



Comparison of Different Types of Pedestrian Paving Materials

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ABSTRACT : The need for selecting correct material for the pedestrian paving is greater than ever before. Due to increasing number of pavements constructed in urban areas the climate conditions of cities are changing into unfriendly levels. With the escalation of prices of the conventional paving materials (asphalt, concrete) and sustainability concepts designers are on the verge of using alternative materials for the road construction which brings sustainable and eco-friendly, more energy efficient living conditions. In this research different types of paving materials are compared through a questionnaire survey, thermal performance test and a cost comparison. The results of the study indicate that the use of clay paving block pavement is more suitable than the conventional pedestrian paving methods. The low cost, the ability of accommodating and maintaining utility services, thermal comfort, aesthetic appearance and environmentally friendly behavior and user satisfaction can be highlighted as the key advantages of clay paving blocks.

1 INTRODUCTION

The history of using different paving materials to pave roads and pedestrian pavements has a long record. The first record of stone paving dates back to 4000 BC in Assyria and by 2000BC, flagstones were being used to pave village streets. Cobblestones were the traditional method of stone paving, being uncut and often water-worn stones or large pebbles about 150mm in size. Later hand-cut stone blocks were introduced (Ling,2012).

Road-making using brick was common in Mesopotamian 2000 BC and clay brick paving was in use in India in 300 BC (Krishnajah & Reddy,2008). It was the Romans who introduced hexagonal-shaped flagstones as a surface course, so the concept of shaped, rather than rectangular blocks, is certainly not new. Perhaps the most famous of all Roman roads is the Appian Way, built by Roman engineers in 312 BC. The 377 kilometer road was surfaced with tight-fitting paving stones that still carries traffic between Rome and Italy's south-eastern port of Brindisi. In Sri Lankan history stone paving was a very common thing in ancient structures like Stupa and Temples. Stone paving have been used around Stupas for a long time and which still in use.

Segmented concrete paving is a system of individual shaped blocks arranged to form a continuous hardwearing surface overlay. Over the past two decades, paving composed of segmental blocks has become a feature of our constructions (Killingsworth et.al, 2011). It is found in commercial industrial and residential areas, in the paved

roads, parking areas and bus stops. (Mendoza et.al, 2012).

The need of selecting correct material for the pedestrian paving is greater than ever before (Gadja & Geem, 2001). Due to increasing number of pavements constructed in urban areas the climate conditions of cities are changing into unfriendly levels (Grimmond et.al, 2010). With the escalation of prices of conventional paving materials (asphalt, concrete) and focus on sustainability concepts designers are on the verge of using alternative materials for the road construction that promote sustainable and eco-friendly, more energy efficient living conditions. (Pomerantz et al,1997).

In order to achieve these conditions, in this research different types of paving materials are compared through a questionnaire survey, thermal performance test and a cost comparison.

2 OBJECTIVES

The main objective of this research is to identify and compare the different types of pedestrian paving materials (methods).

3 METHODOLOGY

1. Questionnaire survey to identify user awareness with existing pedestrian paving materials (methods).
2. Model sample area with different types of paving material and study its thermal behaviour against environmental exposure condition.

3. Collection of cost and rates for the available paving materials and cost comparison.
4. Comparison and analysis of collected data
5. Discussion of collected data

4 DATA COLLECTION

4.1 Questionnaire survey

The main objective of this questionnaire survey is to find out the user awareness of outdoor development and materials used for these developments. Most of the people who took part in the survey are residents of Colombo, Gampaha and Kandy districts.

As the most important part of this questionnaire survey, road users were given an opportunity to select their preferred material for walk way along the road and in recreational areas. The survey found that the material scored best is clay brick that is 48 % in the walkway along the road (Fig. 1).

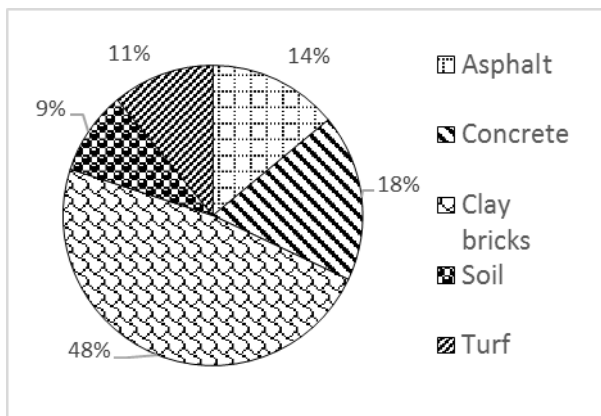


Fig.1: Preferred material for pedestrian pavements

4.2 Testing the performance of paving materials

In order to test the thermal performance of different types of paving materials, six different types of materials were selected;

1. Chip concrete paving blocks
2. Clay paving blocks
3. 4” thick concrete paving
4. Asphalt paving
5. Clear ground
6. Vegetation (grass)

A 1m x 1m square area was paved using these materials, and the paved surfaces were exposed to equal natural conditions (Fig. 2). The top and bottom surface temperatures of the different paved surfaces and surrounding air temperature were recorded for 72 hours using a data logger device (Fig. 3). From these recorded data, a 24-hour period was selected and then hourly mean temperature variances of different materials were plotted with time. The comparison is shown in Fig. 4.



Fig. 2: Modeled paved area



Fig. 3: Temperature data collection

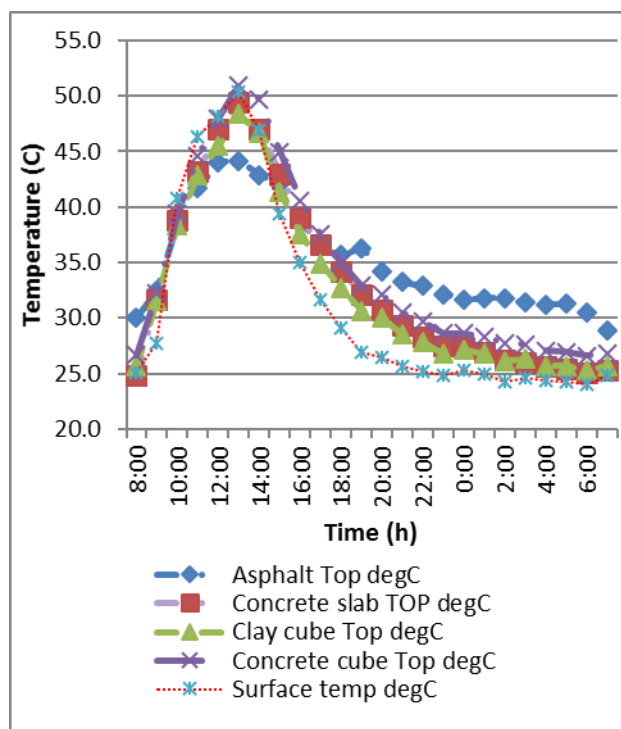


Fig. 4: Comparison of temperature data

4.3 Cost comparison

A cost comparison between different paving methods is performed to check the present market initial cost for the construction of pedestrian pavements.

Table 1: Cost comparison

Pavement type	Cost for 1 m ² in Rs
Asphalt	2887.68
Concrete	3980.49
Concrete block	3322.40
Clay block	1093.08
Grass covering	1013.00

5 RESULTS AND DISCUSSION

5.1 Results

Most of the people preferred grass covering. But there are practical issues in selecting those options for pedestrian pavements because of maintenance issues, etc. The next preferred option of the users is clay paving blocks. Clay paving blocks also possess the same physical and strength characteristics of concrete blocks and do not require continuous maintenance. Therefore, the selection of clay pav-

ing blocks can be considered as the preferred choice of public.

When considering the results from the temperature data collection of modelled areas it is observed that the most heated material during the day is concrete cubes and asphalt. Also they cool more slowly than other materials. So these materials emit more heat to the paved area by radiation during the day and in the night it keeps the surface temperature higher than the air temperature by emitting the stored heat to the atmosphere. So the pedestrians may feel very uncomfortable in the areas which are intended for them to do their leisure activities throughout the day. These materials will contribute a lot to the urban heat island effect which in turn the recreational area of cities into a torturing area.

Also in the cost comparison for the different paving methods clay block and grass covering bears the lowest cost from all methods. In addition to that the cost for clay block pavement is cheaper than other hard surface pavements.

6 CONCLUSIONS

According to the above discussion, as the conclusion of this research paper it is suggested that clay based paving block is used for the paving of pedestrian walkways and recreational areas. It costs less than the conventional paving methods like concrete, asphalt and concrete paving blocks. Also its thermal performance is close to the behaviour of the natural ground and it will help to illuminate surface heating and in return will not contribute to the Urban Heat Island (UHI) compared to other materials.

Cost of the clay block paving is much lower than the other available methods. The most important reason for the selection of clay paving is its eco-friendly, sustainable and energy efficient.

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REFERENCES

- Gadja, J.W. & Van Geem, M.G., 2001. A comparison of Six Environmental Impact of Portland Cement Concrete and Asphalt Cement Concrete Pavements. Skokie: Portland Cement Association.
- Grimmond, C.S.B. et al., 2010. Climate and more sustainable cities: Climate information for improved planning and management of cities. *Procedia Environmental Science*, 1, pp.247-74.
- Killingsworth, B., Lemay, L. & Peng, T., 2011. The Urban Heat Island Effect and Concrete's Role in Mitigation. *Concrete in focus*.
- Krishnaiah, S. & Reddy, P.S., 2008. Effect of Clay on Soil Cement Blocks. Goa, India, 2008. The 12th international conference of International association for Computer Methods and Advances in Geomechanics.
- Ling, T.C., 2012. Effect of construction method and rubber content on the properties of concrete paving block. *Construction and Building Materials*, 28, pp.164-75.
- Mendoza, J.-M.F. et al., 2012. Planning strategies for promoting environmentally suitable pedestrian pavement in cities. *Elsevier*, 17, pp.442-50.
- Pomerantz, M. et al., 1997. Paving Materials for Heat Island Mitigation. Berkeley: Ernest Orlando Lawrence Berkeley National Laboratory, University of California.