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Appling the work study To Reduce Production Lead Time and Improved Planning to Increase Productivity

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ABSTRACT

The productivity improvement is a great significance for steel industries. There are limited resources which should be used to get the maximum output i.e., there should be attempts to perform a job by cheaper, safer and quicker ways. The aim should be optimum utilization of resources, so as to provide maximum satisfaction.

The productivity improvement in steel industry can be approached by different methods. On this thesis productivity improvement by reducing lead time through work study are done, because rolling work is labor-intensive and largely depends on the plant layout and sensibility of the operator. The productivity of a factory is adversely affected by the advantage of the operators.

The objective of this research is to study plant layout of NCRM (Narrow cold rolling mill division) of Ruchi steel Ltd. Ghatta villod based on the layout planning for increased productivity. In this case study, amount of time required in rolling coil production are studied. The detailed study of the plant layout such as operation process charts and flow of material charts and new plant layout has been investigated. The new plant layout has been designed and compared with the present plant layout. The thesis showed that new plant layout significantly decrease the distance of material flow from pickling process until packing in packing department.

This thesis is divided in to nine chapters the introduction part which includes the introduction of company and different operations perform in the plant. There is a bird's eye view study of plant layout and different operations perform in first chapter. The second chapter includes problem formulation. The third chapter includes the literature review .The fourth and fifth chapters' deals with description of work study approach and different work study techniques and introduced to study different charts and diagrams used in work study. The next part which is chapter six includes methodology in which present methodology and proposed methodology is discussed. In this chapter existing plant layout and proposed plant layout is also compared. The chapter seventh and eighth includes conclusion and reference respectively.

Most companies highly utilize the scientific method of work study application. However, BSL Ghatta villod is looking forward to follow the best practice to improve productivity. The main intention of the thesis to reduce time required performing different operations and it can be achieve by analyzing plant layout of NCRM Division, BSL, Ghatta villod.

Key Word: - Electrolysis, Hydrogen, Frequency, Impedance, Equivalent circuit

1.INTRODUCTION OF COMPANY

Ruchi Steel Ltd. formerly known as Ruchi Steel & Strips Ltd. is a globally renowned one of the leading pioneer in Steel Industry. Company has remarkable contribution in cold rolled mild steel coils. Company has established plant in MP at Ghata villod. Backed by more than two decades, of experience in Steel making, Ruchi Steel is now India's 3rd largest Secondary Steel Producer Company with an existing steel production capacity of 2 million tons per annum's approximately.

The company is a source for vivid variety of products such as Cold Rolled Closed Annealed, Galvanized Coil and Sheet, High Tensile Steel Strapping, Color Coated Coils, Glumes Sheets and Coils, Hardened & Tempered Steel Strips, Billets, Sponge Iron, Precision Tubes and Wire Rods.

As one of the prime movers of the technological revolutions in Indian Cold Rolled Steel Industry, BSL has emerged as the country's largest and the only Cold Rolled Steel Plant with an independent line for manufacturing Cold Rolled Coil and Sheet up to a width of 1700mm, as well as Galvanized Coil and Sheet up to a width of 1350 mm.

In due course of time, BSL has grown incredibly its turnover and production capacity by successive expansions as well as improved realizations with these manufacturing units.

The dynamic reason of awesome and unparallel growth of BSL, is rapid integration on the Steel value chain; conceivably, it would be its unwavering focus on acquiring the latest technology and knowhow, also the BSL's commitment to provide its customers with the best quality products.

Given a vibrant Steel industry dynamics in India, Ruchi steel limited on a course to become a fully Integrated Steel & Power Company with market leading offerings in value added Steel in Automotive and White Good Segment with the quality been approved by ISO 9001:2008 & ISO 14001:2004 [From Ref. No. 22]

1.1 Departments of Ruchi Steel Limited

There are four major units in Ruchi steel limited.

- NCRM (Narrow cold rolling mill Division)
- WCRM (Wide cold rolling mill Division)
- POWER PLANT
- TUBE

1.1.1 NCRM Departments: -

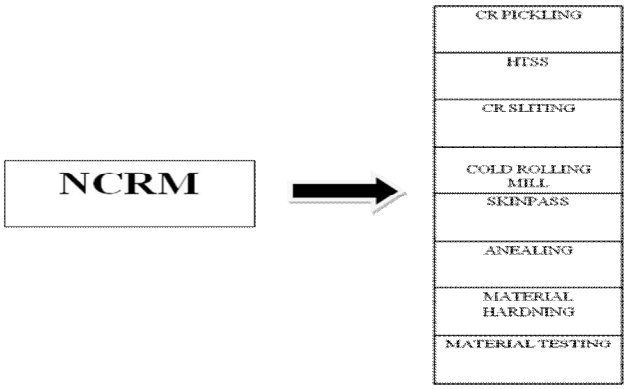

Figure 2: NCRM Departments [From Ref. No. 22]

1.1.2 Other Departments:-

- Safety Department
- Personal Department
- Accounts Department
- ISO Department
- Production Planning and Control Department
- Store Department
- Excise Department
- Quality Assurance Department
- Mechanical maintenance Department
- Electrical Maintenance Department

- Strapping Specification:-
- Confirming to International Standards ASTM D-3953
- TABLE-1
- STRAPPING SPECIFICATIONS

ULTIMATE TENSILE STRENGTH Kg/mm^2	BENDS	ELONGATION ON 152 mm GL	PAINT THICKNESS	WAX THICKNES
93Minimum	2	5 to 6050%	1.75 to 5	0.40
110 Min.	1 R	2.50%	1.75 to 5	Nil
130 Min.	1R	2.50%	1.75 to 5	Nil
93 Min.	1 R	9.00%	1.75 to 5	0.40 to 0.50
77 Min.	2	Negligible	1.75 to 5	0.40to 0.50
77 to 130 Min.	1 R-2	A Desired	1.75 to 5	As Desired

- [From Ref. No. 22]
- Figure11: High tensile steel strip line

2. PROBLEM FORMULATION (PROJECT WORK UNDER CONSIDERATION)

Steel Industries are now a days facing with the intensified competition from the global market as well from within. The reasons behind this are quality problems inefficient management system, on time delivery failures and higher production cost, increase in down time of machine, increasing in production lead time, inefficient material handling machines etc.

The Khopoli plant commissioned in 2004 with the intention to be the largest cold rolling company of the India with its high production but some factors which are required to ameliorate to improve the productivity of the company. There are many reasons the plant did not produce adequate quantities to satisfy the domestic demand both quality and quantity wise:

- The distance between ware house and NCRM is too large about 40 meters and it can be reduced to reduce the unnecessary travelling of product.
- Ruchi steel Ltd. cannot compete with foreign market due to inefficient Production system and under utilization of capacity.
- The time for travelling coils from one machine to another machine can be reduced by some modifications in existing plant layout.
- Some new machines can be installed to increase productivity.
- The existing distance between the machines can be reduced to reduce the travelling of product from one place to another.
- Among productivity improvement, tools, methods study is one of the promising technique and other like line balancing, layout, motion economy and material handling will be considered.
- The Steel productivity can be improved by studying the operation capacity of the work places in terms of both machinery and skill of the operators who work there.
- The transfer of the steel coil from one place to another can be better than existing method and the time of transportation can be reduced.
- Material handling devices should be adopted. Work method and tracks should be improved. Training in machine operators should be developed. The material setting method should be improved.

This process takes a major part of time in unit although this process can be simplified by affording another crane and some other means as lifting cranes of small capacity for small coils. The small coils for different operations also traveled by trolley which effect the travelling of big coils because at a time only one coil can travel on the same path. Some coils have to directly transfer from one line to another. By a crane, moves length wise in unit which is not available the coils have to many times load on the trolley and unload from trolley to transfer from one line to another which take more time thus productivity, mass production, and planning affected.

There are also many operations done by the worker which take a long time and give fever result which decrease the efficiency. For every successful industry it is required to analysis the different operations, plant layout, worker behavior and their skill during the operation. The efficiency and productivity can be increase by reducing lead time of production. As we know that a major part of the time is spent on only travelling the coil from one destination to another so the productivity, mass production can improved by improved planning by reducing the lead time of travelling the coil. We will also study the process of different operation, and workers activity by the different charts as flow process chart, man, machine type, outline process chart, two hand process charts and multiple activity charts. There are also too many distance between respective departments and lines. An important point can also be underlined that each coil does not complete the total process like some coil directly transfer to slitting department after rolling, some coil directly transfer to skin pass after rolling department that's why they have to travel more distance by the trolley and take too

long time because of loading and unloading from the trolleys of the different path and also get travelling of the other coils which are sent to the different machine for different operations.

2.1 Objectives of the Thesis

The desired outcomes that are to be achieved by carrying out this thesis works in general
And specific are the followings.

1. To develop an appropriate model for the improvement of productivity of Steel industry.
2. To initiate and prepare the foundation for future research works related to Steel Industries.
3. To eliminate non value adding activities.
4. To find the best way of doing a job.
5. To have more effective utilization of materials, machineries, and workers.
6. To discuss about sell shorts of the present plant layout of NCRM Division.
7. To discuss reformation of existing plant layout of NCRM Division.
8. Integrating jobs to minimizing make span.

3.PRODUCTION AND PRODUCTIVITY

- Production: Production is defined as an organized activity of transforming raw materials into finished products. It is an outcome of productive forces. Production can be also defined as a sequence of technical processes, requiring either directly or indirectly the mental and physical skill of craftsman and consists of changing the shape, size and properties of materials and ultimately converting them into more useful articles.
- Productivity: Productivity is defined as the human efforts to produce more and more with less inputs of resources, as a result of which the benefit its of production is distributed more equally among maximum number of people. Productivity is related to the effective utilization of resources of an industry (men, material and machines). There are mainly three types of productivity calculations; such as partial productivity (ratio of output to one class of input), total factor productivity, and total productivity (reflects the joint impact of all the inputs in producing the output). [From Ref. No. 24]
- A. Partial productivity:
- $$\text{Partial productivity} = \frac{\text{Out put}}{\text{Input of one factor}}$$
- B. Total factor productivity:
- $$\text{Total factor productivity} = \frac{\text{Net out put}}{\text{Sum of associated labor and capital inputs}}$$
- Net output = (total output) – (Intermediate goods and services purchased)
- C. Total productivity:
- $$\text{Total productivity} = \frac{\text{Total output}}{\text{Sum of all input factors}}$$
- 4.1 Factors Affecting Productivity
- The concept of productivity is of great significance for the well development of an industry. In those companies there are limited resources that should be used to get the maximum output i.e., there should be attempts to perform a job by cheaper, safer and quicker ways. Generally industries will follow “six lines of attack” to improve the productivity:
- 1. Improve the basic process by research and development.
- 2. Provide more and improved physical means to motivate workers.
- 3. Improve the product and reduce the variety i.e., standardize the product.
- 4. Improve the method of operation.
- 5. Improve organization, Production Planning and Control.
- 6. Improve manpower efficiency at all levels.
- The first two lines are sometimes known as “long term planning”, and it requires more time and capital for implementation. The third one is known as “effective planning” and can be implemented immediately. It may or may not need more capital for implementation. The last three lines are known as “short term planning” and can be implemented immediately, that may not need capital investment. [From Ref. No.25]

4. WORK STUDY AND PRODUCTIVITY

- There is a pool of knowledge that has evolved over the years that is designed to increase the productivity of an organization and of the individuals who make up the organization. Work study has as its objective the elimination of unnecessary work, the design of methods and procedures which are most effective, which require the least effort, and which are suited to the person who uses them. Moreover, it provides methods of measuring work for determining a performance index or productivity index for an individual or for a group of workers, a department, or for an entire plant.
- Labor has always been a major factor in the cost of a product. As labor productivity improves, costs go down, wages go up, and profits go up. From the earliest industrial history, management has looked for labor saving techniques. Industrial technology's objective and purpose for being is to increase productivity and quality. Output per labor hour is the most commonly used measurement of productivity. Work-study techniques give management the tools to measure and improve productivity.
- Productivity management is a formal management process involving levels of management and employees with ultimate objective of reducing the cost of the manufacturing, distributing, and selling of a product or service through an integration of the four phases of the productivity cycle: namely, productivity measurement, evaluation, planning, and improvement. [from Ref. No.26]

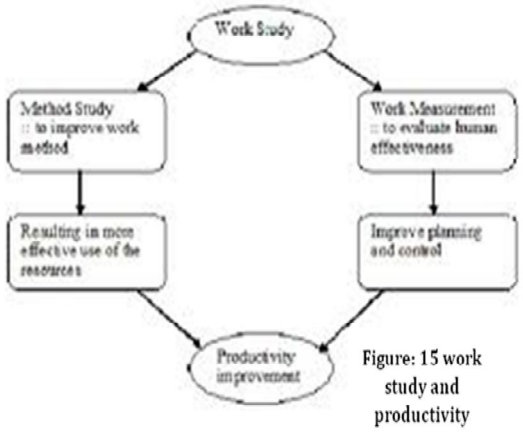

Figure: 15 work study and productivity

5. CHARTS AND DIAGRAMS USED IN METHOD STUDY (TOOLS AND TECHNIQUES)

As explained earlier, the following charts and diagrams are used in method study:

1. Operation process chart (or) Outline process chart
2. Flow process chart.
(a) Material type
(b) Man type
*(c)*Equipment type
3. Two-handed process chart or Left hand-Right hand chart
4. Multiple activity chart
5. Flow diagram.
6. String diagram.

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5.1 Operation process chart:

An operation process chart is a graphic representation of the sequence of all operations and inspections taking place in a process. It is also known as outline process chart. It gives a bird's eye view of the overall activities. Entry points of all material are noted in the chart.

Process chart symbols:

Process Chart Symbols

Sym	Name	Action		Examples
	Operation	Adds Value		Saw, Cut, Paint, Solder, Package
	Transport	Moves Some Distance		Convey, Fork Truck, OTR Truck
	Inspect	Check For Defects		Visual Inspect, Dimension Inspect
	Delay	Temporary Delay/Hold	STOP	WIP Hold, Queue
	Storage	Formal Warehousing		Warehouse or Tracked Storage Location
	Handle	Transfer Or Sort		Re-Package, Transfer To Conveyor
	Decide	Make A Decision		Approve/Deny Purchase

Figure 17: Process chart symbols

5.2 Operation process chart by existing method:
A small process of changing damage coil by operation process chart is shown in the figure: 18.
Task: Changing a damaged roll
Method: Present Method
Chart begins: Test the mill
Chart ends: Testing of machine
Charted by: Self

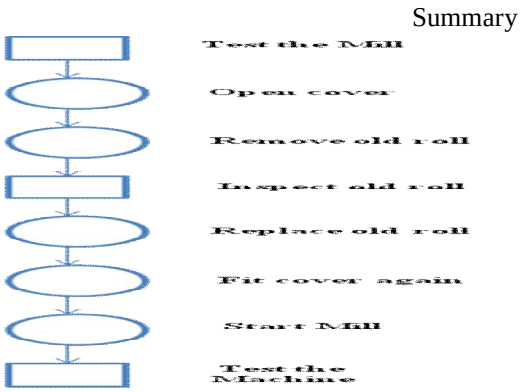

Figure 18: Operation process chart

6. METHODOLOGY

6.1 Present Methodology:
The coil transportation from one machine to another machine can only take place with the help of trolley and for this type transportation every time the worker has to load coils on trolley and after destination have to unload it. This process takes a major part of time in unit. The small coils for different operations also traveled by trolley which effect the travelling of big coils because at a time only one coil can travel on the same path. Some coils have to directly transfer from one line to another. For every successful industry it is required to analysis the different operations, worker behavior and their skill during the operation. The efficiency and productivity can be increase by reducing time during the operation. As we know that a major part of the time is spent on only travelling the coil from one destination to another. An important point can also be underlined that each coil does not complete the total process like some coil directly transfer to packing department after rolling, some coil directly transfer to packing after HTSS department that's why they have to travel more distance by the trolley and take too long time because of loading and unloading from the trolleys of the different path and also effected travelling of the other coils which are sent to the different machine for different operations.
According to the operation flow process chart; coil transfers to the pickling department from the ware house after pickling process coil transfer to the rolling mill. After rolling process coil transfers to the annealing department than it sent to the skin pass. The slitting operation performed finally than coil transfers to the packing department.
6.2 Present plant Layout of NCRM Division

No. of operations	5
No. of inspections	3
Total No. of activities	8

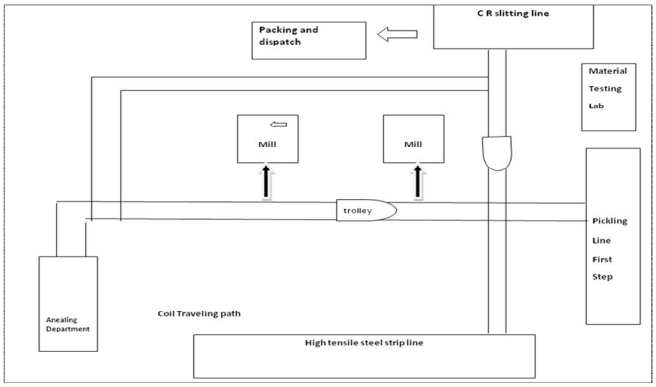

Figure 23: Present plant layout

[From Ref. No. 22]

6.3 Flow process chart According to current process

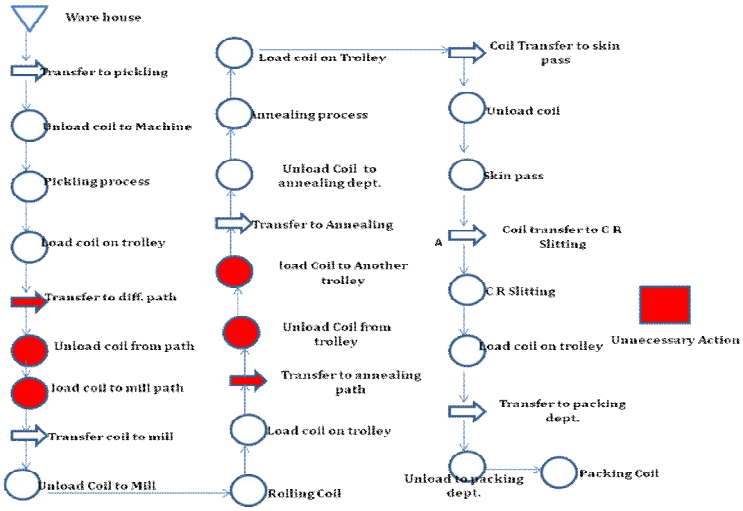

Figure 24: Existing flow process chart

According to the current plant layout; as we seen in the above process chart; there are different operations performed on the rolling coil. According to the process chart the coil transfer to the pickling department from the ware house. The coil unloads to the pickling department and pickling process performed on it. After the pickling process the coil again load on the trolley and transfer to the rolling line path. When the coil riches to the rolling mill path it unload from the pickling line trolley and load to the trolley of mill path. Now the coil riches to the mill by the mill path and coil unload to the rolling mill. After the rolling process the coil transfers to the annealing path. The coil is unloaded from the trolley and loaded to the trolley of annealing path trolley and riches to the annealing department. After the annealing process the coil is transfer to the skin pass and then to the slitting department. The slitting is the final process of the coil and the coil transfer to the packing department. As we seen in the above process when the coil is transfer to the mill from the pickling department, the coil has to unload from the current trolley to the another trolley because of the deferent path of rolling mill that's why the coil unloaded and loaded to the different path and the time required to sent the coil to the mill from the pickling department is increased. After the rolling process the coil sent to the annealing department and the same problem is faced there i.e. the coil is again unloaded and then loaded to the trolley of annealing path and again the time increased of sending of coil from mill to the annealing department. After the annealing process the coil is transfer to the skin pass and then to the C R slitting department. Finally the coil transfer to the packing department. According to the TABLE-A total distance covered by the coil in NCRM department is 140

Meter and total time required to cover the distance is 80 Minutes by the existing method according to the current NCRM Layout. [From Ref. Appendix- A]
As seen in the TABLE-B the total time required to perform the different operation on the coil is 165 minutes (2.75 hours) by the existing method according to the current NCRM layout.

6.4 Limitations:
There are some limitations of the present plant layout which decrease the efficiency and productivity of the plant. As we understand from above methodology that a large part of time in working hours is only spent of traveling the coils and in its loading and unloading. This time can be reduced by introducing some improved planning and some machines. In every industry there are some limitations of every planning and it is fact that all the limitations cannot be eliminate but it can be reduced by some improved planning and ideas. As we seen in the above flow process chart after the pickling process the coil has to again unloaded from the trolley and loaded to the trolley of the rolling mill path. Therefore because of the change of the path the extra time is spent to unloading and loading the coil to the path of rolling mill. This time can be saved improving the plant layout. Same as after the rolling process the coil is transferred to the annealing path and the coil loaded to the trolley of annealing department which required the extra time again.
There are five major limitations of the existing plant layout:
1. The distance between the pickling department and ware house:
   In the existing plant layout the distance between ware house and pickling department is 20 meter.
2. There is not a direct path between the pickling department to the rolling mill and from the rolling mill to the annealing department:
   Because of this there is extra loading and unloading of the coil which waste the time.
3. The distance between the rolling mill and cold rolling slitting machine is too large therefore the coils which are direct transfer for the C R slitting after rolling have to travel a large path.
4. The coils which are required skin pass after the rolling process have to traveled a long path although a new path can be installed between the empty passage between skin pass and rolling mill.

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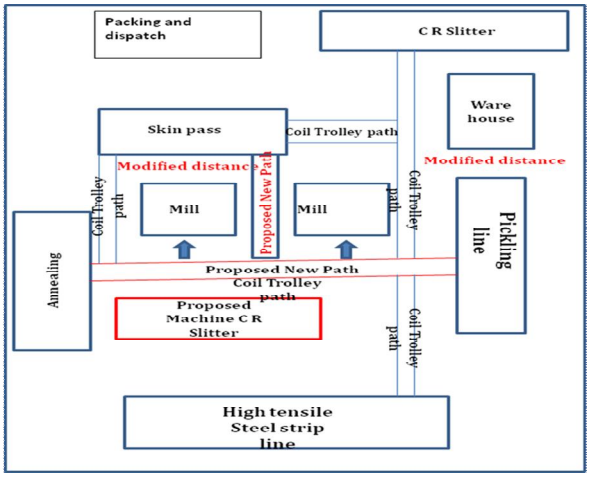

Figure 25: Proposed plant layout of NCRM Division

6.6 Advantages:
As explained above with the help of proposed plant layout a major part of time in working hour can be saved. This time can help us to improve productivity and mass productions. It decreases the down time of the machine as well as increase productivity and working efficiency. With the help of proposed method the plant can save 40 minutes in each shift and 100 and 125 in CR slitting and skin pass operations respectively in each shift, of 8 hours and this time can be used in extra production and improving the planning.
As we seen in the existing plant layout Figure-23; there are five improvements proposed discussed below:
1. The distance between Ware house and pickling department can be reduced:
   In the existing plant layout the distance between the pickling department and ware house is 40 meter which distance can be reduced according to the new plant layout so that the distance traveled by the coil from ware house to pickling department will reduce and the travelling time of coil will saved.
2. Direct path between the Pickling Department and Annealing Department:
   As we seen in the old plant layout; the coil is loaded on the trolley from the pickling department after the pickling process and transfer to the mill path than coil is unloaded from the current trolley and loaded to the trolley of mill path.

Same as after the rolling process the coil is transfer to the annealing path and then coil unloaded to the trolley of annealing path therefore the coil is two times loaded and unloaded for changing the path of the coil which required extra time for loading and unloading. It is also increased extra work for the man power which reduces the efficiency of the workers.

In the new plant layout there is a direct path between the pickling and annealing is proposed which is also passes through the mill department so that if the coil is loaded one time from the pickling department, it can directly transfer to the mill and from mill department to the annealing department and the extra time for two times loading and unloading can be saved.

3. Proposal for a new cold rolling slitting machine between the pickling line and Annealing Department (In front of the Rolling Mill):

According to the demand of product and material properties some coils are directly transfer to the slitting process after the rolling operation. In the NCRM department there are 20 % coils are directly transfer to the CR Slitting department after the rolling process. According to the existing plant layout the distance between rolling mill and slitting department is 20 meter.

A new CR Slitting line can be installed between the pickling department and annealing department i.e. near the rolling mill so that the coil which required direct slitting after the rolling process can be rolled at this slitting machine which can be installed at the distance of 5 meter from the mill.

4. Proposal for a new path between the rolling mills to the skin pass department:

According to the existing plant layout there is not any way between the rolling mills and skin pass department. In present condition the coils required skin pass process after the rolling process are transfer the path in front of the Annealing department which increase extra traveling and time.

7. CONCLUSION

The objective of this synopsis was to show that there are some limitations of existing plant layout and it takes some extra time to perform the operations. There are some also modification in present planning and need to improve the planning. In this project we have discussed that the coil travelling time in the NCRM Department can be reduced by implement the present method and plant layout. Some techniques are also introduced in the project which will help to increase the productivity and mass production by improving the planning.

A layout project will always reach a "creative phase" where it is due to the experience possessed by the user of the model, how good the result will be. In this project there are major changes in plant layout but also a potential for improvements. In another company this would have been different. This makes it obvious that a good model can be very helpful, especially in the early stages of the project, but it is not sufficient to reach an optimal solution.

On one hand technical limitations and space requirements and on the other hand a lack of willingness to do extensive investments stands in between the existing layout and serious potential future improvements. The finishing section proved to be fit to meet the future changes without any serious adaptations at all. This means that it will be hard to motivate expensive investments.

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