

Increasing Productivity of Beam Fitment Machine

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Abstract— During the project work study , time taken for each and every process step is analyzed and it was noticed that considerable amount of time was spent on the welding time and welding inspection of the web plate , carried out by manual ARC welding and calling for change of welding methods. Methodology used in the project is consisting of Defining of problem, using Problem solving techniques, study of Present Production system, identifying the problematic area in the present process, Proposing Production system, data collection of both existing process and suggested process and finally Results & Conclusion.

Index Terms— Minimum 7 keywords are mandatory, Keywords should closely reflect the topic and should optimally characterize the paper. Use about four key words or phrases in alphabetical order, separated by commas.

1: INTRODUCTION [1]

1.1 Overview M/s Halley Blue Steels Pvt Limited, Ballari.

Halley's Blue Steels Private Limited is a structural fabrication company started in the year 1993, by Mr. K M Shiva Murthy, with a commitment and vision to emerge globally as trusted and committed metal building solutions company.

Company is driven by highest quality principles, complete safety standards & ethical business practice, with inherent passion & commitment towards steel building solutions.

As on date, company has successfully completed over 500 projects in India and International markets

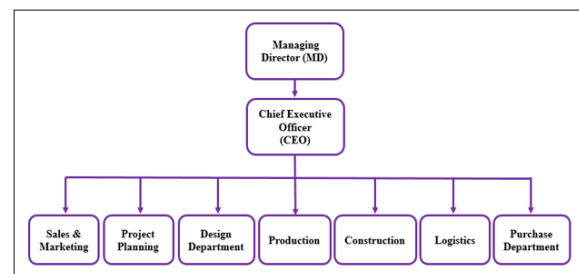
Company has a manufacturing facility at Ballari and having offices in Ballari, Hubli, Bangalore and Hyderabad.

1.2 Company's Vision:

- To be most innovative & reliable company for each and every customer, no matter how small and delivering the best and optimum building solutions.
- Not only deliver the highest quality and stable building to our customers, but also educate them about building design, stability criteria, relevant standards and quality of each material used in the project.

- Achieve leadership in the industry by individual and combined dedication, through innovation and integrity.
- Provide opportunity to employees for their personal and professional growth.
- Develop and maintain supplier / customer relationship, based on open communication, mutual trust and respect.
- To follow standard industrial safety practices at every step, every day and everywhere.

1.3 Overall organization structure



1.4 Plant & Main Infrastructure:

Total Area of the plant: 1, 25,000 sq. ft.
Covered Area in the plant: 60,000 sq. ft.
Number of Modules in the plant: 3
Production Capacity of the plant: 20,000 Mt per annum.

1.41 Facilities in Module 1

- Raw material storage up to 1500 Mt.
- Hydraulic shearing.
- CNC punching
- Primary built fit up

1.42 Facilities in Module 2

- H beam welding line
- Accessories fit up.
- Full welding.

1.43 Facilities in Module 3

- Cold form sections lines (C & Z).
- Sheeting line.
- CNC press brake
- CNC crimping.

1.5 Products offered by the company

1.51 Pre engineering building

Halley blue pre engineering buildings, are pre-designed, fabricated and erected meeting the customer requirements in totality at optimum cost.

1.52 Cold rolled sections

Cold rolled sections are advanced sections made of high tensile galvanized steel in the thickness ranging from 1.0 mm to 3.0 mm in various depths as per design standards, suitable for different spans and loadings

1.53 Color coated sheet Profiles

Color coated sheets are produced by color coating on the galvanized metal surface. These profile sheets are manufactured by cold - rolling techniques. Thickness ranges from 0.3 mm onwards.

1.6 Business areas of the company.

- Supply of products
- Design & Engineering.
- Execution of Civil works.
- Supply of pre engineering buildings.
- Supply of fabricated products.
- Erection and commissioning of steel and civil buildings.

1.7 Man Power Details

There are 300 number of employees working in the company.

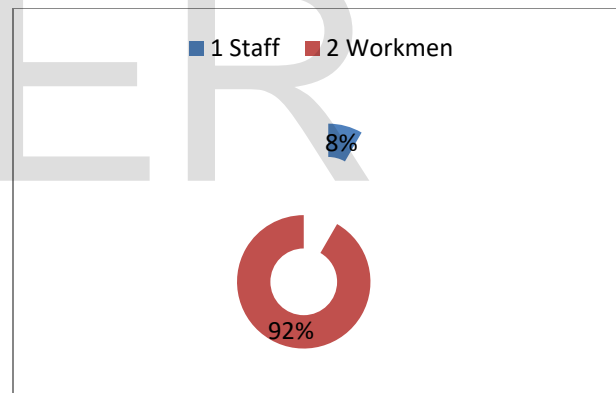
Employees are mainly categorized under two groups.

- Staff
- Work men

Staff group is comprising of engineers, diploma engineers, MBA etc.

Workmen is comprising of ITI, skilled and UN skilled labor.

Focus is given in employing local talent and improving their livelihood.



1.8 Types of machines and their functions



1. NC Plasma Multi Torch

Specification: 2.0 mm thk to 75.0 mm thk, size is 3.0 mtr to 15.0 mtr
Function: For cutting sheets and plates in to various profiles, as per the design.



4. H – Beam fit up machine

Specification: Automatic CNC drive, twin wire sub arc weld type. Depth 180 mm to 2500 mm, thickness 4.0 mm to 24.0 mm
Function: For cutting sheets and plates in to various profiles, as per the design.



2. Shearing Machine 1

Specification: 0.5 mm thk to 14.0 mm thk and up to 6.5 mtr length
Function: For shearing sheets and plates



5. CNC Punching Machine

Specification: CNC type, for punching holes of dia 32 mm in plaes up to 32 mm thk
Function: Punching Holes



3. Shearing Machine 2

Specification: 0.5 mm thk to 24.0 mm thk and up to 2.0 mtr length
Function: For shearing sheets and plates



6. Sheet Crimping Machine

Specification: 0.2 mm to 0.8 mm thick
Function: Crimping operation

2 : LITERATURE SURVEY [2]

2.1 Concept, evolution, advantages and applications of PEB.

Pre engineering building concept is evolved as a solution for the time consuming conventional steel building construction.

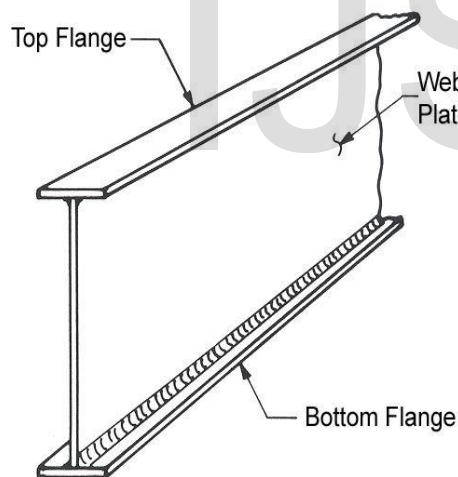
In conventional steel building construction, entire fabrication is carried out at the site mainly using manual methods.

In pre engineering building concept, the required components of steel building like columns, beams, roof rafters etc. are produced in the factory with latest machines and welding technology and are shipped to the site location for erection.

Column or beam or roof rafter mainly consists two flanges and web and are made of steel plates of thickness 4 mm to 22 mm.

Each beam is measuring between 6 mtr to 13.5 mtr and transportation is constraint in case of transportation of beams from factory to the site.

Plates are cut as per the required dimensions of flanges and web and are welded together to form the product.



PEB is designed by a PEB supplier, fabricated by using best manufacturing methods that can efficiently satisfy a wide range of structural and aesthetic design requirements.

In 1960, there were standard designs called PEB's in the market.

Advances in computer-aided design technology, materials and manufacturing capabilities have assisted a growth in alternate forms of pre-engineered building.

In order to accurately design a pre-engineered building, engineers consider the following

- clear span between bearing points,
- bay spacing,
- roof slope,
- live loads,
- dead loads,
- collateral loads,
- wind uplift,
- deflection criteria,
- internal crane system and
- Maximum practical size and weight of fabricated members.

Historically, pre-engineered building manufacturers have developed pre-calculated tables for different structural elements in order to allow designers to select the most efficient I beams size for their projects.

However, the table selection procedures are becoming rare with the evolution in computer-aided custom designs.

While pre-engineered buildings can be adapted to suit a wide variety of structural applications, the greatest economy will be realized when utilising standard details.

An efficiently designed pre-engineered building can be lighter than the conventional steel buildings by up to 30%.

Lighter weight equates to less steel and a potential price savings in structural framework.

2.2 Components of pre engineering buildings

Historically, the primary framing structure of a pre-engineered building is an assembly of I-shaped members, often referred to as I-beams (built up sections).

In pre-engineered buildings, the I beams used are usually formed by welding together steel plates to form the I section.

The I beams are then field-assembled (e.g. bolted connections) to form the entire frame of the pre-engineered building.

Some manufacturers taper the framing members (varying in web depth) according to the local loading effects. Larger plate dimensions are used in areas of higher load effects.

Other forms of primary framing can include trusses, mill sections rather than three-plate welded, castellated beams, etc.

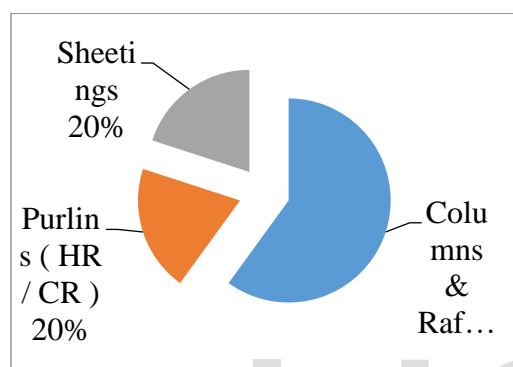
The choice of economic form can vary depending on factors such as local capabilities (e.g.

manufacturing, transportation, construction) and variations in material vs. labour costs.

Cold formed Z- and C-shaped members may be used as secondary structural elements to fasten and support the external cladding.

Roll-formed profiled steel sheet, wood, tensioned fabric, precast concrete, masonry block, glass curtain wall or other materials may be used for the external cladding of the building.

Typically, pre-engineering buildings comprises of columns + rafter up to 50 to 60 %, 20 to 25 % of HR / CR purlins and balance 20 % of sheeting.



2.3 Production steps and Process Flow chart

1. Inspection of raw material.
2. Shearing / cutting of sheets & plates.
3. Beam fitment
4. Accessories fixing to the beam...
5. Beam welding.
6. Final drilling / punching.

2.4 Production Process - Details

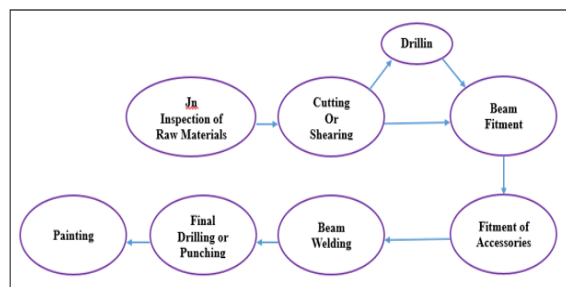


Figure: Process flow chart

2.5 PEB: Advantages over conventional steel buildings.

- PEB's are 30 % lighter. Optimised design by tapered OR varying depths beams / built up sections, with higher depths in the areas of highest stress.
- High tensile steel having YS more than 350 Mpa is used.
- Quick & efficient, making use of international design software, codes, standards and connections.
- Longer spans eg 100 mtr and lesser steel consumption
- Simple, economical and less number of foundations.
- Standards connections are hence lesser erection time.
- Low weight, flexible frames offer higher resistance to seismic forces.

2.6 PEB: Applications

- Industrial - Factories, workshops, warehouses, cold stores, car parking sheds, bulk warehouses etc.
- Institutional - Schools / Colleges, convention halls, hospitals, theatres, auditoriums, sports complex etc.
- Commercial - Show rooms, supermarkets, restaurants, offices, service stations, shopping malls etc.
- Heavy Industrial - Steel Plants, fertiliser plants, oil refineries, power plants, automobile plants etc.
- Recreational - Gymnasium stadiums, swimming pools, indoor tennis / badminton courts etc.
- Aviation & Military - Air crafts hangers, administration buildings, residential barracks, support facilities etc.
- Agricultural - Poultry / dairy farms, green houses, grain storage etc.
- Residential - Single / multi storied buildings, mega apartments, villas, labour quarters etc.

2.7 Production steps and Process Flow chart

1. Inspection of raw material.
2. Shearing / cutting of sheets & plates.
3. Beam fitment
4. Accessories fixing to the beam...
5. Beam welding.

2.8 PEB - Selection and Application standards

- Codes Applicable : AISC/MBMA/ IS
- Wind load Application: IS 875 Part 3 (Enclosed)/ Semi-enclosed/ Full open.
- Seismic Loads: IS 1893 - 2002 & 2005
- Welding Standards: American Welding Society AWS D1.1.98.

2.9 Inspection and Quality Assurance Process.

2.91 Inspection / quality check is carried out at various stages, as indicated below.

1. Quality of raw materials.
2. Quality of cutting / shearing of steel sheets and plates.
3. Quality of built up sections at fitment process.
4. Quality of fitment of accessories.
5. Quality of MIG welding.
6. Quality in selecting the vendors / suppliers.

2.92 Quality parameters, at Cutting / Shearing Process

- The sheared edges, should be free from burr.
- The dimensions i.e., length, width, thickness should be as per design / drawings.
- Cutting edges are to be in right angle so that the joining process is accurate.
- In tapered jobs, the degree of cut should be proper, to get accurate built-up.
- Sheared plates will be free from rust and oil mark to get better welding quality.

2.93 Quality parameters at Built-up Section / Fitment Section

- The joint welds for both flange and web will be done by SAW equipment , in order to get accurate and defect free weld at joints (defect types are blow holes, pin holes, undercut, penetration defect, over cut, weld size)
- UT (Ultrasonic Testing) is conducted for the joints, as per relevant standards.
- The thickness of welding should be as per design standard and is dependent on thick of base-metal.

- In SAW, the I or H beam is fitted with correct dimensions and then welding is done.

2.94 Quality parameters at accessories fixing Section

- All necessary connections like, Base plate, Connection Plate, Gussets, Stiffeners, Cleats, Stool brackets, Crane brackets, and additional clips will be attached properly, as per the drawing.
- Calibrated steel tapes are used for the measurement.

2.95 Quality parameters at MIG Welding

- Optimum Quality of welding at all the weld positions.
- Thickness of the weld at all positions, as per the drawing.

CHAPTER 3: STUDY OF EXISTING SYSTEM

3.1 Beam Production: Major Activities

1. Shearing of plates as per the requirements.
2. Joining of plates by SAW welding (one side) to get the required length.
3. Beam fitment and welding of flange plates with web plate.
4. Manual Arc Welding of other side of the web plate.
5. Inspection, re-work of the weld joint.

3.2 Process Study

- Activity by activity is studied with a focus,
- To identify the process improvement areas and
- To reduce the timing of each activity ,
- To improve the effectiveness and productivity.

3.21 Process time study

- The time taken by various activities are studied and tabulated.
- It is to be noted that, the total time taken for the beam production is about 35 minutes.
- In the process, considerable amount of time i.e. 5 minutes is taken only for the inspection and re work of the web weld joint carried out by the ARC welding

Sr NO	Activity	Duration in minutes.
1	Shearing of plates as per the requirements.	5
2	Laying / Joining of Plates	10
3	Beam fitment and welding	10
4	ARC welding time	5
5	Inspection / Re work	5
6	Total Time per Beam	35

Table: Activity Time

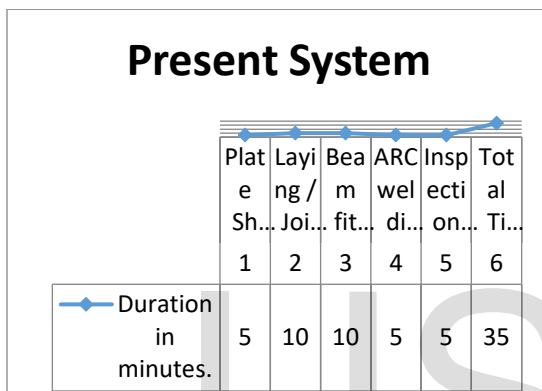


Fig Total time Vs Inspection / re work time in present system.

3.3 Identifying the problematic area of the present production system.

During the study, time taken for each and every process step is analyzed and it was noticed that considerable amount of time was spent on the welding time and welding inspection of the web plate, carried out by manual ARC welding. ARC welding process is observed and has associated with safety and quality issues, as indicated below.

Quality Issues:

- Incomplete Penetration / Incomplete Fusion
- Undercutting / Over welding
- Slag Inclusions / Flux inclusions
- Blow holes , pin holes
- Cracks
- Poor surface finish

3.4 Conclusion based on the finding of the existing process.

1. Inspection and weld rectification consumed considerable amount of productive time during the process, calling for change of welding methods.
2. Sometimes, the nature of the defect is so severe that, the part produced i.e beam need to be scrapped, increasing the cost of production, apart from project delay , which is impacting the profit and negative customer satisfaction .
3. Need for change of welding technique which improves both quality and productivity.

CHAPTER 4: PROPOSED SYSTEM

4.1 Productivity: Existing System

- 14 Number of beams produced per shift.
- 35 Minutes of time taken for the production of beam.
- As observed in the study, manual ARC welding and inspection time were considered as the major causes for productivity loss and higher cost of production.
- In order to reduce the production time and thus increasing productivity, various other means of welding techniques were considered.

4.2 Project Objectives.

1. Improvement in productivity
2. Cost optimization.

4.3 Changes in proposed system.

4.31 Evaluation of different welding techniques

Different weld techniques like MIG and SAW types was considered for welding of web plates, on the basis of following.

- Capital cost.
- Operational cost.
- Space required for the operation.
- Handling of the work piece and equipment.
- Welding speed.

- Welding quality
- Weld finish.

During the evaluation, we have found out that following issues are associated with SAW

- High initial cost
- High operation cost
- Requirement of more space for the operation.
- Lesser welding speed
- Job Handling issues

On the other hand, MIG welding type has following advantages.

- Negligible or NIL welding defects.
- Good Weld quality.
- Good weld finish.
- Good weld penetration.

4.32 Suggestion of suitable technique

Considering the limitations of SAW type and advantages of MIG type, manual ARC welding of web plate is replaced with continuous MIG type.

As a first step, detailed study was conducted on the manufacturing process or the procedure adopted for the production of the beams and identified the areas of improvement.

4.33 Proposed system: Main activities.

Shearing of plates as per the requirements.

1. Joining of plates by SAW welding (one side) to get the required length.
2. Beam fitment and welding of flange plates with web plate.
3. Usage of MIG Welding technique for other side of the web plate.
4. Final Inspection.

In the proposed system, manual ARC welding is replaced with automatic MIG welding.

The suggested method has brought considerable time savings in the production of the beams, with a better quality of weld joint, which has resulted in the improvement in the productivity and cost optimization.

Equipment set up for the proposed welding process is shown below.



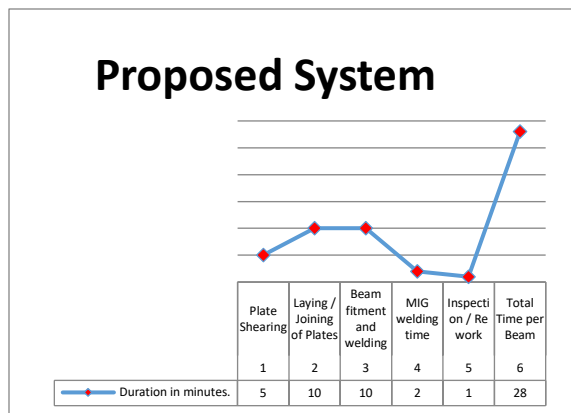
Fig: Automatic Continuous MIG welding of



web plate



4.4 Time Study: proposed system



It is to be noted that, the total time taken is about 28 minutes when compared to the present system of 35 minutes.

The saving in terms of time is about 7 minutes per beam production.

CHAPTER 5: RESULTS AND CONCLUSION

5.1 Project Work - Methodology.

1. Defining of problem.
2. Problem solving techniques.
3. Present Production system.
4. Identifying the problematic area in the present process.
5. Proposing Production system
6. Data collection of both existing process and suggested process.
7. Results.
8. Conclusion.

5.2 Problem Definition:

- Productivity i.e. production of number of beams per shift, is a major concern.
- Number of beams produced per shift is about 14 numbers on an average.
- Time taken for the production of each beam is about 35 minutes.
- Aim and Objective of the project is to improve the productivity and cost optimization.

5.3 Problem Solving Technique:

The ways of productivity improvement is to

- either reduce the time taken for the each of the production process or
- To modify the process in order to complete the job in a shorter duration.

As a part of Project work, study is conducted on the production process, with an objective of increase of productivity and in turn optimizing the costs.

5.4 Data Collection

List of activities and time taken during existing production system (manual ARC welding) and proposed system (automatic MIG welding) is tabulated below.

Sr NO	Activity	Duration in minutes.
1	Plate Shearing	5
2	Laying / Joining of Plates	10
3	Beam fitment and welding	10
4	MIG welding time	2
5	Inspection	1
6	Total Time per Beam	28

Sr NO	Activity	Present System	Proposed System
1	Plate Shearing	5	5
2	Laying / Joining of Plates	10	10
3	Beam fitment and welding	10	10
4	Web Plate Welding	5	2
5	Inspection / Re work	5	1
6	Total Time per Beam	35	28

Figure 12: Activity time Existing System Vs. Proposed System

5.41 ATA - Analysis

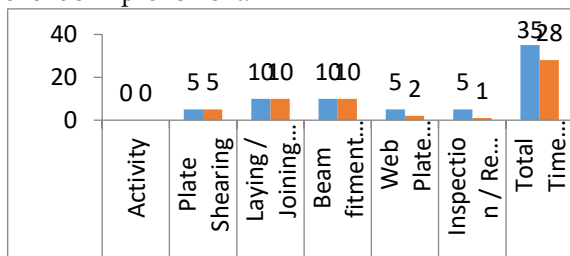
1. It is clearly evident that the time taken by the proposed system is 28 minutes in comparison with present system of 35 minutes.
2. In other words, there is a time saving of about 7 minutes for every beam production.

5.5 Result and Project Outcome:

Implementation of continuous MIG welding technique has resulted in defect free production of

Beam and improving the following parameters.

Productivity Improvement & Cost Reduction.
Revenue improvement.



Enhancing the customer satisfaction.

Production Existing Vs Proposed

It is to be noted that, the production of number of beams per shift is increased from 14 no's to 17 no's.

5.52 Revenue Improvement:

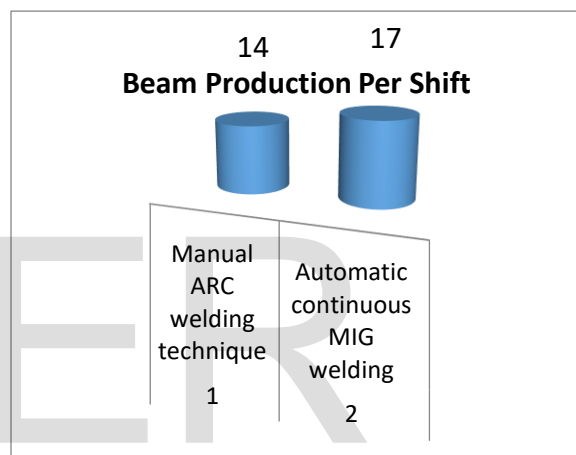
Improvement in the revenue is tabulated

below

Revenue Existing Vs Proposed

It is to be noted that, revenue is improved by 22 % with the proposed system.

It is to be seen that, the proposed system has increased the revenue by Rs 3, 60,000 per shift.



5.6 Conclusion:

Conclusion is drawn by changing the method of welding from manual ARC welding technique to automatic continuous MIG welding technique

Sr No	Description	Unit	Present	Proposed
1	Number of beams per shift	Nos	14	17
2	Reduction in the production time	Minutes	35	28
3	Production per shift	Mt	21	25.5
4	Revenue per shift	Rs	1680000	2040000

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