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Energy Efficient Cancer Hospital in Surabaya

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ABSTRACT

Buildings for cancer patients are also focusing on energy savings, it is necessary for analysis of the criteria the needs of residents and energy-saving cancer hospital in the context of designing a Cancer Hospital Surabaya. Firstly, on this design done in advance the discussion of a reference design of a cancer hospital with theories that relate to the design of an existing hospital, the cancer patient psychology, and science of architecture typical of cancer hospital, which is different from other general hospitals . In the context of the energy savings, had been made compilation of precedents hospitals and cancer hospitals that are energy efficient by saving the use of artificial and artificial lighting. The main result is a energy-saving cancer hospitals building design study who pay attention to psychological factors and psychological motivator for the residents through façade shape and arrangement of space and organizations building zoning on the cancer hospital in Surabaya.

Keywords: cancer, hospital, energy-efficient hospital, Surabaya.

INTRODUCTION

Cancer treatment in Indonesia, Surabaya in particular is still not maximal, this is due to a special place to handle this disease in terms of providing care are integrated in a hospital building, so that many patients eventually receive medical treatment abroad [1].

According to that demands, this study reviews the factors that influence the design of this Cancer Hospital. The building is expected to serve the patient's health both physically and psychologically. Psychological treatment is needed because of early period cancer would cause emotional distress and deep misery either for people who contracted cancer as well as her family[2]. Its application can be given in the form of consultation for patients and families as well as the provision of facilities that support the psychological recovery (such as creativity room, entertainment room, playground, etc.) and cancer hospital buildings that have different characteristics with hospital in general.

Because of the increasing use of energy in the world, energy saving efforts are needed, especially in Indonesia. Design study of the cancer hospital is expected to provide input to build a holistic and energy efficient cancer hospital. Especially if associated with the functions of a cancer hospital building is architecturally integrated have specific criteria in Surabaya tropical and application of energy saving at the cancer hospital. Looking at this background, the author tries to examine the cancer hospital further through energy efficient architectural solutions and is in the location of the tropical city of Surabaya.

MATERIALS AND METHODS

Study area descriptions

Surabaya is a capital city of East Java province and the second largest city in Indonesia, with the population of 2.861.928 on December 2007 [3].

Surabaya is a low-lying topography with an altitude of between 3-6m above sea level, only the southern hilly land with an altitude of 25-50m, with an area of approximately 33.306,30 Ha. Located between 07 degrees 9 minutes - 07 degrees 21 minutes latitude (south latitude) and 112 degrees 36 minutes - 112 degrees 54 minutes East (east longitude), Surabaya has a minimum humidity of 42% and 96% maximum, minimum temperature of 23.3 °C and maximum 35.2 °C. Dry season: May to October, the rainy season: November-April [3]. Surabaya can represent coastal cities with humid tropical climates around the equator.

Evaluation criteria for cancer hospital

The determination criteria of cancer hospitals and energy efficient buildings are taken from various references and case studies to produce the following criteria: Facility needs criteria of cancer patients:

- A comfortable patient rooms, of a particular culture would be uncomfortable in a room separated by curtains in the area of radiation oncology[4].
- Patient room, increasing the level of impact on the patient peace of families, staff, administrators and doctors[5].
- Patient room have a visual scene for visual recreation[6].
- The interior design should be attractive, thereby improving spirit. One of them with the cooperation of art galleries in the hospital building or the provision of recreation through the greening of interest.
- Procurement of music therapy in the building that help calm the patient and psychological healing.
- The existence of library facilities, audio visual room, internet room, exercise room, so the patient do their daily activities as usual.
- Lot of space infusion bay, thereby reducing patient waiting time[7].
- The patients circulation must a short circulation and not complicated arrangement of the building with an efficient circulation on zoning and planning[8].
- An optimal greening inside and outside the building to enhance the quality of the atmosphere that supports the building, so it can be enjoyed from inside and outside the building[9].

Facility needs criteria of cancer patients family:

- The existence of a waiting room, family room personal counseling, and educational space planned and integrated with the building layout and zoning. For example, some cultures can support each patient brings the group members with their families, especially during the initial clinical diagnosis and stage of disease detection[10].
- The existence of a close family waiting room with the patient's personal space, thus maximizing the visual contact. The room is expected to have comfort or visual recreation outside the building so that the atmosphere in the room become more comfortable.
- Design of the hospital lobby will provide a bright spirit.
- Optimization of greenery inside and outside the building to enhance the quality of the atmosphere of the building.

Facility needs criteria of medic and non medic hospital staff:

- Room staff that can help employees cope better to release patients stress at work (especially in oncology).
- Environmental staff room design is a positive factor in attracting and retaining qualified employees.
- Good lighting to help do the job accurately.
- The direct and not complicated corridor. Workers are sometimes sensitive to walk a long way in a long corridor, to get supplies and medicine[11].
- Desentralization charting station plan, which is placed close to a fixed location to collaborate with patient care. Which allows staff to spend more time in patient care and to respond to patients faster[11].
- Optimization of greenery inside and outside the building to enhance the quality of the atmosphere of the building.

Energy-efficient cancer hospital criteria :

- Reduction of energy use and the use of artificial air circulation system and artificial lighting system.
- Maximizing the opening for artificial lighting that saves energy for electrical, on a private patient rooms, family waiting room, lobby entrance[12]. The opening could be combined with the need for visual needs of greeny outside the building in which provide a comfortable and encouraging[13].
- Maximizing the opening may also reduce the electrical load to cool the not septic room.
- The use of the park also protects the soil from the sun radiation that makes the environment a hotter, while also supporting the soil to absorb water from rain water so that the surface of the ground water can be maintained and the micro temperature can be lowered[14].
- Incorporate natural elements as interior elements such as artificial waterfalls, hydroponic plants, vertical greenery to create an atmosphere that supports patients, families and hospital staff emotional, which is useful as an air filter and reduce pollution.
- Planting should be optimized within and outside the building to enhance the quality of the atmosphere of the building.
- The use of roof garden to reduce heat conduction and for the provision of recreation for residents[15].
- The use of storage systems and rainwater recycling[16].

RESULTS AND DISCUSSION

General criteria

Based on the criteria for cancer hospitals in Surabaya, then collaborated conclusions from a variety of reference are as follows:

• The mass of the building and façade design.

Through project design Cancer Hospital in Surabaya, the concept design uses the concept of analogy which takes the form of ships and leaf clover as a screen with a technique to display the characteristic of Surabaya. Ship forms are applied to reduce the solar radiation load with accessories roof use. Ship form is taken from the typical form found in Surabaya so does the leaf clover as façade elements with protective devices in combination with solar radiation.

- The usage of main void on the main building for artificial lighting and visual recreation. So the energy savings for lighting during the day can be saved, and visual recreation can be enjoyed by residents on each floor of the building.
- The usage of opening on building façade and balcony to reduce direct solar radiation to the building[17].
- The usage of indirect solar radiation from building openings could reduce energy usage for artificial lighting needs. And the opening could give access to the building occupants to have outside greenery visual recreation.
- Greenery on the site and inside the building. Used as a visual recreation by the occupants of the building to give spirit and motivation to achieve a cure or calm.
- Arrangement of care units that gives direct circulation that support building energy savings.

Arrangement care unit, such as chemotherapy unit, medical rehab unit, ICU, HCU (usually up to 300m2 unit area) on the East side where solar radiation is not too hot, and help the healing process. On the contrary, the West side for a place for service spaces. Circulation space arrangement on the North, South and West side as a zones that isolate the building from solar heat radiation so this arrangement does not make the care units exposed to direct sun radiation. North side is the warmest side of the building on the year, so did the West side (Priatman, 2002)[18].



(a) Care (300m2) unit arrangement on the East side (b) Corridor unit arrangement on the North side Figure 1. Medic unit placement in one level layout

Criteria Application

Greenery cloud block the solar radiation on the soil surface, in which could lowered the micro climate temperature[14]. Beside that the greenery along the street make positive ambience for the pedestrians and the environment. Seemed to convey the message that the hospital buildings do not have to be serious, or cold, but also could be green and full of trees and greenery. Where greenery is a very important element for building occupants that provide a visual recreation of positive energy as well for the patient, family, staff and medical staff.

Planted trees are trees that have the ability to filter air pollutants, the cypress and headlands, help clean the air to be used as cancer hospital building indoor air[19]. In addition to air pollution filter function, trees placed on the pedestrian in the north wing of the building is expected to provide shade for the site and car park of solar radiation.

Coloumn and beam construction system and of concrete floors applied to this building, is expected by the selection of materials can reduce the heat load from concrete construction, where the use of iron construction can distribute the heat from solar radiation into the building. The building use 8×8 meter module for the coloumn, because the module is easily adaptab 2, 3, and 4 meters coloumn modul.

On the ground floor layout, the design arrange the management unit position next to public facilities because of its semi-private so we put in the hall near the main entrance so that visitors and management intersection circulation does not occur. Health facilities area such as fluoroscopy, x-ray, MRI, CT Radiology, PET / CT, ultrasound and mammography area are arranged to the other side of the building. For catering unit is positioned in the backside of the main building, behind the void, with access from the rear of the building and connected to elevator to distribute food and drinks to each floor of the hospital.



Figure 2. Ground Floor layout plan

On the second level floor layout, designed for medical facilities, including for routine outpatient care is also provided on this floor. Chemotherapy and medical rehabilitation unit was designed in the main building and the area that includes poly eye clinic, pediatric, ENT, surgery, internal medicine, gynecologic pathology occupies the right side of the building is equipped with anatomic and clinical pathology laboratory at the back. To invite a visual on the second floor is made void so that users can banguan have visual contact to the ground floor. Part of public facilities such as libraries and recreation areas are also located on this floor to meet the needs of visitors of this medical facility.



Figure 3. Level 2 layout plan

The position of the waiting room is arranged on the center of medical units so that the family who wait can indirectly sense the presence of family members who are undergoing the treatment, as well as the patient could visually see the immediate family residing in the waiting room. Where the patient immediately felt motivated and close to his family.

Surgery room, ICU ward, HCU and Haemodialisa facilities arranged on the third floor. Surgery rooms are designed to follow standard medical on 8x8 meter coloumn modul, in which can fit the needs of a standard operating room, the 5 meters ceiling height, and on the right side of the main building. For the service zone surgery room needs is equipped with a service corridor that surrounds this zone in which maintain sterility of the surgery room unit area.

The waiting room was also placed around the lift so families that bring patients to feel close to the patients who were conducting the surgery or medic rehabilitation. For visual recreation patient and their family can enjoy a vertical plants wall and open gardens on the ground floor of the main building and also the park boundary the building.



Figure 4. Level 3 plan

In the other hand the inpatient unit arranged on the typical floor in the main building where the elevator area, toilet area and the fire escape to the west side so does could reduce the absorption of heat load on a inpatient unit on the typical floor (level 4-8). Meanwhile, to reduce heat radiation received by the roof of the west side building, then created a roof garden on the right wing of the main building. Where the roof garden in the western part is expected to lower the the micro climate temperature so that heat transmission can be reduced on the west side of the building. And the heat transmission on west wall of the typical floors could be reduced and energy usage for cooling loads on typical floors of buildings could be also reduced. This roof garden also serves as a recreational facility that is expected to increase the positive psychology of cancer patients. Some outdoor air conditioner unit belong to the right wing of the building also arranged on this roof garden.

Nurse station, consulting room, head of unit room arrang in the middle of building layout is expected to hospital staff to monitor the entire inpatient floor corridor so that if there is a case of emergency in inpatient floor could be easily handled.

On this typical floor is also designed with garden balconies on its north, east and south side. The arrangement expected to reduce indirect radiation of the sun so it does not affect the temperature in the building. It can also be a visual recreation for the inhabitants of this cancer hospital buildings.



Figure 5. Typical layout floor plan

Service facilitiy (warehouse, workshop, cafeteria, mosque, linen laundry facilities, security room, PABX-telephone center, CCTV), corpse storage facility, drug storage facility, electrical mechanical (electrical panel room, generator room) and disposal facility (WWTP, STP, litter pool) designed on the basement floor, expected noise pollution and vibration caused by the generator room, room air conditioners, and the loading dock does not interfere activities on floors above the medical facility. Radioactive medical unit, such as LinAc, cobalt,etc also arrange on this basement level[20].



Figure 6. Basement layout floor plan

Composition of the hospital buildings seem designed using the analogy method from ships form, sails screen and leaf clover where these elements are typical of Surabaya. The appereance of the building want to give the impression to the patient that they are about to depart with the ship toward better health with all the their hopes. This condition look likes going to do *mudik* trip every year to the their home during Eid al-Fitr in Surabaya and Indonesia. And the facade also uses a form of the hull and sails pinisi ship with clover leaf motif composed a solar radiation protective equipment.

Hariadi et al., 2012



Figure 7. Analogy method and design concept for cancer hospital

DISCUSSION

The criteria of the cancer hospital facilities needs can be used as a design guide to design the energysaving cancer hospital in the humid tropical climate in Surabaya and adapt Surabaya distinctive character. Application of design concepts that adapt the criteria is:

a. Facility needs criteria of cancer patients:

- Patients rooms should have a visual view for recreation.
- The interior design should be able to boost positive spirit and positive atmosphere.
- Hospitals should make the peace for the patient so could give a positive impact to staff, families, administrators and doctors.
- Optimization of greening.
- b. Facility needs criteria of cancer patients family:
 - Should be room for the patient consultation.
 - Should be a waiting room near the patient's family.
 - Lobby the hospital should be designed to increase positive impact and atmosphere.

c. Facility needs criteria of medic and medic staff:

- The staff room for breaks.
- Room staff to reduce stress.
- Corridors should be as short as possible and not complicated.
- The organized arrangement of the staff room.

d. Facility needs criteria of energy efficient cancer hospital:

- Must use a system that can reduce electrical energy consumption.
- Must use a system utility that helps building electrical energy consumption efficiency.
- Use of natural resource utilization.
- Using materials that support energy savings.

The Surabaya micro climate data can be a limitation in applying the design of a cancer hospital design that is energy efficient. The main concern of the micro-climate is based on solar radiation, air movement, and the rain water which refers to the thermal comfort was analyzed so that the design can reduce energy consumption of artificial air conditioner and artificial lighting system.

a. Planning façade and building mass.

Calculated based on the solar chart and integration with the city of Surabaya in the greenery can provide its own form in a pre-planned cancer hospital buildings that save energy consumption from saving the use of artificial lighting and visual look of buildings that have a characteristic of Surabaya.

- The composition of the vessels shape, leaf clover shape and solar radiation shield is composed from vertical and horizontal sun shading on the hospital façade using the analogy methods from a particular form of the typical Surabaya on cancer hospital buildings that are energy efficient.
- Sequence application is done by the integration trees in a cancer hospital building façade. That make up a story of motivation and the provision of shelter / protection to the physical and mental health patients and families at the time was in front of the building.
- Void application of in the main building and opening a window on the entire building façade cause indirect sunlight can enter the building and help reduce artificial lighting energy savings.

b. Special rooms or unit arrangement.

Placement of special room in the arrangement of zones in an organized cancer hospital can improve the psychological quality of cancer patients, families and hospital staff, and saves energy consumption from the use of artificial contrast to other public hospital buildings.

- Chemotherapy unit, is positioned adjacent and there is visual contact with the waiting room.
- Clinic rooms and laboratory unit that have a visual openings directly facing the greenery outside the building that provides a positive psychological and help reduce energy on air conditioner and artificial lighting systems.
- Medical treatment rooms, inpatient rooms have views towards the greening on the main void and outside the building to provide a positive psychological and help reduce energy on air conditioner and artificial lighting systems.

CONCLUSION

Factors that may influence cancer patients' psychological hospital can be used as a reference to set out the criteria to develop the concept of a cancer hospital to encourage and motivate residents (patients, patient families, hospital staff) in the wet tropical building on Surabaya. These factors include: the formation factor in the construction and arrangement of space can increase positive encaurage and provide a psychological positive for patients, patient families and hospital staff which applied to the design of cancer of building façade that provides indirect lighting from the window openings and the design of the building façade integrate with the greenering; factor in the placement of green building elements applied to the integration of these elements with architectural elements to encourage and motivate the psychological state of the patient, family and hospital staff, cancer, and the latter is a factor structuring an organized corridors and zoning on building the cancer hospital can help improve cancer patients' psychological, family and hospital staff, so does the building did not have swirling circulation and building occupants have a visual guide on its way in achieving a particular facility units. The Surabaya micro climate data can be a limitation in applying the design of a cancer hospital design that is energy efficient.

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