Development of Implementation Guidelines for Maintenance and Treatment Work of Mechanical Components in Universitas Indonesia Building and Area based on Work Breakdown Structure (WBS)

Kallista Alsadila and Yusuf Latief
Civil Engineering Department, Universitas Indonesia, Depok, Indonesia

Keywords: Guidelines, Maintenance, Mechanical, Building, Work Breakdown Structure.

Abstract: In maintaining the quality and reliability of buildings in accordance with standards that apply during their useful life, regular maintenance and treatment work are required. With these activities, various aspects can be fulfilled during building utilization, such as safety, health, comfort, convenience, and efficiency. At the University of Indonesia, several phenomena have resulted in building damage and other losses such as costs and time. The poor maintenance activities due to the absence of complete guidelines, causing damage to the mechanical components. In fact, the mechanical component is the most influential component in determining building performance. The purpose of this study is to develop a standard implementation guideline based on a proven decomposition technique, the Work Breakdown Structure (WBS). The independent variables used are WBS level, from work types until technical specifications. The research method used is the study of literature, Delphi's techniques, and validation with various experts. The results of this study are the establishment of standard guidelines for the implementation of maintenance and treatment work of mechanical components for Universitas Indonesia that cover several type buildings and environment, that can be used as references and applied in other buildings.

1 INTRODUCTION

According to The Committee on Building Maintenance, in maintaining a building facility to remain in a condition that is in accordance with applicable standards, an activity called maintenance is required (Usman & Winandi, 2009, p. 2). In addition, maintenance activities are carried out to maintain the usefulness and value of the building, which includes updating and repairing activities (Usman & Winandi, 2009, p. 2). In 1987, Redlin explained the purpose of this maintenance and treatment activity was to minimize repair costs, increase user satisfaction, increase activity efficiency, minimize energy use costs, and minimize potential safety problems (Aditya, 2018). Wimala (2000) states, with good building maintenance activities, it will give each individual a feeling of being comfortable, safe, calm and clean so as to increase work productivity (Handayaniputri, 2009, p. 1).

In 2014, there was a fire phenomenon that caused damage to buildings that occurred in Universitas Indonesia (UI). As a result, one of the faculty building was burned down entirely, along with important documents stored in it. In addition, total costs incurred, reaching approximately 40 billion Rupiah (Prayitno, 2018). After tracing, the cause of the fire was damage to the mechanical component, which was shorted to the air conditioner (Anshari, 2014). Another phenomenon occurred in 2017, namely an air conditioner short circuit that caused a fire in the Faculty of Pharmacy Building, and caused losses of up to 25 million Rupiah (Prayitno, 2018).

One effort that can be done to overcome the phenomenon that occurs, is to carry out the good maintenance and treatment work of mechanical components. According to Wimala (2000), a guideline is needed in achieving effective and efficient management in carrying out maintenance and treatment activities (Handayaniputri, 2009). With the existence of clear guidelines, it is expected to reduce the risk of expenditure due to damage to buildings (Handayaniputri, 2009). According to (the United States Environmental Protection Agency, 2017, p. 1), the operational standard procedure or standard of implementation is a set of written instructions about the routine activities followed by an organization. The use of standard operating

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procedures can reduce the possibility of differences and improve quality through consistent procedures. With the use of guidelines for maintenance and treatment work, the utilization of buildings that meet the requirements of safety, health, comfort and ease and efficiency can be realized, in harmony with the environment (Permen PU No. 24, 2008).

The Work Breakdown Structure (WBS) is a process of detailing project work deliverables into smaller and more manageable components (Project Management Institute, 2013). Garcia-Forniels et al. (2003) emphasize that, WBS may be the most important tool for project management because it provides the basis for planning, scheduling, control, assigning responsibility and information management (Ibrahim et al. 2009, p. 389). In making guidelines or implementation standards, each element has different characteristics, so it requires special handling. Making standard implementation based on WBS, can avoid missing an element in a component to be maintained.

According to The Government Accountability Office / GAO (1990) states that, the WBS helps in the process of estimation there are no forgotten items and also helps to make comparisons with several similar projects (Fitriadi, 2017). This is a preventive action taken, in order to reduce the possibility of a bad phenomenon, due to the presence of elements that are not maintained.

This study will discuss how to develop implementation guidelines for maintenance and treatment based on WBS, in this study focusing on mechanical components in Universitas Indonesia building and area scope. There are several previous studies that also discussed the maintenance and treatment work of mechanical components namely, (Aditya, 2018) for a government building, and (Aryaningrum, 2018) which is also for government buildings, but more specifically for green buildings. The difference in this study is the scope which is not only intended for buildings, but also the area. The area used as the object of research, Universitas Indonesia, has a variety of building types. That way this study covers a wider and more complete range of maintenance and treatment related to mechanical components.

This guideline can be used as a reference and later can be modified and applied to similar buildings or areas. Not only the results, the steps taken in the process based on WBS, the proven decomposition technique, will show more structured steps, thus minimizing the missed work packages. The technique used in making the results guidelines are expected to be applied in making all types of guidelines without exception.

2 RESEARCH OBJECTIVES

The objectives of this research are :

1. To identify the work type and work package of the WBS for the maintenance and treatment work of mechanical components in the buildings and areas of the University of Indonesia.
2. To identify design alternatives and activities in each work package of maintenance and treatment work on mechanical components in the buildings and areas of the University of Indonesia.
3. To identify resources and implementation requirements for each activity in the maintenance and treatment work of mechanical components in the buildings and areas of the University of Indonesia.
4. To identify technical specifications used in each activity of maintenance and treatment work of mechanical components in the buildings and areas of the University of Indonesia.
5. To identify ways to develop implementation guidelines based on the WBS (Work Breakdown Structure) for the maintenance and treatment work of mechanical components in the buildings and areas of the University of Indonesia.

3 LITERATURE REVIEW

3.1 Universitas Building and Area

Universitas Indonesia is one of the largest educational institutions in Indonesia. According to the QS World University Rankings, the University of Indonesia ranked first as the best university in Indonesia (Quacquarelli Symonds Limited, 2018). The Universitas Indonesia campus, located in Depok, has a land area of 320 hectares and there are 85 buildings that have been built on the land, (Prayitno, 2018).

The Universitas Indonesia area, is a unique area because it consists of various multi-disciplines. Therefore, there are various types of buildings in the University of Indonesia areas such as lecture buildings, administrative buildings, hospitals, library and others.

3.2 Maintenance and Treatment Work

Maintenance of the building is an activity to maintain the reliability of building buildings and infrastructure

and facilities so that building is always functional (preventive maintenance) (Permen PU no. 24 2008). Building maintenance is also an effort to avoid damage to components / building elements due to obsolescence before their age ends.

Whereas, treatment is an activity to replace parts of buildings, components, building materials, infrastructure and facilities so that buildings are curative maintenance (Ministry of Public Works, Directorate General of Cipta Karya, 2008). There are three types of building treatment work, namely, rehabilitation, renovation and restoration.

Other sources state that building maintenance is defined as "work" to maintain, restore or repair every part of the building, to maintain the performance of building and service fabric and its surroundings, meet standards and maintain the utility and value of buildings. This includes improvements and repairs to works from existing facilities (Pļaviņa & Geipele, 2013).

In Undang-undang (UU) No. 28 of 2002 concerning building, it was explained that the building utilization was carried out by the owner or user of the building after the building was declared to have fulfilled the requirements of function worthiness. In terms of maintaining function-worthy requirements, periodic maintenance, maintenance and inspection work must be carried out on buildings (UU No. 28, 2002).

Based on the guidelines for the operation and maintenance of the building, maintenance work includes several activities as follows; cleaning, tidiness, inspection, testing, repair, replacement of building materials or equipment **(**Ministry of Public Works, Directorate General of Cipta Karya, 2008).

Maintenance and treatment work of building is done to maintain the requirements achieved by a building, namely; safety of the building, building health, the comfort of the building, and ease of building (Ministry of Public Works Directorate General of Cipta Karya, 2008).

3.2.1 Scope of Maintenance and Treatment Work of Mechanical Components

Based on the Minister of Public Works Regulation No. 24 of 2008, regarding the Guidelines for Maintenance of Buildings, it is explained about the scope of building maintenance for mechanical components as follows:

a. Maintain and carry out periodic inspection of the air system, so that the air quality in the room still meets the technical and health requirements required including maintenance of the main equipment and air ducts.
b. Maintain and carry out periodic inspections of water distribution systems which include the provision of clean water, sewage installation systems, hydrant systems, sprinklers and septic tanks and waste treatment units.
c. Maintain and carry out periodic inspection of the transportation system in the building, both in the form of lifts, escalators, travelators, stairs and other vertical transportation equipment.

3.3 Mechanical Components

Facilities and infrastructure found at the building in the form of important components, are interrelated with each other in order to achieve the function of the building to provide comfort and security for its users (Suyono, Prasetyo, & Assafat, 2011). One important component in the building is a mechanical component. Where this component becomes very vital because all facilities contained in the building are supported by these components. The mechanical component accounts for 46.2% as the most influential component in determining building performance (Juarti, Marlailana, & Noorlaelasari, 2015, p. 57). In handling, if not done carefully, mechanical components can be harmful to humans and their environment. So, the applicable provisions and standards are needed, so that they are safe and there is no damage that can endanger the users (Suyono, Prasetyo, & Assafat, 2011).

3.4 Work Breakdown Structure (WBS)

According to Norman, Brotherton & Fried (2008), the WBS is a tool for monitoring and control that defines the scope of a project (Ajizah, 2018). Work Breakdown Structure (WBS) is a hierarchical decomposition of the scope of work that must be completed by the project team to achieve the objectives and deliver the expected results (Project Management Institute, 2013). Decomposition is a technique used to divide the project scope and project results into divisions and sub-divisions, making it easier to manage (Project Management Institute, 2013). The decomposition process is carried out from the highest level, namely the project itself, to the lowest level, namely the work package. With this decomposition technique, it is expected to cover all existing mechanical elements, thereby reducing the risk of building damage.

3.5 Implementation Guidelines

Implementation standards or guidelines for maintenance and treatment work are intended to be a reference in carrying out the work activities, in this case the maintenance and treatment of mechanical components of buildings in the University of Indonesia. This guideline aims to realize the use of buildings that meet the requirements of safety, health, comfort and convenience and efficiency, harmonious and in harmony with the environment (Permen PU No. 24, 2008). According to Amare (2012), the existence of guidelines can reduce errors in the implementation process. Based on (Permen PU No. 24, 2008), the scope of this guideline includes management of maintenance and treatment, procedures, systems and programs, equipment, equipment and performance standards for building maintenance and treatment, as well as guidance.

4 RESEARCH METHODOLOGY

4.1 Research Process

In looking for results to answer each research question, qualitative methods were used in this study. Beginning with literature review and archive analysis, expert validation, analyzing data to results for each research question. After all the data is obtained then the implementation guideline for maintenance and treatment work of mechanical components is made and followed by final validation. Figure 1 is a flow diagram that shows the stages of how this research will be carried out.

4.2 Data Collection Method

There are two types of data collected in this study, namely, primary data and secondary data. According to (Kusmayadi & Sugiarto, 2000, p. 80), primary data is data collected directly from the object of research by researchers. While secondary data is data that is the result of gathering people or agencies in the form of research, reports, and publications.

In this study, the primary data is obtained from interviews with experts who are experts in their fields, assisted by questionnaires as research instruments. For this study, experts asked for validation amounted to three to five people for each research question, with five questionnaires used, in total. While secondary data is obtained through literature studies of Undang-undang, government regulations, previous research, UI archives, standards such as ISO, SNI and other supporting documents.

For each research question begins with secondary data collection. Then proceed with making a questionnaire based on the collected secondary data. After that the Expert is asked to validate, give opinions and provide improvements that must be done, through interviews and filling out questionnaires. The results of the questionnaire were then used as primary data in this study. Finally, the primary and secondary data obtained is processed and validated back to the experts using Delphi's method, to produce the implementation guidelines.

5 RESULTS

Based on (Rajasa, 2017), (Supriadi et.al, 2018) and (Aryaningrum, 2018), the WBS used in this study consisted of 6 levels. Level 1 is for the project name, level 2 is for work sections, level 3 is for the type of work, level 4 is for work packages, level 5 is for activities, and level 6 is for resources. All levels of the WBS will be developed to serve as the implementation guidelines for maintenance and treatment work of mechanical components.

5.1 Work Type and Work Package

Based on validation at the data collection stage, type of work is divided into five items; gases, plumbing, fire protection systems, air conditioning systems, and vertical transportation systems. The results obtained for research question one, can be seen in Table 1.

WBS level 4 consists, of 49 work packages which are decomposition from the upper level, the work type. In its application, the WBS used can be different, adjusting to the needs based on the object (building and area).

5.2 Design Alternatives/Method and Activities

The alternative design or method referred to in this study becomes a shadow level that is found between levels 4 and 5. Its function is to provide information related to alternatives that might be found for the design and method used, from each work package that is available. In developing this guideline, each alternative design and method will be lowered to the next level, thus that it has each different activity.

Activities at level 5 are derived from each alternative a . Each alternative design / method will have four typical activities consist of; inspection,

maintenance, treatment and testing. Inspection is an activity carried out at any time, in the form of checking the existing condition of an object. Maintenance is an activity carried out periodically to maintain the reliability of an object. Treatment is an activity in the form of object repair if damage occurs. The last, testing is an activity to check whether after repairing the object has been functioning optimally again, after repairs are made.

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5.5 Resources & Implementation Requirements

Resources contained in level 6 WBS consist of tools, materials and labor resources for each activity. Based on ILO Encyclopaedia (2011), tools are primarily used to put things together or to take them apart, furthermore the usage lasts for many years.

Table 1: WBS Level 1 – 4.

WBS Level 1	WBS Level 2	WBS Level 3		WBS Level 4	
Name of Project	Work Section	Code	Work Type	Code	Work Package
Maintenance and Treatment Work of UI Buildings and Area	Mechanical	X1.1	Gas System	X1.1.1	Evaporator
				X1.1.2	Meter Gas
				X1.1.3	Gas Pipe
				X1.1.4	Riser Pipe
				X1.1.5	Gas Tank
				X1.1.6	Accessories
		X1.2	Plumbing	X1.2.1	Carbon Filter
				X1.2.2	Filter Pump Rain Harvesting Tank
				X1.2.3	Floor Drain
				X1.2.4	Clean Water Pipe
				X1.2.5	Rain Water Pipe
				X1.2.6	Dirty Water Pipe
				X1.2.7	Swimming Pool Pipe
				X1.2.8	Pump Booster
				X1.2.9	Pump Deep Well
				X1.2.10	Pump Filter
				X1.2.11	Swimming Pool Pump
				X1.2.12	Dewatering Pump
				X1.2.13	Sampit Pump
				X1.2.14	Transfer Pumps
				X1.2.15	Roof Tank
				X1.2.16	Sewage Treatment Plant
				X1.2.17	Water Treatment Plant
		X1.3	Fire Protection System	X1.3.1	Accessories
				X1.3.2	Detector
				X1.3.3	Hydrant Pillar
				X1.3.4	Fire Pipe
				X1.3.5	Riser Pipe
				X1.3.6	Fire Pump
				X1.3.7	Siamese Connection
				X1.3.8	Sprinkler
				X1.3.9	Solar Tank
		X1.4	Air Conditioning System	X1.4.1	Air Handling Unit (AHU)
				X1.4.2	Ducting
				X1.4.3	Evaporator
				X1.4.4	Fan Coil Unit (FCU)
				X1.4.5	Filter Dryer
				X1.4.6	Filter Expansion
				X1.4.7	Indoor Fan
				X1.4.8	Outdoor Fan
				X1.4.9	Compressor
				X1.4.10	Condenser
				X1.4.11	Cooling Tower Cooling
				X1.4.12	Cooling
				X1.4.13	Refrigerant
		X1.5	Vertical Transportation System	X1.5.1	Freight Elevator
				X1.5.2	Passenger Elevator
				X1.5.3	Escalator
				X1.5.4	*Gondola*

Materials are items that can be finished product. Labor is the man power who execute the process/activity.

Implementation requirements are the stages carried out at each activity at level 5 WBS. The goal

is that the implementation process is in accordance with the standards and the results obtained have the quality as expected. Table 3 showing the example of

Table 2: Alternative design/method.

WBS Level 4 Work Package	Alternative Design / Method
Evaporator	Evaporator
Meter Gas	Meter Gas
Gas Pipe	Gas Pipe
Riser Pipe	Riser Pipe
Gas Tank	Gas Tank
Accessories	Accessories
Carbon Filter	Carbon Filter
Filter Pump Rain Harvesting Tank	Filter Pump Rain Harvesting Tank
Floor Drain	Floor Drain
Clean Water Pipe	Clean Water Pipe
Rain Water Pipe	Polyvinly Chloride
Dirty Water Pipe	Dirty Water Pipe
Swimming Pool Pipe	Swimming Pool Pipe
Pump Booster	Pump booster
Pump Deep Well	Submersible
Filtter Pump	Filtter Pump
Pump Swimming Pool	High-density polyethylene
Dewatering Pump	Dewatering Pump
Sampit Pump	Sampit Pump
Transfer Pump	Transfer Pump
Roof Tank	Roof Tank
Sewage Treatment Plant	Activated Sludge
Water Treatment Plant	Water Treatment Plant
Accessories	Fire Alarm
	Alarm Bell
	Break Glass Emergency
	Check Valve
	Gate Valve
	Disposal Valve
	HydrantBox
	Light Indicator
	Pipe Mouth
	Socket Emergency Phone
Detector	Fire Detector
	Smoke Detector
Hydrant Pillar	Two-way type
Fire Pipe	Black Steel
	High-density polyethylene
Riser Pipe	Wet Riser System
	Dry Riser System
Fire Pump	Diesel Pump
	Electric Pump
	Pump Jockey
Siamese Connection	One Way Type
	Two Way Type
Sprinkler	Pendant
	Upright
	Sidwalls
Solar Tank	Solar Tank
Air Handling Unit (AHU)	Air Handling Unit (AHU)
Ducting	Horizontal Ducting
	Vertical Ductiing
Evaporator	Split Duct, Ceiling Cassette, Floor Standing, VRV
	Wall Mounted
Fan Coil Unit (FCU)	Fan Coil Unit (FCU)
Filter Dryer	Filter Dryer
Filter Expansion	Filter Expansion
Indoor Fan	Split Duct, Ceiling Cassettes, Floor Standing, VRV
	Wall Mounted
Outdoor Fan	Split Duct, Ceiling Cassettes, Floor Standing, VRV
	Wall Mounted
Compressor	Split Duct, Ceiling Cassete, Floor Standing, VRV
	Wall Mounted
Condenser	Split Duct, Ceiling Cassette, Floor Standing, VRV
	Wall Mounted
Cooling Tower Cooling	Tower
Chiller	Air cooled chiller
	Water cooled chiller
Refrigerant Pipe	Refrigerant Pipe
Freight Elevator	Freight Elevator
Passenger Elevator	Passenger Elevator
Escalator	Escalator
Gondola	*Gondola*

resources used for one package, in this case for the vertical transportation system and the example of implementation requirements can be seen on the appendix.

5.6 Technical Specification

According to Aryaningrum (2018), technical specifications are needed to meet certain quality standards. Another goal is to ensure the achievement of accurate measurement results, according to what has been determined. The example of the technical specification is presented in table 4. To obtain the technical specification used in this guideline, several standards are used related to mechanical components such as SNI, ISO, ASME, PUIL and applicable government standards.

Table 3: Resources.

VERTICAL TRANSPORTATION SYSTEM		
PASSENGER ELEVATOR		
WBS LEVEL	DESCRIPTION	
WBS LEVEL 2	WORK SECTION	Mechanical
WBS LEVEL 3	WORK TYPE	Vertical Transportation System
WBS LEVEL 4	WORK PACKAGE	Passenger Elevator
	DESIGN ALTENATIVES/ METHOD	Passenger Elevator
WBS LEVEL 5 ACTIVITY	WBS LEVEL 6 RESOURCES	
Inspection	Materials	-
	Tools	Checklist Form
	Labor	Mechanical Technician
Maintenance	Materials	oil, greas, accu water, cleaning liquid
	Tools	1 set of elevator maintenance equipment
	Labor	Mechanical Technician
Treatment	Materials	accumulator, floor buttons, emergency switches, steel straps, tire handles, anvils and combplates
	Tools	1 set of elevator treatment equipment
	Labor	Mechanical Technician
Testing	Materials	-
	Tools	1 set of elevator testing equipment, all instalation operations requirements testing form, equipements testing form, cable testing form
	Labor	Mechanical Technician

Table 4: Technical specification.

Technical Specification
a. Meet the regulations of Electric Lift, Aircraft Lift, and Transportation from the Ministry of Manpower of the Republic of Indonesia, the latest edition
b. Meet the SNI-03-2190-1999 standard or the latest on Passenger Lift Construction with Traction Motor.
c. Meet ASME A Standards 17.1 - 1996 regarding "Safety Code for Elevators and Escalators", or the latest edition.
d. Meet the PUIL standard (General Electrical Installation Regulations) that applies or the latest edition.
e. All equipment from the material and components must be new according to the brochure, published and in accordance with the specifications as described as well as on the plan drawings and are products that are still outstanding, produced regularly and must attach a letter of support.
f. Must be produced by the same factory (brand), so as to provide the possibility of being exchanged.

6 DISCUSSION

After all results are obtained from stage one to four, all elements are compiled to form a guideline for each work package. Can be seen for work type, the results obtained are in accordance with the research (Aryaningrum, 2018). In this study, there is a slight difference, namely the addition of one work type, namely gas work type. For work packages, there are several items omitted from the literature study based on Permen PU No. 24 Tahun 2008, Aryaningrum (2018) and Rajasa (2017). This adjusts to the needs of the UI based on the results of expert validation. In the alternative design / method section, show the type that might appear for each work package. For example, the detector is divided into a smoke detector and fire detector. This aims to ensure that implementation requirements are specific and can eliminate errors.

For the guideline format used, it can be adjusted based on user needs. In this study, the sample format used for each work package can be seen in table 3 and the appendix. The format used can show each component for each WBS level clearly, so that all the information needed can be summarized properly.

It can be concluded to obtain a guideline based on the WBS consisting of 8 stages. These stages consist of; determining work types, determining work packages, determining alternative designs/methods, determining activities, determining resources, determining implementation requirements, determining technical specifications and compiling all the guidelines components. The determination that occurs at each stage depends on the project carried out, so it needs a little modification if it is made or applied in a different place. Furthermore, for a smaller scope project, adjustments can be made to the number of levels used in the guideline making the process.

7 CONCLUSION

The guidelines produced from this study are very important and needed to be used as a reference for maintenance and treatment work. The goal is to achieve maximum quality results, so that it can minimize building damage that occurs. This can be achieved by using a WBS as a technique in the making process. By decomposing the scope of work to the smallest part, it is expected to cover all existing elements to the smallest part, without any exception. By applying the guidelines correctly as a preventive action, it will reduce the possibility of a bad phenomenon occurred.

This guideline can be used as a reference and later can be modified and applied to similar buildings or areas. Not only in the construction field, but the WBS technique used can also be applied to make guidelines in other fields.

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APPENDIX

IMPLEMENTATION REQUIREMENTS

INSPECTION

1. Elevator checks are carried out routinely every 1 (one) week.
2. Checking is done as follows:
   a. check the condition of the passenger elevator is functioning properly or there is damage.
   b. check the availability of oil and grease and rail oil.
   c. check the cleanliness condition of the door motor, casting, roof governor and CWT chain and its functions.
   d. Check the man save deflector sleave whether it works properly or not.
   e. Checking cleanliness conditions Slow down car switch rail, CWT rail, car door mechanic and outside door, hosway and elevator door seel and rail and its functions.
   f. Check the condition of the installation of the air phone, reset button, earthquake detector, lift control from BAS and the elevator door sensor, whether it works properly or not.
   g. Check the battery conditions, is it still functioning properly or need to add water batteries or not.
   h. Check the roof of the train (Top of Car), which includes inspection of emergency door access on the train (emergency exit), inspection of more speed safety switches (safety operated switches), inspection of broken tape switches, inspection of emergency stop switches, inspection limit switch at the top end of the launch room and inspection of door contacts (door contacts).
   i. Checking the engine room, which includes checking the value of the fuse (ampere), motor power rating (kW), motor rotation (rpm), frequency (Hertz), temperature rise motors and motor insulators.
   j. Check the pits, which include a counter weight check, monkey ladder inspection, basic pit cleaning checks, final limit switch checks, and directional limit switch checks.
   k. Checking the floor of the lobby of the elevator, which includes checking the condition of the floor door (hoistway entrance) with the requirements not ringing, not vibrating and the position is not tilted for door leaf meetings, the functions of the buttons, the function of indicator lights on each floor and the emegency key
   l. Check the cleanliness of the elevator room and the condition of the elevator machine.
   m. Check the condition of the gear box oil if there is a leak or not.
   n. Check the condition of the main shave and alternating whether it is functioning properly or not.
   o. Check whether the shave cover is open / closed.
3. Analyze whether maintenance / maintenance needs to be done.

MAINTENANCE

1. Prepare equipment and materials needed for elevator maintenance
2. Maintenance carried out as follows:
   a. Repair elevator repair if damage occurs.
   b. Add oil and grease and rail oil if it is reduced or empty.
   c. Perform dirty cleaning of the motorbike and make repairs if there is damage (jam).
   d. Perform cleaning clearance, roof governors and dirty CWT chains / comensstarting and make repairs if damage occurs.
   e. Manages to save save deflector sleave in case of damage and does not function properly.
   f. Perform cleaning Slow down car switch main rail, CWT rail, car door mechanic and outside door, hosway and elevator door seel and rail and make repairs if damage occurs.
   g. Repairing the air phone installation, reset button, earthquake detector, elevator control from BAS and elevator door sensor in case of damage.
   h. Add water batteries if needed.
   i. Repair floor buttons and emergency switches if they are not functioning properly.
   j. Cleaning the engine room, sliding and pit chambers from garbage, dust and oil spills.
   k. Regularly lubricate guide rails, governors, pesawawt, trains, doors, machines, buffers and equipment with the type of lubricant that suits the type and brand.
   l. Lubricating dry steel ropes your data shows signs of corrosion with special lubricating oils.
   m. Repairing If there is a leak in the gear box oil

TREATMENT

1. Prepare equipment and materials needed for elevator maintenance.
2. Treatment is carried out as follows:
   a. Change batteries if they don't work according to the specifications specified.
   b. Replacing damaged floor switches and emergency switches in accordance with specified specifications.
   c. Replace steel straps that show signs of cracking, breaking or breaking on some wire or rusting components and diametrnya shrinkage of more than 10% of the original size, in accordance with the specified specifications.
   d. Replace the tire handle that shows signs of cracking or breaking in accordance with the specified specifications.
   e. Replace damaged or broken / cracked runway and combplate according to specified specifications.

TESTING

a. Prepare equipment and materials needed for testing elevators.
b. Test cage speed, cage current and speed, current and voltage of the elevator motor.
c. Test upwards without load.
d. Do testing below without load.
e. Perform testing above with full load.
f. Perform testing below with full load (magnetic switch) open.
g. Carry out testing with full load (magnetic switch) closed.
h. Testing the brakes, left and right rails, r steel cables, steel cable governor tensioning, cage safety brakes, safety switches, governor and governor switches.