The study of green roof application in apartments in Indonesia

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Abstract. This research was done to study the application of a Green Roof in apartment buildings in Indonesia. The objective of the study is to understand what aspects are needed from the application of the Green roof to apartments. The method used is descriptive method, in which the author focuses more on finding and processing data and information about the design and application of green roofs in apartments in Indonesia, both direct secondary and primary data through other intermediaries. The results of the study show that the application of green roofs to apartments has several aspects, namely aspects of application and types of plants.

Keywords: apartment, application, green roof.

1. Introduction

The number of residents from year to year causes the need for housing and settlements to be increasingly limited, so the authors decide to design a vertical housing design, because the occupancy capacity is more than horizontal housing [1]. In addition to community residences, the apartment that the writer designs must also be adjusted to the problem of green areas in the city of Jakarta which is less than 30%, which is a factor causing the Urban Heat Island (UHI) phenomenon, so as to minimize the main problem source, namely the limited green space in the city of Jakarta with provide design solutions for building design projects in the form of the application of a green roof or roof garden which has the potential to minimize the limitations of green land in Jakarta where the green area is less than 10% which if left unchecked will make the city even hotter and cause the phenomenon of global warming, and give a comfortable effect of the benefits provided [2].

Green Architecture, namely the concept of architectural design that is environmentally sound and based on concern about the conservation of the natural global environment with an emphasis on energy efficiency (energy-efficient), and sustainable patterns (sustainable). So that the building can be maximized for mutual benefit with the surrounding environment. One aspect that makes buildings environmentally friendly according to the Green Building Council Indonesia (or often abbreviated as GBCI) is to create air quality and reduce air temperature. Improving air quality is like producing air that is free from air pollution and decreasing air temperature as it makes the air feel cooler [3].

By doing so to support the realization of the concept of environmentally friendly, the authors apply a design solution which has benefits based on the environmentally friendly aspects, one of which is applying the green roof as the design solution [4]. Green roof or roof garden is the roof surface of a building which is covered by vegetation and growing media or growing substrate which is planted in a
planting container on the surface layer of the building. Green roof is a technology that can help reduce some of the negative effects of hard surfaces in cities by reintroducing natural landscapes into the urban environment without making major changes to the infrastructure in the city [5]. Green Roof consists of 3 types namely Extensive Green Roof (low planting media), Semi-Intensive / Extensive Green Roof (medium growing media), and Green Roof Intensive (high planting media) [6].

Table 1. Green roof types and criterias.

| CRITERIA                | Extensive green roofs | Semi-extensive green roofs | Intensive green roofs [root garden] |
|-------------------------|-----------------------|-----------------------------|-------------------------------------|
| Load-bearing component  |                       |                             | Maximum pitch 6%                     |
| Plant choice            | Sedums, mosses, perennials | Perennials, small shrubs, lawns | Shrubs, trees, lawns                |
| Thickness of growing medium | 4 to 15 cm    | 12 to 30 cm                        | 30 and over cm                      |
| Weight of compositu system (kg/ft²) | 75 to 150 | 200 to 500                        | 500 to 2000                        |
| Irrigation              | No*                  |                             |                                     |
| Maintenance             |                       |                             |                                     |
| Cost of roofing          | €                     | €                            | €                                   |
| Accessibility           | No                   | Limited                      |                                     |

*With the exception of southern areas and sloping roofs

Source: Vegetal i.d

Therefore, the writer will formulate a problem for research, so that the green roof study becomes easier, first the research is aim to how to apply green roof designs in apartment design, to minimize the limitations of green land in Jakarta, and to find out the typology and criteria (aspects of plants, aspects of maintenance, aspects of structure and installation) green roof applied to apartment projects.

2. The methodology

In this study, the authors used a descriptive method to research the green roof. By using this method, the writer will be more focused to data / information regarding the design and application of the green roof on apartment, so the author must prepare or collect data both data primary and secondary data to strengthen the idea of applying green roof to the apartment building. Searching and collecting data consists of 2 types, namely primary data, and secondary data.

Primary data is data obtained by the writer directly with the field survey. While secondary data is data obtained indirectly, but through literature search, both print media, references, and digital. Primary data obtained in two ways, namely field surveys, and documentation. The field survey aims to understand the condition of the green roof contained in each apartment that the author observes, such as the location of the application in the roof area and the plants used, then the author documents each of these conditions, to capture each image that can make it easier for the author to process the data.

For secondary data, where the authors obtain data about green roofs through literature books, where the authors get data on structural aspects that need to be applied in the application of green roofs, the book that became the author's guide is a growing green guide.

The data obtained were then analyzed to obtain conclusions about the application of green roof in apartments and as a guide for designing apartments with environmentally friendly concepts.
3. Result and discussion

3.1. Analyze the apartments in Indonesia that applying green roof

Analysis carried out to find out what green roof was applied to the apartment; especially what type of green roof would be applied. The building that was the purpose of the survey, it was determined that the existing buildings in the previous comparative study were certainly located in Indonesia especially Jakarta which also applied the roof garden.

Table 2. Analysis of apartments in Indonesia that applying green roof.

| No | Project / Precedent | Location         | Extensive | Typology  | Placement   |
|----|---------------------|------------------|-----------|-----------|-------------|
|    |                     |                  |           | Semi Intensive | Intensive   |             |
| 1  | Apartemen T W       | Indonesia (Jakarta) |           |           | v           | Podium Rooftop |
| 2  | Apartemen S BSD     | Indonesia (Tangerang) | v         | v         | v           | Podium Rooftop |
| 3  | Apartemen A P L     | Indonesia (Tangerang) |           |           | v           | Podium Rooftop |
| 4  | Apartemen S C       | Indonesia (Jakarta) | v         | v         | v           | Podium Rooftop |

Source: author's analysis

The following is an analysis of 4 apartment buildings with green roof in the table above, the types of green roof that are most widely applied in apartments around Jakarta are Green Roof Intensive and Semi Intensive. The location for laying the green roof is mostly placed on the podium floor. Therefore, for the application of the roof garden in the apartment that the author designed more prioritized to Green Roof Intensive and Semi Intensive which has large greening and more varied such as trees and shrubs.

3.2. Analyze the application plants of green roof

Application of plants based on plants that have been applied to the apartment, which is the author's comparative study, and analyzed the characteristics of these plants. Then adjusted based on location factors and the most usage factors of the 4 comparative study projects. The following are the results of the plants that will be used in the design project: the plants that are applied to the apartment which the survey author has are plants that function as ornamental plants which are intended as a visualization of the public area of the podium roof garden. These plants are also tropical plants, because based on their location they are all found in Indonesia [7]
Table 3. Results of plant analysis.

| Tanaman Mondoaki | Palem Palas Payung | Pandan Bali | Palem Putri |
|------------------|--------------------|-------------|-------------|
| *Tabernaemontana* | *Licuala grandis*  | *Cordyline australis* | *Veitchia merrilli* |

![Tanaman Mondoaki](image1)

![Palem Palas Payung](image2)

![Pandan Bali](image3)

![Palem Putri](image4)

| Rumput Zoysia | Palem Dop | Bunga Soka Jawa |
|--------------|----------|----------------|
| *Zoysia japonica* | *Pritchardia pacifica* | *Ixora javanica* |

![Rumput Zoysia](image5)

![Palem Dop](image6)

![Bunga Soka Jawa](image7)

Source: author's analysis.

4. Conclusion

The conclusion of this study from the 3 aspects analyzed by the author can be described, the first regarding the aspects of the application of the green roof location to apartments in Indonesia which have been surveyed by the author shows that the application of extensive, intensive, and semi-intensive green roofs is on average applied to the roof podium functioned as a garden.

Then for the plant aspect, the plants applied from these apartments use tropical ornamental plants and these plants are also located in Indonesia, so they are available to get.

References

[1] Perumnas 2011 *Peraturan Undang-Undang Republik Indonesia. Pasal 1 ayat 1 No.20 Rumah Susun*. Kementrian Agraria dan Tata Ruang/Badan Pertahanan Nasional

[2] Databox 2017 *Jumlah Ruang Terbuka Hijau Menurut Wilayah di Provinsi DKI Jakarta* retrieved: 24 January 2017 https://databoks.katadata.co.id/datapublish/2017/01/24/jumlah-
ruang-terbuka-hijau-di-jakarta-mencapai-3100

[3] Murray, J 2019 What is Green Architecture? Sustainable Building, hal 1

[4] Duggie, A 2007 Study on Green Roof Application in Hong Kong In Association with Leigh & Orange Ltd.

[5] Johnstone, J & Newton, J M 2004 Building Green: A guide to using plants on roofs, walls and pavements (London: Greater London Authority).

[6] Dunnett, N and Kingsbury, N 2004 Planting Options for Extensive, Semi-Extensive Green Roofs and Intensive In Proceedings: The 2nd International Green Roof Infrastructure Conference, Portland.

[7] Sia, A 2005 A Selection Of Plants for Green Roof in Singapore (Singapore: Publication)