Suggestion of Raw Material Warehouse Layout Improvement Using Class-Based Storage Method (case study of PT. XYZ)

by Lina Gozali

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Monday, 3 Agustus, 2020

Room : Conference Room 5
Time : 13.00 – 15.00
Track : Mechanical & Industrial Engineering

NO	SCHEDULE	PAPER TITLE	AUTHORS	INSTITUTION
1	13.00-13.15	SPHC Material Inventory Control Analysis in Project VI01 Centralized By The EOQ Method In Automotive Company Indonesia	Bethriza Hanum, Jakfat Haekal, Dian Eko Prasetio	Universitas Mercu Buana, Universitas Islam As-Syafiiyah
2	13.15-13.30	Application of Single Minute Exchange of Die (SMED) on HPDC DC350T Line Casting to Reduce Changeover Time of Dies Engine Block	Hendra, Fandi Irawan Setioko, Yogy Yayang Saputra, Moh. Haris, Dady Kadarsan, Hernadewita	University of Sultan Ageng Tirtayasa, Mercu Buana University
3	13.30-13.45	Implementation of Quality Function Deployment (QFD) to Improve Service Quality at Marine Cilandak Hospital	Hermiyetti, Jacob Indra Efrialdi, Chiven, Rahmawati, Ramli, Hernadewita	University of Bakrie, Mercu Buana University
4	13.45-14.00	Overall Equipment Effectiveness (OEE) and Six Big Losses Analysis in Laboratory Industry: A Case Study in PT. IUS Jakarta	Hernadewita, Afifulloh, Susiyanti Nurjanah, Ahmad Rozak, Amalina Shadrina, Hendra	Mercu Buana University, University of Sultan Ageng Tirtayasa
5	14.00-14.15	Experimental Study on The Crashworthiness Response of Hybrid Al/GFRP Crash Box Structures Under Axial Compression Loading	Citra Asti Rosalia, Ichsan Setya Putra, Tatacipta Dirgantara, Annisa Yusuf, Bambang K. Hadi	Institut Teknologi Bandung
6	14.15-14.30	Forecasting using Artificial Neural Networks and Aggregate Production Planning and Dynamic Model of Inventory Control for Rib and Single Knit Fabric	Lina Gozali	Universitas Tarumanagara
7	14.30-14.45	Suggestion of Raw Material Warehouse Layout Improvement using Class-Based Storage Method (Case Study of PT XYZ)	Lina Gozali, Iveline Anne Marie, Natalia	Universitas Tarumanagara
8	14.45– 15.00	A Proposal of Image-Based Measurement instead of Laser-Based Measurement for Indoor Application	John Reigton Hartono, Oei Fuk Jin	Universitas Tarumanagara

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SUGGESTION OF RAW MATERIAL WAREHOUSE LAYOUT IMPROVEMENT USING CLASS-BASED STORAGE METHOD (CASE STUDY OF PT XYZ)

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Suggestion of Raw Material Warehouse Layout Improvement Using Class-Based Storage Method (case study of PT. XYZ)

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Abstract. PT XYZ is a manufacturing company engaged in advertising and producing signage. The problem that occurs in the raw material warehouse and has no fixed rules in raw materials placement. This study aims to redesign the layout of raw material warehouse for signage manufacturing company to reduce the distance of raw materials movement and raw materials arrangement. The method used in this research is a class-based storage method. The improvements of raw material warehouse layout applied by considering the order of activities, class formation, current warehouse area, and calculating the total distance of the movement. Based on the data calculation results and improvement reduce the space of warehouse requirement for amount 23,98% to 16.12%. The distance of raw materials movement also decreased, from 755.211 m to 522.587 m. First layout alternative gives the best solution that will reduce material handling costs, will reduce the distance of raw materials movement, and will reduce the time of raw materials movement.

Keywords: Layout, Warehouse, Class-Based Storage, Space Requirements, Distance of Movement

1. Introduction

Storage is a place to store goods, both raw materials that will be processed and finished goods that ready to be marketed. [1]

PT XYZ is an advertising contractor engaged in the design, production and installation of media branding. PT XYZ manufactures signage. Because of the signage demand is increasing, it requires more raw materials. The raw material storage system at PT XYZ is not well structured. It means the placement of raw material is not based on the total frequency of receiving and delivering raw materials, so storage of raw materials had not been neatly arranged.

PT XYZ will buy a large-sized machine that will be placed near the production area. The consideration of the wider of raw material warehouse, the company decided to re-layout the raw material warehouse and replace it to the production area. The aim of this paper finding the best layout for storage area which reducing the total distance of raw materials movement, arranging raw materials based on total revenue and expenditure, utilizing the warehouse space raw materials with class-based storage method. The distance measurement of the raw materials displacement calculation will applied the rectilinear method.

2. Literature Review

2.1. *Warehouse Function*
The function of warehousing in general is to maximize the use of existing resources while maximizing service to customers with limited resources. The important functions of warehousing that made the raw material easy to reach and remained in good conditions. [1]

2.2. *Raw Material*
The raw materials such as tobacco, paper, plastic or other materials that are obtained from natural sources or are purchased from suppliers or are processed for the production process in manufacturing companies. [2]

2.3. *Warehouse Layout Design*
Warehousing has a function to maximize the utility of various resources in order to fulfill customer demand or maximize customer demand within the limited resources[3]. Therefore, warehouse layout planning can maximize the need for space, equipment, workers, and also the ease of accessing and using materials available in raw material warehouses. [4]

2.4. *Transfer of Raw Materials*
Material transfer is a very important activity in production activities and is closely related to the planning of the layout of production facilities[5]. When transferring material, there will be no change in the shape, dimensions, or physical properties of the material to be moved[6]. Therefore, the material transfer activity is carried out by moving the material at the shortest possible distance by arranging the layout of the existing production facilities. [7,8,9,10]

2.5. *Warehouse Layout Method*
There are 4 methods that can be used to design a warehouse layout in product storage or placement, namely Dedicated Storage Policy, Random Storage Policy, Class-Based Storage Policy, and Shared Storage Policy. Following is an explanation of each method: [11]

1. Dedicated Storage Policy
   Dedicated storage or also called the fixed lot storage method is a warehouse storage method that uses a specific location for each component or item stored.
2. Random Storage Policy
   Random storage or also called the floating lot storage method is a storage method that makes the storage location for a particular component or product change all the time or in other words the component or product does not have a definite location or location.
3. Class-Based Storage Policy
   Class-Based storage is a storage method that is between the rules of dedicated storage and random storage so that this method becomes more flexible and widely used. Using this method, products or components are divided into three, four, or five classes. Products that are fast moving products are categorized as class A products and next are class B products, then class C products, and so on. Dedicated storage rules are used to determine class location, while random storage is used to determine location in class.
4. Shared Storage Policy
   In an effort to reduce the need for storage space in dedicated storage methods, warehouse managers use variations of the dedicated storage method as a solution. Different components use the same storage slot but at different times, even though only one component occupies one slot. This storage model is called shared storage.

2.6. *Distance Calculation Method*

To be able to calculate the distance of the movement of raw materials, the data that must be obtained is the coordinates of the central point of raw materials as well as the coordinates of the points of reception and expenditure. The coordinates of the central point of the raw material can be calculated using the formula of the combined center of gravity of homogeneous objects [1].

$$x_o = \frac{A_1x_1 + A_2x_2 + A_3x_3 + \cdots + A_nx_n}{A_1 + A_2 + A_3 + A_4 + \cdots + A_n} = \frac{\sum_{i=1}^{n} A_i x_i}{\sum_{i=1}^{n} A_i} \quad \ldots\ldots(1)$$

$$y_o = \frac{A_1y_1 + A_2y_2 + A_3y_3 + \cdots + m_ny_n}{A_1 + A_2 + A_3 + A_4 + \cdots + A_n} = \frac{\sum_{i=1}^{n} A_i y_i}{\sum_{i=1}^{n} A_i} \quad \ldots\ldots(2)$$

2.7. Rectilinear Method

Rectilinear method is a method used to calculate the distance of raw material transfer where the distance measured follows the perpendicular path. Rectilinear distance measurements are often used because of their easy calculations, easy to understand and more appropriate for some problems, for example to determine the distance between cities, the distance between facilities where the raw material only can be moved in a straight line. Distances are measured along a path using one perpendicular line to another[12].

$$D_{i,j} = |x_i - x_j| + |y_i - y_j| \quad \ldots\ldots(3)$$

3. Research Methodology

The research methodology is a knowledge that examines the provisions regarding the methods used in research. The research methodology used in this study is illustrated in the flow chart which shown in Figure 1.

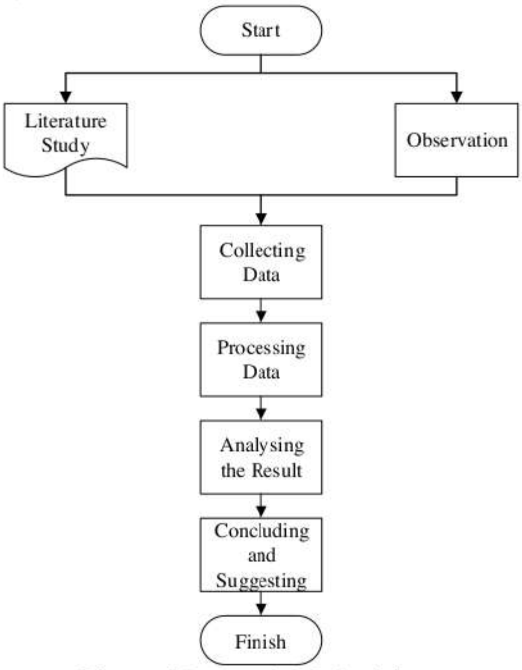

Figure 1 Research Methodology

4. Results and Discussion

4.1. Current Raw Material Warehouse Layout
Warehouse layout at PT XYZ has a total length 26,5 m and a total width 9,6 m. Warehouse has a few block which have the different size and also the capacity of storage. The current layout of the raw material warehouse can be seen in Figure 2.

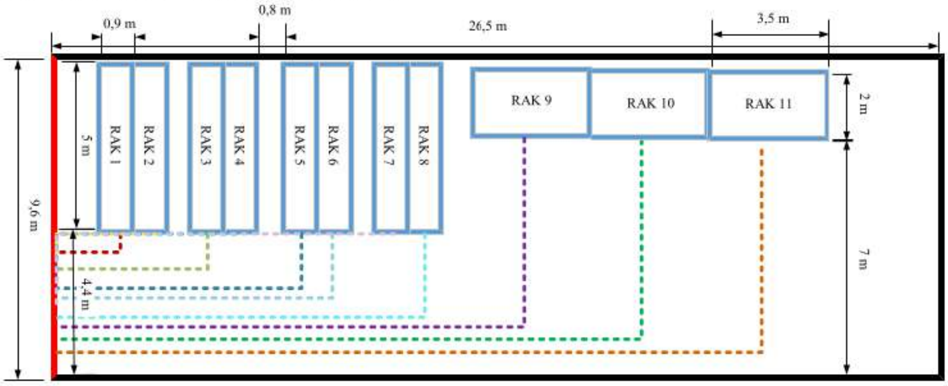

Figure 2 Current Raw Material Warehouse Layout

4.2. The Current Space Requirement
Warehouse area: 254,4 m^2
Total area of available storage blocks: 61 m^2
Space requirement calculation:

$$\text{Space requirement} = \frac{Total\ area\ of\ available\ storage\ blocks}{warehouse\ area}\ x\ 100\% \quad (4)$$

$$\text{Space requirement} = \frac{61\ m2}{254{,}4\ m2}\ x\ 100\%$$

Space requirement = 23,98%

4.3. Calculation of the total distance of movement of initial raw materials
The coordinates of the entry point (receiving) and the center of exit point (delivering) are (2,0) in meters. To find out the displacement distance, data is needed in the form of the frequency of raw material displacement and the distance of the storage block from the entrance and the exit. The distance of raw material displacement can be calculated by the rectilinear method. The results of the calculation of the initial raw material displacement distance can be seen in Table 1.

Table 1 Distance of Initial Raw Material Receiving and Delivering

No.	Raw Materials	Frequency of Receiving	Distance Movement (m)	Total Movement (m)	Frequency of Delivering	Distance Movement (m)	Total Movement (m)
1	Steel box 30x30x1.5mm-6m	3.671	7,85	28.817,35	3.633	7,85	28.519,05
2	Steel box 30x60x1.5mm-6m	455	7,85	3.571,75	455	7,85	3.571,75
3	Steel box 40x40x1.2mm-6m	596	7,85	4.678,6	595	7,85	4.670,75
4	Steel box 40x40x1.5mm-6m	236	6,85	1.616,6	267	6,85	1.828,95
5	Steel box 100x100x4.5mm-6m	209	6,85	1.431,65	209	6,85	1.431,65
6	Steel box 20x20x1.5mm-6m	358	6,85	2.452,3	373,5	6,85	2.558,475
7	Steel box 25x25x2mm-6m	1.976	10,65	21.044,4	1.820	10,65	19383
8	Steel box 20x40x1.2mm-6m	992	10,65	10.564,8	609	10,65	6.485,85
9	Steel box 30x30x3mm-6m	4.777	10,65	50.875,05	5.052,66	10,65	53.810,83
10	Steel box 40x40x4mm-6m	638	9,65	6.156,7	593	9,65	5.722,45
11	Steel box 50x50x5mm-6m	875	9,65	8.443,75	941	9,65	9.080,65
12	Aluminium box 12x12x2mm-6m	205	9,65	1.978,25	225,45	9,65	2.175,593
13	Aluminium box 25x25x2mm-6m	1.274	5,25	6.688,5	1.253,5	5,25	6.580,875
14	Aluminium box 19x19x2mm-6m	1.202	5,25	6.310,5	1.115	5,25	5.853,75

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No.	Raw Materials	Frequency of Receiving	Distance Movement (m)	Total Movement (m)	Frequency of Delivering	Distance Movement (m)	Total Movement (m)
15	Aluminium As Diameter 6mm-6m	1.984	5,25	10.416	1.928	5,25	10.122
16	Aluminium Extrude 85602-5m	764	4,25	3.247	633	4,25	2.690,25
17	Aluminium Extrude (Fin A) 181307050	5.507	4,25	23.404,75	5.169	4,25	21.968,25
18	Aluminium Extrude (Fin B) 181307051	177	4,25	752,25	141	4,25	599,25
19	Aluminium Extrude 181307052 6m Mf	167	13,25	2.212,75	145	13,25	1.921,25
20	Aluminium Extrude 181307053-3.9m Mf	544	13,25	7.208	544	13,25	7.208
21	Aluminium Extrude 18140714-3.9m	2.202	13,25	29.176,5	2.151	13,25	28.500,75
22	Aluminium Extrude 7261/Ca/5m	717	12,25	8.783,25	629	12,25	7.705,25
23	Aluminium Extrude Tention 181307054	3.282	12,25	40.204,5	3.418	12,25	41.870,5
24	Steel Plate 1220x2440x6mm	20	14,85	297	19	14,85	282,15
25	Steel Plate 1220x2440x8mm	11	14,85	163,35	10	14,85	148,5
26	Steel Plate 1220x2440x10mm	80	14,85	1.188	81	14,85	1.202,85
27	Steel Plate 1220x2440x15mm	16	14,85	237,6	5	14,85	74,25
28	Steel Plate 1220x2440x0.8mm	434	14,85	6.444,9	367	14,85	5.449,95
29	Steel Plate 1220x2440x1mm	216	20,3	4.384,8	196,5	20,3	3.988,95
30	Steel Plate 1220x2440x1.2mm	604	20,3	12.261,2	594,5	20,3	12.068,35
32	Steel Plate 1220x2440x2mm	651	20,3	13.215,3	653,5	20,3	13.266,05
33	Steel Plate 1000x2000x1.5mm	528	20,3	10.718,4	482	20,3	9.784,6
34	Acp Alpolic Silver White Metalic	370	23	8.510	228	23	5.244
35	Acp Alcolite Red Glosy (Rg-05)	202	23	4.646	222	23	5.106
36	Acp Alcolite Bright Silver (Bs-0	184	23	4.232	127,6	23	2.934,8
37	Acrylic Susu (445) 1220x2440x4mm	472,5	23	10.867,5	462,5	23	10.637,5
38	Acrylic Plexiglas Xt 070	80	23	1.840	52,5	23	1.207,5
39	Acrylic Merah Shinkolite Dx R747	150	23	3.450	60	23	1.380
	Total			**385.552,1**			**369.658,9**

4.4. Classification of Raw Material Classes

Classification of raw material based on the amount of raw materials received and delivered. This amount separated the classes into A, B, and C category based on the percentage of usage. Classification of raw shows in Table 2.

Table 2 Raw Materials classification

No.	Raw Material	Usage Persentation (%)	Total Persentation (%)	Class
1	Aluminium Extrude (Fin A) 181307050	14,1%	76,6	A
2	Steel Elbow 30x30x3mm-6m	13,0%		
3	Steel Box 30x30x1.5mm-6m	9,7%		
4	Aluminium Extrude Tention 181307054	8,9%		
5	Aluminium Extrude 18140714-3.9m	5,8%		
6	Steel box 25x25x2mm-6m	5,0%		
7	Acrylic Susu (445) 1220x2440x4mm	4,1%		
8	Aluminium Box 25x25x2mm-6m	3,3%		
9	Aluminium Box 19x19x2mm-6m	3,1%		
10	Acp Alpolic Silver White Metalic	2,6%		
11	Aluminium Plate 1220x2440x1.5mm	2,5%		

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No.	Raw Material	Usage Persentation (%)	Total Persentation (%)	Class
12	Steel Elbow 50x50x5mm-6m	2,4%		
13	Steel Box 20x40x1.2mm-6m	2,1%		
14	Acp Alcolite Red Glosy (Rg-05) F	1,9%		
15	Aluminium Extrude 85602-5m	1,8%		
16	Aluminium Extrude 7261/Ca/5m	1,8%		
17	Steel box 40x40x1.2mm-6m	1,6%		
18	Steel Elbow 40x40x4mm-6m	1,6%		
19	Aluminium Plate 1220x2440x2mm	1,5%	17,6	
20	Aluminium Extrude 181307053-3.9m Mf	1,4%		B
21	Acp Alcolite Bright Silver (Bs-0	1,4%		
22	Aluminium Plate 1220x2440x1.2mm	1,3%		
23	Steel Box 30x60x1.5mm-6m	1,2%		
24	Aluminium Plate 1000x2000x1.5mm	1,1%		
25	Steel Box 20x20x1.5mm-6m	1,0%		
26	Aluminium Plate 1220x2440x0.8mm	0,9%		
27	Acrylic Merah Shinkolite Dx R747	0,9%		
28	Steel Box 40x40x1.5mm-6m	0,7%		
29	Steel Box 100x100x4.5mm-6m	0,6%		
30	Acrylic Plexiglas Xt 070 Opal Wh	0,6%		
31	Aluminium Box 12x12x2mm-6m	0,6%		
32	Aluminium Plate 1220x2440x1mm	0,5%		C
33	Aluminium Extrude (Fin B) 181307051	0,4%		
34	Aluminium Extrude 181307052 6m Mf	0,4%	5.8	
35	Steel Plate 1220x2440x10mm	0,2%		
36	Steel Plate 1220x2440x6mm	0,0%		
38	Steel Plate 1220x2440x8mm	0,0%		
39	Steel Plate 1220x2440x15mm	0,0%		

4.5. The First Alternative of Raw Material Warehouse Layout

After grouping raw materials based on the amount of receiving and delivering, it can create a new raw material warehouse layout. The raw material warehouse at PT XYZ has a total length 26,5 m and total width 9,6 m. The warehouse consists of several blocks that have different sizes and storage capacities.

The First Alternative of Raw Material Warehouse Layout can be seen in Figure 3.

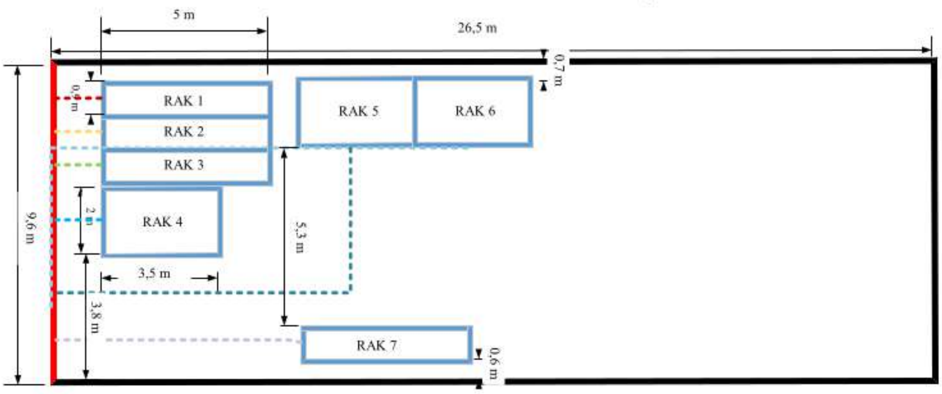

Figure 3 The First Alternative of Raw Material Warehouse Layout

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4.5.1. The First Alternative Space Requirement

Warehouse area: 254,4 m^2

Total area of available storage blocks: 41 m^2

Space requirement calculation:

$$\text{Space requirement} = \frac{41\,m2}{254{,}4\,m2}\ x\ 100\%$$

Space requirement = 16,12%

4.5.2. Calculation of the Total Distance of Movement of Initial Raw Materials of First Layout

The results of the calculation of the distance of movement of raw materials for the first alternative can be seen in Table 3.

Table 3 Distance of Initial Raw Material Receiving and Delivering The First Alternative

No.	Raw Materials	Frequency of Receiving	Distance Movement (m)	Total Movement (m)	Frequency of Delivering	Distance Movement (m)	Total Movement (m)
1	Steel Box 30x30x1.5mm-6m	3.671	7,75	28.450,25	3.633	7,75	28.155,75
2	Steel Box 30x60x1.5mm-6m	455	6,5	2.957,5	455	6,5	2.957,5
3	Steel Box 40x40x1.2mm-6m	596	4,75	2.831	595	4,75	2.826,25
4	Steel Box 40x40x1.5mm-6m	236	7,75	1.829	267	7,75	2.069,25
5	Steel Box 100x100x4.5mm-6m	209	10	2.090	209	10	2.090
6	Steel Box 20x20x1.5mm-6m	358	5,75	2.058,5	373,5	5,75	2.147,625
7	Steel Box 25x25x2mm-6m	1.976	6,5	12.844	1.820	6,5	11.830
8	Steel Box 20x40x1.2mm-6m	992	5,75	5.704	609	5,75	3.501,75
9	Steel Elbow 30x30x3mm-6m	4.777	7,75	37.021,75	5.052,66	7,75	39.158,12
10	Steel Elbow 40x40x4mm-6m	638	6,5	4.147	593	6,5	3.854,5
11	Steel Elbow 50x50x5mm-6m	875	5,75	5.031,25	941	5,75	5.410,75
12	Aluminium Box 12x12x2mm-6m	205	10	2.050	225,45	10	2.254,5
13	Aluminium Box 25x25x2mm-6m	1.274	5,75	7.325,5	1.253,5	5,75	7.207,625
14	Aluminium Box 19x19x2mm-6m	1.202	5,75	6.911,5	1.115	5,75	6.411,25
15	Aluminium As Dia 6mm-6m	1.984	5,75	11.408	1.928	5,75	11.086
16	Aluminium Extrude 85602-5m	764	7,75	5.921	633	7,75	4.905,75
17	Aluminium Extrude (Fin A) 181307050	5.507	7,75	42.679,25	5.169	7,75	40.059,75
18	Aluminium Extrude (Fin B) 181307051	177	13	2.301	141	13	1.833
19	Aluminium Extrude 181307052 6m Mf	167	13	2.171	145	13	1.885
20	Aluminium Extrude 181307053-3.9m Mf	544	6,5	3.536	544	6,5	3.536
21	Aluminium Extrude 18140714-3.9m	2.202	6,5	14.313	2.151	6,5	13.981,5
22	Aluminium Extrude 7261/Ca/5m	717	7,75	5.556,75	629	7,75	4.874,75
23	Aluminium Extrude Tention 181307054	3.282	6,5	21.333	3.418	6,5	22.217
24	Steel Plate1220x2440x6mm	20	12,5	250	19	12,5	237,5
25	Steel Plate1220x2440x8mm	11	10,5	115,5	10	10,5	105
26	Steel Plate1220x2440x10mm	80	10,5	840	81	10,5	850,5
27	Steel Plate1220x2440x15mm	16	12,5	200	5	12,5	62,5
28	Aluminium Plate 1220x2440x0.8mm	434	12,5	5.425	367	12,5	4.587,5
29	Aluminium Plate 1220x2440x1mm	216	12,5	2.700	196,5	12,5	2.456,25
30	Aluminium Plate 1220x2440x1.2mm	604	10,5	6.342	594,5	10,5	6.242,25
31	Aluminium Plate 1220x2440x1.5mm	1.136	3,5	3.976	1.114,5	3,5	3.900,75
32	Aluminium Plate 1220x2440x2mm	651	3,5	2.278,5	653,5	3,5	2.287,25
33	Aluminium Plate 1000x2000x1.5mm	528	10,5	5.544	482	10,5	5.061
34	Acp Alpolic Silver White Metalic	370	3,5	1.295	228	3,5	798
35	Acp Alcolite Red Glosy (Rg-05)	202	3,5	707	222	3,5	777
36	Acp Alcolite Bright Silver (Bs-0)	184	10,5	1.932	127,6	10,5	1.339,8
37	Acrylic Susu (445) 1220x2440x4mm	472,5	3,5	1.653,75	462,5	3,5	1.618,75
38	Acrylic Plexiglas Xt 070 Oval	80	12,5	1.000	52,5	12,5	656,25
39	Acrylic Merah Shinkolite Dx R747	150	12,5	1.875	60	12,5	750
	Total			**266.604**			**255.983,9**

4.6. The Second Alternative of Raw Material Warehouse Layout

The Second Alternative of Raw Material Warehouse Layout can be seen in Figure 4.

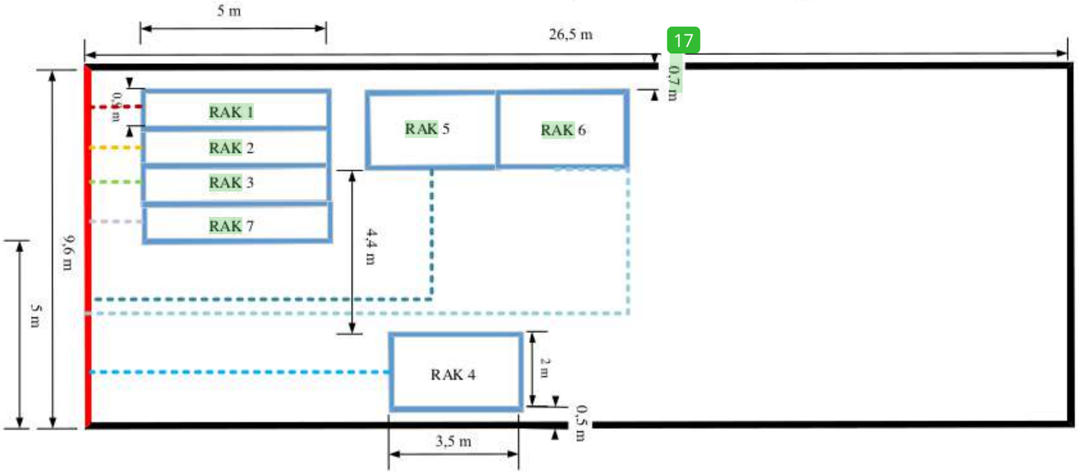

Figure 4 The Second Alternative of Raw Material Warehouse Layout

4.6.1. The Second Alternative Space Requirement

Warehouse area: 254,4 m^2

Total area of available storage blocks: 41 m^2

Space requirement calculation:

$$\text{Space requirement} = \frac{41\,m2}{254{,}4\,m2}\ x\ 100\%$$

Space requirement = 16,12%

4.6.2. Calculation of the Total Distance of Movement of Initial Raw Materials

The results of the distance of raw material for the second alternative can be seen in Table 4.

Table 4 Distance of Initial Raw Material Receiving and Delivering The Second Alternative

No.	Raw Materials	Frequency of Receiving	Distance Movement (m)	Total Movement (m)	Frequency of Delivering	Distance Movement (m)	Total Movement (m)
1	Steel box 30x30x1.5mm-6m	3.671	7,75	28.450,25	3.633	7,75	28.155,75
2	Steel Box 30x60x1.5mm-6m	455	6,5	2.957,5	455	6,5	2.957,5
3	Steel Box 40x40x1.2mm-6m	596	4,75	2.831	595	4,75	2.826,25
4	Steel Box 40x40x1.5mm-6m	236	6,2	1.463,2	267	6,2	1.655,4
5	Steel Box 100x100x4.5mm-6m	209	6,2	1.295,8	209	6,2	1.295,8
6	Steel Box 20x20x1.5mm-6m	358	5,75	2.058,5	373,5	5,75	2.147,625
7	Steel Box 25x25x2mm-6m	1.976	6,5	12.844	1.820	6,5	11.830
8	Steel Box 20x40x1.2mm-6m	992	5,75	5.704	609	5,75	3.501,75
9	Steel Elbow 30x30x3mm-6m	4.777	7,75	37.021,75	5.052,66	7,75	39.158,12
10	Steel Elbow 40x40x4mm-6m	638	6,5	4.147	593	6,5	3.854,5
11	Steel Elbow 50x50x5mm-6m	875	5,75	5.031,25	941	5,75	5.410,75
12	Aluminium Box 12x12x2mm-6m	205	6,2	1.271	225,45	6,2	1.397,79
13	Aluminium Box 25x25x2mm-6m	1.274	5,75	7.325,5	1.253,5	5,75	7.207,625
14	Aluminium Box 19x19x2mm-6m	1.202	5,75	6.911,5	1.115	5,75	6.411,25
15	Aluminium As Dia 6mm-6m	1.984	5,75	11.408	1.928	5,75	11.086
16	Aluminium Extrude 85602-5m	764	7,75	5.921	633	7,75	4.905,75
17	Aluminium Extrude (Fin A) 181307050	5.507	7,75	42.679,25	5.169	7,75	40.059,75
18	Aluminium Extrude (Fin B) 181307051	177	6,2	1.097,4	141	6,2	874,2
19	Aluminium Extrude 181307052 6m Mf	167	6,2	1.035,4	145	6,2	899

No.	Raw Materials	Frequency of Receiving	Distance Movement (m)	Total Movement (m)	Frequency of Delivering	Distance Movement (m)	Total Movement (m)
20	Aluminium Extrude 181307053-3.9m Mf	544	6,5	3.536	544	6,5	3.536
21	Aluminium Extrude 18140714-3.9m	2.202	6,5	14.313	2.151	6,5	13.981,5
22	Aluminium Extrude 7261/Ca/5m	717	7,75	5.556,75	629	7,75	4.874,75
23	Aluminium Extrude Tention 181307054	3.282	6,5	21.333	3.418	6,5	22.217
24	Steel Plate1220x2440x6mm	20	12,5	250	19	12,5	237,5
25	Steel Plate1220x2440x8mm	11	10,5	115,5	10	10,5	105
26	Steel Plate1220x2440x10mm	80	10,5	840	81	10,5	850,5
27	Steel Plate1220x2440x15mm	16	12,5	200	5	12,5	62,5
29	Aluminium Plate 1220x2440x1mm	216	12,5	2.700	196,5	12,5	2.456,25
30	Aluminium Plate 1220x2440x1.2mm	604	10,5	6.342	594,5	10,5	6.242,25
31	Aluminium Plate 1220x2440x1.5mm	1.136	14,8	16.812,8	1.114,5	14,8	16.494,6
32	Aluminium Plate 1220x2440x2mm	651	14,8	9.634,8	653,5	14,8	9.671,8
33	Aluminium Plate 1000x2000x1.5mm	528	10,5	5.544	482	10,5	5.061
34	Acp Alpolic Silver White Metalic	370	14,8	5.476	228	14,8	3.374,4
35	Acp Alcolite Red Glosy (Rg-05)	202	14,8	2.989,6	222	14,8	3.285,6
36	Acp Alcolite Bright Silver (Bs-0)	184	10,5	1.932	127,6	10,5	1.339,8
37	Acrylic Susu (445) 1220x2440x4mm	472,5	14,8	6.993	462,5	14,8	6.845
38	Acrylic Plexiglas Xt 070 Oval	80	12,5	1.000	52,5	12,5	656,25
39	Acrylic Merah Shinkolite Dx R747	150	12,5	1.875	60	12,5	750
	Total			**294.321,8**			**282.264**

4.7. Comparative Analysis of Initial Layout and Alternative Layouts

After calculating the space requirements and the distance of raw material movement, then the comparison result of first proposal and the second proposal layout can be seen in Table 5.

Table 5. Comparative Analysis of Initial Layout and Alternative Layouts

	Current Layout	First Alternative Layout	Second Alternative Layout
Space Requirement	23,98%	16,12%	16,12%
Percentage Reduction in Space Requirements	-	32,78%	32,78%
Movement Distance of Receiving Raw Materials (m)	385.552,1	266.604	294.321,8
Movement Distance of Delivering Raw Materials (m)	369.658,9	255.983,9	282.264
Total Movement Distance (m)	755.211	522.587,9	576.585,8
Percentage Reduction in Movement Distance	-	30,80%	23,65%

5. Conclusion

The first alternative layout gives the best solution for layout chosen. It can be seen in the current layout arrangement that has a space requirement of 23.98%, allowing the first alternative layout and the second alternative has a space requirement of 16.12% with a percentage increase in space requirements of 32.78% based on the current layout. It can also be seen that the total distance of replacement of raw materials is currently 755.211 m, while the total distance movement of the first alternative is 522.587 m and the total distance movement of the second alternative is 576,585.8 m. The percentage decrease in the distance of the first alternative raw material was 30.80%, and the percentage decrease in the distance of the second alternative raw material was 23.65%. Based on the total distance of the replacement of the first raw material which has a shorter distance than the second alternative, and also the percentage of the change of the first raw material which is greater, it is requested that the chosen raw material for the layout of the raw material be arranged.

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