Improving Cycle Time in Electrical Level Luffing Crane Using Lean Tool and Technique

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Abstract

In this era in large and medium scale industries, material handling equipment plays a vital role hence for the company manufacturing material handling equipment the delivery of the product on time is essential to meet the customer satisfaction. During the manufacturing of Electrical Level Luffing (ELL) crane the company is facing time setback due to inappropriate procedure. So it is necessary to do time study of Electrical Level Luffing crane at micro level and optimize the cycle time. By analysis of procedure of each component at micro level and with the help of lean tool and technique, areas could be found where cycle time would be optimized hence there would be cost reduction as well as effective management of daily hours available. By optimizing cycle Time the company would be able to forecast the dispatch of the product in right period as well as it would do proper distribution of resources and proper utilization of space available.

Keywords: *Electrical Level Luffing crane, Time Study, Lean tool and Technique, Work Method Study, resources and space utilization*

INTRODUCTION

Material handling is a crucial section of any manufacturing and distribution system and the material handling industry is quite active and competitive. Material handling is an important practical consideration in the design of new manufacturing and research into better material handling equipment and practices is important in both academia and industry. Cranes are playing an important role in material handling. There are different types of cranes based on their application. One of the type of cranes is an Electric Level Luffing crane. For any company dispatch of the product on time is very crucial in order to meet customer satisfaction and maintain company image. Presently the time required to manufacture Electrical Level Luffing Crane is approximate 250 days. The attempt is to reduce time with reduced cost of manufacturing the crane. Also the focus is to Improve the cycle time of Electrical Level Luffing Crane as much as possible resulting into cost reduction simultaneously. The time for the fabrication would be reduced as in turn it will lead to reduce in cost of fabrication as the crane would be early finished and cost for running the fabrication would not been incurred. Normally the crane with a hinged Jib will tend to have its hook also move up and down as the Jib moves. The ELL crane is used at port, construction, railway department, ship building and in many area for handling material which are level luffed while they are lifted. This objective cannot be filled by any other cranes. Thus it's crucial that ELL Crane reach its destination on time in order to fulfil his objective. It forms the important part of the process area. Hence working of ELL Crane on the site is major concern and it widely affects the projects.

Figure 1 Level Luffing Crane

To raise the productivity automation is one of the predominant tool. Several case studies are discussed, which uses automation to rise the productivity [8,9,10,11,12].

RESEARCH METHODOLOGY

Different area under the project definition would be studied and process analysis of the different fabrication would be done with the help of flow chart from which the area of improvement would be drawn out and with the help of necessary lean tools

suggestion would be made[13,14]. The time and cost analysis would be done for the different suggestion which would lead to results and discussion at the end.

Process Analysis

Terms considered in the Process are operation sequence, time and space utilization by flow process chart.Process analysis is divided in two phase: Fabrication Process and Assembly Process.

- Fabrication Process Further classified as:
  1. Jib Fabrication
  2. Machinery Frame Fabrication
  3. Boggie Fabrication
  4. Vertical Mast Fabrication
  5. Portal Leg Fabrication
  6. Portal beam Fabrication

The days of fabrication of every single component was being measured with the help of flow process chart and actual days for the fabrication was been calculated by summation.

Portal Beam Fabrication

Description	Time (day)	○	⇨	D	□	△
MARKING OF ALL PLATES, DIAPHRAM, STIFFNERS	2	●				
CUT ALL THE PART AS PER DRAWING	2	●				
GROUND ALL THE CUT PARTS	1	●				
BUTT WELD OF ALL PLATES AS PER DRAWING	2	●				
CHECK THE RADIOGRAPHY RESULT	1				●	
DO STRAIGHTNESS TEST	1				●	
WELDING OF STIFFNER AS PER DRAWING	2	●				
ARRANGEMENT OF PLATES AS PER DRAWING	½	●				
OUTSIDE WELDIG OF DIAPHAM	2	●				
DO INSPECTIN	1				●	
DO INSIDE WELDING OF DIAPHRAM	2	●				
CLEAR ALL THE WELD JOINTS, REMOVE SLAG	½	●				
PUT PRIMER PAINT BY SPRAY/BRUSH	1	●				
MART WEB PLATE POSITION ON THE BOTTOM PLATE AS PER DRAWING	½	●				
CHECK THE STRAIGHTNESS OF PLATES	½				●	
PLACE THE BOTTOM PLATEON UPOSITION PORTAL BEAM	2		●			
AGAIN CHECK STRAIGHTNESS	½				●	
OUTSIDE WELD OF PORTAL LEG	3	●				
CLEANING OF THE WELD JOINTS	½	●				
IF ANY VISUAL DEFECT OBSERVED GROUND THE SAME AND REWELD	1/2				●	
FINAL INSPECTION OF PORTAL BEAM	1				●	
Total days	24.5					

Figure 2 Flow Process chart

Setback Analysis

Table 1 Setback Description

Fabricated Component	Plan days	Actual days	Setback days
Jib fabrication	**27**	**38**	**11**
Machine frame Fabrication	**22**	**27**	**5**
Boggie Fabrication	**22**	**27.5**	**6**
Vertical Mast Fabrication	**23**	**26**	**3**
Portal Leg fabrication	**28**	**32.5**	**5**
Portal beam Fabrication	**23**	**24.5**	**2**
Total	**145**	**176.5**	**32**

Table 2 Areas of Setback

Reason identification	Design	Material Delay	Space	Rework and Manpower	other
Setback reason in per.	17.75	30.25	19.75	32.25	0

Suggestions to reduce time

1. The setback in design is mostly due to missing or wrong information as well as miscommunication between the worker and supervisor. These are the precipitous setback, hence could be only detected at the time of real work. In order to incorporate the missing or wrong information one has to flow long procedure b y consulting the supervisor followed by head of production followed by mail and documentation to the Design office situated at Mumbai, waiting for the reply to take action, generally this procedure takes 1 day for its decision. In saviour case the material has to be rejected and process has to be re-established.
   This setback can be avoided by simulating the process of work before being actually worked. Hence discussing the flow of work according to the design available will ensure the detection of the defects at the initial stage. As well as it will incorporate the mail and documentation time and also decision under consideration. In other words it is means of increasing the transparency between the company and the contractors. A small scale experiments were conducted for 4 days following the above improvement suggested (Discussing the drawing with worker). On fourth day a defect in design (Hole diameter missing [23 mm]) was observed and was solved on the prior day rather than on the day of actual manufacturing. Here usually in actual manufacturing its takes 120 to 180 min for its cure. The Discussing time for the drawing with the worker was 60 to 75 min. Hence 60 to 120 min is saved in day. As this is precipitous setback its days are not taken into the consideration.

2. Management of space is crucial for any company and for the company like Anupam plays a vital role. The company has large work space available. The present layout has area of improvement. This improvement will lead to less material handling time and effective handling of material as well as fabricated parts.
   The storage of metal plate is far from the infrastructure while its space can be easily made within the infrastructure will would lead to easy access to the plate as well as compatible environment for the storage of the plate. Presently the plates are stored in the ground in open area. Though the client sends the metal plate being NDT tested defects are observed by QC department after procurement of the plate and storing it in the yard and retrieving it after some weeks. The main cause of it is due to the weather atmosphere around it as company is situated in the middle between the agricultural land humidity content in the atmosphere is high. While storing in yard adsorption of the water is theirs. Our improvement will also solve this problem. The storage of the new plate has been shown the new plant layout [fig 2].

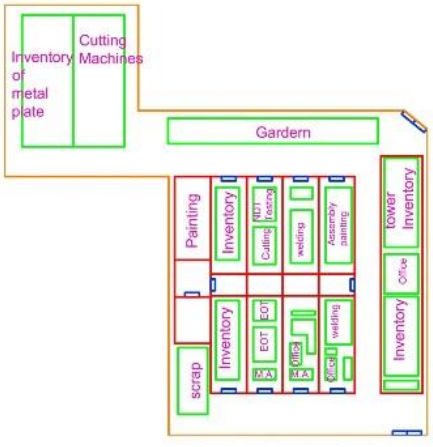

Figure 3 Present Plant Layout

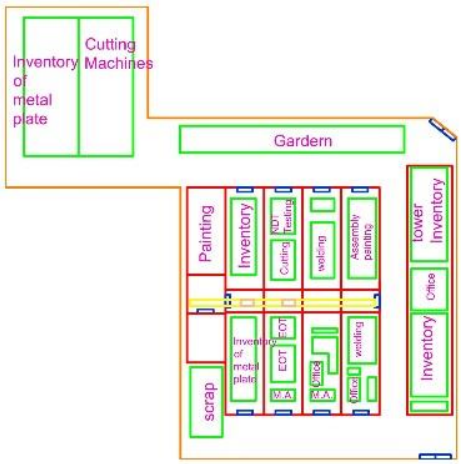

Figure 4 Modified Plant Layout

The company has number of cranes for the material handling in the longitudinal direction but in transverse direction it has no means for handling the equipment. In order to move the work piece in transverse indirection the company has to issue a **mobile crane or trailer** for the transportation hence such time setback stops the production area as new product fabrication cannot be started while the place where the work piece is to be placed has not yet reached. These setback has a saviour effect has it makes the manpower idle until the mobile crane or trailer full fill its work. Our improvement is to place a sliding trolley on the mid area with the help of which the any job can be effectively handled in transverse direction. This will reduce the material handling time as well as the idleness of the worker. It is not a large capital has such trolley can be fabricated within company itself. This improvement has been shown in the new plant layout.

3. In the fabrication of vertical mast and connecting body with the main frame their part between them called ring. The accuracy of the ring is essential for the smooth and easy movement of the crane. The company after consulting the dimension of ring gives contract to the vendor. The ring has to have dimensional accuracy and required tolerance in order to satisfy the requirements. The cost of the ring is very high as it is fabrication outside the company and it has to be transported within the company with high care. The fabrication of the ring take 5 days of its completion and also requires 2 days for the transportation as the company is situated in the remote area from the other industries.One solution of these is fabricating the ring within the company as the dimension of these are known by the fabricator of the company, a template could be prepared based on the dimension and imprints could be set on the ring and machining could be done effectively meeting the required tolerance and accuracy on the surface. For the drilling and boring the hole of required accuracy company has line portable drilling machine which can achieve accuracy of 0.2 mirco-milimeter which is more than enough. The company has to design and fabricate a fixture for handling this ring which can be done within the company itself. With this method the company can fabricate this ring in 4 days hence total 3 days are saved by the company. Also company will endure less cost compared to the vendor as it is fabricated within the company. This cost cannot be predicted as this model has to be tested. The Fixture used for the ring can also be used for the fabrication of the other parts like pulley Rim, Portal Beam Base Rim, etc

Table 3 Ring costing analysis

Description	Cost (Rupee)
Vender fabrication	32,620
In factory fabrication	14,200
Cost saved	18,420

4. The company has two mobile crane of the contractor working in the area **[14 ton capacity and 12 ton]**. After being issued the crane will reach the destination **in 25 to 35 min**. On average one can say that the mobile crane reach its destination in **30 min.** The trailer on the other hand is used to transport objects of weight higher the **15 ton** as it would be beyond the capacity of the mobile crane. The company does not have its own trailer in the working area. After the issue of trailer, it reaches the destination in **120 min to 180 min**. On an average it could be said that trailer reaches its destination in **150 min**. In present scenario company uses trailer 2 to 3 times a day and mobile crane 20 to 25 times a day.The dimension and drawing is analysed.

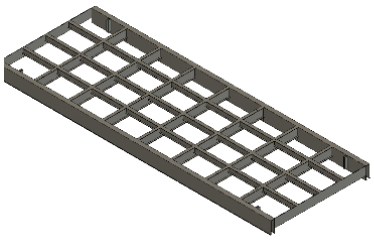

Figure 5 3D Model of Trolley

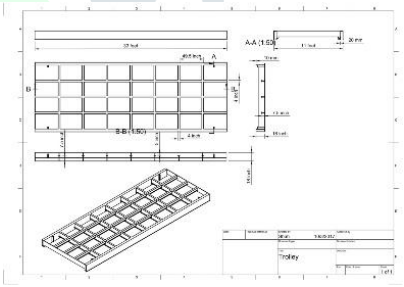

Figure 6 Dimension of Trolley

Table 4 Time analysis for present scenario

Description	Setback(min)	Usage per day	Total setback(min)
Mobile crane	30	20	600
Trailer	150	2	300
Total setback			900

Table 5 Trolley fabrication cost

Description	Unit cost	Requirement	Cost(Rs)
Mild steel, I-beam, etc	38 Rs/kg	5139 kg	195,282
Mortar	7000	4	28000
Guider Wheel	5000	8	40000
Total cost			263,252

Table 6 Cost Comparison

Description	Cost (Rupee)
Present	283,600
Trolley implementation	263,252
Cost saved	16,348

Table 7 Cost of the day

Description	Cost(Rupee)
Manpower cost	16,800
Electricity bill cost	30,000
Staffs cost	3775
Total cost per day	50,575

CONCLUSION

Based on the suggestion made the company could manufacture the product 4 days early. Hence cost saved approximate would be equal to the capital of 4 days.By finishing the job earlier the company could also work on other job hence more profit will be endured by the company.The company is facing time setback of 32 days, here the company would not be able to dispatch the product on predicted time but cycle time of ELL crane has been optimised to some level.The capital saved by the company is 202,300 Rupee which is considerable amount. Also due to the suggestion made the area of improvement could save up to 34,768 Rupee.Hence company endures benefit of 237,068 rupee.

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