CHAPTER 4
IMPROVEMENT DESIGN AND IMPLEMENTATION

4.1. Analyze the Current Plant Layout Performance

From the current plant layout information, it is seen that many areas need improvement. From these data, we can use all of them to design a new plant layout for improvement as shown in the next session.

4.1.1. Material Flow data

From the process chart, flow diagram and from-to chart, we can see the characteristic of material flow in this plant. The material flow of this plant is not effective in many areas. Firstly, as shown in the process chart, there are a lot of non value added activities such as transportation of work in process and finishes good that are 54.54 % of overall activities. In a flow diagram, we can see that the existing plant layout was poor as seen that the route of material flow was chaos and repeat. That because management and location of each department was not proper and work in process, finished good were distributed stock everywhere in the factory. Besides these, from the activity relationship chart and from-to chart we can analyse to be a string diagram. It shows frequency of transportation among department in the plant. From this data, we can see more clearly that some pair of department that usually interacted was placed very far away. Such as, blow molding processing line and UV room that have high frequency of transportation but place them very far away. It leads to loss of workforce and time in transportation among department.

4.1.2. Factory area data

From the plant layout, we will see the area and structure of the factory that it will be a database of limitation of move workstation.

4.2. Identification Area of Improvement

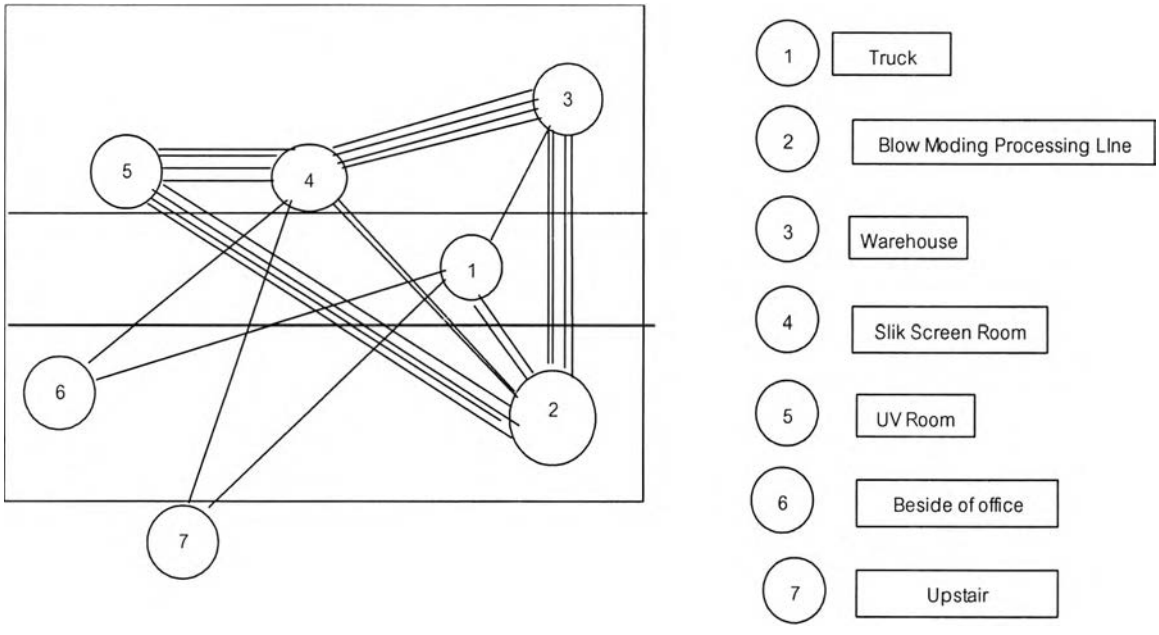


Figure 4.1 The String Diagram

From the initial data in previous session, we can conclude problems that occurred in the current plant layout as following;

1. **Material Flow Diagram**

The location of workplace of UV room and blow molding room is very far away.

2. **Stock of work in process and finished good**

Keeping work in process and finished good still did not have a good management because in the present situation them are placed anywhere they want without recognizing distance and conveniences of transportation. Moreover with poor plant layout will effect to the quality of product. With no more close system, clean, poor material handling and poor warehouse management, the quality of goods will be reduced. From observation customer complain after they had visited the factory, they always complain in a poor plant layout. Moreover, do not having a good management of work in process warehouse will effect to the quality of goods. According, the regulation of setting plastic bottle that the bottle must leaved one day before bring them to paint, but some bottle was brought to pain before because the worker did not know which one was commit the age, worker will bring the closest one to be paint, first. As a result of distortion of milk plastic bottle that the customer always complain in this area. Not only the faster work in process milk bottle is painted before its age, the later of work in process that was leaved or forgot to produce in anywhere in the factory will lead a loss to the factory. They will loss opportunity in sale the product, the product quality will be reduce because contamination. They will be cleaned before paint it that loss in material and labour cost.

3. **Improper workplace of the painting room**

From observation workplace of the painting room and oven room, it can see that these two workstation have a wall among them even these two station have a high frequency of material flow. So, in each of transfer material the worker must open the door of oven room to bring out the painted first colour bottle out and go to open the door of the painting room to bring the bottle in it. For this situation we will see that the chance of contaminate dust, insect and dirty will come with the wind that blow into the room when open the door almost all day and all night, even this area is control area that it should be clean as more as possible. So, it has a chance that the dirty thing will be in the milk bottle. That 's all will be affect to customer satisfaction and reputation of the company in dueling business together and to be a partnership in the future.

4. **Improper workplace of painting a milk bottle size 830 cc.**

From painting a 830 cc. milk bottle that it started from framing a milk bottle surface with fire in UV room and then it will be brought to the screen room for painting, we can see that they will lost time in delivery bottle between workstation. After studying, the cause of problem came from can not set up the UV silk screen bottle to paint the bottle, perfectly, so the bottle must be brought to the screen room to paint it.

After we know problems that occur in the current plant layout and cause of it, we will find solution of improvement all of these problems by designing a better plant layout in order to eliminate all of those problems. The solution will be design follow the problem observation as seen in all above. The presentation will start from the plant layout and the flow diagram of the plan and follow with its benefit.

4.3. Design Plant Layout Solution

From the problem that are discussed in previous section, we will design a new plant layout to solve all problem. We will start from dividing the existing warehouse into two parts. One of them that is in a left hand side will be designed for keeping work in process product. At the wall that it is between silk screen room and work in process warehouse will have a rectangle hole for loading work in process product into the silk screen room. Having this hole will reduce a chance of contaminate of dirt, dust and insect with our product. So, it can reduce both of time, distance and workforce of transportation and a chance of contaminate. Furthermore, the floor of keeping will be a slove floor. The worker will load a box of blowing milk bottle in the end side of the floor. Then the box will slide down to the lower floor that the worker who bring a unpaint bottle into a silk screen room will pick up the first of loading box before. We can see that this system will support FIFO system in order to improve flow of material better.

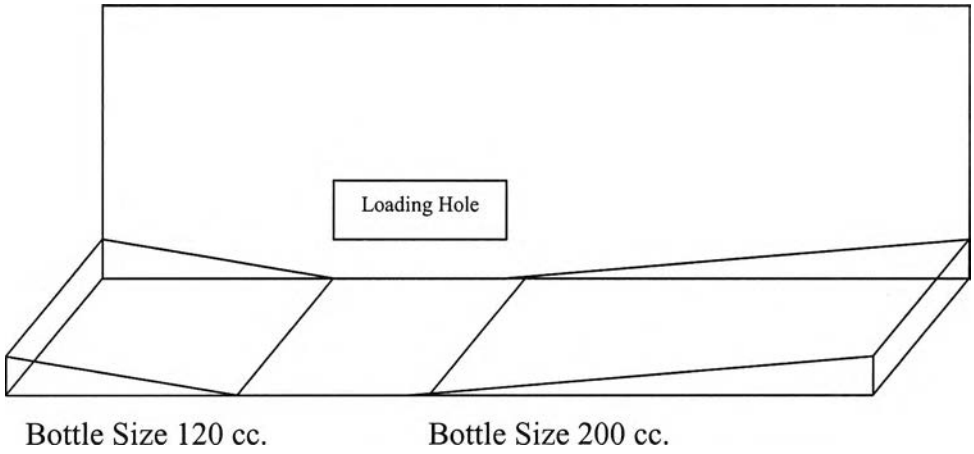


FIGURE 4.2: THE DESIGN OF WORK IN PROCESS WAREHOUSE

For the other part of divided warehouse will be designed to be a place of stock finish good. Because this place is nearest the silk screen room rather than place them in anywhere of the factory. So, distance and time that use for delivery finished good will be decreased. Moreover, keeping the same kind of product in the same place will be easy for managing them. We will know where each of them was placed and when it will be sent to customer. That 's all activities also supports the FIFO system that can improve quality of product.

After the warehouse of work in process and finished good were designed, we will move to design workplace to be cleaner and more close system. Besides, the designed of work in process will benefit for transportation, it also benefit for building close system workplace environment by dividing among work in process and finished good warehouse with non permanent material like a plastic curtain. From these design, the keeping area will be more close system and reduce contaminate of dirt from the outside. For the wall between silk screen room and oven room, it should be made a internal door between them for transportation material in order to more close system to reduce dirt from outside. All of described design will be represented in the plant layout and flow diagram at the next page;

5. **Plant Layout of the new solution**

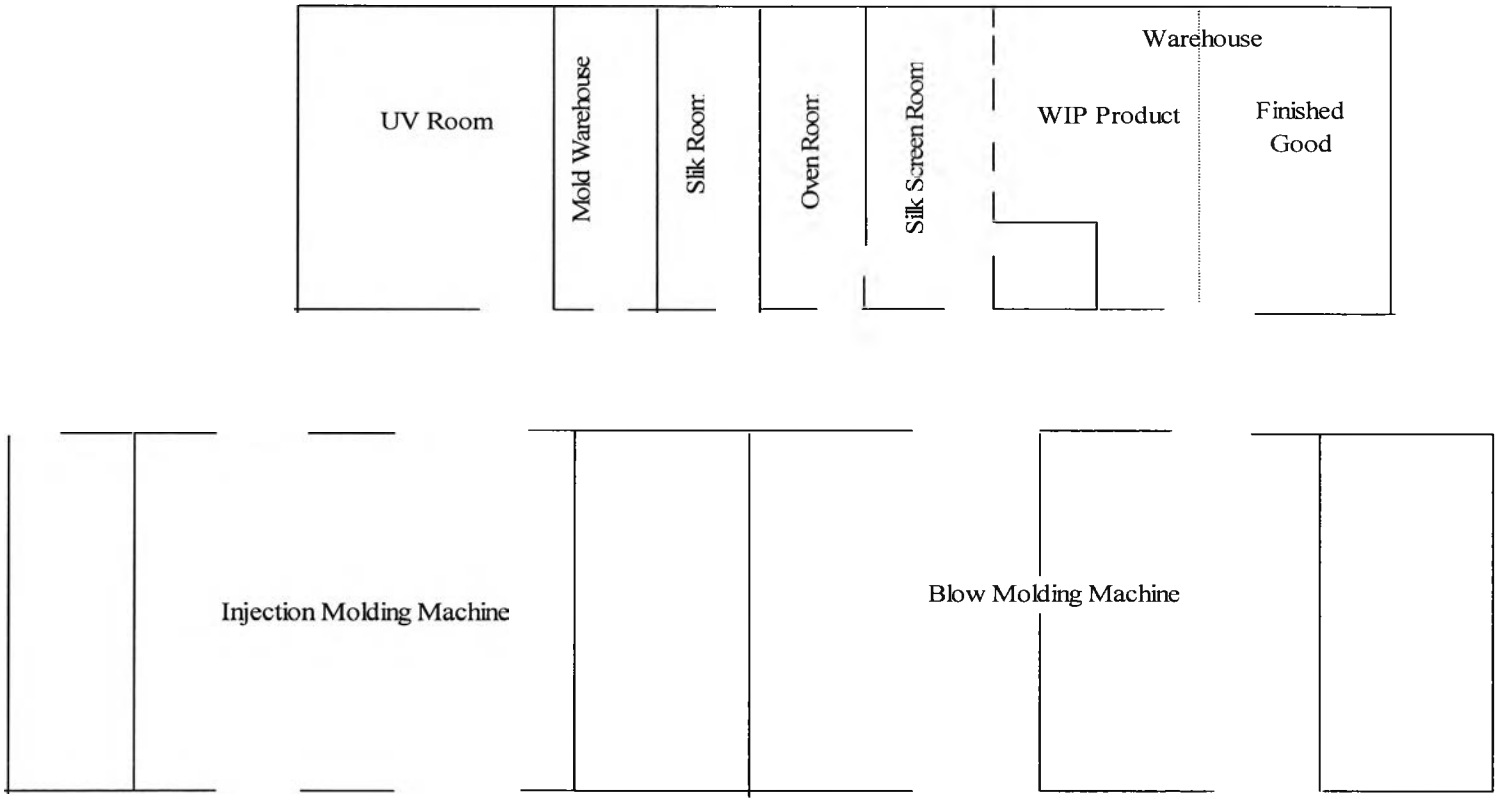


FIGURE 4.3. PLANT LAYOUT OF THE NEW SOLUTION

6. **Flow Diagram of the New Solution**

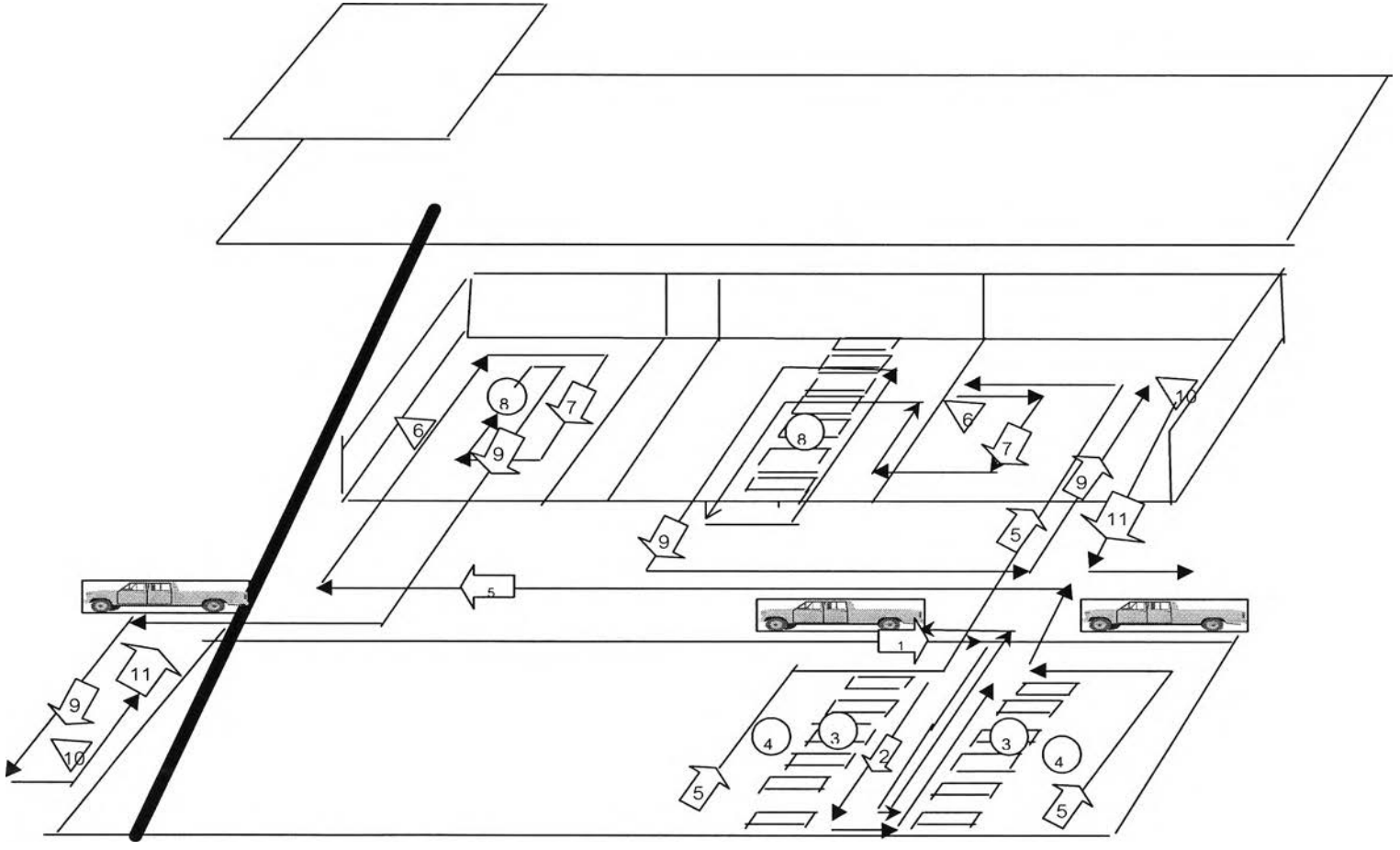


FIGURE 4.4. FLOW DIAGRAM OF THE NEW SOLUTION

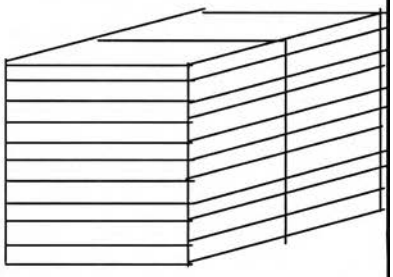
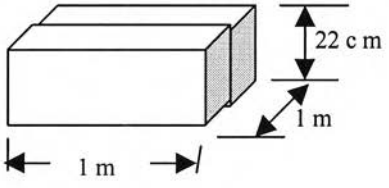
4.4. The Process in Developing Implementation of the New Plant Layout

After the plan was generated, we need to developing further detail of implementation. Basically, it is management the place of stock product that proper to transportation both inlet and outlet. We will consider in nature of each product flow in area of average amount of inlet, on hand and outlet product. After that we will design where and how much of area that each product require in keeping them with the available area.

To calculate the required area of each product, we will start from studying amount of product, as shown in detail in Appendix.. An example of this calculation is shown in the following table.

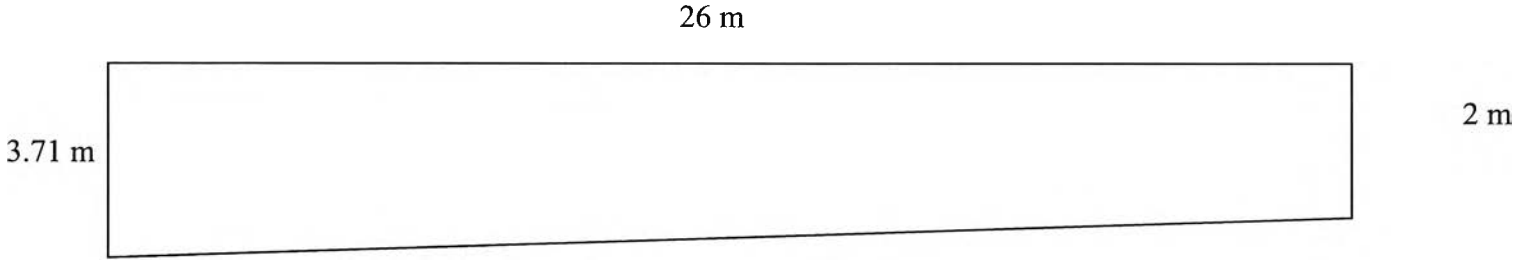
4.4.1. List of Overall Product

Name Middle Home bottle (blow molding room)

Date	Amont of Product (bag or box)						Month	Inlet frequency	Outlet frequency	Characteristic of stack
	Month									
	7	8	9	10	11	12				
1	0	1	0	0			8	3	1	
2	0	1	0	6			9	0	1	
3	0	1	0	8			10	0	0	
4	0	1	0	19			11	6	1	
5	0	1	0	31						
6	0	1	0	14						
7	0	1	0	27						Size of Stack
8	0	1	0	27						(width x legth x high)
9	0	1	0	27						
10	0	1	0	0						
11	0	1	0	0						
12	0	1	0	0						
13	0	1	0	0						
14	0	1	0	0						
15	0	1	0	0						
16	0	1	0	0						
17	0	1	0	0						Amount of stack
18	0	1	0	0						10 Levels
19	5	0	0	0						
20	20	0	0	0						
21	1	0	0	0						
22	1	0	0	0						
23	1	0	0	0						
24	1	0	0	0						
25	1	0	0	0						
26	1	0	0	0						
27	1	0	0	0						
28	1	0	0	0						
29	1	0	0	0						
30	1	0	0	0						
31	1	0	0	0						

4.4.2. Calculation of Space Requirement for each Product

4.4.2.1. Space available of side office area



Top view

From the above drawing, we can calculate the area;

$$\text{Area} = \tfrac{1}{2} \times (3.71+2) \times 26$$

$$= 74.23 \text{ m}^2$$

and the high of this area equal 2.92 m, so the volume of this area =

$$\text{Volume of this area} = 74.23 \times 2.92$$

$$= 216.7516 \text{ m}^3$$

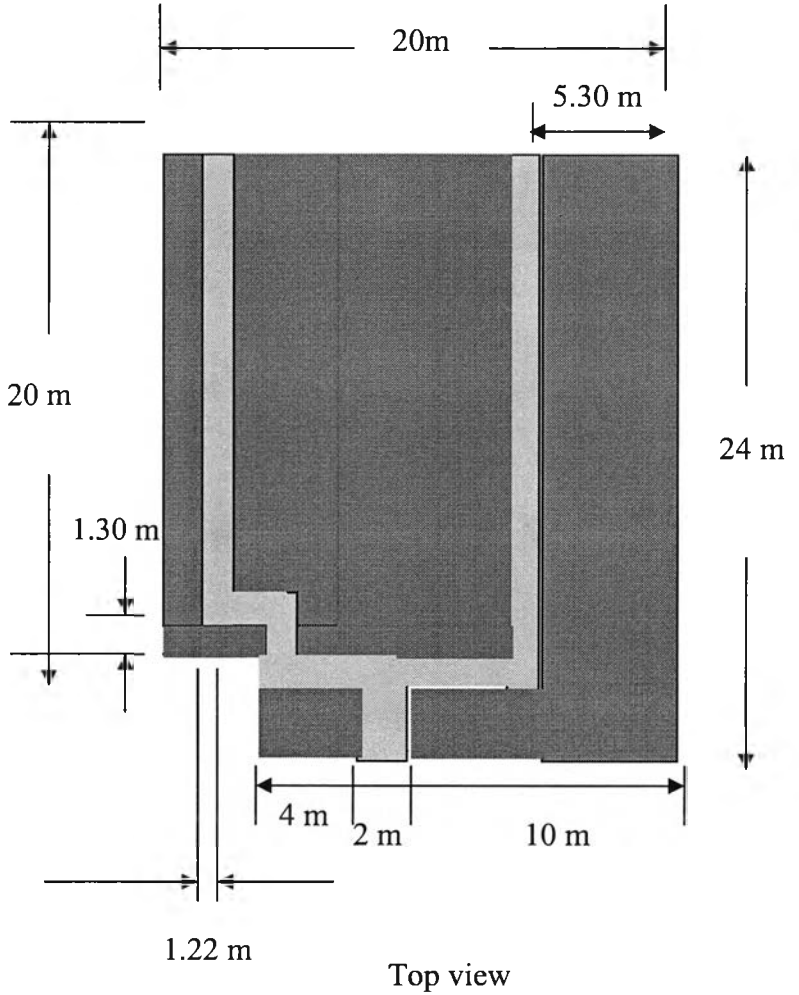
But the boxes can not be placed in some place

Volume that cannot be placed = (0.84 x 2.92 x 2) + (0.84x 3x0.57x 0.305)+(0.75x0.32x2.92)

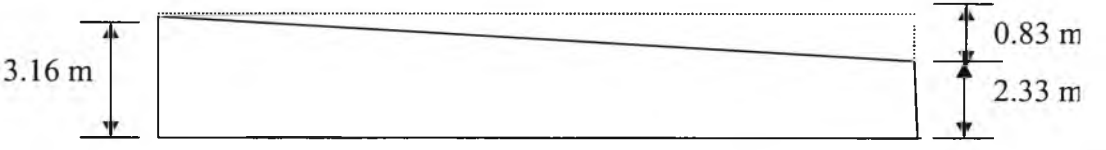
So, Avalible area will equal = 7.028102m^3

Avalible Volume = 216.7516-7.028102 = 216.47058 m^3

4.2.1.2. Space of warehouse



Top view



Side view

Total space of warehouse = 20m x 24m – (4m x4m) = 480m^2

Area of Aisle = 1.22m x (21.22m + 4m + 1.3m + 18.7 + 4m + 4.7m)

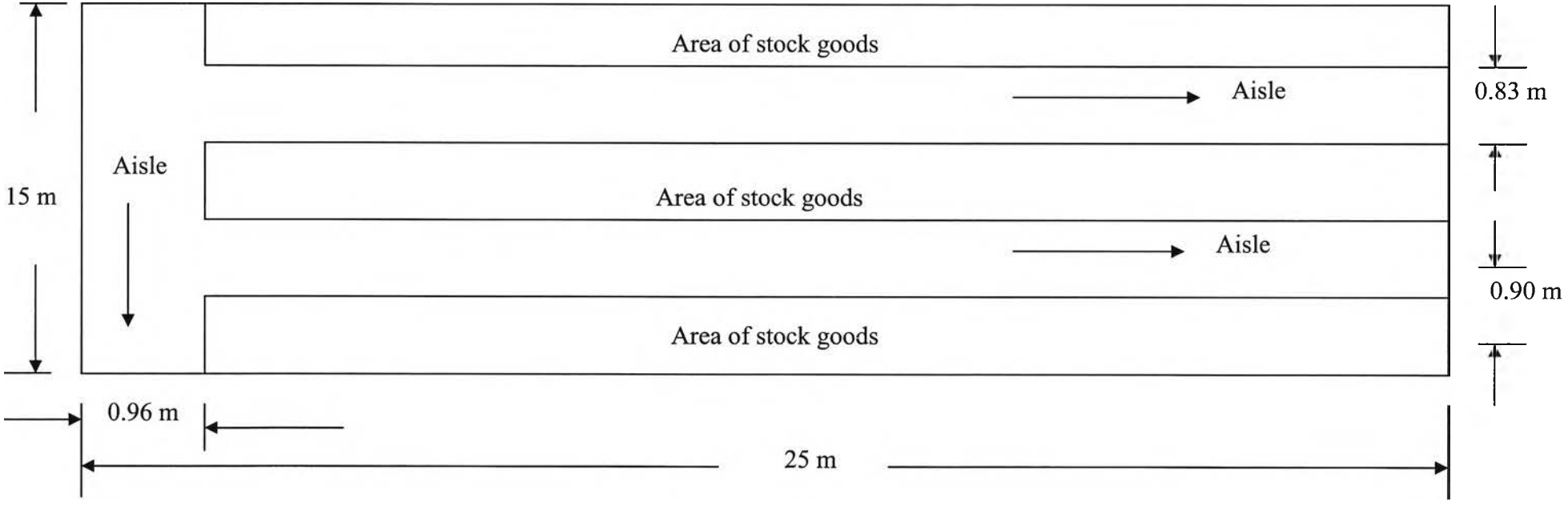
= 65.7824 m^2

So, net space of warehouse = 480 – 65.7824 = 414.2176 m^2

And volume of warehouse = 414.2176x3.16-1/2 x 414.2176x 0.83

= 1137.027312 m^3

4.2.1.3. Available area of upstairs warehouse

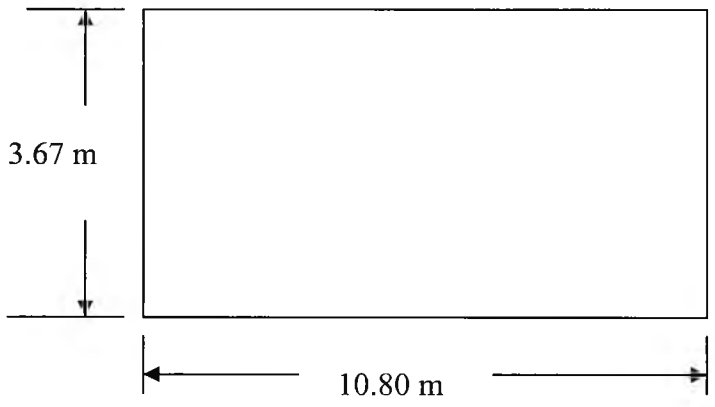


From the previous picture we can calculate the available volume as following;

$= (15x\ 25) - (0.96 \times 15) - (925 - 0.96) \times 0.9) - ((25 - 0.96) \times 0.83)$

$= 319.0108\ m^{3.}$

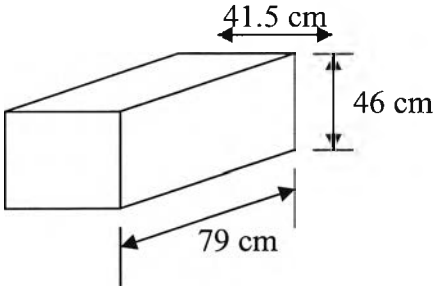
4.2.1.4. The Space Behind of the Office Warehouse

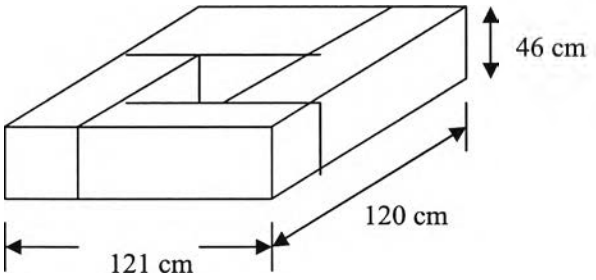


So, the space behided the office warehouse will be = 3.67*10.8*2.85
= 112.9626 m^3

4.4.3. Calculation of milk box volume

4.4.3.1. Milk box of bottle size 800 cc





One Stack of box of bottle milk size 830 cc

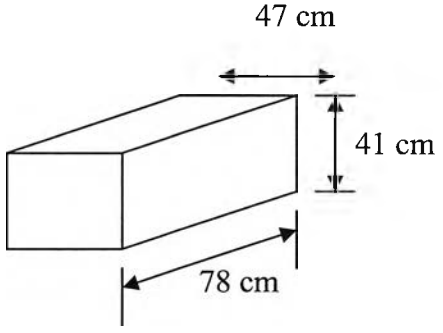
Space requirement of one stack = 121x 120 x 46 = 667920 cm^3

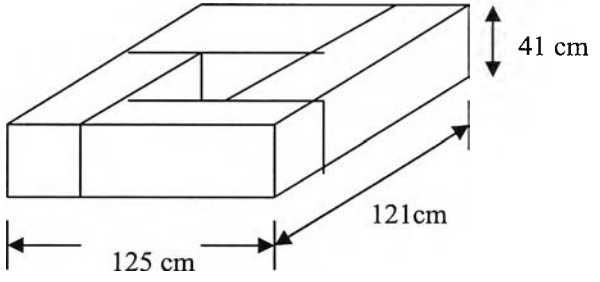
Average amount of box per day = 228 boxes

So, Number of stack will be = 228/4 = 57 stacks

And space requirement of them = 57 x 667920 =38017440 cm^3 = 38.017440 m^3

4.4.3.2. Milk box of bottle size 450 cc





One Stack of box of bottle milk size 450 cc

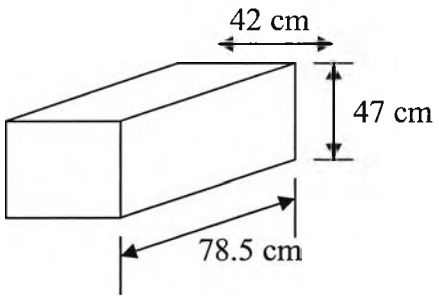
Space requirement of one stack = 125 x 121x 41 = 620125 cm^3

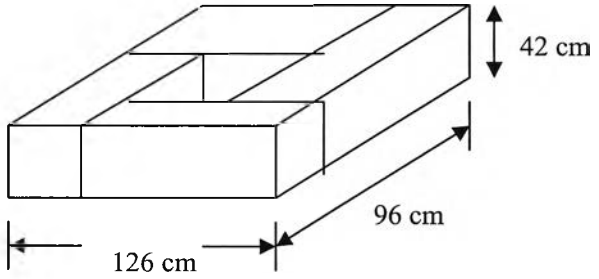
Average amount of box per day =126 boxes

So, Number of stack will be = 126/4 = 31.5 stacks

And space requirement of them = 31.5 x 620125 =19533937.5 cm^3 = 19.5339 m^3

4.4.3.3. Milk box of bottle size 200 cc





One Stack of box of bottle milk size 200 cc

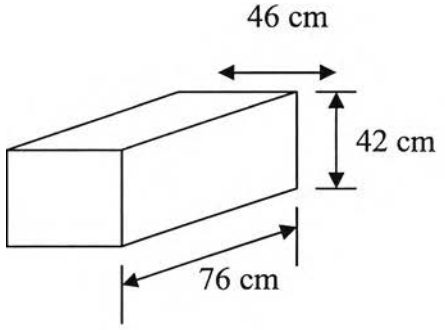
Space requirement of one stack = 126 x 96 x 42 = 508032 cm^3

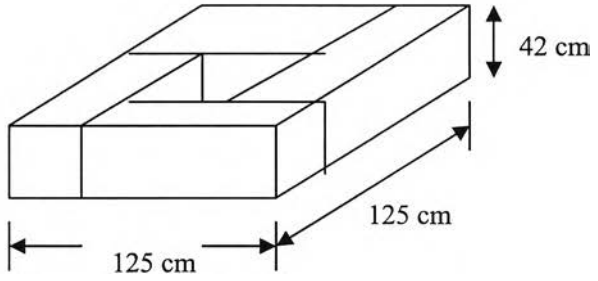
Average amount of box per day = 290 boxes

So, Number of stack will be = 290/4 = 72.5 stacks

And space requirement of them = 72.5 x 508032 =368323220 cm^3 = 36.832320 m^3

4.4.3.4. Milk box of bottle size 120 cc





One Stack of box of bottle milk size 120cc

Space requirement of one stack = 125 x 125 x 42 = 656250 cm^3

Average amount of box per day =146 boxes

So, Number of stack will be = 146/4 = 36.5 stacks

And space requirement of them = 36.5 x 656250 =23953125 cm^3 = 23.953125m^3

4.4.4. Identify Inventory Place of each Product

After the space available, the space requirement and frequency of each product were known. We will match a product to keep in suitable place. The following tables are list of product that are placed in each area;

Warehouse Available volume 1137.027

Product	from	Amont of boxes	Volume
Milk bottle 830 cc.	Silk Screen Room	227.14	266.12208
Milk bottle 450 cc.	Silk Screen Room	125.71	136.7373
Milk bottle 200 cc.	Silk Screen Room	289.39	258.0361
Milk bottle 120 cc.	Silk Screen Room	145.43	167.671875
Non painted Milk bottle 200cc.	Blow Molding Room	289.39	110.2645354
Non painted Milk bottle 120 cc.	Blow Molding Room	145.43	71.57882813
		Total	1010.410718

Behide Office Available volume 112.9626

Product	from	frequency		Volume
		inlet	outlet	
Big Home Bottle	Blow Molding Room	15	7.5	3.14323
Wash dish liquid bottle	Blow Molding Room	11	5.5	8.439228
Long table lag	Blow Molding Room	13	5.5	5.4087264
Conditioner Bottle	Blow Molding Room	10.5	4	9.28
Cusson Shampoo 500 ml	Blow Molding Room	10	3.5	3.51654
Plastic Ball	Blow Molding Room	22	4	22.35415
Shower Cream bottle 6000 ml	Blow Molding Room	6	4	4.6971723
Toothpate cover	Injection Molding Room	12.25	4.5	0.680043
PE Cup	Injection Molding Room	13.33	11.66	28.944
Avon power untensil	Injection Molding Room	6.5	2.5	0.5100323
Breeze Fresto type R bottle	Silk Room	5	2	25.059534
			Total	112.03266

After we have a plan of managing warehouse, we will implement it in the current plant layout. In the next chapter will be the result of implementation, later, we will analysis the outcome of implementation.