

The usage of green building concept to reduce operating costs (study case of PT. Prodia Widyahusada)

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Abstract

Purpose – The purpose of this paper is to emphasize green building concept usage and its effect on operating costs and uses Grha Prodia, a building with a green concept owned by PT. Prodia Widyahusada.

Design/methodology/approach – This research will test whether Grha Prodia could earn Leadership in Energy and Environmental Design (LEED) certification based on the aspects that it has and it will also compare the operating costs of Grha Prodia with Prodia Tower. The two main theories used in this research are cost and green building.

Findings – The result of this research is Grha Prodia is considered as a green building and it could earn LEED certification if the current aspects are continuously implemented and maintained.

Originality/value – Moreover, it can fulfill all prerequisite credits in each criterion and further enhance it by fulfilling optional credits in all criteria available. Grha Prodia is also able to demonstrate lower operating costs than a regular building, with 63 percent less water usage and 53 percent less electricity usage.

Keywords Cost, Green Building, Electricity usage, Operating cost, Water usage

Paper type Research paper

Introduction

The ever-changing conditions in the business environment mean that management has to create constant innovation in their businesses. Innovations are created in order to keep the customer from switching to a competitor. There are many forms of innovation that can be done by the company; one of them is the improvement of the infrastructure. This improvement will hopefully increase the number of customers by attracting them with sophisticated infrastructure. An office building is one of many kinds of infrastructure used by a company to run its business and in the past few years, green infrastructure, including office buildings, is becoming a trend worldwide. Research shows that green building usage will yield many benefits, such as increasing asset value, indoor environmental quality and lowering operating costs (Kats, 2010; Yu *et al.*, 2011).

Lower operating costs is also one of the top three reasons in some countries that triggers future green building activities, ranking as the number two reason in Australia, Brazil and South Africa and placed third in the USA and Singapore (Dodge Data & Analytics, 2013). In Asia, lower operating costs is also the main trigger that drives the future green building activities, with 31 percent of Singapore respondents and 29 percent from nine other Asian countries (China, Hong Kong, India, Indonesia, Japan, Malaysia, Philippines, Sri Lanka and Taiwan).

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As one of the biggest clinical laboratories in Indonesia, PT. Prodia Widyahusada is capable of producing accurate test results because it has the latest equipment, such as Cobas IT and MPA (Modular Pre Analytic). PT. Prodia Widyahusada is also concerned about the global warming issues that we are facing today. Their new building called Grha Prodia, which is located at 149–151 Diponegoro Street, Surabaya, has many kind of features that can be considered as green building, such as an independent water treatment system, automatic switch for lamps and their building glass is specially designed to let the sun's rays in but keep the heat out so as to reduce the usage of lights. Those features will make Grha Prodia the first green health building in Indonesia.

Grha Prodia is used as an object of this research because it is the first privately owned green building that is registered for LEED certification in Surabaya. This research will try to find out whether Grha Prodia is considered as a green building according to LEED certification. Another reason for conducting this research is to find out how the green building concept reduces operating costs. Hopefully this research will provide benefits for PT. Prodia Widyahusada, the writer and readers in general.

This research uses two main theories, cost and green building. This paper will be followed by an examination of the literature review, research methods, results and discussion, and conclusion, that will end this research.

Literature review

Cost

Cost in a broad sense can be defined as sacrifices of economic source that is measurable in monetary value which has been or will be used to achieve a certain goal. On the other hand, in a narrow sense cost is defined as a part of the cost of goods sold that was sacrificed in order to get revenue (Muhadi and Siswanto, 2001, p. 3). According to Suryana (2006), cost is all the sacrifice given to produce or obtain a commodity. To make a product (output), we need a number of inputs depending on the output. In the medical world, especially a clinical laboratory, the output is the service provided by the company that will produce various test results, such as feces analysis, endocrinology and hematology. In order to deliver the output successfully, inputs such as buildings, medical and non-medical tools, medical personnel and other inputs that are not directly related to the patient are needed.

Operating costs

According to a book entitled *Cost Accounting* by SP Gupta, Ajay Sharma and Satish Ahuja, operating cost is defined as the expenses which are related to the operation of a business, or the operation of a device, component, or a piece of equipment or facility. This research will focus more on the overhead section of operating cost. Overhead cost of a business can be defined as a cost that is used by an organization to maintain its existence. Although usually overhead costs are not directly related to the product or services rendered by a company, overhead cost is still vital because it provides critical support for the company's profit-making activities.

Essentially there are two types of overhead costs, administrative and manufacturing overheads (Cook and Graser, 2001, p. 187). Some of the items that are classified as administrative overheads are utilities, strategic planning and other supporting functions. Examples of administrative overheads are office equipment and supplies, external legal and audit fees, travel and entertainment costs and so on. Manufacturing overheads on the other hand are all costs incurred by the company that are within the platform where the product or service is created. The difference with administrative overheads is that manufacturing overheads take place where the profit-making activities are done (Banker *et al.*, 1994, p. 115). Examples include rent or factory building or office, depreciation of assets and equipment and utilities.

Green building

Green building is a type of building that tries to reduce the energy usage and pollution, protect the environment, keep its occupants healthy and also maximize the usage of space available throughout its life cycle (Hong and Minfang, 2011). By building green buildings, it will help to reduce the amount of carbon emission produced by the building which accounted for 40 percent from the total value (Erviyanto, 2012). Green building is also a part of sustainable development, a process to encourage people to preserve and protect earth's life support system. In its framework, green building will be beneficial for people, the environment and the building's life cycle cost (Wu and Low, 2010).

According to *Green Building – Guidebook for Sustainable Architecture* (Bauer *et al.*, 2010), there are several reasons why green building is now becoming a trend worldwide. The first two reasons are economic and social factors. Continuous improvement in our life standards has led to the global warming issue because new buildings have been built, more motor vehicles are on the road and so on. As the temperature rises, people are faced with more environmental catastrophe. This catastrophe has caused relatively big economic damage to our society. The third reason is a continuous increase in energy costs. The last reason is because building green is one way to preserve energy. Since energy is a fundamental thing for our life, many investors and operators put their belief in new technologies and resources to make them self-sufficient.

Green buildings are known for having a high level of comfort and a healthy indoor environment, while relying on renewable energies and resources that allow the energy and operating costs to be kept at a minimal level. These buildings are developed according to economically feasible considerations, in which the entire building's life cycle is taken into account.

Leadership in energy and environmental design

Developed by the US Green Building Council (USGBC), LEED is used to assess a building's design and its impact on the surrounding environment. LEED began its development in 1993 by Robert K. Watson, a former Natural Resources Defense Council senior scientist. Finally, in 1998 the first LEED pilot program named LEED 1.0 was launched and went full release two years later (Gauthier and Wooldridge, 2011).

The USGBC's LEED rating system is categorized into a number of distinct rating systems intended for various types of building and at a certain point of the development process (US Green Building Council, 2015). There are five major categories: LEED for Building Design and Construction, LEED for Operations and Maintenance, LEED for Interior Design and Construction, LEED for Building Design and Construction (residential area) and LEED for Neighborhood Development.

Grha Prodia is registered for LEED Building Design and Construction: New Construction v3 LEED 2009. To achieve this certification, there are some criteria that must be met. In general, there are five criteria with each one having their own prerequisites that must be met. In addition to that, there are also optional credits that can be earned. These criteria are sustainable sites, water efficiency, energy and atmosphere, materials and resources and indoor environmental quality.

Previous studies

There are several pieces of research that are used as the foundation. First, research titled, "Impact of Sustainability Perceptions on Optimal Material Selection in Construction Projects", found that the material database gathered by investigating the factors that influence users' perceptions on material sustainability and by predicting users' attitudes could become valuable tools to help in purchasing sustainable materials. Another piece of research is a study titled "Building Momentum: an Analysis of Investment Trends in LEED and Energy Star-Certified Properties" (Fuerst, 2009). This research tried to analyze

investment trends for LEED and Energy Star-Certified buildings in the USA with a view towards deriving clues for expected future developments in the face of the current economic downturn; this research found out that there is no significant difference for the average time to sale for eco-certified buildings. The last, research titled, "Green Retrofitting Cost and Benefits: A New Research Agenda" (Yu *et al.*, 2011), found out that retrofitting existing green commercial buildings to get certification has proven to be relatively insignificant when compared to the cost of new buildings or when compared to their capital values. Benefits that can be extracted from retrofitting commercial buildings are through the reduction in energy consumption.

To summarize, the main difference between this research and all other previous research is a clinical laboratory that uses green building as one of their infrastructures and studies its impact to that laboratory's operating cost. This research is unique because the object itself is the first privately owned green building that is registered for LEED certification in Surabaya.

Methods

Research approach

This research uses qualitative explanatory as an approach to complete the research. Study case strategy will be used in this research. This research will not only gather the data about Grha Prodia's operating costs, but it will also analyze them. The processes that will be conducted for this research are as follows: gathering, classifying, presenting and analyzing the data to come up with conclusions regarding the findings. This research will be conducted in PT. Prodia Widyahusada's green building, Grha Prodia in Surabaya, East Java, Indonesia. The green building concept is applied because PT. Prodia Widyahusada has concerns about the global warming issues and wants to contribute in minimizing the greenhouse effect.

Research scope and focus

The research will discuss whether Grha Prodia can be considered as green building based on LEED, the certification that Grha Prodia is currently trying to achieve and the impact to its operating costs. For that reason, the scope and focus of this research are the building aspects of Grha Prodia and its operating costs in 2015. Building aspects will be compared with the appropriate LEED certification credits, while the operating cost data will be compared with the operating costs of Prodia Tower, a similar but conventional building which is also owned by PT. Prodia Widyahusada.

Type of data and data sources

Data for this research will be obtained from the company. There are two kinds of data, qualitative and quantitative data. Qualitative data for this research is obtained by interviews with the management of PT. Prodia Widyahusada Region 6 as the occupants of the building. Interviews will be conducted with related persons in the management, like the Regional Head, Regional Finance Manager and Regional HR and General Affair Manager of Region 6.

Quantitative data for this research is acquired from company documents. This data will be gathered from inquiries with the management. Data needed for this research mainly comes from the company's cost report, but it also includes other sources, such as financial statement, business procedures, standards and other written policies.

Data analysis technique

This research used qualitative explanatory as the data analysis technique by constructing a narrative explanation, a technique used to narratively describe logical thinking of a case. The aim is to analyze this case in accordance with the theoretical thinking behind it, and therefore

will convince readers regarding the validity of this research. Data analysis is done by comparing the building aspects of Grha Prodia with the appropriate LEED certification criteria. The results will then be compared with the corresponding theories to see its appropriateness.

Results and discussion

Comparison between Grha Prodia's aspects and LEED Building Design and Construction: New Construction v3 LEED 2009 Criteria

In the sustainable sites category, there are a few aspects that Grha Prodia has. Grha Prodia is located in Diponegoro Street, which is considered as one of the main roads in Surabaya, so it is covered by a lot of public transportation. Furthermore, there are many places of interest, such as shops, banks, drugstore and mosque, that will enable employees to fulfill their everyday needs. Grha Prodia also supports a bike-to-work program by providing 15 bike parking lots and three shower rooms. Grha Prodia also cares for its surrounding environment by minimizing the carbon footprint it produces and provides considerable space for landscaping. Grha Prodia only occupies 50 percent of the total land owned and the rest is being used for a green roof and landscaping. Grha Prodia also provides 22 percent of green open space, more than twice compared to the government regulation. The customer drop-off area is also designed with grass blocks to maximize the water infiltration to the ground. Most of the roofs used in Grha Prodia are categorized as cool roof, which reflects a huge amount of heat and sunlight. Together with usage of the green roof, the temperature of the building interior will be isolated from excessive solar heat and therefore reduce the usage of air conditioners. Lighting usage after office hours at Grha Prodia is also minimized due to the light and motion sensor to switch on or off automatically, according to the light and occupancy level. The parking spaces for cars are located underground, so Grha Prodia does not provide new space for parking.

In the water efficiency criterion, Grha Prodia has some effective strategies that are already implemented. The third aspect that Grha Prodia has to offer is a water efficiency program. This building uses multiple strategies to reduce clean water usage by 40 percent. The first strategy is to harvest rainwater on the roof and store it in tanks located in the basement. Grha Prodia also has a good on-site wastewater treatment (sewage treatment plant or STP). As a result, the processed water from STP, together with the collected rainwater, is used to flush the toilet and to water the plants. Lastly, Grha Prodia uses water efficient toilet products such as dual-flush toilets, automatic taps, low-flow showers and waterless urinals to reduce clean water usage even further.

For the third criterion, energy and atmosphere, Grha Prodia has some aspects to help them achieve some credits. These aspects falls into two different strategies, active and passive strategies. Features that cost additional investment can be categorized as an active strategy. Grha Prodia is equipped with high-performance glass that is thicker than standard glass because there is an extra air cavity in the middle to decrease the heat from sunlight. The air conditioning system in Grha Prodia also uses a Variable Refrigerant Volume (VRV) system that automatically adjusts electricity usage of the air conditioner according to the current room occupancy. The air conditioning system is also controlled centrally to prevent excessive usage outside operating hours. Grha Prodia also uses LED lamps that use less energy and are more durable than normal lights. Each room is also equipped with a light and motion sensor to switch on or off automatically according to the light and occupancy level. On the contrary, a passive strategy that is implemented is the building design. Grha Prodia is designed so that most of the building is located in a relatively cool area. On the interior, rooms that have high occupancy are located in the cool area and those with relatively low occupancy are placed in the hot area. This kind of structuring enables Grha Prodia to reduce the usage of air conditioners.

In the fourth criterion, materials and resources, the design team prioritized local, recycled, and natural materials to build Grha Prodia. For example, all steel bars used in this

building are made from recycled steel produced by a local supplier. Furthermore, linoleum, which is made from natural resources and categorized as a rapidly renewable material, is used to cover the laboratory floor. Grha Prodia also reuses some parts of the old building in the entrance area.

The last criterion is about indoor environmental quality. It concerns the comfort and well-being of the occupants, which Grha Prodia is also concerned about. Materials like paint, flooring, and others have been carefully selected so that the used materials are the ones that have little or no Volatile Organic Compound (VOC), which is dangerous for health. Each room also has good air circulation and enough natural light to make its occupants comfortable. Windows in each room are designed to enable its occupants to have an outside view with no obstruction, and some of the windows in each room can be opened to let fresh air from the outside come in. Furthermore, Grha Prodia also prohibits its occupants from smoking inside the building so there will be zero tobacco smoke indoors (Table I).

Comparison between Grha Prodia's and Prodia tower's operating costs

In this research, the operating costs of Grha Prodia, a building with a green concept, will be compared with Prodia Tower. Prodia Tower is also owned by PT. Prodia Widyahusada and it is located at 150 Kramat Jaya Street, Central Jakarta. Prodia Tower was built in 2009 as a manifestation of PT. Prodia Widyahusada vision, "Centre of Excellence". There are several reasons why this research used Prodia Tower as a comparison. The first is because Prodia Tower, like Grha Prodia, is owned by PT. Prodia Widyahusada. The second reason is because these two buildings have similar usage, for both offices and a clinical laboratory. Furthermore, Prodia Tower is not designed with the green concept, so it is a perfect candidate to see the effects of the green building concept on its operating cost.

Because Grha Prodia and Prodia Tower are located in different cities, it is necessary to state the condition of both cities. Grha Prodia is located in Surabaya, while Prodia Tower is in Jakarta. In general, Surabaya has a slightly higher temperature than Jakarta because the location of Surabaya makes it more directly exposed to sunlight. Furthermore, Surabaya has higher humidity than Jakarta, so Surabaya feels hotter than Jakarta. However, there is no doubt that Jakarta has a higher level of air pollution than Surabaya and it will affect the temperature in the long run. To sum things up, Surabaya has a higher temperature than Jakarta because of its location and its humidity.

Tables II and III presented the differences between elements of operating costs of Grha Prodia and Prodia Tower, the water usage and electricity usage. Both the average usage and cost data are obtained from PT. Prodia Widyahusada itself, so the number presented is reliable. Please note that the building size of Grha Prodia is only half of Prodia Tower, 4000 and 8.483 m², respectively. While both water and electricity usage of Grha Prodia are lower than Prodia Tower, the water usage shows more difference than electricity usage. There are some reasons for that, but it will be discussed in a later paragraph.

In Table II, there is a 63 percent of difference in average water usage between the water usages of Grha Prodia and Prodia Tower. This number is not surprising considering the multiple strategies like rainwater harvesting and sewage treatment plant that Grha Prodia implemented to reduce the water usage. The highest difference occurred in March, which amounted to 967 m³. Even so, this difference is not so accurate because in March 2015, Grha Prodia has just started its operation. However, the second highest difference which occurred in December can give a more reliable picture on how the water efficiency strategy in the green building concept helps to reduce the water usage. In December, 765 m³ difference occurred mainly because it was in rainy season so the rainwater harvesting system helped to reduce the clean water usage further.

Criteria	Credits earned
Sustainable sites	Prerequisite 1 – construction activity pollution prevention Credit 1 – site selection Credit 2 – development density and community connectivity Credit 4.1 – alternative transportation – public transportation
Sustainable sites	Credit 4.2 – alternative transportation – bicycle storage and Changing rooms Credit 4.4 – alternative transportation – parking capacity Credit 5.2 – Site development Credit 6.1 – Stormwater design – quantity control Credit 7.1 – heat island effect – nonroof Credit 7.2 – heat island effect – roof Credit 8 – light pollution reduction
Water efficiency	Prerequisite 1 – water use reduction Credit 1 – water efficient landscaping Credit 2 – innovate wastewater technologies Credit 3 – water use reduction
Energy and atmosphere	Prerequisite 1 – fundamental commissioning of building energy systems Prerequisite 2 – minimum energy performance Prerequisite 3 – fundamental refrigerant management Credit 1 – optimize energy performance Credit 4 – enhance refrigerant management
Materials and resources	Prerequisite 1 – storage and collection of recyclables Credit 1.1 – building reuse – maintain existing walls, floors, and roof Credit 2 – construction waste management Credit 4 – recycled content Credit 5 – regional materials Credit 6 – rapidly renewable materials
Indoor environmental quality	Prerequisite 1 – minimum indoor air quality performance Prerequisite 2 – environmental tobacco smoke control Credit 2 – increased ventilation Credit 3.1 – construction indoor air quality management plant – during construction Credit 3.2 – construction indoor air quality management plant – Before occupancy Credit 4.1 – low-emitting materials – adhesives and sealants Credit 4.2 – low-emitting materials – paints and coatings Credit 4.3 – low-emitting materials – flooring systems Credit 4.4 – low-emitting materials – composite wood and agrifiber products Credit 6.1 – controllability of systems – lighting Credit 6.2 – controllability of systems – thermal comfort Credit 8.1 – daylight and views – daylight Credit 8.2 – daylight and views – views

Table I.
LEED Building
Design and
Construction: New
Construction v3 LEED
2009 Credits That
Grha Prodia
Could Earn

Source: Processed Data (2016)

Although the amount is not as much as the water usage, Grha Prodia has successfully reduced electricity usage by 53 percent. The highest difference for electricity usage occurred in September, where Grha Prodia used 144.206 kVA less than Prodia Tower. There are various reasons as to why this could happen, like less usage of meetings room in Grha Prodia, or maybe there were more meetings occurring in September at Prodia Tower. In the other months throughout the year, on average Grha Prodia could save around 50 percent in electricity usage. However, in December, Grha Prodia only used 87.773 kVA or 38 percent less than Prodia Tower. This little difference can be caused by more usage of rooms in Grha Prodia for meetings and events.

Month	Prodia Tower		Grha Prodia		Difference (Rp)	Difference (m ³)	% (m ³)
	Average usage (m ³)	Average cost 2013– 2015 (Rp)	Average usage (m ³)	Cost 2015 (Rp)			
March	1,070.82	10,431,295	104.25	520,500	9,910,795	967	90
April	974.42	9,486,541	511.38	2,963,300	6,523,241	463	48
May	965.49	9,399,029	360.97	2,060,800	7,338,229	605	63
June	1,114.49	10,859,229	430.20	2,476,200	8,383,029	684	61
July	966.49	9,408,828	396.95	2,276,700	7,132,128	570	59
August	935.81	9,108,229	396.95	2,276,700	6,831,529	539	58
September	963.49	9,379,429	480.87	2,780,200	6,599,229	483	50
October	1,036.15	10,091,562	417.53	2,400,200	7,691,362	619	60
November	1,003.82	9,774,695	344.92	1,964,500	7,810,195	659	66
December	1,090.82	10,627,295	326.03	1,851,200	8,776,095	765	70
Total	10.122	49,283,066	377	21,570,300	76,995,832	6,352	63

Source: Processed Data (2016)

Table II.
Water usage difference analysis

Month	Prodia Tower		Grha Prodia		Difference (Rp)	Difference (kVA)	% (kVA)
	Average usage (kVA)	Average cost 2013– 2015 (Rp)	Average usage (kVA)	Cost 2015 (Rp)			
March	216,748	276,339,148	114,264	145,679,269	130,659,879	102,484	47
April	225,341	287,295,350	108,505	138,336,954	148,958,396	116,836	52
May	245,887	309,086,900	114,815	144,326,145	164,760,755	131,072	53
June	242,832	306,080,210	106,375	134,082,155	171,998,055	136,457	56
July	230,655	304,645,733	96,611	127,602,228	177,043,505	134,044	58
August	234,227	312,736,800	98,576	131,617,405	181,119,395	135,651	58
September	241,978	316,682,116	97,772	127,956,073	188,726,043	144,206	60
October	254,507	329,528,777	108,672	140,705,245	188,823,532	145,835	57
November	246,512	314,286,039	120,702	153,887,697	160,398,342	125,810	51
December	231,930	299,396,988	144,197	186,143,674	113,253,314	87,733	38
	2,370,617	3,056,078,061	1,110,489	1,430,336,845	1,625,741,216	1,260,128	53

Source: Processed data (2016)

Table III.
Electricity usage difference analysis

Comparison between research result and theories

According to GSA public services in 2011 regarding green building performance of 22 Federal Buildings in the USA, the difference of water usage between the average green buildings that GSA studied and the national average is at 13 percent. However, as stated before, there is a 63 percent difference between the two buildings. The main reason for this big difference is because 27 percent of the buildings studied by GSA public services have higher usage than the national average. The highest difference occurred at Scowcroft Group building in Ogden, Utah, which uses 19 gal/gsf more than the national average (Table IV).

Conclusion	
Water usage	Significant reduction by 63% when compared with Prodia Tower & higher than GSA's (2011) finding, which is 13%
Electricity usage	Significant reduction by 53% when compared with Prodia Tower & higher than GSA's (2011) finding, which is 25%

Source: Processed data (2016)

Table IV.
Comparison between research results and theories

For electricity usage, GSA public services found out that the average usage of electricity in green buildings studied is 25 percent less than conventional buildings, which is less than the amount shown by Grha Prodia, which is 53 percent. It is important to keep in mind that the scale of this research is much smaller than the one conducted by GSA, so the variable for this research is also less than GSA's research. The highest difference recorded in GSA studies is in a Federal Building in Auburn, Alabama. That building shows a 76 percent difference with the national average. A courthouse in Seattle, Washington shows similar difference in percentage with this research result, with 52 percent or \$1,33 less when compared with the national average.

In conclusion, Grha Prodia has successfully implemented water efficiency in its building and this has resulted in lower operating costs, while the energy efficiency technique that Grha Prodia implements is not so impeccable due to various reasons mentioned earlier.

Conclusion

There are some conclusions that can be drawn from the discussion in the previous chapter. Grha Prodia can fulfill all of the five criteria in this certification. Apart from the prerequisites credit in each criteria, Grha Prodia also fulfills a considerable amount of credits, most notably from the water efficiency criteria, where Grha Prodia can earn all of the available credits. Based on the analysis, Grha Prodia is considered a green building and can earn LEED certification for the categories that are proposed, LEED Building Design and Construction: New Construction v3 LEED 2009.

The green building concept reduces the operating costs of Grha Prodia by reducing the usage of water and electricity. For water usage, Grha Prodia successfully reduced it significantly when compared to the Prodia Tower, a similar building in terms of usage which is also owned by PT. Prodia Widyahusada. For electricity usage, Grha Prodia also manages to reduce it significantly because of various methods used such as building positioning, light sensors and VRV air conditioning system.

There are some limitations to this research that can be improved by future research. The first limitation is regarding the research object, Grha Prodia, which started its operation in March 2015. Because of that, there is not enough time to get more data needed for this research. To get a better picture regarding the effects of a green building concept, a longer data period is needed. Another limitation encountered in this research is the lack of comparative data used to compare the operating costs of Grha Prodia. The reason behind this limitation is due to the limited amount of time to search for another comparative data other than Prodia Tower.

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