THE ANALYSIS OF PAVING BLOCK QUALITY CONTROL WITH VARIABLE APPROACHES (Study Of CV. Proton In Palu City)

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Abstrak

The purpose of this study was to determine how the quality control limit of Paving Block with Control By Variable Approach at CV. Proton in Palu City and find out whether the Paving Block quality process with the Control By Variable Approach is within the control limits. The research was conducted at CV. Proton in Palu City. The type of research used in this research is quantitative analysis. Data collection methods are carried out by interviews and field surveys. The sample in this study was 4 pieces of Paving Block / day for 20 days of research which was tested with a pressure load test. Data analysis was carried out using Check Sheet and control map with Control By Variable approach (X-bar and R-Chart). The results prove that the Paving Block quality process with the Control By Variable approach at CV. Proton is within the control limits. This is indicated by the results of UCL, CL, LCL on the X-bar and R-chart with control limits of 3-sigma and 2-sigma), which means that the quality control of this Paving Block is within the control limits so that the quality of the Paving Block belonging to CV. Proton is said to be good, and for both the graph results on the X-bar and R-chart show that almost all points are within the control limits, this is indicated by the absence of points that go outside the control limits, namely UCL and LCL, so that the quality control of the Paving Block owned by CV Proton is good.

Keywords: ***Keywords: Quality Control With Control By Variable Aproaches, Paving Block, Pressure Load Test***

INTRODUCTION

According to Saleh et al., (2019) economic development in Indonesia is supported by several sectors, one of which is the industrial sector. The industrial sector that is growing quite rapidly is the construction industry, where the construction industry sector supports progress in infrastructure and property development that requires materials such as concrete bricks or Paving Blocks. The Paving Block industry is one component that is often used in many developments both for personal use and for public facilities used by pedestrians, parks or yards. Indonesian people are almost familiar with concrete bricks for floors which are better known as Paving Blocks. Concrete brick or Paving Block is considered environmentally friendly because its use can provide water infiltration into the ground compared to using asphalt or concrete floors.

Indonesia already has an SNI related to concrete bricks (paving blocks), namely SNI 03-0691-1996 Concrete bricks (paving blocks), considering that the domestic concrete brick or paving block industry is very diverse, ranging from large industries to MSME industries. This SNI was developed by Technical Committee 91-02 Building Material Chemistry. Concrete brick or Paving Block is a composition of building materials made from a mixture of porland cement or similar hydraulic adhesives, water, and aggregate with or without other additives that do not reduce the quality of the Paving Block. Paving Blocks can be used as a solution so that flooding does not occur during the rainy season

because one of its functions is as infiltration land and maintenance and installation is quite easy to do. As for the classification, namely, quality A concrete bricks are used for public roads, quality B concrete bricks are used for parking lots, quality C concrete bricks are used for pedestrian sidewalks, and quality D concrete bricks are used for city parks or home yards (BSN, 1996).

At this time every company engaged in the manufacture of Paving Blocks is faced with increasingly rapid changes along with an increasingly competitive level of competition. This competition encourages Paving Block industry players to think about competitive strategies to survive in market share and focus on improving product quality in order to win the competition and retain customers. (Irawan dan Iing Pamungkas, 2020). One way to produce quality Paving Block products is through quality control. Quality control includes a series of activities used to ensure that products and services meet requirements and are continuously improved, which means that quality control is a process carried out to ensure that the products or services produced meet or exceed the established quality standards (Rizendra 2019). The purpose of Quality Control according to Ahmed (2019) is to ensure that the process is carried out in a way that is in accordance with established standards and then produces products or services that meet the desired quality.

Palu City is a city located in Central Sulawesi Province, Indonesia. Palu City is directly bordered by Donggala Regency to the West and North, Sigi Regency to the South, and Parigi Moutong Regency to the East. Almost all business sectors are developing and contributing income to Palu City, there are many types of businesses that are developing in Palu City, one of which is the business category of the cement goods processing industry which is currently widely used in the construction sector, such as road pavements and sidewalks, open area parking lots, housing and others. There are 68 companies in the Paving Block industry in Palu City. One of the companies in Palu City engaged in this industry is CV. Proton. In 2023 CV. Proton is a company that has the most production capacity of 14,400,000 pieces (Dinas Perindutrian Kota Palu, 2023).

CV. Proton was established in 2003 which was founded by Mr. Mistono who is the owner of CV. Proton. Various kinds of products owned by CV. Proton is already quite well known in various user circles, one of its consumers is PT Putra Palu Mandiri for Green Gawalise Mandiri housing, in Tatanga District which uses one of its products, namely Paving Block. CV. Proton is a company engaged in the concrete business, one of which is making paving of various sizes with good quality. CV. Proton continues to strive to improve the quality and quantity of products it produces in order to meet customer expectations. CV Proton produces as many as 6,000 to 8,000 pieces of Paving Block every day. Several choices of Paving Block colors available at CV. Proton which is also in demand and is a request from its consumers, namely brick red and black, this variation in the color of the Paving Block makes the Paving Block more beautiful and attractive in terms of its aesthetic value when used. CV. Proton also produces Paving Blocks, bricks and tiles. Apart from marketing its products in Palu, CV. Proton also markets its products to Poso, Morowali, Manado, West Sulawesi and other areas in Central Sulawesi.

Based on this description, the objectives of this study are (1) To know and understand how the Paving Block quality control process with the Control By Variable approach at CV. Proton in Palu City. (2) To find out whether the Paving Block quality control process with the Control By Variable approach at CV. Proton is at the control limit.

LITERATURE REVIEW

Quality Control

Increasingly fierce business competition requires companies to produce high quality products or producers must produce high quality products. This has an impact on consumer satisfaction because when consumers use a product,

consumers expect the goods or products to be in good condition, guaranteed and meet expectations. Quality control is a technique that needs to be carried out before the production process begins, during the production process to the final production result. Quality control must of course produce products and services that meet the standards set by the company (Carmelita, 2022).

Quality control is an activity carried out to ensure that production and production activities are carried out in accordance with the plan and if there are deviations, these deviations can be corrected, so that the expected results are achieved. Defining quality control is inseparable from what has been defined, that quality control is an engineering and management activity, with which we measure the quality characteristics of products, compare them with specifications or requirements and take appropriate remedial action if there is a difference between the actual appearance and the standard. Maintaining the quality of the products produced is a difficult task because a quality control is needed to keep the quality of the products produced in accordance with the standards that have been set. Good product quality and according to standards is achieved if the quality control is also good (Kartika, 2013).

Control Chart

Control charts were first invented by Dr. Walter A. Andrew Shewar in the United States in 1924. When Walter A. Andrew Shewar worked for Bell Labs in 1920. Dr. A.W.Shewhart and his colleagues continued to develop quality control charts from 1920-1930. In these techniques, the process of providing manufactured goods and services can be more predictable and more consistent. Control Chart is a graphical tool used to check and evaluate whether an activity/process is in quality control, and describes the statistical values of errors or defects in the results equipped with upper control limits, center lines and lower control limits (Besterfield, 1994).

A control map is a tool that can be graphically used to monitor and evaluate whether an activity/process is in statistical quality control or not so as to solve problems and produce quality improvements. This control map shows changes in data over time, but does not show the cause of the deviation even though the deviation will be visible on the control map. This control map is one of many tools for monitoring processes and controlling quality. These tools are for the development of methods for quality improvement and enhancement (Irwan & Haryono, 2015).

Control Chart Variable

Variable control maps are control maps for quality characteristics that can be measured on a numerical scale, such as length, thickness and acidity. This control map is used to control product quality during production that is variable and can be measured. This control map is divided into two, namely (Irwan & Haryono, 2015):

1. Average Control Map (X-Bar) which is used to find out the average of measurements between the examined subgroups.
2. Range control map (R-Chart) used to determine the range / difference between the largest measurement value and the smallest measurement value within the sub group being checked.

According to ontgomery (2009) the average or X-bar Control Map is used to detect changes in the average between subgroups and to test for central tendency or location effects. The X-bar function, namely, monitoring changes in a spread or distribution of an original variable in terms of its location (centering), whether the process is still within the control limits or not, and whether the average product produced is in accordance with predetermined standards whereas, the R-chart Control map is used to detect changes in variation within a subgroup and test the effect of dispersion (Dispersion Effect). The function of the R-chart, which is to monitor changes in terms of its Spread (spread), and

monitor the level of accuracy or accuracy of the process measured by finding the Range of the samples taken.

Paving Block

Paving blocks began to be recognized and used in Indonesia starting in 1977/1978. Paving Block itself has a variety of shapes to meet the tastes of users. The use of Paving Block is adjusted to the level of one's own needs. Paving Block is a composition of building materials made from a mixture of portland cement or other hydraulic adhesives, water and aggregate with or without other additives that do not reduce the quality of the concrete, (BSN, 1996). The following is a table of physical properties of Paving Block:

Table 1.
Physical Properties of Paving Blocks

Quality	Usability	Compressive Strength (Kg/cm^2)	
		Average	Min
A	Pavement	400	350
B	Parking Lot	200	170
C	Pedestrian	150	125
D	City Park	100	85

Sumber : (BSN, 1996)

METHODS

Frame Of Mind

The framework of this research is the analysis of Paving Block quality control at CV. Proton owned by Mr. Mistono, located on Jl. Trans Sulawesi KM 6, Tondo Village, Mantikulore District, Palu City, Central Sulawesi Province which is the main framework in this study, so as to determine the quality of Paving Block using the Control By Variable approach at CV. Proton.

During the research process, researchers used interviews and observation methods with informants to obtain information and data that suited the needs of researchers so that researchers could get accurate data so that it could facilitate researchers in writing and analyzing and drawing conclusions. The following is a chart of the research framework in Figure 1 below:

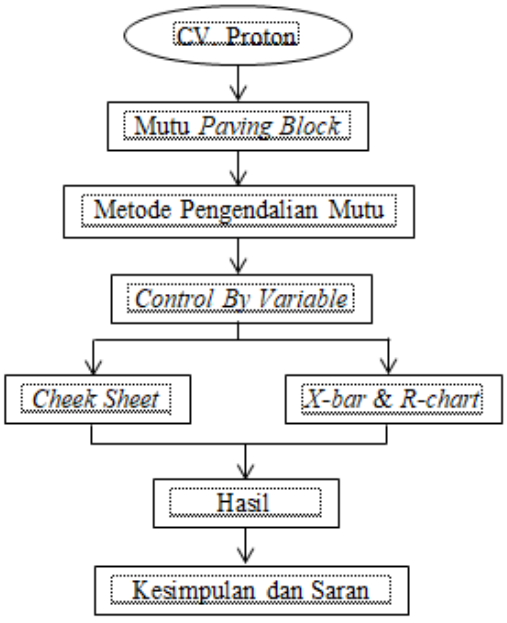

Figure 1. Frame of mind

RESEARCH RESULTS

1. Results

There are 3 Paving Block quality control processes at CV. Proton, which are as follows:

a. Pre-production. A good quality control process in the process of making Paving Blocks can be seen from the selection of raw materials for producing Paving Blocks which consists of selective selection of sand as raw material by CV. Proton uses sand from Kalukubula, Sigi Regency, three-wheel brand cement from Pantoloan, gravel and stone ash from Loli Village, Donggala Regency. all raw materials have passed the screening and cleaning process from kotaran such as leaves so as to get fine and clean sand material. If the stock of raw materials starts to run low, usually an order is made. all ordered raw materials will be directly delivered to CV. Proton.

b. During the Production Process. The workforce that carries out the production process is 35 employees divided into three production sites. each production site usually consists of 6 or 7 employees. Production equipment facilities at CV. Proton is very complete, consisting of 3 Hydraulic Press machines (molding machines), 3 mixer / mixer machines, and 6 trucks to deliver products to consumers. 35 employees have their respective duties consisting of screening sand, mixing raw materials, drying it is carried out by 4 employees, while for printing machine operators it is done by 3 people. Each employee can work on all tasks, so it is not monotonous to do just one task so that they can work on each other or handle other tasks. Supervision in the ongoing production process, the business owner supervises directly and indirectly using CCTV in his room on the performance of his employees in doing their work. to produce quality Paving Blocks, the material mixing process is carried out with a mixture of comparisons, namely 1: 1: 1: 2 / arco. Paving Block products that are ready for sale are at least 1 week old and a maximum of 3 months after the drying process. The Paving Block production process is carried out when the Paving Block stock is running out or the order increases, the production process will be carried out again.

c. Post-production process. After the Paving Block is produced, the next process is drying, storing and shipping products to consumers. To get quality Paving Blocks, CV. Proton carries out the drying and storage process in the factory yard by drying the paving blocks that have been made in the factory yard. For watering Paving Block is done before drying. Usually in the morning the Paving Block is finished in print then the paving is stacked then in the afternoon watering is carried out. For the preparation of Paving Blocks to be dried, they are usually arranged in a place that is still empty, there is no numbering or giving certain codes based on the length of time drying. This is because the employees can find out the time of the length of time the paving blocks are dried. As for the delivery of consumer products in accordance with the wishes of consumers, usually for around Palu City, delivery is carried out by CV. Proton to the hands of consumers, if the distance of delivering products to consumers is far enough, delivery costs are usually charged, for example to Donggala or usually consumers come directly to pick up the ordered products themselves. Products that will be sent to consumers usually pass checks to ensure that there are no cracked or broken products, but if the product reaches the consumer there are defects such as cracks and breaks during the trip it is the responsibility of the CV. Proton. CV. Proton will replace the cracked and broken products. Payment is usually made after the product reaches consumers.

Based on the information data obtained from the research results of the pressure load test on the Paving Block owned by CV. Proton can then be processed using POM For Windows Software to see this control process is still within the control limits, it can be seen using the control map graph output. The X-Bar and R-chart control map charts can be shown as follows:Peta Kendali *X-Bar* dan *R Chart* (Batas-Batas Kontrol 3-Sigma)

3 sigma (99.73%)	X-bar Chart	Range Chart
UCL (Upper control limit)	417,3904	185,0588
CL (Center line)	358,2722	81,095
LCL (Lower Control Limit)	299,1539	0

Figure 2. Results of UCL, CL, LCL X-bar and R-chart (3-Sigma Boundaries)

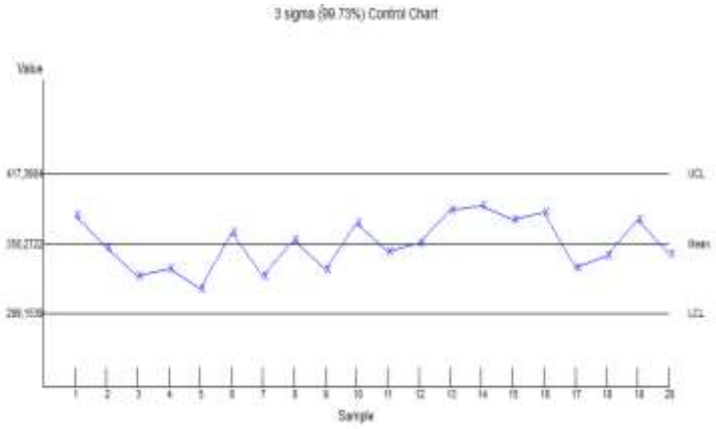

Figure 3. X-bar Control Map (3-Sigma Control Boundaries)

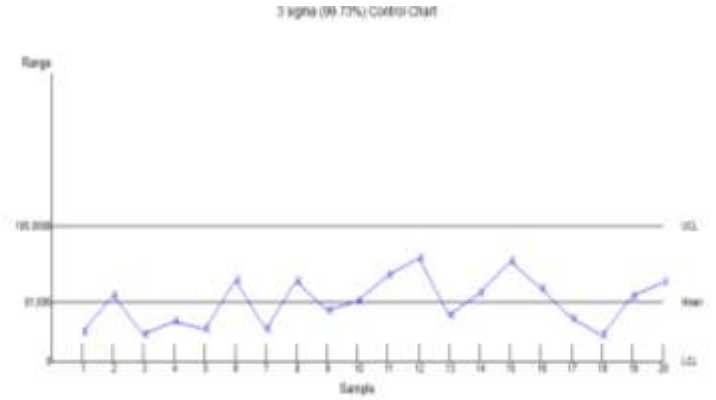

Figure 4. R-chart Control Map (3-Sigma Control Boundaries)

Based on the output of the X-bar and R-chart control maps using the 3 Sigma limits in figures 2 to 4, it shows that almost all points are within the control limits shown from the X-bar results for CL of 358.272, UCL of 417.390 and LCL of 299.154, and the R-chart results for CL of 81.095, UCL of 185.0588 and LCL of 0, which means that the quality control of Paving Blocks using X-bar and R-chart control maps is within the control limits so that the quality of Paving Blocks owned by CV. Proton is said to be good based on tests conducted using Control By Variable so that it does not require improvement. Improvements are made if the production process still experiences deviations, meaning that the proportion point is outside the control limits (UCL and LCL).Peta Kendali *X-Bar* dan *R Chart* (Batas-Batas Kontrol 2-Sigma).

2 sigma (95.45%)	X-bar Chart	Range Chart
UCL (Upper control limit)	397,6843	150,4042
CL (Center line)	358,2722	81,095
LCL (Lower Control Limit)	318,86	27,0317

Figure 5. Results of UCL, CL, LCL X-bar and R-chart (2-Sigma Boundaries)

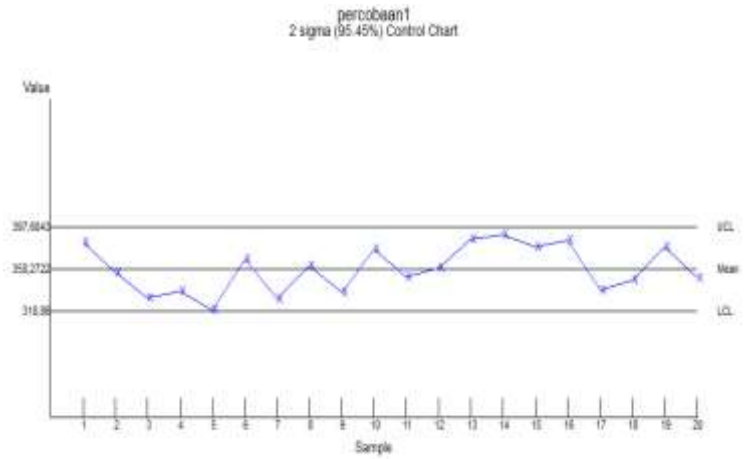

Figure 6. X-bar Control Map (2-Sigma Control Boundaries)

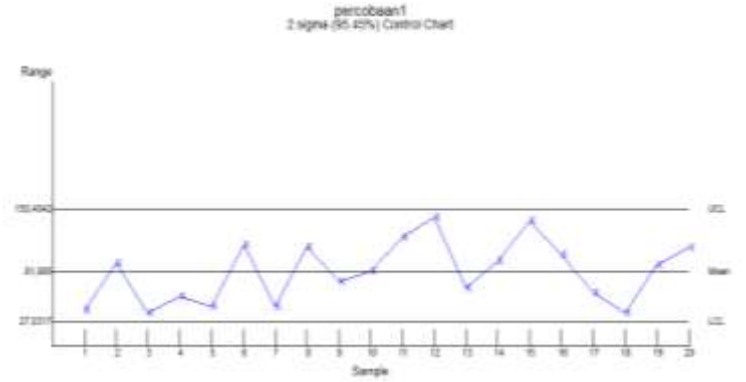

Figure 7. R-chart Control Map (2-Sigma Control Boundaries)

Based on the output of the X-bar and R-chart control maps using the 2 Sigma limit in figures 5 to 7, it shows that almost all points are within the control limits shown from the X-bar results for CL of 358.2722, UCL of 397.6843, and LCL of 318.86, and the R-chart results obtained CL of 81.095, UCL of 150.4042, and LCL of 27.0317 which means that the quality control of Paving Block using X-bar and R-chart control maps is within the control limits so that the quality of Paving Block owned by CV. Proton is said to be good based on tests conducted using Control By Variable so that it does not require improvement. Improvements are made if the production process still experiences deviations, meaning that the proportion point is outside the control limits (UCL and LCL).

2. Research

Based on the observations made, the authors see that the quality control carried out on Paving Blocks at CV. Proton in Palu City is only testing physically, so the author uses a statistical test. Where this quality control analysis is used to determine the quality of the Paving Block that has been produced based on taking 4 samples / day which is carried out for 20 working days with a total sample of 80 pieces of Paving Block and tested using the pressure load test. To determine the quality of the Paving Block, it can be done by looking at the variable control map using the X-Bar and R Chart.

Based on the control maps as shown in Figures 2 to 7, it can be seen that the dot pattern of the X-Bar and R-Chart graphs using the control limits of 3, and 2 sigma fluctuates, the pattern of these points is still around the UCL to LCL, which means that the quality control of this Paving Block is within the control limits so that the quality of

the Paving Block owned by CV. Proton is said to be good based on tests conducted using Control By Variable so that it does not require improvement.

This is in accordance with Ariani (2005), that a process is said to be in control if the observation value is within the UCL and LCL limits. A process is said to be under control if the patterns or points of the plot variation values on the control map have a pattern that there are 2 or 3 points close to the center line, the points close to the control limits are only a few, the points are back and forth between the center line, the points on both sides of the center line are equal in number, and there are no points that cross the control limits.

CONCLUSION

The quality control process applied by the Paving Block production business at CV. Proton in Palu City is carried out with 3 approaches, namely, pre-production control, during the production process, and post-production. Based on data processing using quality control tools, namely variable control maps in product quality control, the following can be identified:

1. Paving Block quality process with Control By Variable approach at CV. Proton is within the control limits. This is indicated by the results of UCL, CL, and LCL on the X-bar and R-chart with control limits of 3-sigma and 4-sigma, which means that the quality control of this Paving Block is within the control limits so that the quality of the Paving Block belonging to CV. Proton is said to be good.
2. For the results of the graphs on the X-bar and R-chart with control limits of 3-sigma and 2-sigma, it shows that almost all points are within the control limits, this is indicated by the absence of points outside the control limits, namely UCL and LCL, so that no improvement is required.

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