A Literature Review: Strategy Design of Transition Space Using Wind Potential

Andyka dwi Acsazha, I Gusti Ngurah Antaryama ,Vincentius Totok Noerwasito N
Department of Architecture Design and Planning,
Institut Teknologi Sepuluh Nopember
e-mail: andyka014@yahoo.com

***Abstract*—Transition space is a link between one space and another space where this space has a function of adaptation to changing conditions from the previous space to the next space, this study discusses some transition space design strategies in building skyscrapers and groundscrapers by utilizing wind potential through usable design building elements. By implementing a transitional space strategy in building skyscrapers or groundscrapers where buildings can adapt energy-efficient buildings. Energy savings can be applied through available natural elements, one of which is wind potential. This research phase requires literature review and transitional space theory to translate the role of transition space in buildings to achieve energy-efficient buildings by utilizing wind. The case study will provide a direct example of the building of transitional space functions to anticipate the wind. The results of this study will provide a transitional space design strategy through architectural passive elements that respond to wind so as to provide comfort for building users using natural ventilation so that energy use is more efficient.**

***Keywords*—Transition Space, Airflow, Skyscrapers/ Ground Scrapers, Energy, Literature Review.**

I. INTRODUCTION

TRANSITION space is a zone between the the interior and exterior of the building, between one space and another space that functions as an environmental control both for health and comfort for the occupants in it.

Transition space can be used as a supporting function such as a gathering area, space to show the aesthetics of a building that can be atrium, plaza, courtyard, skycourt, balcony and others.

Transition space in buildings can control thermals in buildings by engineering solar winds and heat that are received by buildings by using passive elements such as gratings, skylights, dormers, clerestories, belvedere, etc. or simply directing wind from one room to another to get air natural. Therefore, through the good control, it is very possible to design a building transition space that can adapt buildings with more efficient energy use.

II. METHOD

The method used is literature searching from books, journals, perecedent and other relevant sources. The literature includes:

1) Transitional space theory with utilization of wind potential.
2) Application of the concept of transition space in skyscrapers.
3) Application of the concept of transition space in grounscrapers
4) Transitional space design elements to work with the wind.
5) Precedent about energy saving by using the wind potential.
6) Journal relating to transition space concept.

III. RESULTS AND DISCUSSION

The theories used in this paper consisted of energy-efficient buildings by utilizing wind potential, transition space concepts in skyscrapers, transition space concepts in groundscrapers building and utilization of transition space elements in buildings.

A. Strategy of Wind Use

In energy-efficient design the utilization of wind potential is one alternative to get natural ventilation as a way to reduce thermal in buildings therefore energy consumption of buildings will decrease.

Meanwhile, on the implementation of the energy-saving design strategy by utilizing the wind on buildings not only consider the site conditions or around buildings, but more important is paying attention to the comfort of the user with the used strategy.

Table 1.
Comparison of efficiency energy theory

Yeang [1]	Karyono	Hawkes	Givoni [2]
Ecological design, is bioclimatic design, design with the climate of the locality, and low energy design. Emphasizing passive design based on the integration of local ecological conditions, macro and micro climates, site conditions, building programs, design concepts and systems that are responsive to climate, low energy use so as to provide comfort for users	Energy-efficient buildings are architectural thinking based on the idea of minimizing energy use without limiting or changing building functions, comfort and productivity of its occupants, by utilizing science and technology, optimizing the air system and lighting, integration between artificial and natural air systems, and synergy between passive and active methods with materials and energy-efficient instruments.	Designing building to minimize the usage of energy without constraining the building function nor the comfort of productivity of occupants..	The relationship between energy control in buildings and air movement is the effect of heat release on building structures through a convection process on the building envelope so that the heat absorbed by the envelope of buildings is smaller. Convection heat transfer will be more helpful by turbulence that occurs on the outer surface of the building envelope. The less heat absorbed in the building envelope will affect the lower air temperature in the building so that it requires less energy to increase. The side of a building larger than air movement will provide the potential for a larger building structure. Therefore, air movement outside the building must also support the process of building the structure

B. Transition Space

The concept of the transitional space referred to in this research is the relationship between the physical buildings with wind potential that supports building functions while still allowing the emergence of different architectural expressions in each space. Based on wind flow allows the formation of a system that is fast and easy to add, reduce, modify, or assemble buildings using the principle of energy-efficient buildings

Designing transition space here is more directed at building responses to environmental conditions, especially wind, including strategies that can be done. The strategy can be initiated by paying attention to the placement of the balcony, to reduce the side of the heat room, with wide terraces that will easily create a garden that functions as a natural sun shade, and as a flexible area it will be easy to add facilities that will be created in the future will come.

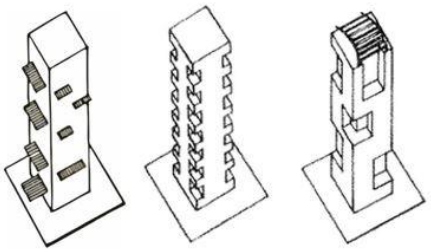


Figure 1. Application of balconies and shading in transitional space [1].

Furthermore, with placement space can be placed in the middle and on the side of the building as air space and atrium. This space can be a space between interior and exterior of a building, this space can be an outer space. Placement of the terrace on the outside of the building can use solar heat or also use protective panels.

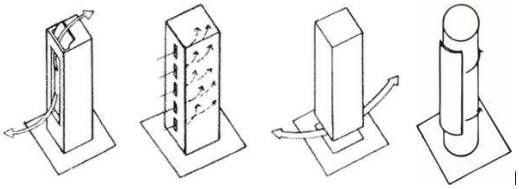


Figure 2. Wind-scoop, a hole in the building envelope and atrium to direct wind, and barrier panels with curved shapes to obstruct and direct the wind [3].

Transition space should be protected in certain parts by roof fins that push wind into the building, this design also functions as wind-scoops to control natural ventilation. In a cool climate, the use of a membrane as a secondary skin can withstand the cold winter and summer heat. Secondary skin is like a protector, but can be opened in the dry season. In the tropics Secondary skin can be moved to become cross ventilation for the comfort of air in the building.

For example, in the Mesiniaga tower it can be seen how the building manages the wind through the transitional space, where the openings that do it aim to direct the wind to the required area, namely towards the wind-catcher, and divide the excess wind through wind-breaker formation. While the holes created as wind management are still used as useful spaces in the form of terraces equipped with vegetation in response to the landscape.

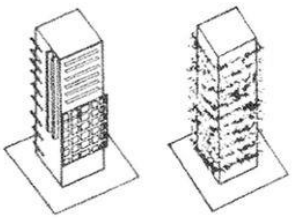


Figure 3. Secondary skin berupa shading dan vegetasi untuk merespon angin [3].

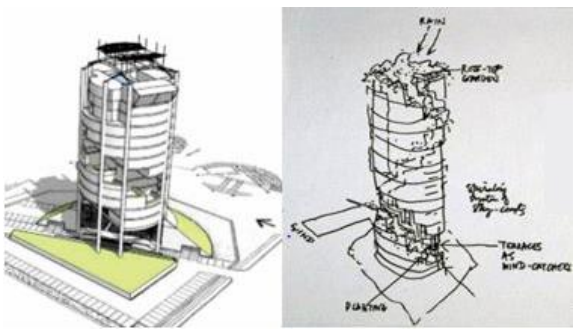


Figure 4. Penerapan ruang transisi pada menara Mesiniaga berupa wind-breaker, wind-scoop dan vegetasi sebagai pengelolaan angin [3].

C. Manage The Transition Space

Implicitly, the concept of transitional space in the realm of architecture can be found in the principle of energy-efficient buildings. The architectural attitude that applies

energy-efficient buildings to the design makes it possible to change in the future, development can be flexible depending on the units of each building [4]. Energy-efficient buildings in an environment that adjusts wind circulation to act as a regulator of the buiding base, while building functions to develop inner spaces and plans can be adjusted to the needs of each space.

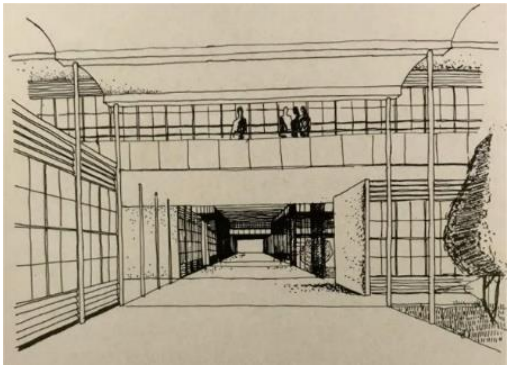


Figure 5. Transition space in the form of a corridor that connects the entire building to courtyards [5].

According to Yeang, the ground floor for tropical buildings should be more open out and use natural ventilation because the relationship between the ground floor and the road is also important. The function of the atrium in the room on the ground floor can reduce the density of the road.

Figure 6. Atrium as a meeting place for users who acts indoor spaces but with an outdoor atmosphere, to manipulate its functions as wind management and also a place for user activities [6].

Plants and landscapes are used not only for ecological and eastetic purposes, but also make buildings cooler. Just like what Ken Yeang did, where the transition space becomes very functional, and really useful for its residents actively, where passively functions space to direct the wind, and actively the space is in the form of sky-court and as wind-driven in the building.

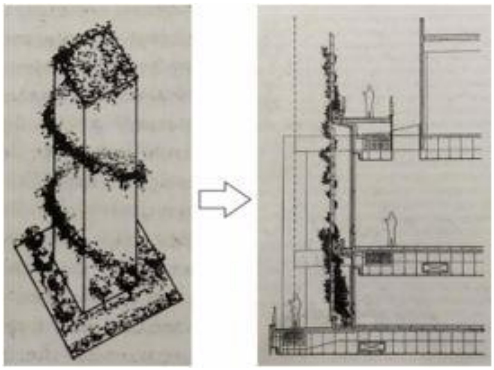


Figure 7. Vertical landscape on sky-court and its application to building design [7].

A building is seen from two aspects, namely its physical aspects (shape, site and structure) and its functional aspects (systems and operations) involving structures that are built in the relationship of buildings to the natural environment that takes place from time to time. The building acts like a living organism such as replacing food, using energy and materials, and also producing something for its environment [7].

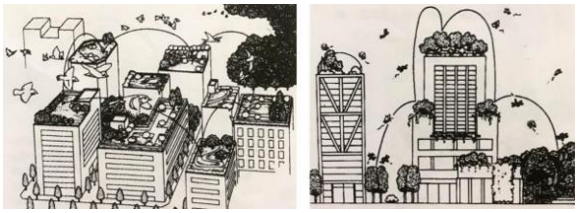


Figure 8. Roof garden and sky-court create new habitats for buildings [1].

D. Transition Space at Skycrapers

The building that respond to the environment are considered as a condition of all design efforts, architects must have more influence to determine the concept and layout of buildings, especially those related with content, location determination, material, operational systems, and other features. While large-scale or multi-story buildings (such as skyscrapers) are considered as ananathema because of high energy consumption. Design skyscrapers should consider this with bioclimatic design or ecological design as listed in Table 1 which contains the design modes of skyscrapers.

Figure 9. Skyscrapers with the application of ecological design modes [6].

Skyscrapers and other types of multi-story buildings should be ecologically designed because these buildings need energy and can damage surrounding ecosystems such as landscapes and global resources. Ecological design will require the view of architects to understand the environment as a natural system and to recognize the dependence of artificial environments on it, it is necessary to have a green design strategy, for example, using computer software mechanically to analyze energy conservation, air flow, and temperature factors that do not consider biological components (eg flora and fauna). Intervention of active design elements, seasonal changes in microclimates can be modified to protect buildings as needed, using a combination of landscape elements and static moving elements. For example, the layout of the skycourts can be designed to accommodate secondary skins that can be moved to various positions depending on the time needed. The way a building is placed against another building and the natural potential of the landscape can be a major determinant of its energy efficiency. The strategy varies, depending on the climate zone. These are some landscape techniques for controlling microclimate, especially for wind potential and the application of transitional space.

E. Transition Space in Groundscrapers

Groundscrapers are the opposite of skyscrapers (skyscrapers), which are low buildings with a broad location (horizontal) and spread as large buildings or mass groups of buildings. A clear characteristic is the placement of buildings many take up land parcels that can significantly change the natural ecosystem in that location. For comparison, groundscrapers and subscrapers are located more broadly (in terms of land coverage or site ratio) than skyscrapers (skyscrapers). The following is a precedent study with the application of design elements as a transitional space strategy at groundscreapers.

In general, a transitional space is a space between two larger or more functionally significant spaces, transitional spaces are often limited by various codes such as terraces often needed in cold climates as temperature controls outside buildings or emergency doors generally have to allow a way out in the event of a fire , but also often occurs in certain buildings where there needs to be a small "habit" when walking from the inside out, or vice versa so that there is an unusual space design (has additional functions).

One of the most important considerations in the transition space is sustainability in building design. The use or use of transitional space accurately can improve energy efficiency better than standard spaces in buildings. When architects talk about the orientation of buildings, building shapes, location organizations, topography, landscapes, they must consider transitional space as one aspect of building design such as some of the following design examples.

Table 2.
Strategy transisi space on skyscrapers

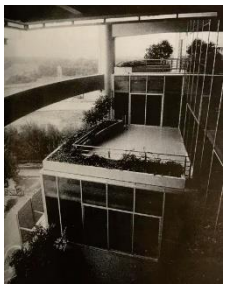
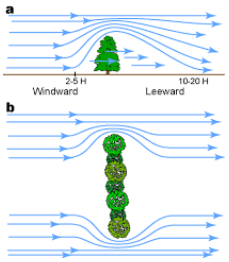
Vegetasi	Shelterbelts	Windbreaks	Wind-stering	Ground shaping
				
Plants can provide summer shade. The choice of plant species will affect the nature of the interception of the sun, that is, plants with thick leaves and trees should be placed on the skycourt with the aim of providing shade denser than the leaves. Solar radiation screening can offer smoother control of light and heat in building skyscrapers	aims to filter wind speed, especially on the lower floors. However, a solid wind barrier will create turbulence and vortex. The turbulence effect is determined by the height of the shelterbelts (a structured combination of trees or shrubs that form linear blocks), if without shelterbelts it can cause the flow of wind speed which increase by 20%. The orientation of the shelterbelts must take into account various wind directions.	can be found on skycourts, the principle is similar to shelterbelts as reducing wind speed, can be a wall or secondary skin that can be integrated with landforms or building shapes. The shaft of these elements must be designed to slow the wind without creating turbulence or produce an immovable air bag.	by directing uncomfortable winds with ground shaping, planting, windbreaks, or structures in the skyscrapers themselves. Cold winds can be slowed down, channeled and driven or directed as desired, for example with thick dense edge plants on skycourts or by forming soil in the form of contours. Windbreaks can take the form of a modified fence so that the atrial conditions have the aperture in the wind walls.	Pembentukan The formation of soil is very effective for channeling wind and when combined with vegetation, the flow of wind will be very good for the user. Constructive ground shaping can integrate skyscrapers (including the place to park the car) with landscaping (including basements). Landscape design must have erosion and water control measures.

Table 3.
Presdent widfsth use of wind potential with transitional space strategies

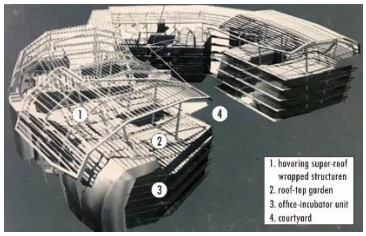
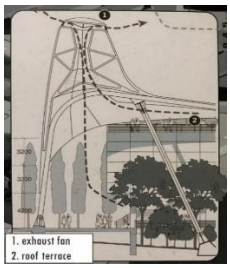
Enterprise Park Malaysia	Tech-Linx	Universitas Nottingham
 1) The building is a unit of unity of space from several building masses connected 2) Canopy structure uses super-roof hovering so that it looks like a single unit 3) U-shaped to surround the middle room in the form of a courtyard. 4) Roof-top in the form of a garden as a form of returning a large land use, the roof-top is protected by a wrapped structure to protect from direct sunlight	 1) Courtyard is in the middle with a protected closed space mass unit 2) Protected by a roof canopy in the form of umberella-roof 3) Combines two sets of open-floor connected offices, with communal facilities and conferences. 4) All courtyard complexes are interrelated by a mass of buildings with natural ventilation with dense forest vegetation 5) The periphery area is also equipped with a water pool to control the temperature in the building.  1) Visual connection between users and the natural environment is achieved by glass ventilation for natural lighting and cross ventilation  1) Utilization of solar energy for hot water, 2) Water collection and recycling for irrigation, 3) Using good plants, the design is influenced by the tropical climate 4) Contours are the benchmark for ecological design	 1) Use of skycourt 2) Shelterbelts as reducing angind speeds in the form of walls or secondary skin 3) Enterance design combines a botanical atrium that is connected with a hall or plaza 4) "Facade tower" wind tunnel to public space. 5) Wind-scoop and wind-tower are used to drive the movement of air from the outside with the fan to help move air mechanically when the wind speed is low. 6) Wind walls that deliver air to the wind tower. 7) Wind-tower is covered by a membrane as a shade of natural light receiver. 8) Open circulation with U-shaped 

Table 4.
Research related strategies of transition space

Vargas	[8]	Chun	Salkini dkk [9]
Research Experiment In a climate change scenario, building design must provide transition space as an adaptation space especially in dynamic conditions and varying temperatures. Lobby space as a transitional space is used as a case study to evaluate the possibility of changing thermal conditions. Preliminary findings indicate that overall residents feel comfortable when they are at temperatures of 21 to 26ºC.	Research Experiment It is plausible and reasonable to suggest that transition spaces of buildings can be operated to a wider temperature tolerance than their accompanying interior occupied spaces and still achieve thermal comfort for those people passing through. Significant reductions in heating energy use can be achieved through the operation of transition spaces at lower than normal temperatures. Orientation has only a modest effect on heating energy use in buildings with transition spaces. Relatively minor reductions in cooling energy use are possible for transition space buildings due to the impact of heat gains. Cooling energy requirements vary more significantly with orientation—a southerly orientation for transition spaces reduces energy use in the main occupied space by the greatest amount but results in the highest transition cooling energy use (the reverse being true for northerly orientated transition spaces). Where transition spaces are used they have greatest effect where they give protection or buffering to the largest facade areas (shown in this study as types A and D).	Research Design Recent research on outdoor comfort reveals a lack of information about responses to transition conditions. Transitional space is arranged depending on its proximity to the interior space. The most efficient architectural form of the transitional space related to the regional climate conditions. They help alleviate shock in humans and reduce energy loss, and this kind of transition of space will be effective in extreme climatic conditions (eg lobbies). Another type of transitional space gives people a feeling of coldness by cutting solar radiation in tropical climates (eg Pagola). . .	Research Experiment Managing the wind by seeing wind pressure in and out of both sides of the inlet air flow will turn to look for another way, in other words, shifting the air inlet on one side changes the pressure conditions in a space. When the openings are in an upright position, the air flow will also flow perpendicularly and directly to the opening where the air is coming out. On the other hand, if the air flow is not perpendicular to the openings, even though the location of the openings is in an upright position the air movement will bounce off the wall and towards the opening where the air exits. This is why the air that is dragging is said to be better than the perpendicular air movement, because the invading air flow will make the air flow in the room more evenly when compared to the perpendicular air flow

IV. CONCLUSION

Design elements contribute a lot to the transition space, pillars, hallways, yards, openings such as doors, lanes, terraces, gardens, trellis windows, pergolas, porches, lobbies etc. If there is no space determined by its function, some of the elements above can make the space functional by itself and make sense.

One strategy for managing transitional space in bioclimatic architectural elements is that transitional space functions to protect the wall from sun penetration and allows absorbing solar radiation in winter, the facade serves to capture cool winds during the summer and the south side is intended for winter. Transition space is a design strategy that is responsive to climate, especially wind.

AKNOWLEDGEMENT'S

This article is part of main author's thesis entitled "Library of Tadulako University with Space Transition Concept" under the supervision of Ir. I Gusti Ngurah Antaryama, Ph.D. and Dr. Ir. Vicentius Totok Noerwasito

REFERENCES

[1] K. Yeang, *Ecodesign: A manual for Ecological Design*. 2006.
[2] G. Baruch, *Man, climate, and architecture*. .
[3] Ken Yeang, *Bioclimatic Skycraper*. 1994.
[4] N. Joohn Habraken, "Variations, the Systematic Design of Supports." .
[5] Constantinos A. Doxiadis, "Architecture In Transition : Constantinos A Doxiadis : Free Download, Borrow, and Streaming : Internet Archive." .
[6] Hamzah and K. Yeang, *Groundscrapers + Subscrapers*. 2001.
[7] K. Yeang, *The Green Skyscraper: The Basis for Designing Sustainable Intensive Building*. 1999.
[8] A. Pitts and J. Bin Saleh, "Potential for energy saving in building transition spaces," *Energy Build.*, vol. 39, no. 7, pp. 815–822, Jul. 2007.
[9] Hadya Salkini, Roberta Lucente, and Laura Grecoa, "Towards adaptive residential buildings traditional and contemporary scenarios in bioclimatic design (the case of Aleppo)." .