Journal of the Structural Division, 55-63, Vol. 104.

2. Oldhand, T. (2013). Homemade columns from PVC pipe. Retrieved August 4, 2013, from eHow home: http://www.ehow.com/info_8724838_homemade-columns-pvc-pipe.html

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