Implementation of Life Cycle Costing for a University Building

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Abstract

Analysis of a design process is very important in controlling the initial costs and future costs in possession of an investment project. Therefore, it should be wise to perform a LCC analysis to determine the cost of any category contained in a building project. The analysis also provide information to see how much the total cost incurred by a development project from initial to the future cost by implementing BS ISO 15686 part 5: 2008. The purpose of this study is to identify the cost proportion and make long-term plans of a university building in term of life cycle costing in the area of Univeristy of Atma Jaya Yogyakarta (UAJY). Results of the study show that there are three groups that make up the LCC: the cost of development of the building, the operating costs, and the cost of maintenance and replacement. For a long-term plan the LCC for 25 years the percentage obtained as follows, initial development cost of Rp. 10,301,450,000 (43%), operational costs Rp. 11,085,000,000 (46%), maintenance and replacement costs Rp. 2.660.570.080 (11%).

Keywords: *life cycle costing; service life; university building; BS ISO 15686-5:2008; Yogyakarta*

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1. INTRODUCTION

In most developing countries, the government has attempted to develop in all aspects of economy, social, politics and technology to support their programs. For running the programs, the countries need infrastructure and buildings as to facilitate all the program. When developing new building and infrastructure, they mostly did not consider the operating and maintenance of the facilities, this was due to lack of knowledge of LCC and encountered with limited funds.

Lack of operation and maintenance strategies to maintain building system performance leads to increased operating and maintenance cost and less healthy buildings. The first step toward improved practices that take advantage of potential operating savings is to identify the O&M practices routinely performed in buildings. Understanding LCC and service lives of building component has two major benefits. First, baseline for service life is the benchmark from which to estimate cost for O&M practices. And second, service life baseline practices can be used as a guide to direct the long terms O& M cost estimate for the assets.

Indonesia as a developing country in the world today is promoting development in all fields. In implementing directed development, planned, integrated and construction strategy, it is expected construction to be able to deliver efficient and effective results and environmentally accepted. This refers to the constructions sustainable concept, where a development can work together between the concept of responsible development, has the spirit of maintenance, and accountability.

Integrated development has been regulated Building Acts No. 28/2002[1], Water Resources Acts 74/2002[2], Highway Acts 38/2004[3] on the road construction, and Spatial Planning Acts No.26 / 2007[4], which aims at balancing between buildings and its environment, as well as be a legal umbrella in harmonizing the utilization of space. Once, a top Public Utility Officer explained that "the future of development policy should be able to boost the quality of the environment, no exception public works infrastructure must meet the characteristics of balance and equality, holds a long-term and systematically saving". The policy the development of which was to apply the concept of construction sustainable, maintain and promote an increase in the percentage of green space against other cultivated areas, maintaining conservation areas, especially urban region, as well as realizing eco-city improve supervision in the aspect of environment control construction implementation.

In line with the concept of sustainable constructions, costs incurred in the development process is based on the calculation of LCC, which is an integrated process in decision making, planning and control, procurement, operational, security, and the final value assets[5].

The purpose of the LCC is to manage the process repeated from the planning to the destruction or replacement of assets, to manage the LCC (long-term) of the short-term savings, to ensure the appropriate consistent quality service of the designed building, to improve sustainability and lowers the risk of failure and maximize the potential and advantages of the provision of services, in order to minimize the associated costs throughout the life of the building itself[6].

Analysis of the LCC of a design process that is important in controlling the cost of initial and future costs in possession of an investment project. Therefore, it is necessary to do a LCC analysis study to determine the cost of any category contained in university building construction project in the university, and also see how much the total costs incurred by a project development a building ranging from the design phase to the technical life of the building.

In planning LCC, information of the service life of component used such as equipment, and building materials are needed. This is something interesting because whenever service life assessment is only done on a building in overall activities. Determine the service life calculation aims at facilitating the maintenance and replacement of components of the building materials that have overdue the limit of its service life.

The objectives to be achieved in this study are as follows 1) identify service life of component of the material a building; 2) make a long-term plan of 25-year LCC a university building on the University of Atma Jaya Yogyakarta.

The building is located in the complex of UAJY Yogyakarta. This development is a tradition separate design and construct project. Contract system used was a lump sum method. This university building plans take as long as 1 year. The building is planned to have 5 floors and functioned for offices, class rooms, auditorium.

1.1. Literature Review

1.1.1. Definition of LCC

There is some understanding of the LCC, according to some experts, including as follows:

1. The cost of the life cycle of a building or structure covers total costs associated ranging from stage the beginning until the end of the demolition phase[7].

2. LCC is a modelling concepts cost calculation of its early to demolition of an asset of a project as a tool

to take a decision on a study analysis and calculation of the total existing costs during its life cycle[5].

3. The cost of the life cycle of a item is the sum of all expenses relating to the item since designed to unused[8].

In other words, the cost of the building is the cost over the life of the plan building. Therefore, LCC can be formulated as follows:

LCC = Initial Cost + Cost + Cost of Care and Use of replacement wherein, the initial cost is the cost of the planning and execution of the building, the cost of usage is the cost incurred during the building operations, and maintenance and replacement costs are costs for maintenance and replacement the constituent components of the building during the design life of the building.

The main usefulness of LCC is at the time of the evaluation of alternative solutions to certain design problems, for example, an option may be available for the roof of a new project. It is necessary to review not only the initial cost, but also the cost of maintenance and repair, service life plan, appearance, and things that might affect the value as a result from the available options. Although aspects of appearance is a consideration aesthetics, and so it is subjective, but it cannot be ignored in the overall evaluation of these alternatives. Thus, LCC is a combination of calculation and wisdom.

Application LCC for major projects in the industry construction causes utilization of buildings and structures form can really different. However, a problem arises in practice because although the initial construction costs are relatively clear and unexpected at the design stage not so for the usage fee. It required calculation thorough review of the costs incurred from construction to the demolition of the building.

1.1.1. LCC Plan

LCC Plan is a plan for spending the proposal of a construction project over the life of the project. On execution of development, ranging from ideas, feasibility studies, planning, implementation, to maintenance and dismantling operations require miscellaneous costs, which are grouped into several components, namely 1) cost of construction [direct and indirect costs]; 2) operational costs [cleaning costs, the cost of utilities, and cost of administration]; 3) the cost of maintenance and replacement, 4) the final value of the building.

1.1.2. LCC for Teluk Bayur Port[9]

Title of research compiled by alzahri is the application of LCCs the construction of the pier (pier case studies CPO Teluk Bayur Port). This Research aimed at identifying factors, and variable LCC in planning the development of the construction dock crude palm oil (CPO) on Teluk Bayur port fields, and determine the amount of the LCC. The methodology used in this study is, first conduct a study literature, both perform model selection using a variable LCC Izzati method, the third conduct field surveys, the fourth calculating LCC, fifth conclusion. The conclusion of this study were 1) conceptual model was selected Izzati model LCCing. Variables used in the planning model CPO pier construction that acquisition costs, operating costs and maintenance, and residual value; 2) the total LCC CPO dock bay Bayur is Rp. 163,196,675,124.; 3) in the 9th year have experienced payback period; 4) the application of LCC for construction of the pier CPO Gulf Bayur in the year to 30, earned a profit of Rp. 48,640,121,124.

1.1.3. LCC for Mixed Office and Residential Building (Rumah Kantor) at Manado [10]

Title of research compiled by Grace Priscilla Kamagi is Analysis LCC of the building (case study: building projects Rukan (Mixed Office and Residential) Bahu Mall Manado. In this study the LCC was applied for 20 years. The methods used is the conduct literature and field studies. The second method used was mutual support to achieve the ultimate goal of research. It also made use of the Internet to search for information relating with research. This study used a life cycle analysis of the actual cost, namely LCC calculation is based on building materials as per specifications cost planning of 9 buildings Rukan Block-N Bahu Mall Manado. To facilitate calculation then there were some cost data needed to be benchmarked. Data cost were: budget planning and the list of unit prices of materials and wages. Analysis jobs were reviewed for the work of walls, floors and roofs.The conclusion of this study were 1) by using the basic calculation of the project LCC of development of Rukan Bahu Mall Manado, for work items walls, floors, and roofs, it was obtained a total cost = Rp1,722,634,337.; 2) based on the calculation of the LCC of the construction project Rukan Bahu Mall Manado, for work items, walls, floors, and roof, then the result is the breakdown as follows: cost of capital construction (beginning) of Rp.574.598.000 (33.36%), cost for maintenance of the wall of Rp. 722,742,750 (41.96%), cost for floor maintenance Rp. 1,059,551 (0.06%), cost for roof maintenance Rp. 418,818,353 (24.31%), and costs of dismantling Rp. 5,415,681 (0.31%).

1.1.4. LCC for Campus Center Building Institute of Technology Bandung (ITB) [11]

Title of research conducted Kawtharazlanshah Koento namely “Estimates LCC (initiation of the concept of green building) campus center ITB”. LCC calculations performed included some aspects of cost: initial cost, the cost of electricity, clean water costs,

maintenance costs, costs maintenance, demolition costs, and resale value. Calculations were performed taking into account the choices made after the service life of the building exhausted. Building service life was assumed to be up to 30 years. The first option was destroyed building after passing the maid, and therefore costs demolition taken into account in the calculation of LCC. The second option was the building was sold after passing the maid, so the calculation of life cycle taking into account the cost resale value ITB Campus Center Building. The conclusion of this research was, most cost aspects the calculation of LCC was the initial cost of building Campus Center ITB which reached Rp. 16,627,638,200. The cost reached 83.93% of the overall total LCC at the first option and 80.31% in the second option. For an annual cost incurred, costs of maintenance was an aspect that had the largest percentage, reaching Rp.2.536.221.568. The cost reached 12.8% of the total LCC at the first option and 12.25% in the second option.

1.1.5. LCC Diamond Building at Malaysia [12]

Based on the analysis conduct by Firsani and Utomo (2012) the study with the titled "LCC Analysis on Diamond Building Green at Malaysia" could be concluded as follows 1) cost category contained on diamond project building, namely the initial cost, energy cost, operational and maintenance cost, and replacement cost; 2) using the Present Worth Method on the level of interest rate (i) = 6% and the period of analysis (n) = 10 years. LCC from diamond building Malaysia were Rp. 759.290.649.000, with the details as follows 1) initial cost of Rp 572.000.000.000, energy cost Rp. 5.599.000.000, operational and maintenance Rp 182.000.000.000, and replacement cost of Rp.201.000.000.; 2) in a sensitivity analysis performed on large LCC value of the rate changes, and interest rates range ± 30%, it can be seen that changes in interest rates are not sensitive to change LCC; 3) at LCC modeling, it can be seen that the percentage each cost category against the total cost if no taking into account the residual value, i.e. initial cost of 75.306%, amounting to 0.737% energy cost, operational and maintenance cost of 23.932%, and replacement cost of 0.026%, while if taking into account the residual value, the percentage of each transformed into cost categories, namely initial cost were 62.44%, 0.61% energy cost, operational and maintenance cost of 19.84%, replacement cost of 0.02%, and residual cost was 17.09%. Modeling of LCC could also be note that with or without taking into account the residual value, the largest percentage of the LCC on diamond building project is initial cost.

1.1.6. LCC Hostel Building at Kediri, Eastern Jawa, Indonesia [13]

The study regarding LCC had carried out in Kediri at a hostel building with the following components 1) there were three groups of estimation of LCC for the hostel building, namely development cost Rp. 4.290.000.000 (46%), operational cost 2.360.412.125 (26%), and maintenance and replacement cost Rp.2.179.307.000 (28%); 2) in operational, the biggest cost go to administration Rp.56.000.000 (61%), followed by utility Rp.22.116.485 (22%), and cleaning Rp.16.300.000 (17%); 3) for maintenance and replacement, the biggest was ME Rp.987.685.000 (38%), sanitary Rp.625.000.000 (24%), wall Rp.431.328.000 (16%), ceiling Rp.197.500.000 (7,6%), accessory Rp.83.500.000 (3,3%), floor Rp.202.947.000 (7,8)% and roof Rp.62.940.000 (2,7%).

2. METHODS

2.1. Data Collection and Analysis

Data collection methods used in this study includes 1) preparation: stages of preparation is done is to formulate the research problem, research objectives, and explore data to the consultant's office to run smoothly; 2) collect data: steps taken in this phase are: a) the field survey to see if there are projects eligible to be used as a research location and conduct the permitting process to the performer, or the owner of the project, b) send questionnaires to the respondents, to collect data for supporting the research; 3) data analysis after the data collected LCC calculation using MS-Excel; 4) discussion; 5) conclusions.

2.2. The Building Under Studied

The institution building is situated at Babarsari no 44, in Yogyakarta. The building consists of 5 floors with a total of floor area of 2400 m^2. It was built at 2013, but the building cost was recalculated using cost data of 2015. It was then estimated LCC of 25 years using history data obtained from the office for building maintenance of the university.

2.3. Cost Model for LCC

The model estimate was adopted the example from ISO 15686 part 5 for LCC[15].

2.3.1. Construction Cost

All costs of initial construction work on the building, including 1) building works costs, which is means cost of building works and external works (presented in the SFCA element cost structure); 2) other construction related costs, which is means all costs payable by the client in connection with the building or constructed asset.

2.3.2. Maintenance Costs

All costs of replacement, maintenance, repair and adaptation of the constructed asset (presented in the SFCA element cost structure. They consist of 1) major replacement costs, includes scheduled replacement and major components and this will form the detailed asset life cycle replacement program; 2) minor replacement and repairs costs. Scheduled replacement of parts and scheduled maintenance and repairs to components and associated making good and minor redecorations including planned preventative maintenance; 3) unscheduled replacement, repairs and maintenance costs. Allowance for unforeseen maintenance arising from early failure, inappropriate use etc.; 4) redecorations scheduled redecorations; 5) refurbishment and adaptation costs scheduled refurbishment and adaptation during the period of analysis. Exclude refurbishment and adaptation carried out as part of the initial construction, which should be included under the construction costs.

2.3.3. Operation Costs

All costs of operating the building or facility arising from the building itself rather than from its occupancy, excluding maintenance costs. It includes : routine and specialist cleaning; windows and external surfaces cleaning windows, curtain walling, glazed screens, cladding, sun screening etc.; internal cleaning; and external works cleaning.

Part of the operation cost is fuel consumption. Fuel consumption shows cost of different fuel separately e.g. 1) gas, 2) electricity, 3) fuel oil, 4) solid fuel (define), and 5) other include any income from the sale of energy.

2.3.4. Administrative Costs

User support costs related to the operation of the building or facility. All costs involved in managing the operation and maintenance of the building. Includes 1) supervisory staff e.g. building supervisor, maintenance manager, facilities manager etc., 2) professional staff e.g. architects, engineers, surveyors etc., 3) clerical staff and administrative staff, 4) general and regulatory surveys commissioned by or on behalf of the client.

3. RESULTS AND DISCUSSIONS

3.1. Analysis of the Data

Distributing questionnaires were conducted to determine service life of components of building materials used in the construction of the university building. From 15 people who responded to the questionnaire obtained an average service life and testimony of building materials used in the construction of buildings. Table 1 below will explain the average service life and testimony of building materials.

Table 1. Service life for Material Components, Source: Kaming &Mardiansyah[13], and other primier data.

GROUP	Component Material	SERVICE LIFE (Year)	Material Brand and Features	REFERENCE (Interview)
ME	CCTV	30	Sony/Samsung/Krisbow	supplier
	Water Heater	15	Ariston/Paloma/Rinnai	supplier
	AC	15	LG/Panasonic/Sharp	consultant
Roof Structure	Steel roof frame	30	Prima Truss	supplier
	Roof clay tile	20	Sokka/Mutiara/KIA	consultant
	Gutter	15	Steel/Zinc	consultant
Wall	Wall paint	8	Taka/Dulux/Movilex/Nippon	supplier
	Aluminium paint	12	Taka/Dulux/Movilex/Nippon	supplier
	Wood paint	15	Taka/Dulux/Movilex/Nippon	supplier
	Frame aluminium	15	Lokal/Aluplus/Alurre	consultant
	Door aluminium	15	Lokal/Aluplus/Alurre	consultant
	Timber frame	30	Jati/Merbau/Bengkirai	consultant
	Timber door	30	Jati/Merbau/Bengkirai	consultant
	Timber windor	30	Jati/Merbau/Bengkirai	consultant
	Door and window glass	20	Glass 3 mm	consultant
Floor	Granit	20	Roman/Platinum	supplier
	Ceramic	20	Asia Tile/ Roman/Platinum	supplier
Ceilimg	Gypsum	15	Local	consultant
	GRC	18	KalsiBoard	consultant
Sanitary	Wastafel	8	Toto/America Standard	consultant
	Stainless steel sink	12	Enchanting	consultant
	Water crane	3	Enchanting	consultant
	Water closet	15	Toto/America Standard	consultant
	Shower	8	Enchanting	consultant
	Floor drain	8	Enchanting	consultant

	PVC pipe	30	Waving	consultant
Accessory	Slot door & window	10	Solid /Paloma/Dorma	supplier
	Handle door & window	10	Solid /Paloma/Dorma	supplier
	Hinge door and window	20	Solid /Paloma/Dorma	supplier
ME	Lamp standard	5	Philips/Krisbow/GE/Osram	supplier
	Lamp down light	5	Philips/Krisbow/GE/Osram	supplier
	Wall Stop contact	20	Broco/Jung/Panasonic	consultant
	Saclar single	20	Broco/Jung/Panasonic	consultant
	Sacla multiple	20	Broco/Jung/Panasonic	consultant
	Fitting	20	Broco/Jung/Panasonic	consultant
	Lift	30	Hyundai/Otis/Schneider	consultant
	Fire alarm	30	Siemens	supplier
	Telephon	15	Telkom/Panasonic/Samsung	consultant

Table 2. Initial Development/Construction Cost Plan

No.	Activity	Cost (Rp)	%
1	Preparation	512.252.258,12	5,47
2	Concrete Work	5.613.748.507,17	59,94
3	Truss and Roof	126.881.881,14	1,35
4	Canopy	97.773.796,67	1,04
5	Doors,Windows and Partition	161.186.080,00	1,72
6	Ceiling and Light Shelves	426.672.197,74	4,56
7	Floor and Wall of Ceramic Tiles	848.405.610,08	9,06
8	Brick Work and Railing	690.612.792,18	7,37
9	Painting Work	177.111.059,87	1,89
10	Sanitary and Fixturex	91.035.979,00	0,97
11	Drainage	77.259.400,00	0,82
12	Plumbing	75.743.714,20	0,81
13	Electrical	225.737.138,00	2,41
14	Lightning Rod	15.210.474,00	0,16
15	Fire Protection and Resistance	75.689.928,00	0,81
16	Others	149.633.978,00	1.60
	Total	9.364.954.794,17	100

Table 3. Estimated LCC for the Building Over 25 years

No.	Detail of Activities Related to Initial Cost	Service Life (Year)	Estmated Life 25 Years (Rp)
1	Preparation		0
2	Concrete Work		0
3	Truss and Roof		69.392.000
	Purlin and Timber Roof Buttens	10	20.808.000
	Rofe Clay Tile and Decrabond	10	41.616.000
	Roof Ridge Decrabond	10	6.968.000
4	Canopy		5.684.000
	Cable Sling Ø 20	12	1.116.000
	Polycarbonate (Transition Room for roof floor)	12	4.568.000
5	Doors,Windows and Partition		11.420.000
	Doors of Machine Room for Lift	15	440.000
	Doors for Toilet/WC	20	10.980.000
6	Ceiling and Light Shelves		0
7	Floor and Wall of Ceramic Tiles		706.683.000
	Ceramic Floor Tile 40x40	20	283.946.000
	Ceramic Floor Tile 20x20	20	57.937.000
	Ceramic Wall 20x40	20	336.225.000
	Ceramic Wastafel Table 10x40	8	28.575.000
8	Brick Work and Railing		0
9	Paint Work		517.830.000
	Wall Paint Weathercoat	8	128.829.000
	Wall Paint Internal	8	194.571.000
	Ceiling Paint	8	167.424.000
	Stell Paint	10	27.006.000
10	Sanitary Fixtures		244.291.000
	Closet Seat Monoblock Toto C420 / S516	15	23.405.000
	Shower Spray TOTO Tipe THX20NPIV	15	4.560.000
	Closet Squat Toto Ce 6	15	4.620.000

	Urinoir TOTO U104	15	16.474.000
	Wastafel TOTO L.220 Dan TGL2205	8	22.557.000
	Bathtub Faucet San Ei Y20 Lc	3	64.379.000
	Kran Garden San Ei Y70	3	10.928.000
	Kran Kitchen San Ei A 20c	3	57.600.000
	Kitchen Sink Single Hole	8	3.606.000
	Floor Drain	8	27.252.000
	Mirror 50x80 Cm, T = 5 Mm	8	8.910.000
11	Drainage Work		151.182.000
	Pipa D4"	8	103.872.000
	Pipa D6"	8	40.590.000
	Roof Drain	10	6.720.000
12	Plumbing		137.466.000
12A	Clean water Instalation		
	Pipe Ø 3/4"	8	2.904.000
	Pipe Ø 1"	8	1.383.000
	Pipe Ø 2"	8	6.312.000
	Stop Kran 2"	3	6.472.000
	Pipe line for Roof Tank	8	6.729.000
	Roof Tank Stainless Steel, 5000 Liter	12	26.000.000
	Fitting-Fitting	8	1.515.000
	Pump Grunfoss Cap. 100 Litre/Second, Head Total 40 M	6	16.000.000
12B	Waste Water Instalation		
	Pipe Ø2"	8	555.000
	Pipe Ø3"	8	3.510.000
	Pipe Ø4"	8	2.949.000
	Pipe Ø6"	8	7.380.000
	Pipe PVC Ø2"	8	6.408.000
	Fittings	8	1.515.000
12C	Brick Work and Railing		
	Pipe Ø2"	8	1.515.000
	Pipe Ø3"	8	6.630.000
	Pipe Ø6"	8	26.754.000
	Pipe Ø8"	8	11.400.000
	Fitting	8	1.515.000
13	Electricity		531.581.000
	Stop Contact ordinary	20	4.412.000
	Stop Contact for Power	20	1.776.000
	Stop Contact for Floor	20	1.414.000
	Saclar Single	20	561.000
	Saclar Multiple	20	256.000
	Lamp TL 2 X 36 Watt RM 300 ACR	5	78.210.000
	Lamp TL 2 X 18 Watt TKI 300 ACR	5	41.630.000
	Downlight DL 25 Watt, RD 100	5	64.820.000
	Lamp Exit B, 10 Watt	5	7.500.000
	Outlet Cabel Data (Inbouwdos)	10	6.800.000
	Main Conduit Cabel Data	10	9.306.000
	Cable Telephone Inside the Building	10	25.500.000
	Cable PABX 40 Pair from Buidling to Ground TB	10	33.704.000
	Cable NYM 2 X 2.5qmm from Saclar Ke Lampu	10	10.290.000
	Cable NYM 3 X 2.5qmm from SDP to Saclar	10	31.916.000
	Cable NYM 3 X 4qmm for Stop Contact Power	10	92.378.000
	Cable NYM 3 X 6qmm for AC Split Duct and pump	15	3.392.000
	Cable NYM 4x 10qmm from MDP to Lighting Panel	10	20.616.000
	Cable NYM 4x50qmm fromØ MDP Ke Panel Power	10	97.100.000
14	Lightning Rod		
15	Fire Monitor and Resistance		
16	Others		
	Total Construction Life Cycle		2.375.509.000
	Design & Construction Contingency - Included		71.265.270
	Risk Allowance - Included		95.020.360
	Management Costs - Included		0
	Overhead & Profit - Included		118.775.450
	Present Value		2.660.570.080
	Inflasi		
	Grand Total		5.251.837.566

3.2. The LCC Analysis

Development cost obtained based on information from the division officer of the university planner was Rp.7.150.000.000. This cost was at 2013. When it was calculated using cost data at 2015 the cost was Rp 9.364.954.000. See Table 2.

The operational cost was estimated with a total of Rp. 11.085.000.000. The component of the cost consists of three parts, namely 1) cleaning and its detail; 2) utilities consist of the cost of electricity, telephone, generator, internet, cable TV, water (State Water Company) and fuel for generator. For details of the calculation of the cost can be seen in Table 5.

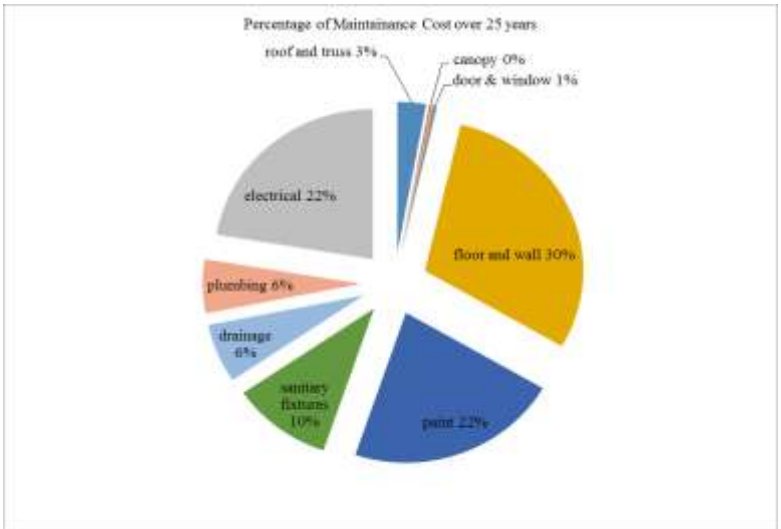

Fig. 1. Proportional of Estimated Maintenance & Replacement Cost over 25 years

Table 4. Estimated Propotional Total Cost of the Building over 25 Years

No.	Cost	Sum (Rp)	(%)
1	Initial Cost of Costruction	10.301.450.000	42,84
2	Maintenance Cost	2.660.570.080	11,06
3	Operational Cost	11.085.000.000	46,10
	TOTAL	**24.047.020.080**	**100,00**

Table 5. Estimated Operational Cost of the Building over 25 Years

No.	Activity	Item	Qty	Unit	Rate (Rp)	Toal Cost (Rp)
1	Cleaning	CS	4,00	Man-Month	1.500.000	6.000.000
		Material	1,00	Ls	500.000	500.000
		Equipment	1,00	Ls	200.000	200.000
					sub total 1	6.700.000
2	Security &	Security force	4,00	Man-Month	1.750.000	7.000.000
	Parking	Parking	2,00	Man-Month	1.000.000	2.000.000
		Equipment	1,00	Ls	150.000	150.000
					sub total 2	9.150.000
3	Utility	Electricity	1,00	Ls	6.000.000	6.000.000
		Telephone	1,00	Ls	1.500.000	1.500.000
		Water	1,00	Ls	850.000	850.000
		Internet	1,00	Ls	5.000.000	5.000.000
		Generator	1,00	Ls	750.000	750.000
	Sub total 3					14.100.000
4	Admin	Management	4,00	Man-Month	1.750.000	7.000.000
	Sub total 4					7.000.000
A	Total per month (1 + 2 + 3 + 4)					36.950.000
B	Total per year (A x 12 month)					443.400.000
C	Total cost over 25 years (B x 25)					11.085.000.000

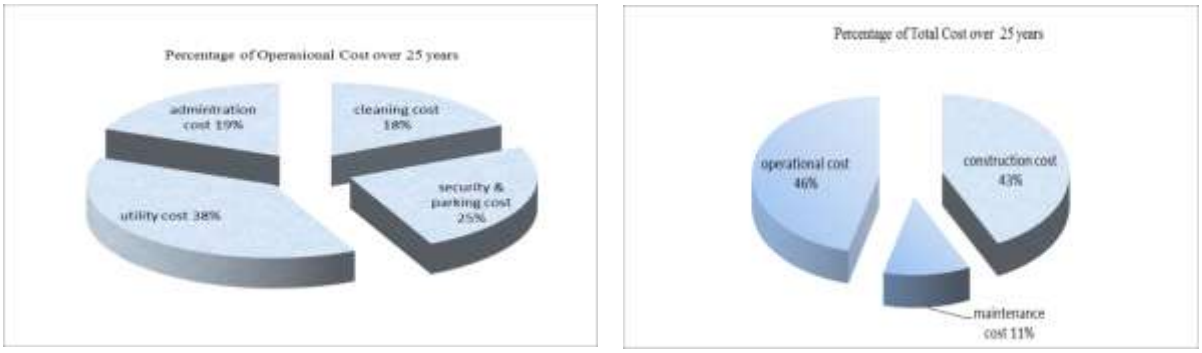

Fig.2. Propotional of operational and total cost of the building over 25 years

4. CONCLUSIONS

The study regarding LCC has been carried out in Yogyakarta at a university building with the following cost components 1) there were three groups of estimation of LCC for the university building, namely development cost Rp. 10.301.450.000 (43%), operational cost Rp.11.085.000.000 (46%), and maintenance and replacement cost Rp. 2.660.570.080 (11%); 2) on maintenance and replacement cost, the largest component went to a) floor and wall ceramic tile of almost 30%; followed by b) electricity replacement of 22.38%; next was c) paint work of 21.8%; d) sanitary fixture of 10.28%; and e) clean water equipment and drainage of around 12%; 3) on operational, the biggest cost went to utility cost of 38%, followed by security and parking staff of 25%, administration of 19% and cleaning of 18%.

This study provided the following recommendation. The service life used in this study was been gathered from stakeholder involved in the suppliers, consultants, and academics, involved in the construction industry, as well as the maintenance officers from the university had some drawbacks in term of its quality and quantity. Perhaps the similar information should be gathered for accurate based the empirical research methodology.

The cost items used in this study was subjective and mostly be relied on the experience of the individual professional and available of service life of the components. The cost could also be adjusted when it could be reduced based on the limited resource available. In future, it was recommendated method of the Davis Langdon and ISO 15686 be applied in LCC[15]. Future research should be emphasize at service life for building and infrastructure components, and create specific LCC research model for more type of building and civil engineering projects in developing country such as Indonesia.

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