Productivity Improvement by Designing Storage Systems in a Manufacturing Industry

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ABSTRACT: *Productivity is crucial to the welfare of the industrial firm as well as for the economic progress of the country. High productivity refers to doing the work in a shortest possible time with least expenditure on inputs without sacrificing quality and with minimum wastage of resources. Originally, it was used only to rate the workers according to their skills. A system of measurement was then evolved to compare the improvement made in relation to the rate of output and in order to improve productivity. One way to improve productivity is to reduce the non-value added activities such as searching time reduction, idle time reduction, etc. Therefore, to emphasis on design of storage systems which reduces the searching time as a tool for improving productivity, a case study has been conducted on selected number of items of one of the leading pump manufacturing company from Western Maharashtra. Since it is impossible to devote equal attention to all items, it is desirable to concentrate on those items which are of highest value and most important. This paper deals with design of storage systems.*

Keywords: *Non-value added activities, Productivity.*

I. INTRODUCTION

Productivity is the quantitative relationship between what we produce and what we use as a resource to produce them, i.e. arithmetic ratio of amount produced (output) to the amount of resources (input). Productivity can be expressed as:

Productivity = Output / Input

This means to improve productivity, output (numerator) should be increased and input (denominator) should be decreased. The manufacturing industries mainly focus on production. To improve the productivity, it requires increasing production. [1]

The production can be increased by effective utilization of resources such as man, machine, material, money, etc. There should not be any delay in production. So that targeted production value can be achieved. Delay in production occurs due to time wasting in searching of required tool, material, etc. For that purpose, study has been carried out in the company and only those materials are selected which requires frequently during production. On the basis of collected data storage systems are designed and implemented on the shop floor. [2]

II. PRESENT SITUATION OF SHOP FLOOR

The Production division of the company is divided into different sections. In grinding section, grinding of line shaft, impeller shaft and column shaft as well as grinding of rubber sleeves, shaft sleeves, etc. is carried out. For grinding of these parts mandrels are required, but there was not any system for mandrels. They were dispersed anywhere on the shop floor.

In assembly section, hydro testing of pumps is carried out. In hydro testing all the bores of pumps i.e. suction bore, delivery bore, etc. are tightly closed with the help of pressure plates and through one bore which is kept open water is filled in pump. The pump is completely filled with water and maximum pressure limit for which pump sustains is recorded by using gauges. For that purpose pressure plates are required. Pressure plates are made up of high carbon steel plates. There are more than 250 pressure plates available. But they were not present at work station. Worker required searching of the required pressure plates.

Each time worker takes his vernier, micrometer, etc. Go on searching mandrel or pressure plate on shop floor. If the worker is permanent employee he knows where he will get the required mandrel or pressure plate. But the temporary worker faces many problems to get the required mandrel or pressure plate. He wastes much of his working time in searching the required mandrel or pressure plate.

III. DESIGN OF STORAGE SYSTEMS

3.1 DESIGN OF RACK SYSTEM FOR MANDRELS

When observed the present practice, it was noted that most of production time was wasted in searching required mandrel (about 2 to 3 hours out of 8 hours of production time). So to design the rack system for mandrels following steps are followed:

(1) Carry out the study of machines for which mandrels are required.

Following points are observed during study:

a. Component to be grinded
b. Drawing dimensions
c. Nominal mandrel diameter
d. Time to search required mandrel

e. Number of components to be machined.
f. Remarks.

(2) Searching all the mandrels dispersed on the shop floor.
(3) Measurement of dimensions of mandrels.
For designing the rack system important dimensions are:
a. Length (L) in mm.
b. Diameter (D) in mm.

(4) Find out the mandrels which are frequently required.
(5) Design the rack system for those mandrels.

Length and diameter of mandrels were measured and arranged in ascending order of first diameter and then length.

3.1.1 DIMENSIONS OF FREQUENTLY USED MANDRELS

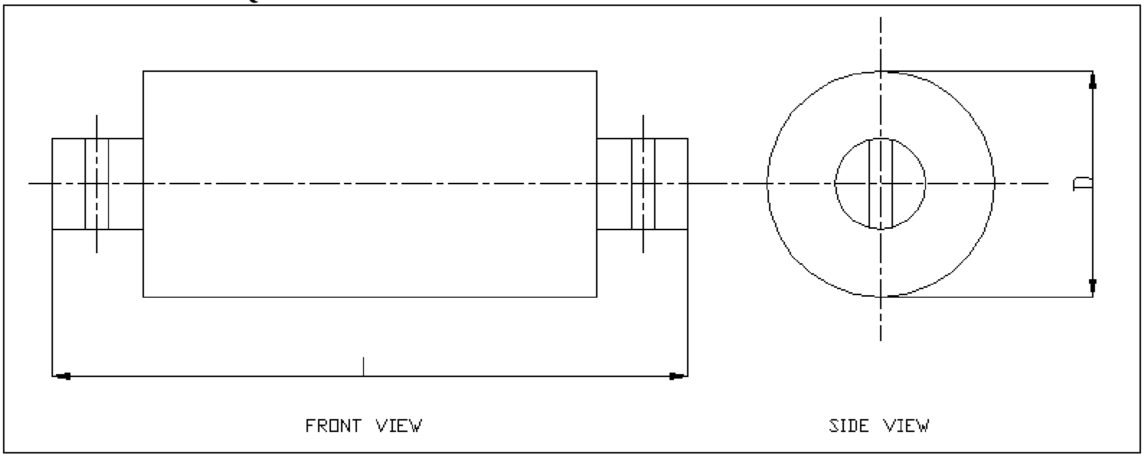

Fig.3.1.1: Mandrel

Table 3.1.1: Dimensions of frequently used mandrels

Sr.No.	Diameter (D)mm	Length (L)mm	Sr.No.	Diameter (D)mm	Length (L)mm
SET 1			SET 2		
1	120	630	**15**	140	865
2	120	710	**16**	140	910
3	123	820	**17**	141	575
4	125	670	**18**	143	600
5	125	740	**19**	145	793
6	130	810	**20**	145	920
7	130	810	**21**	146	720
8	131	920	**22**	150	860
9	132	570	**23**	150	900
10	132	780	**24**	152	620
11	134	820	**25**	155	750
12	135	720	**26**	155	900
13	139	796	**27**	156	1020
14	140	790	**28**	163	740

3.1.2 GIVEN CONDITIONS FOR RACK

(1) Maximum height of rack designed should be less than 1800mm.
(2) There should not be any complications while taking out mandrel from rack.
(3) There should be some cushioning for mandrels.
(4) All the mandrels should be stored in rack.
(5) Heavy weight mandrels should be at bottom of the rack and light weight mandrels should be at top.

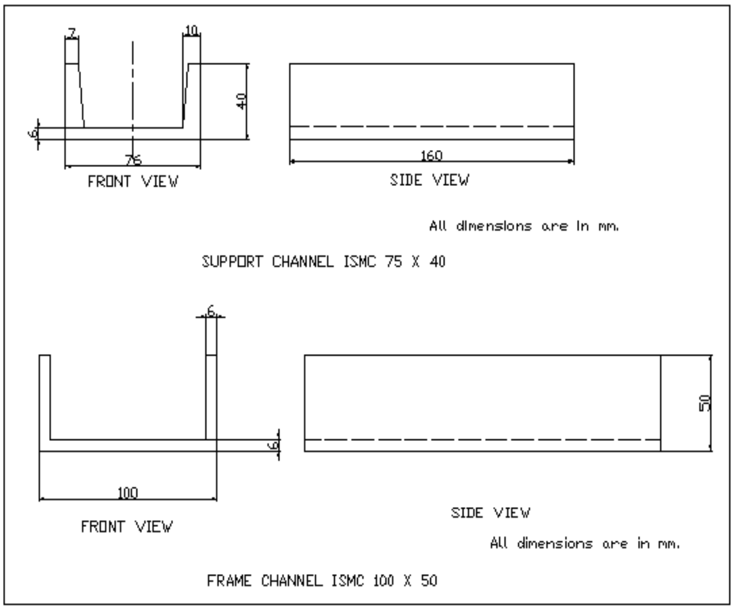

Fig.3.1.2 Frame channel ISMC 100 X 50 Selected for rack

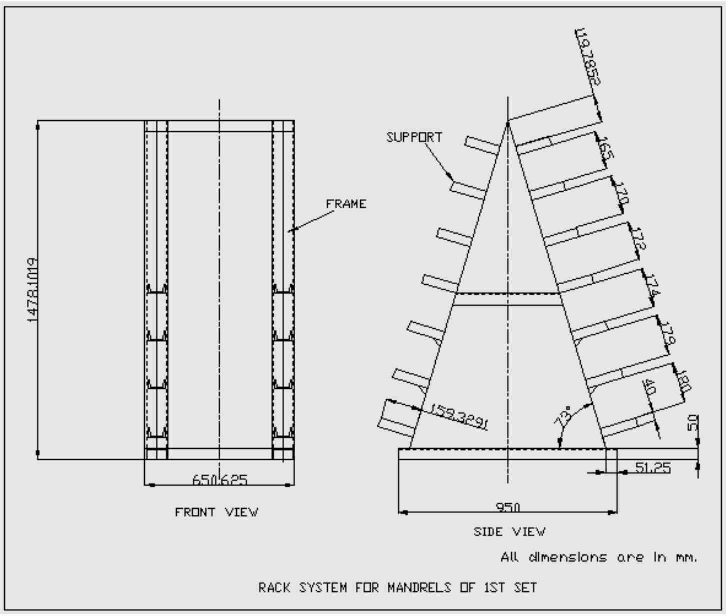

Fig.3.1.3: Rack system for mandrels of 1st set

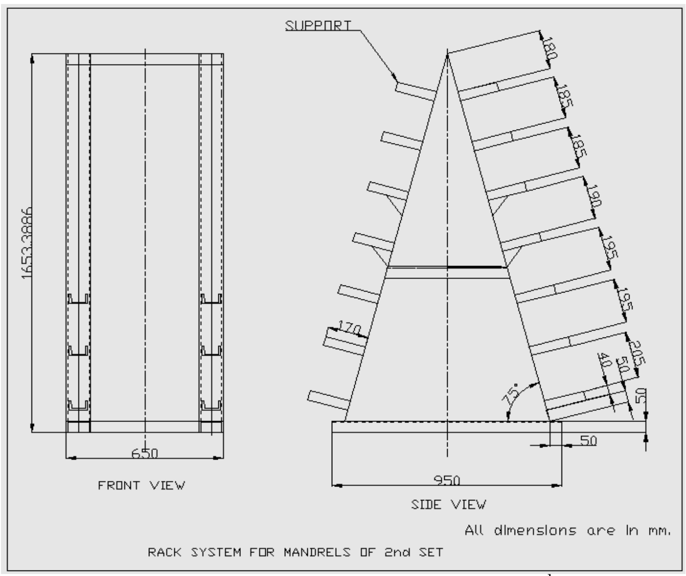

Fig.3.1.4: Rack system for mandrels of 2nd set

3.2 DESIGN OF STORAGE SYSTEM FOR PRESSURE PLATES

3.2.1 STEPS IN DESIGN OF STORAGE SYSTEM FOR PRESSURE PLATES

For designing the storage system for pressure plates following steps are followed:

(1) Creating database of pressure plates by physically measuring the dimensions of pressure plates.
For designing the storage system important dimensions are:
(a) Outer diameter (OD) in mm.
(b) Width (W) in mm.

(2) Design the storage system for those pressure plates.

3.2.2 PARAMETERS CONSIDERED FOR STORAGE SYSTEM OF PRESSURE PLATESs

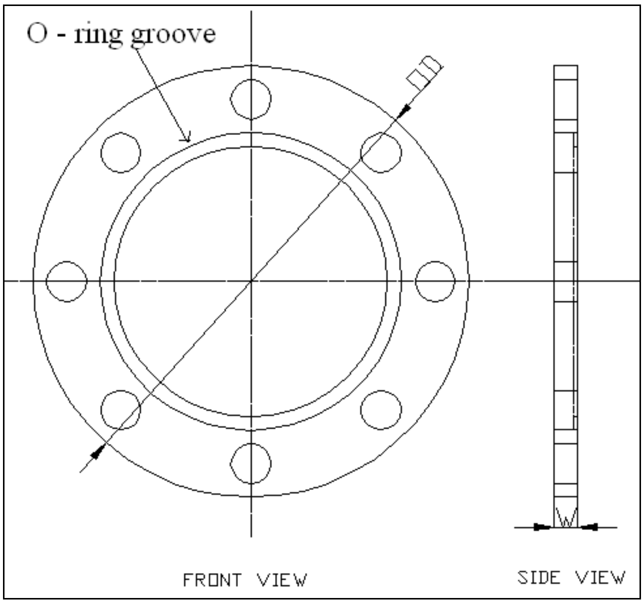

Fig.3.2.1: Pressure plate

The above Fig. 3.2.1 shows the important dimensions of pressure plate. Outer diameter and width of pressure plates are measured and arranged in ascending order of outer diameter and then width.

3.2.3 GIVEN CONDITIONS FOR STORAGE SYSTEM

(1) Maximum height of storage system designed should be less than 2100mm.
(2) There should not be any complications while taking out pressure plate from storage system.
(3) Maximum number of pressure plates should be stored in storage system.
(4) Heavy weight pressure plates should be at bottom of storage system and light weight pressure plates should be at top.

3.2.4 PRESSURE PLATES SELECTED FOR DESIGNING THE STORAGE SYSTEM

Out of all the pressure plates 30 number of pressure plates in the range of 740 mm to 805 mm outer diameter are selected for designing the storage system. Selected pressure plates are listed in Table 3.2.1.

Table 3.2.1: Pressure plates selected for designing the storage system

Sr. No.	**Plate No.**	**Outer diameter (OD) in mm.**	**Width (W) in mm.**
		RACK 1	
1	174	740	47
2	6	740	105
3	244	750	45
4	271	750	60
5	21	750	64
6	239	750	100
7	170	753	50
8	19	780	120
9	177	780	131
10	267	785	40

RACK 2			
11	157	753	88
12	260	755	58
13	28	756	57
14	158	757	121
15	254	760	37
16	85	770	133
17	250	775	105
18	147	775	107
19	4	776	50
20	247	780	42
RACK 3			
21	278	785	42
22	249	785	55
23	269	785	70
24	188	785	86
25	231	790	100
26	7	790	126
27	24	795	58
28	143	795	98
29	167	800	125
30	11	805	41

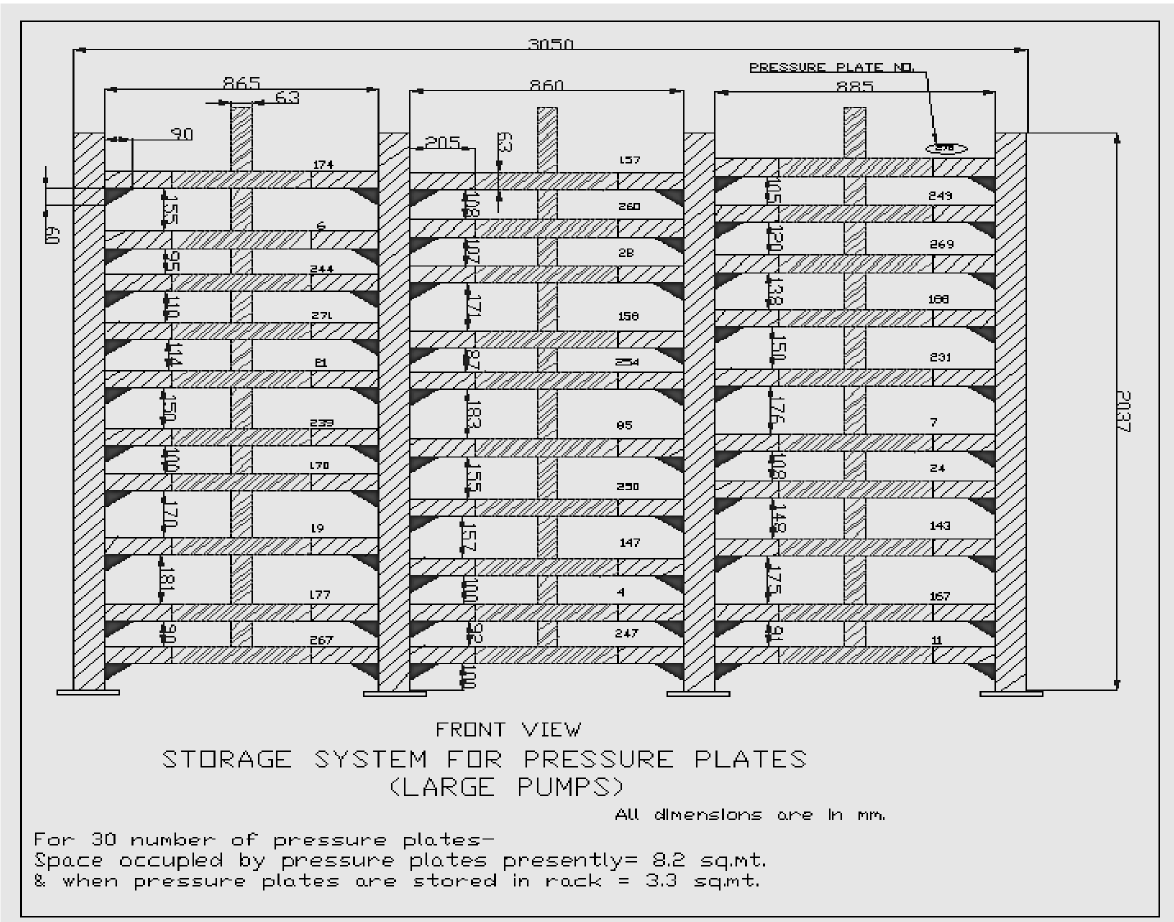

Fig.3.2.2: Front view of storage system for pressure plates

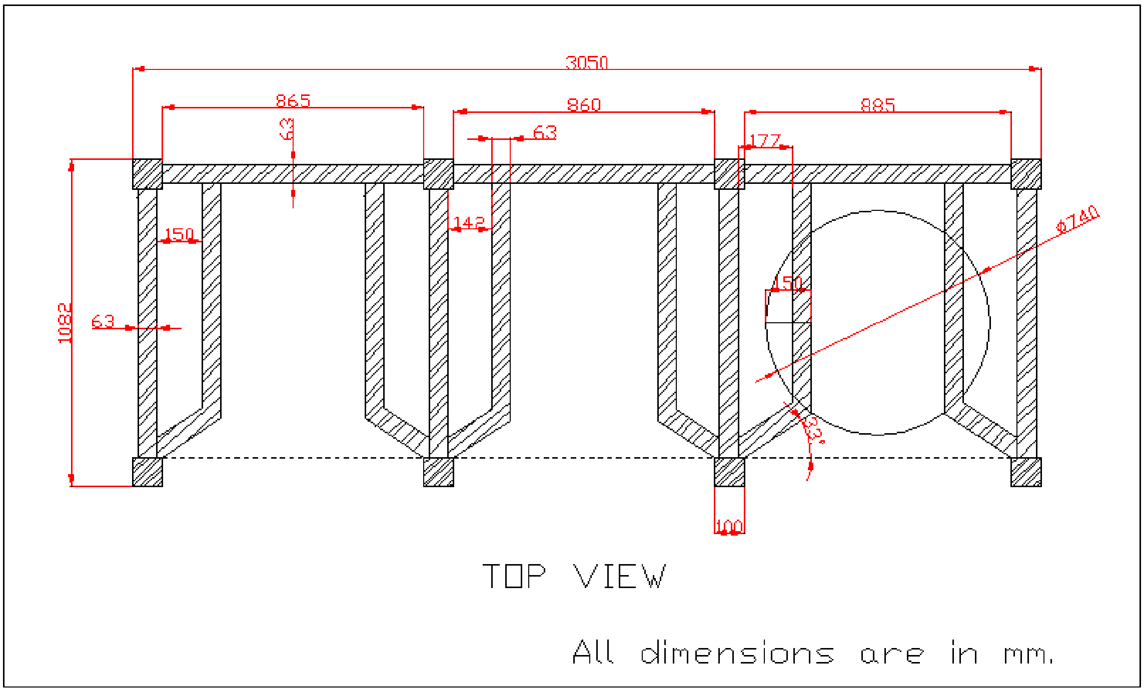

Fig.3.2.3: Top view of storage system for pressure plates

IV. COST SAVING, SPACE UTILIZATION AND PRODUCTIVITY IMPROVEMENT

4.1 PRODUCTION ENHANCEMENT IN GRINDING SECTION

Situation of grinding section before improvement was as given below.
Total time wasted in searching the required mandrel and carrying it up to the machine
= (Total production time – Total machining time) min.
= (420 – 180)
= 240 min.

Total time wasted in searching the required mandrel and carrying it up to the machine in terms of percentage of total production time
= (240 / 420) * 100
= 57.13 %
Average number of components ground by worker in a shift = 4

Situation of grinding section after improvement is as given below.
Number of components ground in a shift
= (Total production time) / (Average time required to grind the component)
= 420 / 45
= 9

Increase in production in comparison with the production before improvement is shown in Fig.4.1.

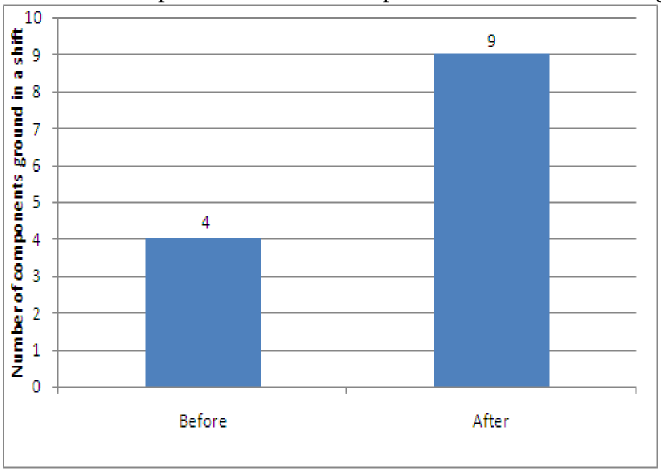

Fig.4.1: Number of components ground before and after improvement

4.2 COST SAVING IN MANUFACTURING OF STORAGE SYSTEM FOR PRESSURE PLATES

Weight of the storage system = 1250 kg
If storage system is given to vendor for manufacturing
Total cost = Material cost + Labour cost
= 55,000 Rs. + 10,000 Rs.
= 65,000 Rs.

If storage system is manufactured in house by using scrap material available only labour charges require paying.
Scrap material cost = 18 Rs. /Kg
Therefore,
Cost of scrap material = 18 x 1250 Rs.
= 22,500 Rs.
Total saving = Vendor's Total cost – (Scrap material cost + Labour cost)
= 65,000 – (22,500+10,000) Rs.
= 32,500 Rs.

The cost saved after manufacturing the storage system in house is compared with the vendor rate as shown in Fig.4.2.

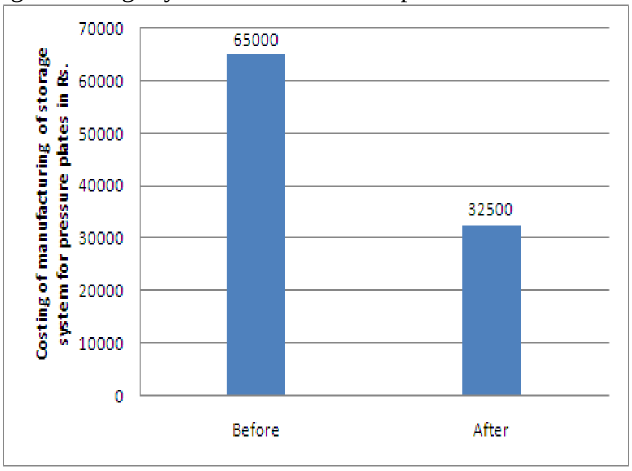

Fig.4.2: Cost saving in manufacturing of storage system for pressure plates

4.3 SPACE UTILIZATION

Before implementation of storage system, pressure plates were kept on shop floor. In that situation space occupied by 30 number of pressure plates was 8.2 m^2.
After implementation of storage system space require for 30 number pressure plates is 3.3 m^2.

V. CONCLUSION

The industry is successfully implementing storage systems and getting better results. The productivity of the industry is improved and quality of their products is enhanced.

The situation of mandrels and pressure plates are shown in Photo 5.1 to Photo 5.4.

Photo 5.1: Situation of mandrels before improvement

Photo 5.2: Improved situation of mandrels

Photo 5.3: Situation of pressure plates before improvement

Photo 5.4: Improved situation of pressure plates

The design of storage system gives following advantages

1. After implementing the designed storage systems required mandrels, pressure plates are found without any time loss i.e. searching time is reduced.
2. The storage systems are vertical as per workplace organization system.[3][4]
3. Easy accessibility because forklift driver can easily retrieve the pressure plate without anyone's help.
4. Almost 50 % of space is released.
5. Chances of accidents are reduced.
6. Storage system is manufactured by using in house scrap material which saved around 32,500 Rs

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