

A Study on Sustainable and Eco-Friendly Lay-Out Design for Hospital Buildings

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Keywords: *Sustainability, Landscape, Hospital, Treatment.*

1. INTRODUCTION

The belief that plants and gardens are beneficial for patients in healthcare environments is more than one thousand years old, and appears prominently in Asian and Western cultures [1]. The awareness of positive influences of outdoor environment on patients' healing process has long been present in hospital architecture. The term healing garden applies to the gardens that promote recuperation from illness. In this context, 'healing' does not necessarily refer to curing, but to the overall improvement of well-being. Integration and unity of hospital buildings and their surrounding outdoor spaces contribute to creation of hospital as a 'small city within a city', with its own specific patterns of use. [2]

2. CHARACTERISTICS OF PLANTS

Plants possess their ability of escalating the pain tolerance effects in the patients to recuperate from their illness or any surgery. This ability of the plants is found nil in the first cast and comparatively higher in the 3rd case than the 2nd one in the following category [3]: 1. No plants, 2. Foliage plants 3. Foliage + Flowering plants Patients in hospital rooms with plants and flowers have significantly showed more positive physiological responses, lower ratings of pain, anxiety and fatigue, and more positive feelings and higher satisfaction about their rooms than the patients who are kept in rooms without plants. [4]

Findings of such researches suggested that plants in a hospital environment could be noninvasive, inexpensive, and an effective complementary medicine for patients recovering from abdominal surgery. Researchers who have assessed the impact of nature/plants on human health have suggested that nature and plant experiences are positively associated with human physical [5], psychological [6], emotional [7], and cognitive health [8]. In addition, viewing nature/plants is linked to pain reduction, less need for analgesics, and fast recovery from surgery [9].

3. INTERIOR PLANTS

When plants were added to the interior space, the participants were more productive (12% quicker reaction time on the computer task) and less stressed (systolic blood pressure readings lowered by

one to four units). Immediately after completing the task, participants in the room with plants present reported feeling more attentive (an increase of 0.5 on a self-reported scale from one to five) than people in the room with no plants. [10]

In 2006, a number of studies were published that indicate that simply having three small potted plants can significantly reduce (50-75%) the total VOC (Volatile Organic Compound) levels in a real office of 30-50m³ [11].

The National Aeronautics and Space Administration studies on indoor landscape plants and their role in improving indoor air quality included reports on toxins common to the interior environment, specifically benzene, formaldehyde, and trichloroethylene. [12] The following list of plants typically used in the interior environment outlines the plants found to be more effective in air purification, based on the NASA studies. [13]

Aechmea fasciata (Excellent for formaldehyde and xylene)

Aglaonema modestum (Excellent for benzene and toluene)

Aloe vera (Excellent for formaldehyde)

Chamaedorea Bamboo (Excellent for benzene and formaldehyde)

Chlorophytum elatum (Excellent for carbon monoxide and formaldehyde)

Chrysanthemum morifolium (Excellent for trichloroethylene, good for benzene and formaldehyde)

Dendrobium Orchid (Excellent for acetone, ammonia, chloroform, ethyl acetate, methyl alcohol, formaldehyde and xylene)

Dieffenbachia maculate (Good for formaldehyde)

Dracaena deremensis (Excellent for benzene and trichloroethylene.)

Dracaena deremensis (Excellent for benzene and trichloroethylene, good for formaldehyde)

Dracaena marginata (Excellent for benzene, good for formaldehyde and trichloroethylene)

Dracaena Massangeana (Excellent for formaldehyde)

4. A SURVEY IN HOSPITALS AT CHENNAI

As the aim of this research was conceptualized to calculate the ratio of the minimum open space required for landscape in a hospital to the built up space of the site, the research was further proceeded to organize a survey with the people who inhabit the hospital premises.

Surveys were carried out in three major hospitals in Chennai in the following categories: 1. a hospital in the populated / noisy zone of the city. 2. A hospital specialized for a single disease. 3. A hospital located in outskirts.

Following hospitals in Chennai were selected for survey: 1. Rajiv Gandhi Government Hospital, Central, Chennai. 2. Cancer Institute, Adyar, Chennai and 3. Kamachi Memorial Hospital, Velachery Road, Chennai.

Selection of People for Survey:

It was already planned that the selection of the people for survey was as per the requirement of the research. So, the people for survey were categorized in four following types: 1. With respect to occupation, 2. With respect to their age, 3. With respect to the time of survey and 4. With respect to their gender.

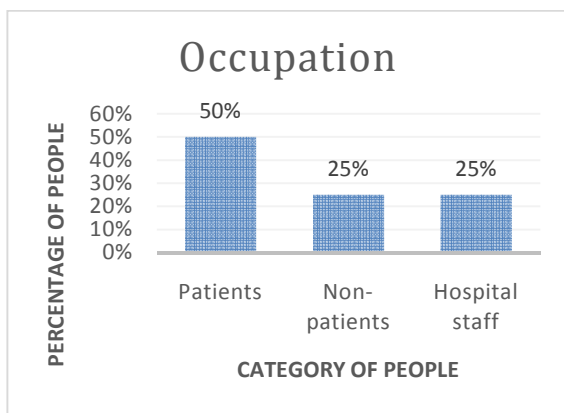


Fig. No. 01

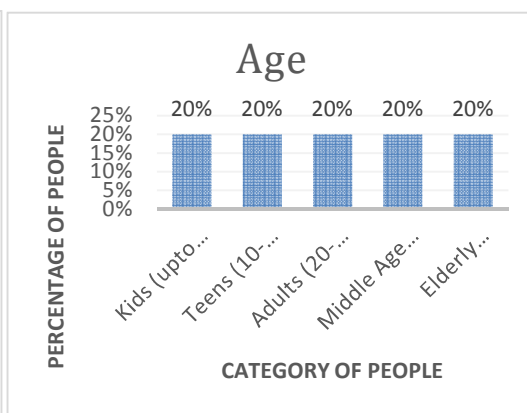


Fig. No. 02

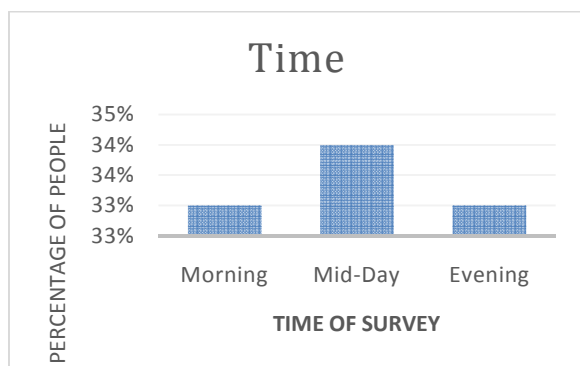


Fig. No. 03

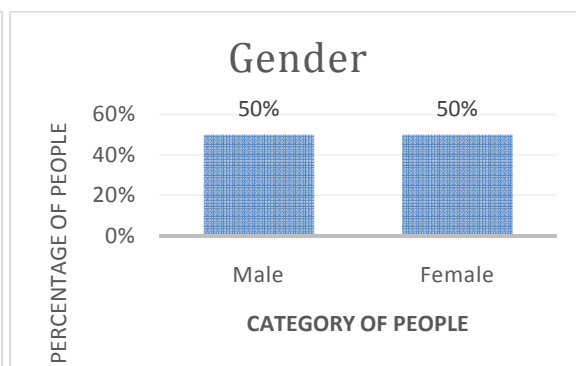


Fig. No. 04

5. REPORT ON THE SURVEY

The following are the sample statistical riposte for the questionnaire prepared for the survey:

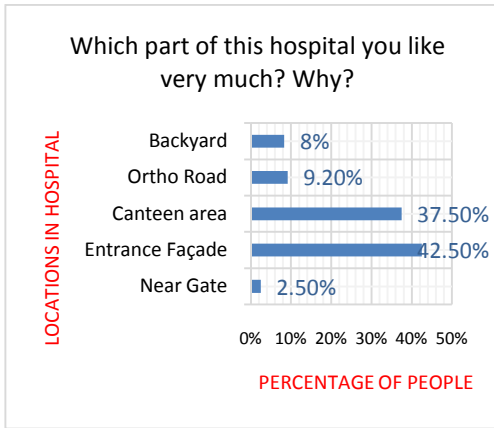


Fig. No. 5

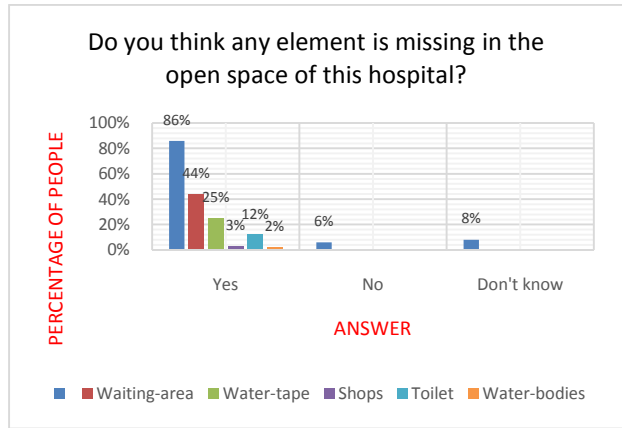


Fig. No. 6

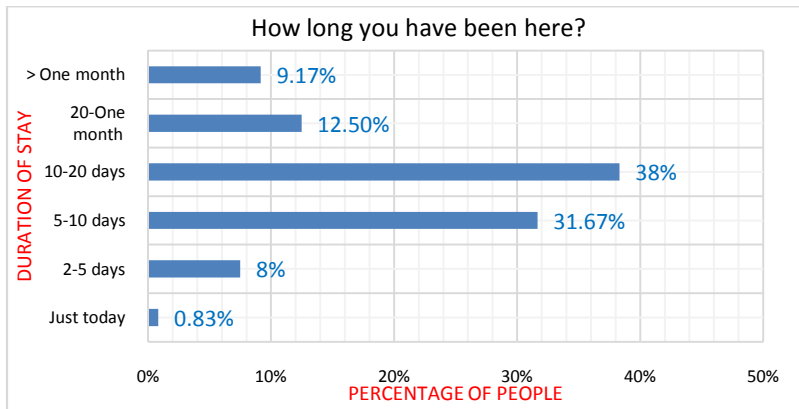


Fig. No.7

6. SYNTHESIS OF THE SURVEY

From the above report of the survey conducted in three hospitals in Chennai, the following are the syntheses observed:

- 57.5% People feel comfort in the place where the following trees are planted: *Azardirastra indica*, *Ficus religiosa*, *Ficus bengalinensis*, Flowering trees and *Pongamea pinnata*.
- 63.7% of people desperately want some mode of system to enhance their breathing comfort, and 50% among them recommended for plants inside the building.
- As most of the previous researches proved, here also people of 45% preferred flowering plants in their vicinity and they expressed that they felt relaxed compared to the people who were not having flowering plants in their rooms.

4. Equally, 40% of people preferred earth walkway and also lawn in the open space of the premises.
5. 65% of people complained that the process of shedding leaves of trees is irritable than the problems of insects over it (32% complained of insects).
6. Among the occupation of the people surveyed, 75% of patients, 65% of non - patients and 78% of staff members of hospital prefer to rest under the tree during mid-day.
7. Age wise, 82% of above 55 age people preferred noiseless area than the active / noisy area.
8. Almost 95% of the women prefer to rest inside the building than resting under trees, street-benches or anywhere in open spaces.
9. Almost 88% of the men patients whose rooms were not having plants felt boredom and wanted to move around, when the same feeling was felt only 15% of the men patients whose rooms had plants.
10. Almost 90% of all age group men and women who are patients prefer to have a walk in either morning or evening in the road which has trees, than the road which doesn't have.
11. Area Calculation of the First hospital: Total Area - 61,336.0716 sq.m and the total open space is 22,114.0452 sq.m.
12. Area Calculation of the Second hospital: Total area - 31,567.9558 sq.m and the total open space is 16,423.8566 sq.m
13. Area Calculation of the Third hospital: Total Area: - 12,437.2557 sq.m and the total open space is 3,211.7854 sq.m
14. The satisfaction level of the people staying in the premises in terms of overall aspects, synthesized from all the three hospitals is as follows: 71.35%, 83.75% and 56.21% are the percentage of the satisfaction level measured from the first, second and third hospitals respectively.
15. With the above satisfaction levels measured, the total built up area, total open space area and the site area of all the three premises are multiplied with the percentages of the satisfaction level.
16. 71.35% of 22,114.0452 sq.m. = x
17. 83.75% of 16,423.8566 sq.m= y
18. 56.21% of 3,211.7854 sq.m= z

19. Built up spaces of all the three premises are considered as a, b and c.

7. CALCULATION OF RATIO OF MINIMUM OPEN SPACE FOR A HOSPITAL:

$(x+y+z) / 3 = X^{os}$, where x, y, z are the satisfied open area for a hospital and X^{os} is the factor for open space.

$(a+b+c) / 3 = Y^{bs}$, where a, b, c are the built up area of the hospital buildings and Y^{bs} is the factor for built up space.

8. CONCLUSION

“Research gathered over recent years has highlighted the countless benefits to people, wildlife and the environment that come from planting trees and creating new woodland habitat. It is obvious trees are good things,” says Clive Anderson.

For very long years, the importance of aesthetics in relevance to the health was not experimentally proven as the additional quality of plants. Apart from the recuperation of illness, Aesthetic of plants is another important philosophical discipline which must be added to the ambience of hospital for the further betterment to both patients and doctors. High quality in nursing care includes the aesthetic dimension.

Aesthetics influence a person’s feelings, both physical and psychological. Both aesthetic and non-aesthetic surroundings create an impression and affect a person consciously or unconsciously.

The research concludes that $X^{os} : Y^{bs}$ is the ratio of minimum open spaces to the built up space of a hospital premises. The following are the prescribed recommendations for a sustainable and Eco-friendly layout design for a hospital premises: 1. Bio walls are created for sound barriers. 2. Insect repellent trees are planted in the next layer. 3. Air purification trees are designed in the third layer. 4. Humidity control plantations are done in the inner layer. 5. The building must be placed in the centre of the above circular layers of Medicinal landscape.

The research is taken to the next level in further scrutinizing the data observed from the statistics of the survey. Such data will be further synthesized for the post research findings of sustainable hospital landscape.

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