

Implementation of Green Building Concept in Commercial Buildings: Malls and Trade Center in Jakarta

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ABSTRACT: Development which is less attention to the environment, inefficient use of energy as well as the increasingly dense city make space for the concept of green building to grow even more in Indonesia. The purpose of this study was to determine the extent to which the implementation of green building principles in commercial buildings. There are three buildings complexes that were examined in this study that is Puri Indah Mall, West Jakarta, International Trade Centre Permata Hijau, South Jakarta and International Trade Centre Cempaka Mas, Central Jakarta. The method used is descriptive with respect to some aspects of building of green aspects such as open space planning, sources of clean water, utility systems, energy management in buildings, refrigerant management and indoor air quality. The results show that the three complexes of buildings are already implementing the provisions for open space areas such as building coverage and infiltration wells. However, the open space is still widely used for parking space. Site drainage is still directed to the city utilities. In terms of energy, these three buildings are still use refrigerant for air conditioning systems.

Keywords: Green buildings, Commercial buildings, Green building criteria

INTRODUCTION

The definition of green building does not only cover the building itself but also the environment in which the building is exist. Thus, the successful of the building performance is also determined by its environmental performance. According to United States Environmental Protection Agency (2012), green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building (United States Environmental Protection Agency, 2012).

Green buildings are designed to reduce the overall impact

of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources;
 - Protecting occupant health and improving employee productivity;
 - Reducing waste, pollution and environmental degradation.
- According to Green Building Council Indonesia (2005) there are six factors which characterizes green building, that is:
- Appropriate Site Development;
 - Energy Efficiency and Conservation;
 - Water Conservation;
 - Material Resources and Cycles;
 - Indoor Health and Comfort;
 - Building Environmental Management.

Appropriate Site Development is the first category of criteria that emphasize the importance of keeping the city green areas to benefit the environment. Therefore this category encourages the preservation of green areas and development in the area

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of non-existing green. Selecting sites linked to the transport network, in particular the public transport system with the possibility of the use of bikes entered into the criteria, because it will result in less energy use for transportation and a lighter ecological impact. Landscaping a building site is important to maximize the environmental benefits derived from green land. Human comfort through quality microclimate around the building and the site is also considered as a target of appropriate land. Other criteria are the quality of runoff rain water drainage system to reduce the burden of the environment.

The second category is Energy Efficiency and Conservation. It defines the criteria for energy savings and environmental and economic benefits. Installation of electrical sub-meter is seen as the basis for further energy management. The overall thermal transfer value (OTTV) between the building and environment is the criteria that determine energy usage for thermal comfort in building. Other measures to make energy use more efficient give plus points. It can be derived from the efficient use of energy for artificial lighting, vertical transportation systems and air conditioning. Energy savings can be done to further the optimal use of natural lighting and natural ventilation in public spaces. The reduction of CO₂ emissions will provide additional points. Points are also awarded if there are renewable energy generated on the building site

The third category is Water Conservation. This category involves water meter to measure water usage in the building operations as a basis for better water management. Reduction in water use by implementing austerity measures are considered as criteria. To achieve this goal, the necessary actions such as using water-efficient fixtures, recycling of water used for example water and rain water. Points are available if the water comes from sources other than groundwater or Jakarta Raya Potable Water Company is used to irrigate landscaping.

The fourth category is Material Resource and Cycle. This concept uses materials that have a high impact on ozone depletion are not recommended. The use of waste materials, green materials, certified wood, pre-fabricated materials is recommended. Materials with components from Indonesia and materials of the area within a radius of 1000 km from the construction site are eligible for additional points.

The fifth category is Indoor Health and Comfort. This category attributes Green Building. It emphasizes the importance of building occupants. To maintain a certain quality of indoor air is advice to have a sufficient air exchange with the outdoor. Indoor air quality is maintained by monitoring the concentration of CO₂, smoke control and reduction of chemical pollution. The high level of occupant comfort is achieved through the criteria as views to the outside of the building, visual comfort, thermal comfort and humidity, as well as a comfortable noise level.

The last category is Environmental Management Building. This category defines Simple waste separation in the building that will simplify the recycling process gets extra points. Two criteria to encourage the reduction of construction waste and

waste management include how garbage should be managed. The presence of a Professional GREENSHIP during the design process will contribute to a positive rating (Green Building Council Indonesia, 2005). The actual operation of the initial planning to be accompanied by commissioning system is good and right. Submission of green building data, the application of green building principles for the fit-out activities and conduct user surveys of buildings will give you more points for this category

The principles of green building or sustainable building is important to be implemented considering the problems related to buildings and environments that require serious attention from the government and society. Among these problems are the shortage of energy supply, inefficient use of energy in buildings, water supply shortages, inefficient use of water in buildings and waste from the building both during construction and use of buildings (Adiwoso & Prasetyoadi, 2010). In commercial buildings it is commonly known that this type of building uses much more energy in order to maintain the performance of the building. Not only energy use, almost every aspect of the building is directed to this goals. This paper will review some aspects of green buildings that is applied in the planning and design of commercial buildings, especially in Jakarta.

MATERIALS AND METHODS

The objects of the study are three that is: Puri Indah Mall, Permata Hijau Trade Centres, and International Trade Centres Cempaka Mas. Puri Indah Mall is located in Kembangan, West Jakarta, while Permata Hijau Trade Centres in South Jakarta, and ITC Cempaka Mas in the North Jakarta. Puri Indah Malls consists of 3 levels and a basement. The total area of the building is 5.7 and the site is 12.5 Ha. Permata Hijau Trade Centres has the building area of 6 ha and consist of 6th floor. Last, ITC Cempaka Mas has the building area of 18 ha and consist of 5th and 11th floor building. The area of its site is 4.7 ha. These three samples are taken by purposive sampling. The distance from Puri Indah Mall to ITC Permata Hijau around 7 km. while from ITC Permata Hijau to ITC Cempaka Mas is 17 km.

The methods used in this study are observation and measurements. Observations are conducted using green buildings criteria while measurements carried out by taking environmental data, such as air temperature and humidity, from the buildings.

There are six main criteria used in this study. These criteria are divided into more detailed sub criteria. The main criteria used are: Appropriate Site Development (ASD); Energy Efficiency and Conservation (EEC); Water Conservation (WC); Indoor Health and Comfort (IHC) and Building Environmental Management (BEM). MAP analysis.

The thermal environment, especially air temperature and humidity, are taken because it is the important factor of thermal comfort of the occupants. It is also a crucial factor in building

that uses air conditioning. The measurements are taken in three to four level of the building.

RESULTS AND DISCUSSION

The results and discussions of this study explained following the main criteria of green building as follows:

Appropriate Site Development (ASD)

The detailed criteria of Appropriate Site Development (ASD) are; Community Accessibility, Public Transportation, Bicycle, Site Landscaping, Micro Climate and Storm Water Management. Generally, these three commercial complexes are located in and around housing estate. It means that the access is not a problem, so far. However, these complexes are not so close to the housing complexes. It needs ten to fifteen minutes to reach these commercial complexes. This is because the commercial complex is surrounded by shop houses complexes. Sometimes, the residents may use transport to reach this building.

The three cases have good accessibilities where their locations are very close with the public transport. However, Puri Indah Mall is only passed by small vehicles (non-bus transport). As shown in figure 1, Puri Indah Mall (Mal Puri Indah) is located in the center. It is surrounded by Carrefour Puri Indah (hypermart) in the left side, toll road in the front, shop houses in the left side and business center (Sentra Niaga Puri Indah) at the back side. (Fig.1)

The next mall, that is ITC Permata Hijau is located in the old urban settlement as shown in Fig. 2. These commercial building are indicated with brown blocks .

In the left and right side of the complexes are newly development area of commercial buildings, such as offices and commercials, whether modern or traditional shops. In the back of the buildings are settlements areas. And last, in the front is also commercial complexes and apartments (The Belleza Apartments)



Fig. 1: The situation of Puri Indah Mall (big block at the centre) in Kembangan, West Jakarta (Soruce: Streetdirectory, 2014)



Fig.2: The situation of Permata Hijau International Trade Centre (block in red colour) at Kebayoran Lama, South Jakarta (Soruce: Streetdirectory, 2014).

The Cempaka Mas ITC is situated in new developed area like apartments, shop houses, and shop offices as shown in Fig.3. Actually, this ITC Cempaka Mas is flanked by two rivers that are Sunter in the back and Kemuning rivers in the front. ITC Cempaka Mas is also passed by toll-road and inspection road of Sunter Kemayoran.

The bicycle area is not available for the three commercial complexes. The uses of open space in these three malls are used for car and motorcycle parking and circulation. The rest is used for landscaping. The area for landscaping in Puri Indah Mal is better than Permata Hijau ITC and Cempaka Mas ITC. The Permata Hijau is the least to provide landscaping.

The availability and characteristic of green open space is of



Fig. 3: The situation of Cempaka Mas International Trade Centre (block at the centre) Sunter Jaya, North Jakarta (Soruce: Streetdirectory, 2014).

course affecting the micro climate around (Negeri, 2007). The micro climate at Puri Indah Mall and Cempaka Mas is moderate. While at Permata Hijau ITC the micro climate is slightly warmer. The three malls already provide some open spaces to fulfill the local regulation requirements. These open spaces are used for circulation, parking lots and landscaping. Open spaces are also used as a means of absorbing water and for aesthetic purposes (Umum, 2008). Puri Indah Mall buildings have Building Coverage (KDB) coefficient of 50%. It means that the rest of the open space should be at 50%. However, the rest of the open space is not only used as a green open space, but as circulations and parking lots. Thus, the source of absorption is reduced because of the solid ground surface and does not penetrate water. Nevertheless, the Mall Puri Indah already provides a number of infiltration wells for rainwater catchment.

In contrast to the Puri Indah Mall, green open space at Permata Hijau ITC is somewhat hard to achieve. Permata Hijau ITC Building, Building Coverage coefficient is the same as Puri Indah Mall, i.e., 50%. The outdoor space is almost entirely used for buildings and street parking. Thus, the source of absorption is reduced because of the solid ground and is impermeable to water. Cempaka Mas ITC actually has considerable land area, about 30 hectares. However, this area is not only used as a trade center, but other commercial buildings such as shop houses, apartments, etc. Drainage system is already implemented in these three commercial buildings. Rain water, surface water and wastewater are directed to municipal sewer. Storm water is also used in this channel. There is a good example in Mal Puri Indah in Kembangan, West Jakarta. Drainage system is directed to some point of infiltration wells.

Drainage system has two roles: First, as channeling rainwater and grey water from buildings, second, as a supplier in the event of flooding. The current problem is inadequate drainage capacity, almost all surface rainwater discharged into the channel. Supposedly, there is a mechanism by which rain water can be absorbed into the ground or soil through infiltration wells.

At Permata Hijau International Trade Centres (ITC), drainage system has been implemented. This channel is usually directed to channel rainwater city (city drainage). Channel has not been channeled rainwater seepage into the pit.

From the observations, almost the entire surface of the ground cover is made from hard surface (interlocking block). The problem is that almost all the water dumped rain on the soil surface to the channel. Perhaps, there is a mechanism in which rain water can diffuse into the soil through the grasslands or seepage pit.

Drainage system at Cempaka Mas ITC is already implemented. Different from those in Puri Indah Mall and Permata Hijau ITC, in this location, drainage system is also directed to Sunter River. So, the amount of water flows to the channel becomes less.

Energy Efficiency and Conservation (EEC)

The parameter of Energy Efficiency and Conservation are Natural Lighting, Ventilation, On Site Renewable Energy



Fig. 4: The series of windows in the Puri Indah Malls located in the first, second and third floor.



Fig. 5: Windows and openings in the first and second floor of ITC Permata Hijau.

(Bonus). However, this paper is not involved all the parameters. It is only Natural Lighting and Ventilation (natural) discussed. In discussing the usage of energy in the building, the overall thermal transfer value (OTTV) between the building and environment is one of the criteria that determine energy usage for thermal comfort. The other criteria is the selection of air conditioning system.

The use of natural light in malls and commercial complexes are somewhat difficult because most of the spaces are used for selling area. The selling areas really need displays for items or articles to be sold. As a consequence, artificial lighting is a prerequisite. The location of selling area, whether in ground, first, second or third floor use this condition (artificial lighting). In Puri Indah Mall natural light is used at some of ground floor area, such as lobbies, restaurant, coffee shop and others. The selling area in ground floor is still using artificial lighting. The

use of natural light is implemented by windows at the ground, second and third floor as shown in Fig. 4.

While, in Permata Hijau ITC, the use of natural light is only at main lobby. Most of the shop has special entrance (directly to outside). The appearance of the windows in ITC Permata Hijau is shown in Fig. 5.

Similar with Permata Hijau ITC, Cempaka Mas ITC also lobbies which using natural light. The other areas which are selling items keep using artificial light.

From the energy efficiency point of views, closing opening with selling items or whatever, will increase energy use in building. On the contrary, this situation will reduce solar radiation coming into the building. Another use of ventilation, especially natural ventilation, is used for additional ventilation in basement parking.

The other aspect of energy efficiency is the use of natural ventilation in building. Natural ventilation in building, especially in commercial building is very rare. This is because they need a specific condition which is suitable for occupant comfort. Natural ventilation also bring in polluted air.

Elevators and escalators are two facilities which are usually used for commercial buildings. Escalator is used because there is a continuous of people moving from one floor to another. For the commercial building surveyed, all the escalators are moving all the time. It means that electrical energy used continuously. The more efficient system is responsive escalator, that is escalator which is working only if passengers come.

Puri indah Mall has two elevators and four escalators each floor. The elevators working if the there is passenger come, while elevators always working eventhough there is no passenger coming. In Permata Hijau there is also four escalators in each floor and three elevators. The mechanism is similiar with Puri Indah Mall. Besides escalators, in Permata Hijau has stairs to complement the circulation systems. In Cempaka Mas ITC so far, similar with the previous commercial complexes. However in this complex stairs is located nearby the selling area, not for emergency exit.

Water Conservation (WC)

The details of Water Conservation are: Water Metering, Water Calculation, Water Use Reduction, Water Fixtures, Water Recycling, Alternative Water Resource, Rainwater Harvesting, Water Efficiency Landscaping

From case studies is known that the source of water is from local potable water company (PDAM) of 26,000 m³ per month. Groundwater which has 200 m deep is used as backup. However the Jakarta Government warned that the main source of water to keep using potable water, while groundwater sources just for backup.

The observation in these three locations is not up to meter data. This is because some of the data is to be confidential.

The reduction of water consumption data is not obtained at the moment. However, the concept of water use reduction has been implemented especially through the use of water fixtures such

as taps, sink and closet. This concepts has been implemented in Puri Indah Mall, Permata Hijau ITC and Cempaka Mas ITC. Concerning with water recycling, only Puri Indah Mall has water recycling facilities which at cost of one billion rupiahs. This facilities are used to process blackwater from the building. The outcomes will be used as a water sprinkler plant.

There is no alternative water resource, except groundwater resource. Water resource can be obtained like from rain water through rain water harvesting. This kind of water harvesting is popular in some other country which is rain is rare. In Indonesia, rain water harvesting is a bit odd. Because Indonesia has a season of dry and wet. Even, for the same season of dry and wet occurs simultaneously. Rain water harvesting is not available in the three malls.

The efficient use of water has implemented in practice, particularly for new buildings. This can be seen from the use of utility features such as closet, sink and urinal.

There should be restriction even banning the use of ground water in the vast building or tall building. Because it will cause the impact on the environment in the long term. Water company can increase its role in the provision of potable water source for the city residents.

From the results of field data, water usage data for building utilities, such as the toilet and sink is quite small. Water usage is very prominent for the consumption of the chiller. From the survey it is known that for a chiller needs 500 m³ of water per day!. If there are 5 chiller means it takes 2500 m³ of clean water. So that it takes 75,000 m³ a month.

In the Permata Hijau ITC found that the main source of water is from PAM. Water originated from ground water, but is only used when the emergency. The depth of the wells is 200 m. Keep in mind that South Jakarta is regional water conservation. So efforts should be continued seepage pit manufacturing encouraged.

Efficient use of water have been carried out at ITC Permata Hijau. It is seen from the use of utility fixtures such as sink and faucet urinal. In relation with the infiltration wells, in the Permata Hijau ITC known that they already implemented rainwater catchment wells.

From the the field, water usage data for public utilities, such as the toilet and sink is quite small. Usage is very prominent for the consumption of the engine coolant chiller.

The principle of efficient use of water has been carried out at ITC Permata Hijau. This is evident from the use of fixtures such as tap water utility sink and urinal. Actually the problem is the water consumption for commercial buildings such as shopping malls, hotels and an office building for lease with occupancy distribution is fair enough or not. The point is that no matter how big the amount of water consumed by a mall, for example, would be paid. But of course there is a limit residential building.

Data field of ITC Cempaka Mas found that the main source of water is from the potable water company (PDAM). The water comes from deep wells are also available, but is only used if the

circumstances emergency. Deep wells dug to a depth of 200 m . Even for Mal Puri, warnings from the government of Jakarta not to use ground water .

From the field data, water usage data for public utilities, such as the toilet and sink is quite small. Usage is very prominent for the consumption of the engine coolant chiller.

Indoor Health and Comfort

The details of Indoor Health and Comfort are: Outdoor Air Introduction, Environmental Tobacco Smoke Control, Outside View, Visual Comfort, Thermal Comfort, and Acoustic Level. From the three commercial buildings complexes, it identified that central air conditioning is used. So, air introduction is used for air circulation system. While, air introduction for other facilities are almost hardly be considered.

Control of tobacco smoke has been implemented with the regional regulations on the prohibition of smoking in public places (Governor of Jakarta Province Regulation, 2012). With these rules then almost the entire building in Jakarta has applied this rule to apply no smoking zone by zone smoke.

Outside view of the building is used in some facilities, such as lobbies and restaurants. In Puri Indah Mall, there is good view form inside to outside, especially form lobbies and other facilities, such as coffee shop and restaurants. People in these rooms can enjoy the view outside, as people and car moving and other scenery.

In Permata Hijau ITC, the view outside is only enjoyed from lobby. The other facilities have no qualities like lobby, especially in second and third levels. In level four, there is another facility, i.e. restaurant that can enjoy the view outside as shown in figure 8. All these conditions are hardly find in Cempaka Mas ITC.

Ventilation for conditioners (AC) obtained from from outside the building. Puri Indah Mall building has the shape of the radial mass both in terms of acquisition of outside air for ventilation. Ventilation systems in buildings are usually used to supply fresh air conditioning and ventilation for a restroom/ toilet, and kitchen. Ventilation uses an exhaust fan to the outside of the building and then diaslurkan.

Thermal comfort has six variables, such as air temperature, humidity, mean radiant temperature, and air movement, level of activities and clothing resistant (Fanger, 1976). Two of the main variable, ie. air temperature and humidity are measured. The thermal environment of the mall is shown in table 1.

In general, there are air temperature at Puri Indah Mall is thermally comfortable. It can suit to comfortable temperature limit, i.e. in the range of 24 0C - 26 0C. However, the level of humidity rather large difference, i.e., from 55 % to 76 %.

The temperature on the third floor warmer due to proximity to a source of natural light through the roof lighting (skylights), which is also a source of heat.

In contrast to air temperature, air humidity in this three floors, it tends to vary much moist in the second and third floor. This condition can be explained that in the second and third floor

Table 1. The thermal environment of the Puri Indah Mall, Kembangan, West , Jakarta.

No.	Floor Level	Use	Air Temp	Humidity
1	Ground floor	Shops	24.5	55 %
2	First floor	Shops	25	72 %
3	Second floor	Food court	26	76 %

Note. From the Author source



Fig. 7: In the top floor (second floor) of the mall, there are culinary facilities. In this space there is a skylight (roof light) that serves to illuminate the space and dining (restaurants).

there are more people than in first floor.

In Puri Indah Mall, natural lighting is used as a secondary source (figure 7). This is implemented in the ground floor, especially for the main entrance lobby, and the atrium. The lighting for atrium illuminates ground floor, first floor to the second floor. The Atrium sky light is shown in Fig. 7.

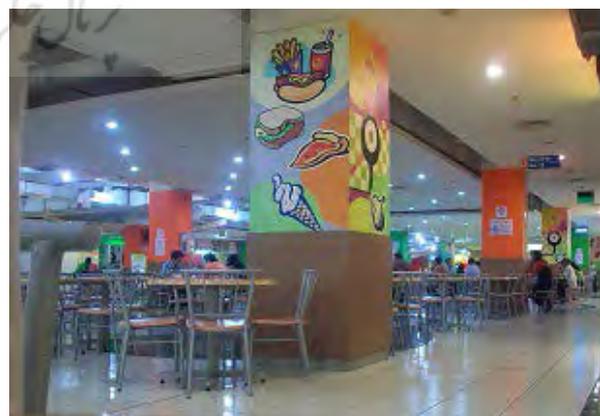


Figure 8. The situation of the fourth level used as culinary centre at Permata Hijau ITC.

Operation of tobacco smoke has been implemented with the local regulations on the prohibition of smoking in public places (Governor of Jakarta Province Regulation, 2012). With these rules then almost the entire building in Jakarta has applied this rule to apply no smoking zone by zone smoke.

Ventilation systems in buildings are usually used to supply fresh air and ventilation for a restroom / toilet, and kitchen. In addition to these purposes, the ventilation is also used to supply fresh air for air conditioning. The use of air conditioning system in Cempaka Mas is shown in Fig. 9.



Fig. 9: As with almost most of the mall, Cempaka Mas ITC use central air conditioning system. This is done to ensure comfort for building users. The mall is dense enough with a tenant that looks a bit dark. (Source: Author documentation)

Indoor air temperature in the ITC Permata Hijau are in accordance with the regulation of Ministry of Energy i.e the interval between 24 0C to 27 0C. Humidity between 55% to 65%. So that could be an efficient use of energy. More complete temperature data is shown in Table 2.

There is a great difference with Puri Indah Mall air humidity. In Permata Hijau ITC is very high. From the discussion before, it is logical because there are more visitors in this building. Everyone release its latent heat to the surrounding.

Table 2: The thermal environment of the ITC Permata Hijau, Kebayoran Lama, South Jakarta

No.	Floor Level	Use	Air Temp	Humidity
1	Ground floor	Shops	26	75 %
2	First floor	Shops	25	83 %
3	Second floor	Shops	24	83 %
4	Third floor	Food court	25	83 %

Natural lighting in buildings, especially applied to the main entrance or the side. There is no roof lighting (skylights), thereby reducing the flux of solar radiation from the roof.

Indoor air quality in ITC Cempaka Mas is still dominated by the use of HVAC systems (AC). So the quality of air in it is also strongly influenced by this system. Actually there are other things that influence, ie ventilation systems, used furniture, state of the dust in the room.

Control of tobacco smoke has been carried out with the local regulations regarding the prohibition of smoking in public places. Given these rules then almost the entire building in Jakarta have applied this rule to apply the zone should not be permitted to smoke zone.

Ventilation systems in buildings are usually used to supply fresh air conditioning and ventilation for a bathroom / wc, and kitchen

The condition of thermal comfort found in Cempaka Mas ITC is somewhat higher than that set by the Minister of Energy and Mineral Resources of between 24 to 26 C. More detailed data on air temperature at the mall are shown in Table 3

Building Environmental Management (BEM)

The details of Building Environmental Management (BEM) are Basic Waste Management, Pollution of Construction Activity, Advance Waste Management, Proper Commissioning, and Occupant Survey. Only the aspects of basic waste management and advance waste management would discuss.

Waste water disposal system in Mal Puri Indah using recharge wells. Infiltration wells in Mal Puri Indah used for rainwater catchment. Infiltration wells made extending adjusted to the volume of water that will be absorbed and the construction site. While the waste disposed of by using the services of Jakarta Sanitation Department.

It should be continuous efforts to monitor the implementation of infiltration wells, especially when the building was constructed before regulations existed. For those who do not have a building infiltration wells, especially for large and tall buildings such as malls and office buildings, then for them is required to make a large catchment wells in accordance with the building area. Likewise, waste treatment facilities and wastewater processing.

With regard to the large building infiltration wells, recharge

Table 3: The thermal environment of the ITC Cempaka Mas, Cempaka Putih, Central Jakarta

No.	Floor Level	Use	Air Temp	Humidity
1	Ground floor	Shops	28.5	85 %
2	First floor	Shops	28	82 %
3	Second floor	Shops	28	82 %
4	Third floor	Food court	27	84 %

wells to be seen whether made proportional not to the clean water needed. Infiltration wells not only serves to absorb rain water, but also can absorb water that has been treated and discharged into the environment deserves. Still from the same case, Mal Puri Indah already have tools for processing water that can be reused for watering plants.

Sewerage system at ITC Permata Hijau is to use municipal utilities. Not seen any facilities for sewage treatment.

Wastewater treatment system has not implemented at Permata Hijau ITC. Waste or garbage is conventionally processed with the transport by part sanitation.

Wastewater treatment system in Mal Puri Indah already implemented in some buildings, especially commercial. The system used is the Waste Treatment Plant (WTP) or Sewage Treatment Plant (STP).

For handling trash, it is still using the conventional way, i.e. by collecting garbage and then transported by garbage trucks every two days. The garbage truck has a capacity of 4 m³. so the waste transported every month is 60 m³.

Wastewater treatment system has been implemented in several buildings, especially commercial. The system used is the Waste Treatment Plant (WTP) or Sewage Treatment Plant (STP), as implemented in ITC Cempaka Mas .

CONCLUSION

From the results of this study can be concluded that some aspect of green building defined in Greenship have been implemented in these three commercial complexes, such as:

Appropriate Site Development (ASD)

Community Accessibility for the three cases generally was not much problems. However the distance from the malls to the housing estate/ settlement still should use transport, especially private transport. In front of and around the malls and shopping centres, public transports were available. Bicycle is still rare to be used, Site Landscaping is still aiming for aesthetics only. Trees for shade are rarely found. Almost of the outdoors were used for parking and circulation. This condition lead to the outdoor thermal environment becomes warmer. As building permit has been issued by the authority, the malls complex has a system of drainage. However, this drainage is still directed to the urban drainage.

Energy Efficiency and Conservation (EEC)

As usual, the layout of the malls is dominated by goods and items displayed. Thus the use of natural lighting was lacking. Almost of the building envelope was blocked by these goods. Natural lighting was mainly used in main entrance area. The use of ventilation, especially natural ventilation, was only use in building utilities, such as toilets, store, mechanical and electrical rooms, parking area and basement. The renewable energy was not available in these three areas.

Water Conservation (WC);

The concept of water use reduction has been implemented through the use of water fixtures, such as sink taps, urinals and closet. However the process of water recycling only implemented in Puri

Malls. Alternative or back up water resource use deep well. It is used only when there is an emergency. The implementation of rainwater harvesting mainly use in catchment wells. Plantations use for landscaping was mainly for aesthetic purpose. It means that these plants were still use regular irrigations.

Indoor Health and Comfort

Outdoor Air Introduction is only implemented for air conditioning. Fresh air for spaces is only used for utility room. Generally, in Jakarta there is a regulation for no smoking area, including public facilities, such as malls. Outside view was implemented in leisure area, such as restaurant and children playground. The interplay of lighting was used in the area of restaurant and games to achieve visual comfort. The level of thermal comfort generally is the rage of comfort level, i.e. 24 C–26 C. However, the level of humidity is slightly higher because the density of the occupants.

Building Environmental Management (BEM)

The implementation of Waste Management was not new issue. The use of Waste Treatment Plant (WTP) and Sewage Treatment Plant (STP) has been implemented for years. The issue of pollution of construction activity was also including in the local regulation.

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