

# Application of physical attributes in underground space of MRT station in Jakarta

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**Abstract.** Physical attributes were taken into account when the underground space was built by considering the environmental aspect. Some Mass Rapid Transit (MRT) stations in Jakarta, Indonesia were in underground space with four main areas: transition area, corridor, main hall, and platform. By using a parameter review of architectural aspects in each of area, this study presented that environment-friendly conditions can be created by applying suitable physical attributes. Some aspects have gained from previous research and compared to the design of MRT Station. The result concluded that physical attributes hold important contributions in underground space design. Interconnection design with the aboveground in transition area will maintain humans' perception when they enter a new underground environment. An artificial window can be simulated by implicating natural wall paintings or photographs. Color, covering system, and additional plants may create positive ambient to overcome negative feelings about a lack of ventilation and access way. some factors have explained previous research relevant to apply in current design which would benefit the future architecture of underground space.

## 1. Introduction

Physical attributes hold important contributions in underground space design. By considering the specificities of the underground space environment, architectures can be used as a leader to enlight underground space development [1]. Furthermore, Tan, *et al.* (2016) highlighted several architectural features as positive aspects of underground space such as good ventilation, spacious room, vegetation, and access to aboveground greenery [2]. To provide energy efficiency, Benardos, *et al.* (2014) designed the underground building to meet the principles of the bioclimatic architecture [3], which included such parameters like indoor-outdoor perception, orientation, and natural ventilation [4]. In addition, to get eco-friendly conditions in underground facilities, Gideon & Tosio in Zhao (2011) designed a pedestrian paths and playgrounds above the underground building [5]. Those previous research concluded that architectural features were taken into account when underground space was built by considering the environmental aspect. This paper presented an architectural review of Mass Rapid Transit (MRT) Station in Jakarta by displaying the main area picture and evaluated how architectural aspects can create an environment-friendly condition.

## 2. Method

This study was performed in two stages. Literature review was first stage to gain some important information related to physical attributes in underground building. Data then

compared with the observation result to get the insight how the objects have applied the theory.

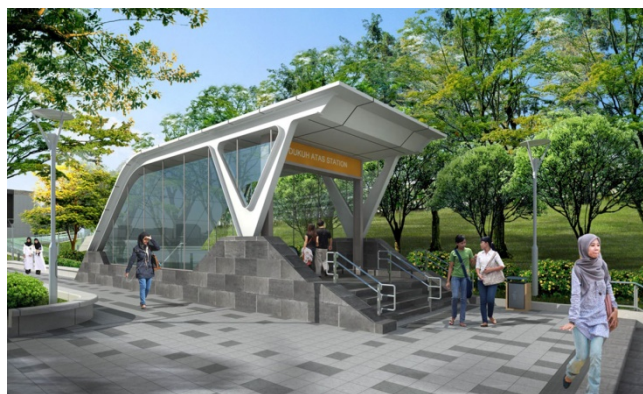
Each main area in MRT station had its particular design. Transition area highlighted wall and canopy material while floor and wall covering were main issues in corridor. Stairs and escalator design were main problems that should be overcome when designing platform while main hall had the most complex design that should be considered. This method is important to conduct to find some relevant factors that will benefit design of underground building.

### 3. Result and discussion

Physical attributes of four main areas in MRT were identified in this study to compare with previous research related to the design of underground building.

#### 3.1. Transition area

In underground space, the transition area gives the human first impression to enter the sub-surface condition. Smooth movement is needed when we feel different ambient between the aboveground and underground environment. In Figure 1, Using glass or transparent material as wall canopy allows natural lighting feature through the transition area. The canopies provide a visual attribute connected to a seamless transition in underground space [6].



**Figure 1.** Transition area in MRT Station, Dukuh Atas - Jakarta  
(Source: <https://jakartamrt.co.id>)

Ylinen in 1989 explained that the transition areas in an underground building should be placed in gardens or parks to create greenery visual perception [7]. In addition, construction materials and grassing techniques were some architectural design that should be considered [8]. Therefore, Figure 1 presented the design of transition area near to green space in Jakarta. Small ramp entrance before staircases or escalators created un-direct access to go “down” to underground space. It made a different impression rather than entering the underground directly. Platform area

#### 3.2. Corridor

Corridor was needed when there was a distance between transition area and the main building. The lack of natural light in a long corridor may create a suppressive environment. Interior design like tranquil colors of wall with a uniform tone may make the corridor larger. An artificial window can be simulated by implicating natural wall paintings or photographs. If it is possible, some indoor plants can be placed in some spots to create natural feelings. The floor is the most significant element in creating cushioned surroundings. High quality

covering of floor is emphasized to treat persons so as not to generate dead-end feelings [7]. The conformity of paints and floor materials should be evaluated to suit indoor lighting [7]. Figure 2 used the same color tone from ceiling to floor and did not apply strong and contrast color. Using Baffle System ceiling may help to correct acoustic problems [9] particularly in public building like MRT station. The suitability of color and planned lighting determine appearance in the underground corridor.



**Figure 2.**Corridor in MRT Station, Bundaran HI - Jakarta  
(Source: <https://jakartamrt.co.id>)

### *3.3. Main hall*

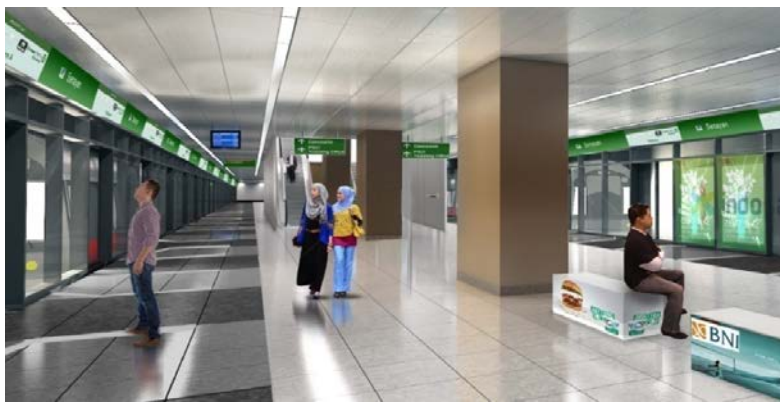
The large area in underground space like the main hall generally has poor orientation [7]. Therefore, artificial devices must be applied to make better orientation and increase social safety due to humans' ability to see each other when they were in the main hall. Figure 3 presented a large area in MRT Station that is visible from all corners. Sufficient lighting is needed to reduce inherent boundary of underground space. Colour variation with the suitability of tone is created in floor covering and ceiling in order to enhance better orientation of the underground space. Since the acoustic problem is generally occurred in main hall, Baffle System ceiling is also applied to absorb echo sound. Wall covering material is also applied on column to conceal a real form of its structure.



**Figure 3.**Main Hall in MRT Station, Dukuh Atas - Jakarta  
(Source: <https://jakartamrt.co.id>)

### 3.4. Platform

Platform area is usually located in the lowest level of underground space. High mobility of passengers to reach the exit area is the main reason for designing access way. Stairs design became main problems to overcome due to the need to ensure comfortable movement of passengers [10], Figure 4 showed that platform area was designed with the different pattern between floor and wall covering. It was equipped with stairs and escalators for the passenger's movement. The different size between stairs and escalators in platform area indicated that escalators cannot meet the stairs' function of evacuation devices [11]. Using acrylic material for visual convenience, platform screen door is also equipped with sufficient lighting that enables passenger to look directly through the door.



**Figure 4.**Platform area in MRT Station, Senayan - Jakarta  
(Source: <https://jakartamrt.co.id>)

## 4. Conclusion

The architectural approach in underground space design may enlighten the development of sustainable underground environment. Agree with [1], paradigm change is required in architecture of underground space according to complexity and mixed-used purpose of the building. This study has presented how physical attributes can create new paradigm of underground area by highlighting four main areas of MRT station as public space. Interconnection design with the aboveground area maintains humans' perception when they enter new underground environment. Agree with research from Tan, *et al.* (2018), negative perception of windowless area in the underground space can be overcome by providing easy access and adding plants in its interior design [2]. Hence, color, covering system, and additional plants may create positive ambient to overcome negative feelings about lack of ventilation and access way. Each MRT station in Jakarta has its own identity that may strengthen sense of place [12]. For this reason, some factors have explained previous research relevant to apply in current design that would be benefit the future architecture of underground space. This study certainly argues negative aspects of underground space that Carmody and Sterling (1993) have mentioned like natural world disconnection, afraid of being trapped, and darkness [13]. However, this study still need more comprehensive research about human's perception affecting physical attributes, especially for public area use to assist architectural design.

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