

# Material and Construction Analysis of Double Skin Facade on Universitas Multimedia Nusantara's New Media Tower Building

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**ABSTRACT** : The use of double skin facade in buildings is closely related to the performance of the building concerned. In the application of double skin facade in buildings, the type of material and construction system are some of crucial things that must be considered, especially in the design. This research tries to describe the use of double skin facade through materials and constructions used in UMN's New Media Tower building as an architectural work that successfully utilizes the principle in improving the building's performance. Based on the data obtained, the construction system on a double skin facade uses a hollow aluminium frame that is connected to the main structure of the building for reinforcement, while the double skin facade material use perforated aluminium panels, which is fabricated based on modules with variant dimensions and patterns.

**Keywords** : double skin facade, construction, material, perforated aluminium

## INTRODUCTION

In architecture, a facade, which derived from the Latin word 'facies' which means face and appearance (Krier, 1988) has an important influence on design, because it gives the main appearance to a building. The composition of a facade is related to the creation of harmonization between each element, namely windows, door openings, sun visors, roof areas to achieve good proportions, among others based on vertical and horizontal structures, materials, colors, and other decorative elements. In tall buildings, facade components consist of supporting frames to carry exterior loads and divert lateral and gravity loads to the main frame structure; insulation intended to protect users from heat, noise and excessive light; connection for ease of construction and also anticipating excessive movement; internal drainage to protect inner chambers from rain water; interior finishing which generally has no direct effect on the performance of the building envelope and is only an architectural product that is related to the interior space; and exterior materials whose main function is to cope with natural and climatic phenomena, as well as to broadly determine the aesthetics of the building facade concerned. The facade of tall buildings has several obstacles, one of which is to cause glare. To deal with this problem, the things being done include the use of a double skin facade, which can also provide the image of a building (Jati, Thojib, & Amiuza, 2011).

The Double Skin Facade is a facade construction consisting of two surfaces separated by the space in which air moves (Saelens, Carmeliet, & Hens, 2003). The use of double skin facade in modern buildings is generally driven by the building's aesthetic needs to achieve a certain level of transparency using glass materials, the need to increase the comfort of indoor spaces, the need to improve the acoustics of buildings located in noisy areas, or reduce the energy used by buildings during occupancy (Marques da Silva & Glória Gomes, 2008; Moon, 2011; Poirazis, 2007; Xiaotong & Chen, 2010). Some things to consider when using a double skin facade on a building include, the cost is more expensive when compared to a single facade, maintenance of the facade, and regulations related to buildings, especially fire prevention (Poirazis, 2007). In general, double skin facade are non-structural, so they can use lightweight materials, such as glass or metal.

Perforated aluminium is one of the popular material used as double skin facade of tall buildings. Aluminium itself is a type of metal that can be used in the form of plates, laminated sheets, and composite panels which can then be arranged as curtain walls (Sebestyen, 2007). Aluminium which circulates in the market is a composite metal mixed with other metal substances such as Zinc, is one material that is quite popular as an exterior material (Zahner, 1995). The aluminium fabrication process is not so different from steel (printing, hot and cold rolling, through machining) as well as its connection methods, such as bolting, pinning, nailing with rivets, welding, gluing, and so on.

Perforated aluminium is a sheet of metal through a perforation process with certain shapes and patterns, both manually and using a machine (Ahmed & Kumar, 2014). In the architectural world, other than used as facade materials, perforated aluminium is also used as a filler panel, heat barrier and sunlight, column coverings, and metal signage.

One of the buildings that uses perforated aluminium as its double skin facade material is Universitas Multimedia Nusantara's New Media Tower. Universitas Multimedia Nusantara (UMN) itself is a private college located in Summarecon Serpong, Tangerang Regency. Inaugurated in 2006, the focus of education from UMN is information and communication technology. The first stage of UMN Campus development (**Figure 1**) is a building consisting of lecture buildings (5 floors) and rectorate buildings (8 floors), while New Media Tower is the first stage of the construction of 5 (five) ecofriendly towers planned to be completed in 2030 by UMN (**Figure 2**).



**Figure 1.** Universitas Multimedia Nusantara (Universitas Multimedia Nusantara, 2019).

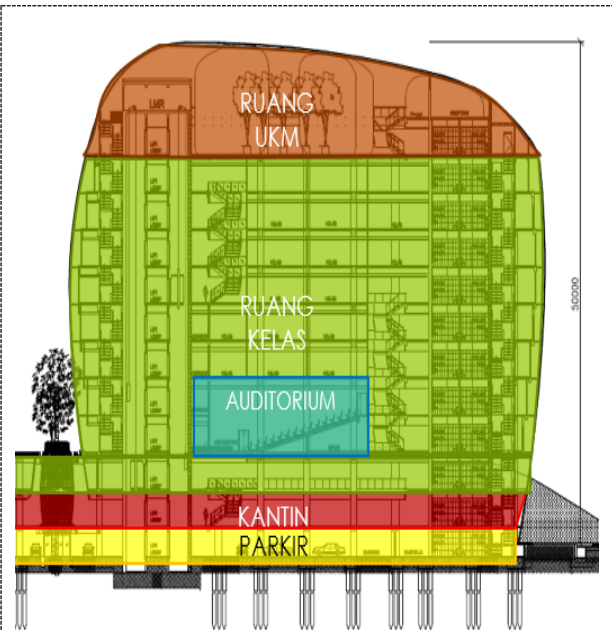


**Figure 2.** Masterplan of Ecofriendly Tower Development (Universitas Multimedia Nusantara, 2019).

Designed by Ir. Budiman Hendropurnomo from PT. Duta Cermat Mandiri with a total building area of around 32,600 m<sup>2</sup>, the New Media Tower (**Figure 3**) was built in a period of 9 months and was inaugurated in September 2012 (**Figure 3**). This 11-story and 1-basement building functions as an academic building with a parking area, waste treatment and other service functions on the basement floor, canteen and student center on the ground floor, classrooms on the upper floor, and student activity spaces on the rooftop (**Figure 4**).



**Figure 3.** New Media Tower UMN (Universitas Multimedia Nusantara, 2019).



**Figure 4.** Vertical Division of Functions.

New Media Tower carries the concept of cocoon in its form, which is in line with the concept of teaching at UMN where students study on campus through the metamorphosis stage to become quality graduates. The concept of the cocoon shape is realized through the secondary skin that covers the entire building. Furthermore, this building has been awarded as an Energy Efficient Building in the Tropical Building category at the Asean Energy Award in 2014 and was awarded the Outstanding Achievement award for the Sustainable Development category at the Indonesian Real Estate (REI) Awards 2016. The award obtained by New Media Tower is not regardless of the use of secondary skin on the facade. In addition to giving a futuristic and contrasting impression, the use of this double skin facade has proven to make the New Media Tower building experience a 47% reduction in electricity consumption.

The widespread use of double skin facade in tall buildings in Indonesia should be accompanied by knowledge of their engineering aspects. For this reason, it is necessary to understand at least the basics of the double skin facade element. This study aims to describe how the double skin facade is applied to the New Media Tower, related to perforated aluminium material and its construction so that it can obtain positive results in its operations. With this research it is expected to be able to provide an understanding of the double skin facade and its application in tall buildings, especially buildings with academic functions.

## METHODS

This research is a qualitative descriptive study, with the aim of describing the double skin facade system on the object of study. Furthermore, descriptive research methods are methods that systematically describe a situation, problem, phenomenon, service or program, or extract information about a condition of a settlement or community or describe a norm of a particular issue (Kumar, 2019). The data used in this study were obtained through direct non-participants observation and documents related to the object of study. This research is limited to the physical identification of the use of double skin facade in the building and focuses on the material used and construction of the double skin facade.

## RESULTS AND DISCUSSION

As a double skin facade building, New Media Tower has a main skin that prioritizes functionality over beauty. Like buildings with double skin facade in general, New Media Tower has a space between the main and secondary skind. The main skin in this building, in general, is divided into 3 (three) groups based on the function of the space inside. The first group is a skin with a glass composition, some of which can be opened for air exchange in a room (Figure 5), another group is a skin with a series of small fixed glasses and service access doors at the end of the skin area (Figure 6), the last group is a composition of fixed glasses which is quite wide with doors on both sides (Figure 7).

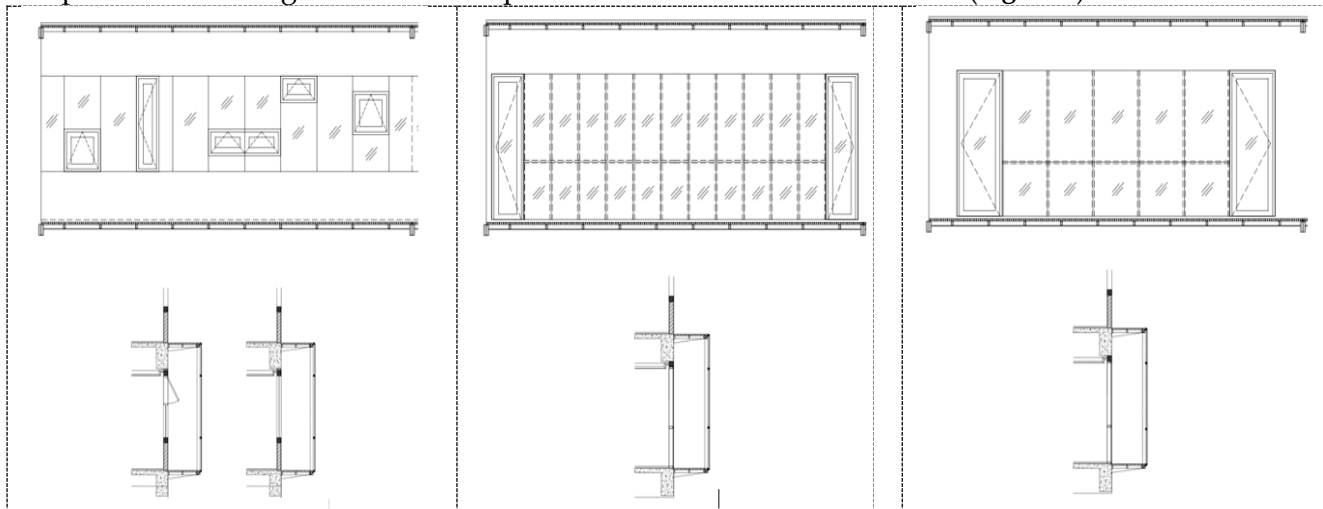


Figure 5. Kelompok Selubung 1.

Figure 6. Kelompok Selubung 2.

Figure 7. Kelompok Selubung 3.

The material of the secondary skin of the double skin facade used in the New Media Tower UMN building is perforated aluminium plates which are installed as curtainwall and give a futuristic impression to the building facade (Figure 8). The configuration of double skin facade in this building then form intermediate spaces between its main and secondary skin. This intermediate space varies in

size, but is basically capable of being accessed by humans and used as a pathway and service area (Figure 9), among others, for storing HVAC units.

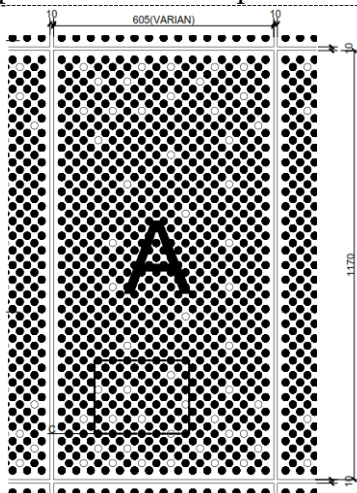


**Figure 8.** Perforated Aluminium Plate Secondary Skin.

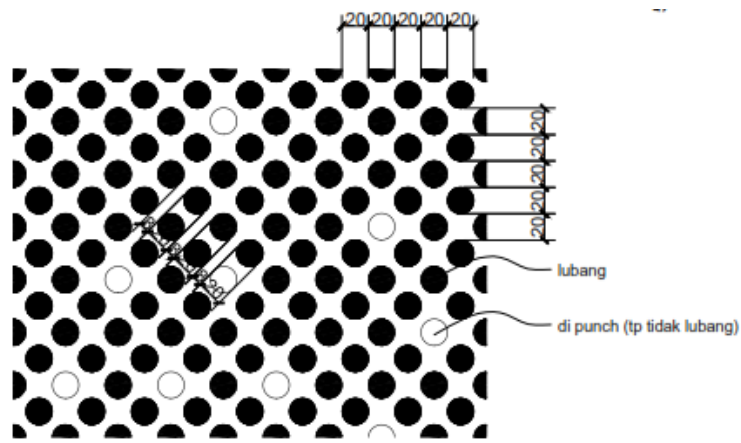


**Figure 9.** Intermediate Spaces between Main and Secondary Skin.

Each perforated aluminium plate is the result of pre-designed modules fabrication. Like fabricated panels in general, perforated aluminium plates have variants of their dimensions (Figure 10). Not only do the dimensions vary, holes in perforated aluminium plates also have variant patterns (Figure 11). These holes serve for the entry of air and sunlight from outside the building, as well as giving the impression of fractal patterns on the building facade.



**Figure 10.** Modular Dimension of Perforated Aluminium Plate.



**Figure 11.** Holes Detail of Perforated Aluminium Plate.

In its installation as a double skin facade, perforated aluminium plates are mounted on a hollow aluminium frame using a bolt system through an elbow plate (Figure 12). Perforated aluminium plates are installed vertically from the ground floor to form a dome roof on the building. At each floor change, a hollow aluminium frame is clamped to the building floor plate (Figure 13).

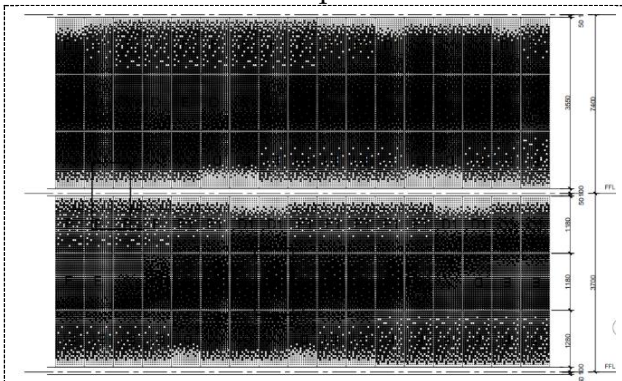


**Figure 12.** Perforated Aluminium Plate Installation over Hollow Aluminium Frame.

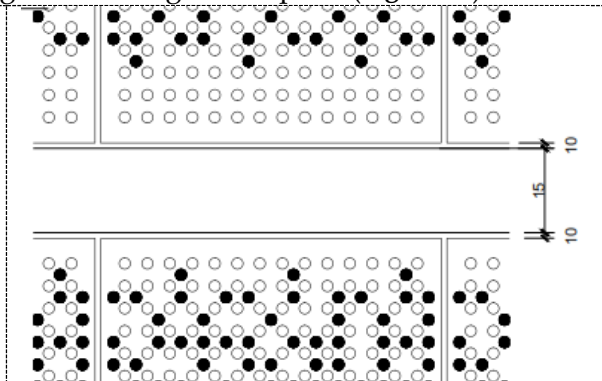


**Figure 13.** Hollow Aluminium Frames Clamped on Building's Floor Plate.

Due to the homogeneous floor height, the installation of perforated aluminium plates is adjusted based on the height of the floor (Figure 14), which is 3 (three) vertical modules per floor and separated by 15 cm horizontal aluminium plate belts that extend along the building's floor plate (Figure 15).

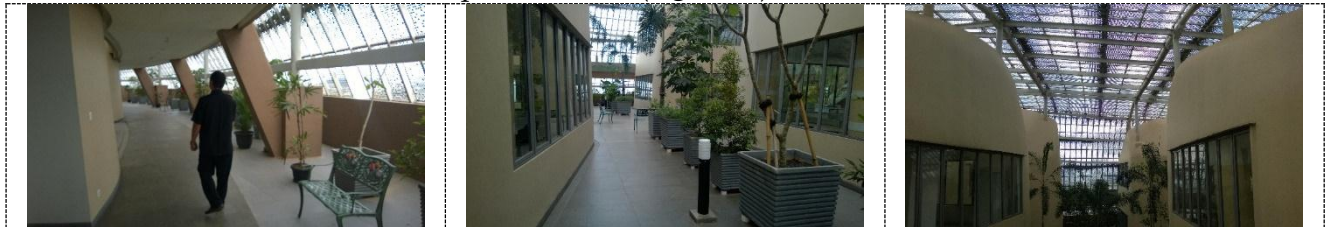


**Figure 14.** Map of Perforated Aluminium Plate Mounting Patterns.



**Figure 15.** Aluminium Belt on the Double Skin Facade.

In the New Media Tower UMN building, the double skin facade element also functions as the roof of the building. The roof with perforated aluminium plate dome gives the impression of a semi-indoor rooftop area. Although the inside area remains wet when it rains, the heat and sunlight it receives becomes more comfortable for campus activities (Figure 16).



**Figure 16.** Atmosphere on the Rooftop Area.

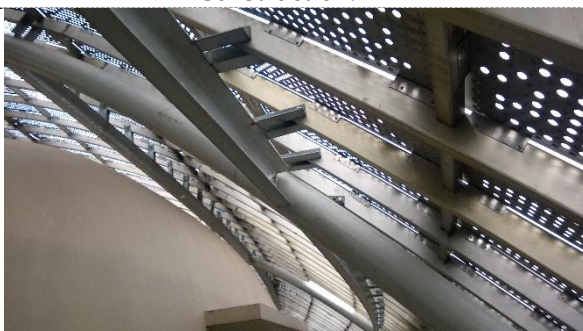
The dome as well as the double skin facade construction of the building also uses hollow aluminium frames (Figure 17). The double skin facade construction is connected on and supported by the main structure frame of the dome roof, which is the combination of vertical hollow pipe column and horizontal CNP beam (Figure 18). This connection technique uses bolt connecting system on the double skin facade frame, and a full weld connecting system on the CNP beam (Figure 19).



**Figure 17.** Hollow Aluminium Frames of Dome Construction.



**Figure 18.** Main Structure of Dome Construction.



**Figure 19.** Bolt and Full Weld Connecting System which Connects Dome's Main Structure to The Double Skin Facade's Construction.

## CONCLUSION

Based on the data obtained, in contrast to the double skin facade in general, in the UMN's New Media Tower building there is no vertical airflow between floors of the main and the secondary skin facade. The space created between the two facade functioned as a service area, this was also made possible by the choice of perforated aluminium plate material as the secondary skin facade of this building.

The choice of material as a double skin facade element in a building greatly influences the impression created by the building itself. The use of perforated aluminium plate material in UMN's New Media Tower double skin facade gives a futuristic and lightweight impression to the building. Dimensional variants on the plates allow for the realization of parametric shapes such as cocoons, while variants of hole patterns provide a unique spatial experience in the inside of the building and an attractive fractal impression as their exterior identity.

The construction of the double skin facade also becomes important, because it forms an overall architectural impression. The use of a lightweight aluminium hollow frame allows the use of a double skin facade spanning from the the ground floor to form a dome as the roof of the building without placing excessive structural loads. However, basically the double skin facade frame must have a reinforcement to be able to stand, in this case the reinforcement is obtained from the main structure of the New Media Tower building. The double skin facade frames are supported through joints on the floor plates, while in the dome area, the frames are supported by CNP beams which are connected to hollow pipe columns as the main structure of the building roof.

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