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Section Change over process at Slab Caster – Steel Melting Shop

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Abstract - *In manufacturing organizations, to improve their system it might mean to reduce the operating costs that come from the wastes in production line or increasing the productivity in the finishing line. The Slab Caster at Steel Melting Shop currently faced a similar situation where it needed to meet the increasing demand using the same level of resources. Previously the slab caster was producing a certain amount of product i.e., slabs which is further used in different rolling mills. As the scenario changed the demand for slab increased, so in order to meet the increasing demands the production also increased, but what was limited is the resources and time to produce one slab. The problem arises in the slab caster to increase the level of production of slabs using the same level of resources. This can be achieved by reducing the set-up time in section change over process in slab caster. For reducing the set-up time in section change over process Single Minute Exchange of Die (SMED) is used.*

Key Words: Production, Resources, SMED, Work Sampling, Utilization, Workload Analysis

1. INTRODUCTION

In a steel manufacturing company, everything is planned, every layout is designed, and almost everything works according to the ones' expectation, but this system rattles when anything goes out of balance. The whole system shakes when the demand for certain product rises above a certain level, especially when the increasing demand needs to be fulfilled with the same limited resources. To stay focused and to survive, steel makers need to address the difficulties of expanding profitability and quality and additionally decreasing generation cost. These require cautious control of every unit procedure and additionally change in the whole steel influencing procedure to course.

The Slab Caster at Steel Melting Shop currently faced a similar situation where it needed to meet the increasing demand using the same level of resources. Previously the slab caster was producing a certain amount of product i.e., slabs which is further used in different rolling mills. As the scenario changed the demand for slab increased, so in order to meet the increasing demands the production also increased, but what was limited is the resources and time to produce one slab

The problem which arises in the slab caster to increase the level of production of slabs using the same level of resources. This can be achieved by reducing the set-up time in section change over process in slab caster. For reducing the set-up time in section change over process Single Minute Exchange of Die (SMED) is used.

1.1 Genesis of the problem

The purpose behind this project was to correct the following:

- The demand of slabs by rolling mills were rising, so in order to meet the rising demand, production of slabs needs to be increased
- As the production needs to increase using the same level of resources, it can be achieved through reduction in set up time of section change over process
- Using Single Minute Exchange of Die (SMED), we can reduce the set-up time in section change over process

1.2 Objective to be addressed

The objective of this project is:

- To reduce the set-up time in Section Change at Slab Caster - SMS – II by analyzing & identifying any Bottlenecks, NVAs & Delays

2. RESEARCH METHODOLOGY

Research methodology is the framework or plan which guides how the study can be utilized effectively to reach the objectives. Research is the scientific way to solve the problems which involves in exploring the data in a systematic manner to find the best possible solutions. The research part began with the collection of data. While research design is the procedures or methods for acquiring the information needed for the solution of the problem. One of the research designs is descriptive research. Descriptive research describes the unit characteristics or functions. The descriptive research method includes the collection of secondary data or observations being taken.

In this project, we initiated our work by studying the current system or the "as-is" process with the help of which we were able to map out the layout of the plant, identify the current steps and procedure while carrying out a process, cycle time of various activities, identify no of persons employed in carrying out a process. After studying the "as-is" process of the system, we were able to draw the process flow chart of different activities employed in the system.

The next step was data collection. Past data of section change over process of 12-14 months was collected and various on-

field observations were recorded. The on-field observations were time-study of various activities performed in the system, in order to know the standard time taken by a worker to perform a given set of task or activities. Through on-field observations we also came to know about the various activities involved in a process, a complete work-breakdown structure of a process.

Data collection is followed by data analysis. The collected data is analyzed using various tools and techniques such as pareto charts, bar graphs, cumulative charts etc. All the collected data of past 12-14 months is analyzed and conclusions were drawn. From the analysis various time delays and turn-around time is calculated. Delays and bottlenecks were identified and the cause and effect diagram of the process is made. Standard time of different processes is calculated from the analysis of the data collected.

Industrial engineering tools & techniques were used to identify the problems in the system such as face to face interaction, interview of the workers for information, time study of different processes, utilization of different workers employed in different set of activities, process flow charts of different process were made, the layout of the plant and equipment was made, employee involvement, time study and work sampling etc. Using above tools and techniques various conclusions were drawn such as the reasons of the delays, cause and effect diagram of the system was made.

Finally different recommendations were made which were in the scope of improvement and which were economically and technically feasible. These suggestions were recommended to the department and their feedback were recorded and validated with the recommendations. The various suggestions were monitored and evaluated on the feedbacks received from the department.

3. DATA COLLECTION & ANALYSIS

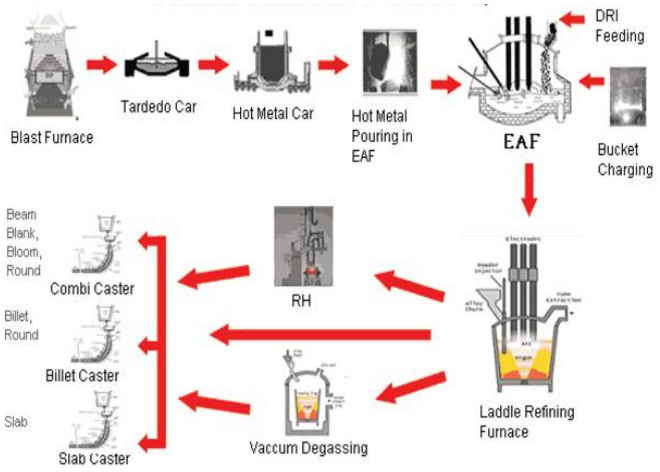

Fig -1: Process flow diagram of steel melting shop

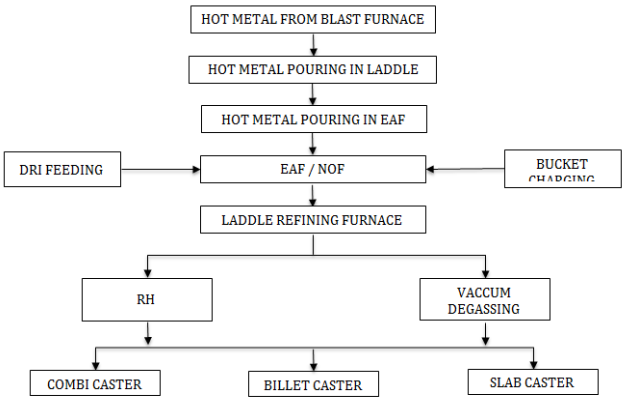

Chart -1: Process flow chart of steel melting shop

Table -1: Past data of section change over time from Apr'16 to May'17

Month	1st Section Change Over Time (mins)	2nd Section Change Over Time (mins)	3rd Section Change Over Time (mins)	Average Section Change Over Time (mins)
April	321	322	322	322
May	313	302	315	310
June	315	303	315	311
July	323	309	310	314
August	321	321	325	322
September	307	311	301	306
October	324	318	321	321
November	304	295	303	301
December	310	315	312	312
January	309	321	311	314
February	295	309	303	302
March	295	320	309	308
April	315	315	296	309
May	300	300	314	305
Max Section Change over Time (Apr'16 – May'17) – 320 mins				
Average Section Change over Time (Apr'16 – May'17) – 308 mins				
Min Section Change over Time (Apr'16 – May'17) – 300 mins				

Table -2: Activity timings at Removable Adjustable Mould (RAM)

S.No.	Activities at Removable Adjustable Mould (RAM)	Resources	Activity Time (mins)
1	Tundish Removal from Top of RAM	Control Room Operator	1
2	Water Spraying at the mould for Cooling	2 Workers	6
3	Alignment Check of Mould	1 Operations Person	2
4	Lifting and Removal of RAM top by Crane	2 Workers & 1 Crane Operator	4
5	Manual water spraying on the mould	1 Worker	5

6	RAM Enclosure lifted and removed	3 Workers & 1 Crane Operator	4
7	Waiting for mould to cool		12
8	Plywood removal And connections opening of mould	3 Workers	5
9	Mould unlocking (4 locks)	1 Worker	5
10	Water valve opening of Segment 1	2 Workers	7
11	Mould & Segment 1 lifted & removed simultaneously	3 Workers & 1 Crane Operator	10
12	Water Spraying in the RAM opening	1 Worker	10
13	Change of Segment hose	1 Operations Person & 1 Worker	8
14	New Segment inserted	3 Operations Person, 3 Workers & 1 Crane Operator	9
15	Plywood Packing	2 Workers	8
16	Segment Water nozzle checking and calibrations	3 Operations Person & 1 Worker	16
17	New mould inserted	4 Worker & 1 Crane Operator	18
18	Mould Locking, connections and mould calibration	2 Operations Person & 3 Workers	20
19	Ram enclosure placed	3 Workers & 1 Crane Opr.	4
20	RAM top placed	3 Workers & 1 Crane Operator	6
21	Water spraying on the mould and RAM	1 Operations Person	3
22	Dummy bar reached the mould and calibrations	3 Operations Person	6
23	Dummy bar simulation	3 Operations Person	40
24	Width calibration at the mould	3 Operations Person	6
25	Preparation activities at the mould for pouring	2 Operations Person	21
26	Tundish placed	1 Operations Person	3
27	Pouring starts	1 Control Room Operator	1

Table -3: Section 2 – 6 Preparation activity timings

S.No.	Segment 2 -6 Preparation Activities	Resources	Activity Time (mins)
1	Packet fixing at Segment 2 to 6 (Total : 5X2X2 = 20 nos.) at first floor	4 Workers	18
2	Inspection of packets	1 Worker	10
3	Hydraulics check at apron chamber	1 Worker	10

Table -4: Dummy bar preparation activity timings

S.No.	Dummy bar Preparation Activities	Resources	Activity Time (mins)
1	Removal of Head from Dummy which is kept on the ground	2 Workers & 1 Contract Supervisor	6
2	Shifting of Dummy bar head to dummy bar head stand area	1 Worker	3
3	Shifting of New head from stand to ground and Insertion of Head into Dummy Bar by help of crane	2 Workers & 1 Contract Supervisor	4
4	Fixing of nuts and bolt of the Head	2 Workers	5
5	Altering the width of head by removing the additional plates	2 Workers	10
6	Cleaning of the Dummy bar by Air spray	2 Workers	38
7	Movement of Dummy stand table from home position to roller table	1 Operations Person	1
8	Old dummy bar kept on the dummy stand is moved forward	1 Operations Person	2
9	Sling is attached on the new dummy bar for shifting on dummy strand	3 Workers	5
10	Cleaning the head and painting white color on head	1 Worker	10
11	Shifting of the dummy bar on the dummy strand	3 Workers & 1 Crane Operator	3
12	Detachment of Sling from dummy bar	2 Workers	3
13	Dummy stand shifted to the Zero position	1 Operations Person	2
14	Old Dummy bar is moved backward for removal	1 Operations Person	1
15	Sling attached to the old dummy bar	3 Workers	5
16	Shifting of the old dummy bar to the ground	3 Workers & 1 Crane Operator	1
17	Sling detached from the old dummy bar	2 Workers	1
18	Dummy bar stand taken moved again to the roller table	1 Operations Person	1
19	New dummy bar is inserted into the segments for simulation	1 Operations Person	44
20	Width correction of Dummy bar	3 Workers, 1 Contract Supervisor, 1 Mechanical In-Charge & 1 Crane Operator	5

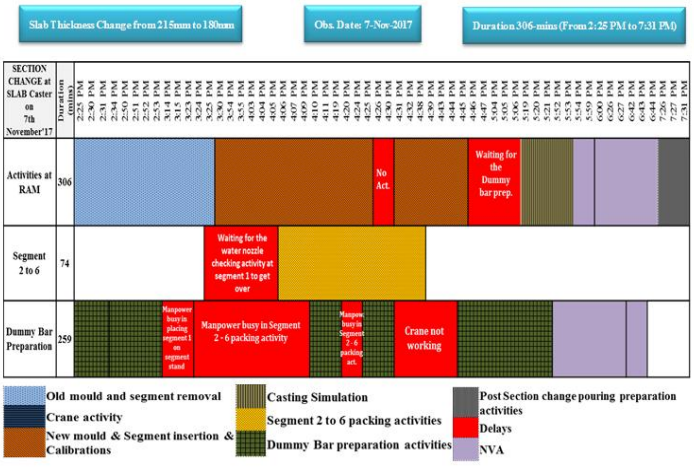

Chart -2: Gantt chart of section change over process at slab caster on 7-Nov-17

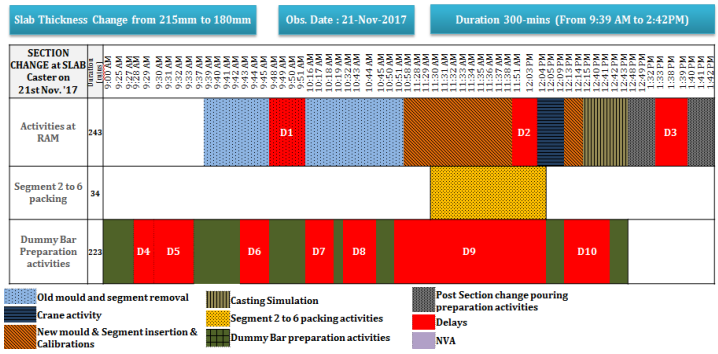

Chart -3: Gantt chart of section change over process at slab caster on 21-Nov-17

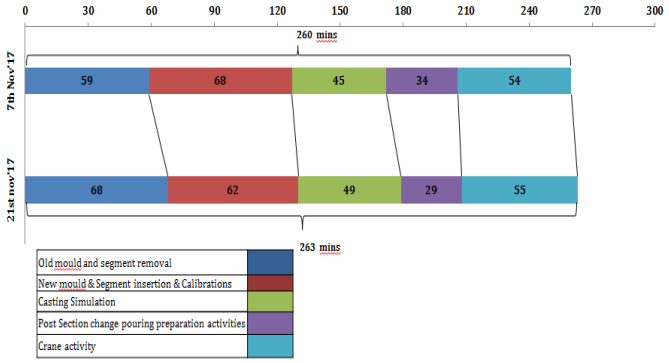

Chart -4: Bar graph – Comparison between RAM Activities

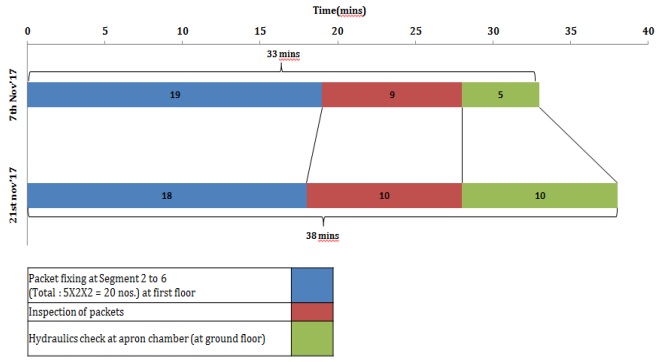

Chart -5: Bar graph – Comparison between Segment 2 -6 preparation Activities

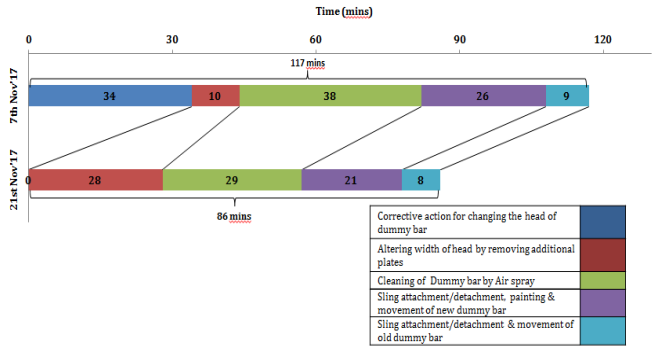

Chart -6: Bar graph – Comparison between Dummy Bar preparation Activities

Fig -2: Fishbone Diagram – Delay in Section Change Over Process

Table -5: Delay Analysis: Section Change at Slab Caster, SMS at 7-Nov-17

Area	Start Time	End Time	Duration (Mins)	Working (Mins)	NVA / Delay (Mins)		NVA / Delay Affecting Cycle Time(Mins)		Delay Code	Reason
Removable Adjustable Mould (RAM)	2:25 PM	7:31 PM	306	218	88	5	67	5	D1	Idle
						21			D2	Waiting for the Dummy bar
						56		56	D3	Movement of dummy bar for re-work as wrong width dummy bar was restranded and needed correction
						6		6	D4	Redundant activity due to wrong width dummy bar calibration
Segment 2 to 6	3:25 PM	4:38 PM	73	33	40		21		D5	Manpower waiting for the water nozzle checking activity at segment 1 to get over
Dummy Bar Preparation Stand	2:25 PM	6:43 PM	259	125	134	3			D6	Waiting for crane operator
						2			D7	Fitter not available
						10			D8	Waiting for Manpower as the gang busy in placing removed segment 1 on segment stand
						46			D9	Waiting for Manpower as the gang was busy in Segment 2 - 6

										packing activity
						14		D10		Crane not working
						43		D11		Movement of wrong dummy bar for re-work
						16		D12		Redundant activity due to Re-preparation of the dummy bar

4. CONCLUSION

4.1 Current shop floor scenarios and recommendation for improvement

- **Problem:** Error in width correction of dummy bar

✓ **Solution:** Presence of company employee reduces such errors in measurement

- **Problem:** Crane Busy in some other activity

✓ **Solution:** Schedule of crane requirement in different activities should be properly segregated such that no activity gets hampered because of the other

- **Problem:** Manpower busy in some other activity

✓ **Solution:** Proper sequencing of activities should be done and conveyed to the manpower

- **Problem:** Chain and sling loading method of crane

✓ **Solution:** Magnetic attachments should be used to lift the loads as it will save manpower engagement and will also speed up the process

- **Problem:** Processing of hot metal takes a lot of time

✓ **Solution:** The hot metal ladles which are to be sent to slab caster should be processed in advanced in order to save time and speed up the process

4.2 Practices changes needed at the shop floor

Manpower employed in section change over process not properly trained

- **Problem:** Manpower employed in some other activity

✓ **Solution:** Proper sequence of activities should be made and conveyed to all the manpower employed

- **Problem:** Error in width correction of dummy bar

✓ **Solution:** The manpower involved in width correction of dummy bar should be properly trained and this activity should be performed in presence of a company employee in order to avoid re-work of dummy bar.

- **Problem**: Crane Operator not available when needed

✓ **Solution:** Water breaks, lunch breaks should be avoided during the section change over process

Loader & Rigger Unavailability

- **Problem:** Loader moves to the office from shop-floor to get instruction from the operator

✓ **Solution:** Proper instruction should be conveyed using appropriate hand signals

- **Problem:** Time is lost to get the updated instruction from the office

✓ **Solution**: Updated instruction should be conveyed before hand

Lack of Instruction

- **Problem:** Loader Visits operator's office for any instruction

✓ **Solution:** Use of Mobile phone for instruction

- **Problem:** Continuous delay at particular workstation not reported to anyone

✓ **Solution:** Log book to be maintained if delay is more than 30 min. By Loader of that particular location

Table -6: Recommendation for reducing set-up time in section change over process

NVA / Delay duration (mins)	Reasons	Suggestions
5	Idle	Can be avoided by proper planning
21	Manpower waiting for the water nozzle checking activity at segment 1 to get over	Clear communication channel should be maintained for movement of Manpower as per the activity need at specific location
6	Redundant activity due to wrong width dummy bar calibration	By proper planning & effective communication*, redundant activities can be eliminated
56	Movement of dummy bar for re-work as wrong width dummy bar was restranded and needed correction	

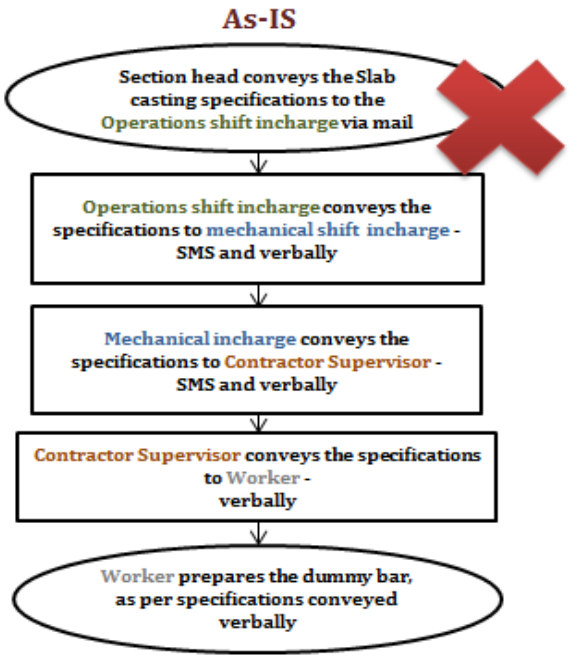

Chart -7: Flow charts depicting the "as-is" process of information flow regarding the section change over process

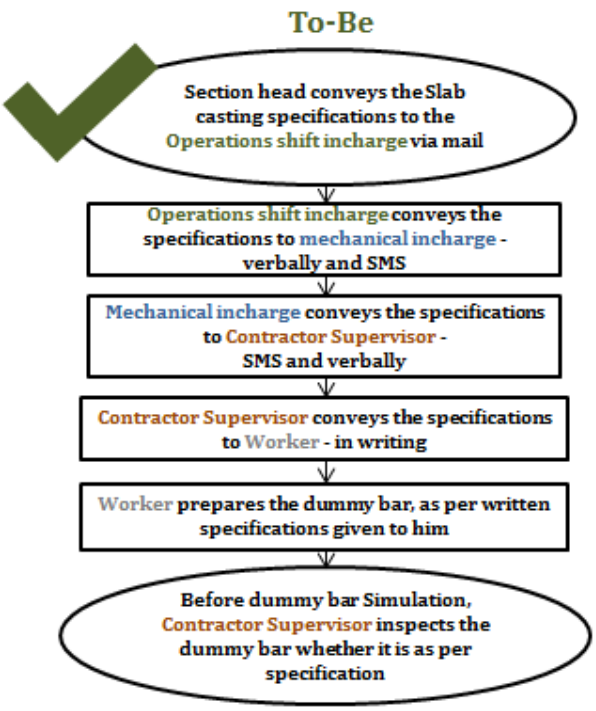

Chart -8: Flow charts depicting the "to-be" process of information flow regarding the section change over process

- Section Change activity took 306 mins incl. 62 mins of NVA & 26 mins of Delays
- Through effective communication, NVAs can be avoided, reducing the Section Change time to ~244 mins
- By implementing the recommendations suggested, delays can be reduced and Section change activity may be consistently done in ~218 mins

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