DESIGN AND MODIFICATION OF KNUCKLE HUB ASSEMBLY LINE

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ABSTRACT

This project consists of an assembly line for the assembly of knuckle Hub, Calipers and Disc. All the components are assembled in five stages. In first stage assembly of Lower Control Arm on knuckle is done. In second stage Assembly of Disc Brake and Wheel Hub is completed. The third stage consists of the Assembly Press Fitting and Bolt Fitting. The fourth stage of the assembly line has the Assembly Caliper mounting and Bolt Fitting. The fifth stage of the assembly line has the Assembly of Sensor Cable Bracket and Bolt Fitting. Before assembly all the separate parts or components are mounted on the fixture. Fixture is clamped with the help of pneumatic clamping device which assures the rigidity of fixture on the worktable. Pneumatic clamping device has a pneumatic cylinder adapted with magnet and reed switch. This reed switch sense a signal to controller on perfect clamping. Controller switch ON the torque wrench when the controller gets signal from the reed switch. This controller provides the appropriate torque, to the torque wrench for the fastening. In this way every single component that is used in the assembly line are adopted with full proofing.

Keyword : - *Assembly-line, knucklehub, design of assemblyline ,construction of assembly line*

1. INTRODUCTION

In earlier days Assembly lines were quite simpler, had a greater number ofstages, bulky in con- strictions, less accurate, required more time and manpower required was more in number with high skills. But with advancements in technology in today's world the assembly line grew smaller and smaller increasing its efficiency by virtue of increasing its accuracy. Assembly line balancing is to know how tasks are to be assigned to workstations, so that the predetermined goal is achieved. Minimization of the number of workstations and maximization of the production rate are the most common goals. The reviews of different works in the area of assembly line balancing and tries to find out latest developments and trends available in industries in order to minimize the total equipment cost and number of workstations.

This project consists of various automation techniques Torque wrench, Pneumatic Clamping and Decamping technique with the implementation of POKAYOKE Principle, Programmable Logic Controller (PLC) interlinked with SCADA, Fixture andmany more. Every Technique plays an important role in the assembly line increasing its

reliability. Fixture being an essential part of the assembly line. The design is to be done with high accuracy. The design of a fixture is a highly complex and intuitive process, which require knowledge. Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the assembled parts. In existing design, the fixture set up is done manually, so the aim of this project is to replace fixture by fixture with pneumatic clamping device to save time for loading and unloading of component. Fixture provides the manufacturer for flexibility in holding forces and to optimize design for assembly operation as well as process function ability.

1.1 Objective

The objective of this project is to overcome the problems faced by industry in the assembly work of the product.

- The main objectives of the project include

1. To increase accuracy.
2. To increase d precision of assembled product.
3. To reduce human interference.
4. To reduce errors while doing assembly.
5. To make the process of assembling simpler in working
6. To reduce workers
7. To reduce overall time required for assembly

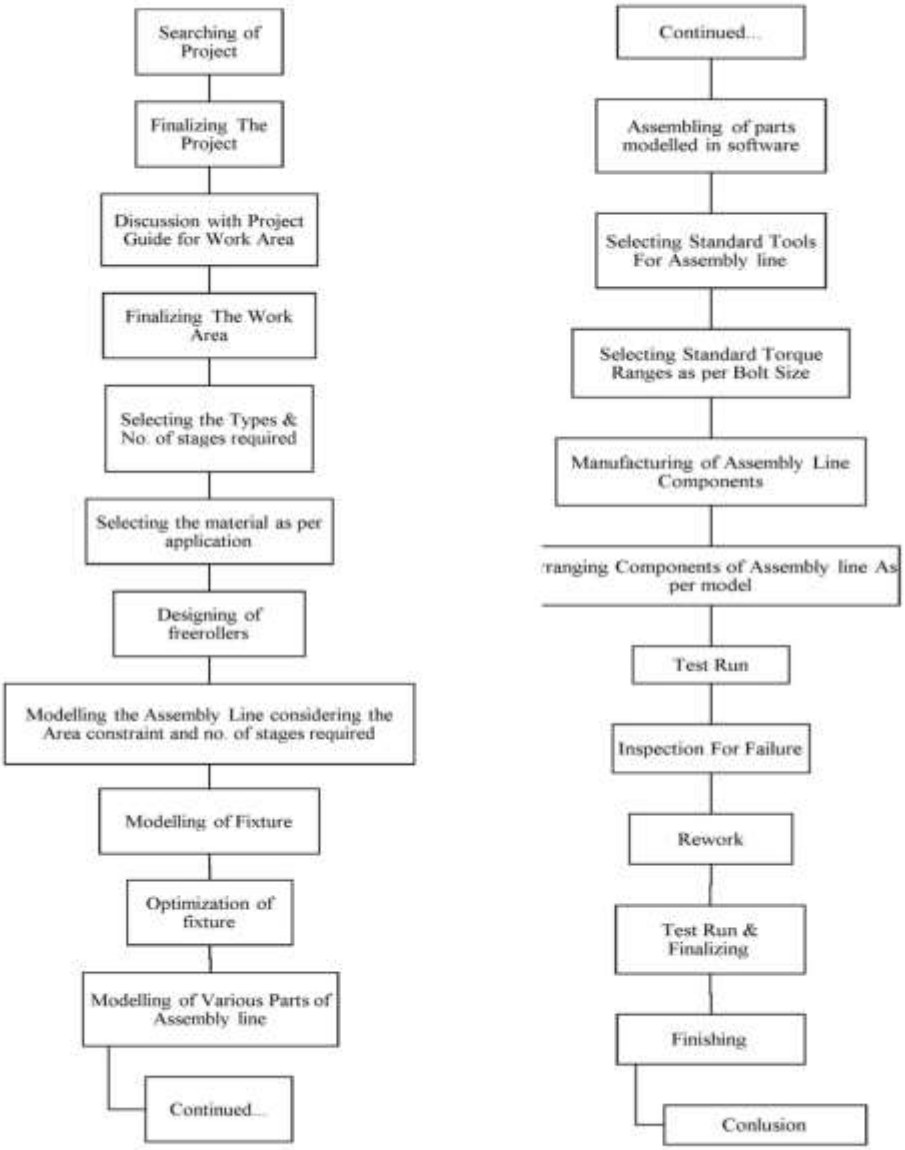
1.2 Methodology

In this Project of the Assembly Line is done, modelling and manufacturing of various parts, fixtures and assembly line is completed. The modelling of all the parts and fixture is done in different CAD software.

The designing of roller is done on the basis of safety parameters.

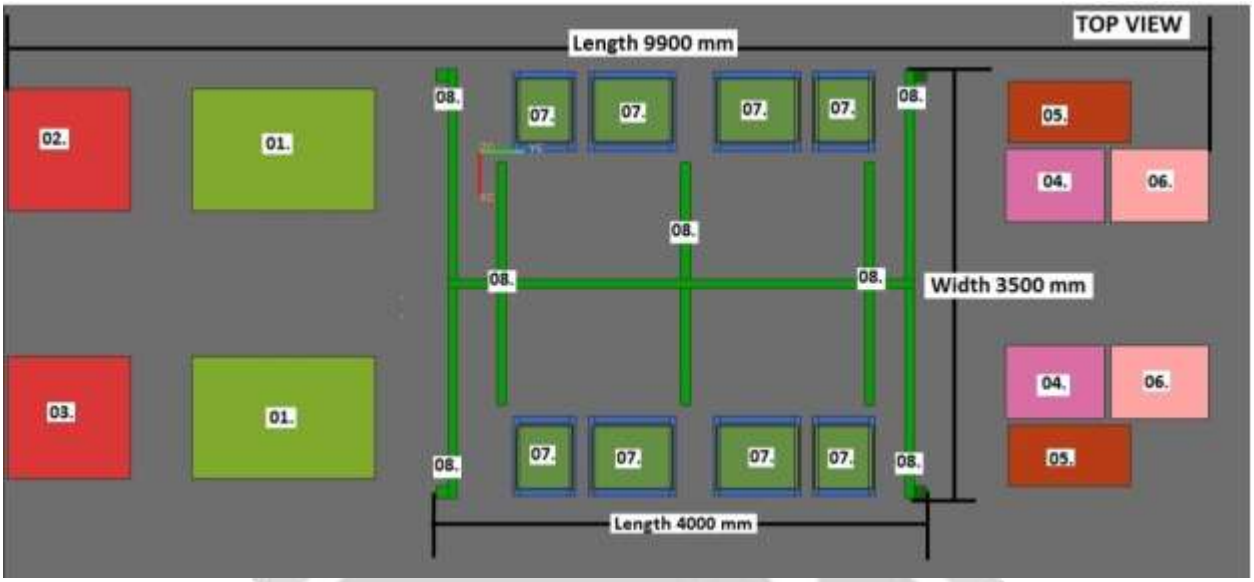
The modelled fixture was optimized as it was changed from closed fixture to the open fixture. Also, the material Selection is to be done and selection of standard tool is done. After the theoretical and analytical work, the actual manufacturing was started.

Initially as per the designed dimensions the bars are made. The parted bars were welded according to model. The various parts which were manufactured were assembled according the stages designed in the assembly line. The assembled parts were tested by taking test runs trials. The errors observed in the trials were eliminated by using various optimizing techniques. After the optimization the project was finalized.



2. DESIGN OF ASSEMBLY LINE

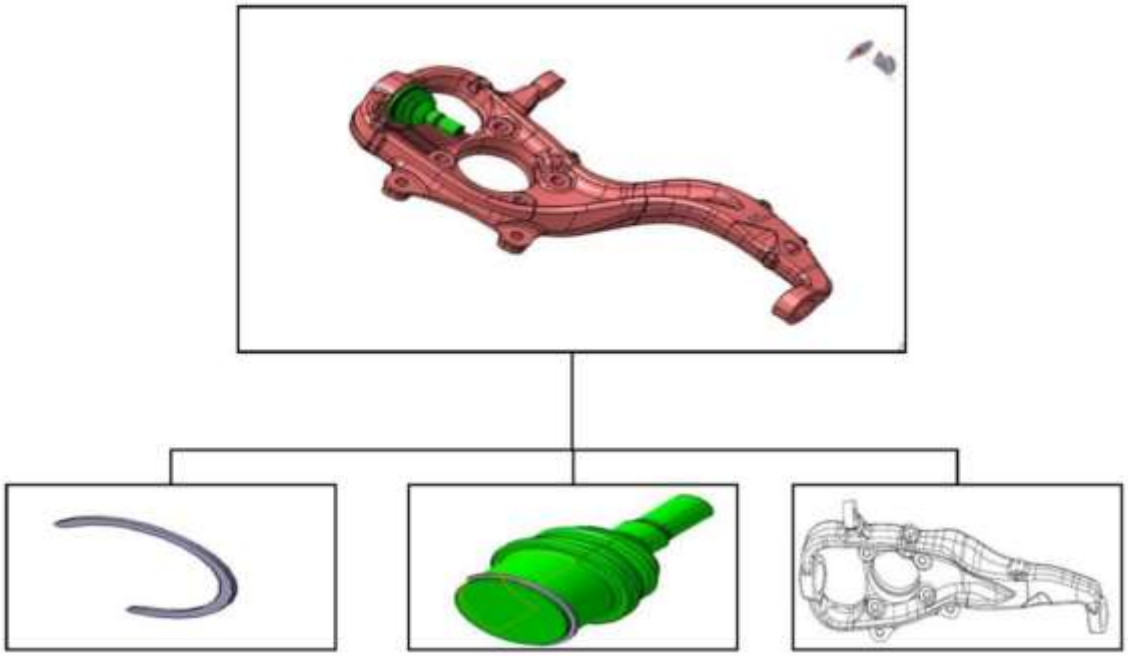
The design of the assembly line is done on the basis of product size, accuracy required, and time required for assembly. The assembly line takes number of products which are unusable when not put together and assemble them into a single product which is then used as one product to perform certain task.



2.1 Various stations in Assembly line

1. Stage 1 LCA Assembly

Operation- 01 (LCA Assembly)
No of Parts -3 Loading Time (Sec) -20
Unloading Time (Sec)-20
Effective Work Time-70



Positive lock ring lower control arm knuckle

2. Stage 2 :Assembly of Disc Brake and Wheel Hub

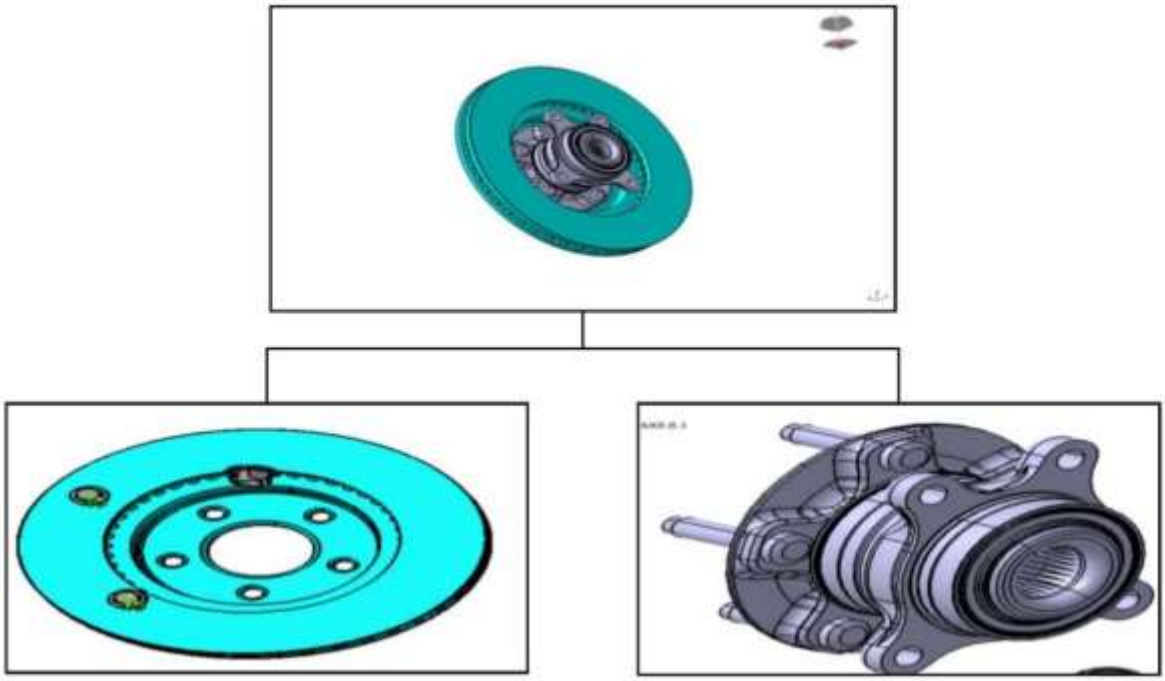
Operation-02 (Assembly of Disc Brake and Wheel Hub)

No of Parts -2 Loading Time (Sec) -25

Unloading Time (Sec) -25

Effective Work Time (Sec) - 100

Total Cycle Time (Sec) – 150



Breake disk Wheel hub

In second stage of the Assembly line there are 2 parts which are needed to be assembled namely wheel hub and brake Disc. The Brake Disc is press fitted on the wheel hub. Brake disc is fitted on the hub from bottom side of wheel hub. Disc has recess of diameter equal to wheel hub outer diameter. Disc has holes for putting bolts which will be required for assembling the parts in next stageof assembly. The Bearing is first press fitted on the hub for reducing friction between the knuckle and hub. This bearing ensures the reduction in friction and smooth movement of the wheel on the knuckle hub assembly.

3. Stage 3 :Assembly Press Fitting and Bolt Fitting

Operation-03 (Assembly Press Fitting and Bolt Fitting)

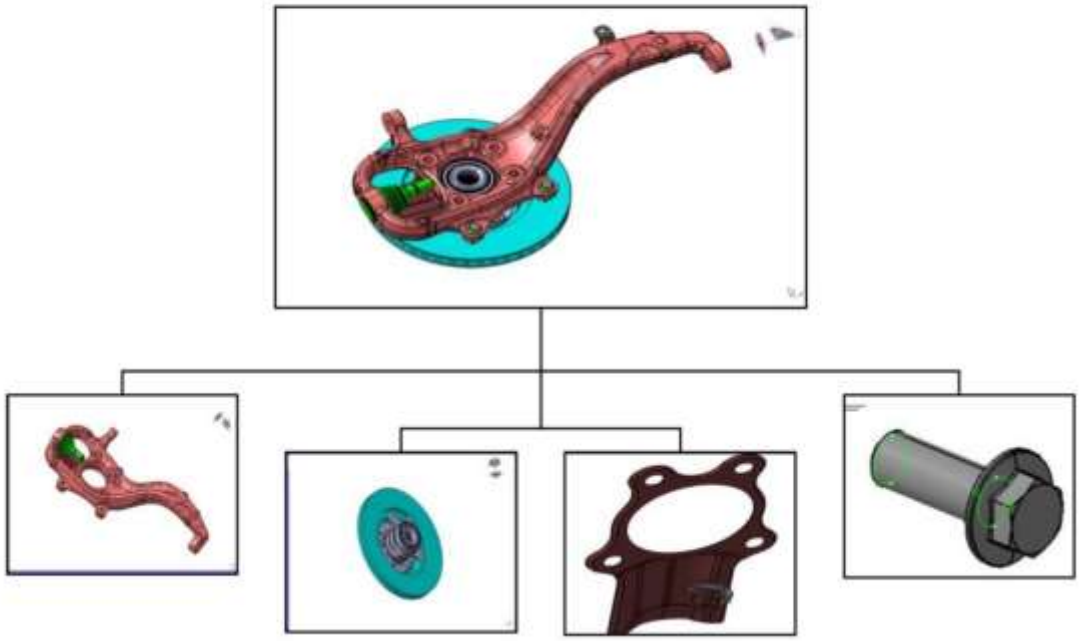
No of Parts -4

Loading Time (Sec) -25

Unloading Time (Sec)-25

Effective Work Time (Sec)- 100

Total Cycle Time (Sec) -150



Knuckle with LCA mounting | brake disc & wheel hub assembly | Wheel hub | Bolts

In third stage of the Assembly line there are 4 parts which are needed to be assembled namely the assembled part in the first stage (i.e., the knuckle with LCA), the second stage assembly (i.e., brake Disc and Wheel hub), Wheel Hub Bracket and Bolts. This stage consists of joining the assemblies which are formed in previous two stages whichare assembly of LCA and Knuckle from first stage and assembly of disc brake and wheel hub from second stage. In this stage we use bolts for assembling the parts. The Wheel Hub Bracket is fitted in the hub and the Knuckle this bracket is used for tight fitting of the huband knuckle. This bracket reduces the vibration and gives interference fit between these two components.

2.2 Instruments/Components used in assembly line

The assembly line contents various components which are stated as below:
1. Torque Wrench
2. Controller
3. Fixture
4. Pneumatic cylinder
5. Roller
6. Castor Bearing assembly

Due to use of such type of automation techniques in the assembly line various problems like accuracy and precision, proper fitting, productivity is solved easily and they can be overcome ease. These types of techniques help in improving the productivity of assembly line.

2.3 Materials

Material table

Sr. No.	Part	Material
01	Rolling Ball Table	MS
02	Castor Table	OHNS
03	Storing Bins (Pendent Box)	HDPE
04	Fixture	MS WITH Al COATING
05	Roller	SS304
06	Loading Table	MS
07	Structure For Cross Rails	MS

3. DESIGN OF COMPONENTS

3.1 DESIGN OF ROLLERS

For internal diameter (d) = 17mm & external diameter (D) = 40mm
Available bearing is 6203
The bearing specifications are
Dynamic load capacity (C) = 9.95kN
Static load Capacity (Co) = 4.75kN
Loading Condition Load Acting in Radial Direction (Fr) = 40kg ∴ 40kg = 409.81 = 392.4N ≈ 400N
Load Acting in Axial Direction (Fa) = 0N Expected Life of Bearing =10000 hr. ∴ P = Fr = (400 + 300) N (Assume Force Applied by Hand =300N) ∴ P = 700N Calculating life of bearing

Roller Table: Length = 3500 mm
Width = 500 mm
Height = 763 mm
Length of single roller = 500 mm
Distance Between Roller (roller table) = 125 mm
Outer Diameter of Roller = 40 mm
Initial Diameter of Roller = 9 mm

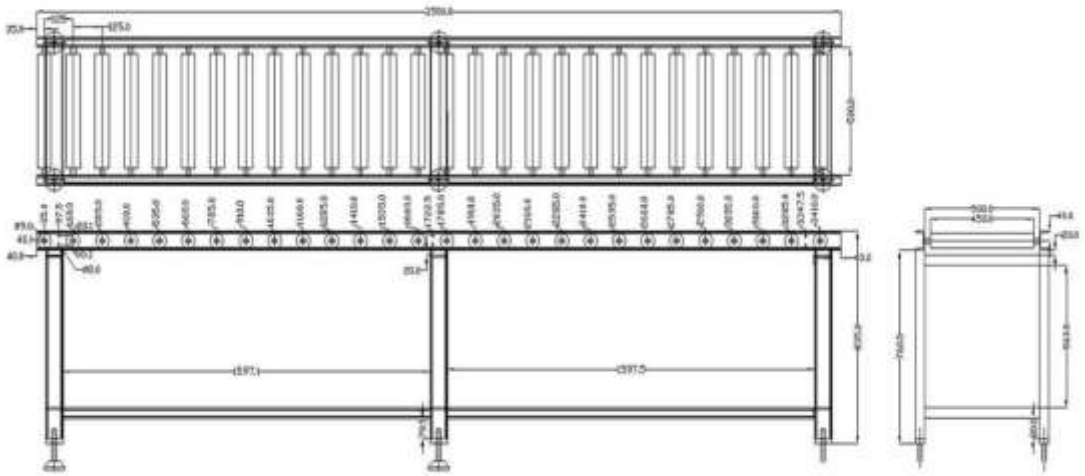
Number of rollers used = 28 roller per table (4 Tables)
Caster Table:
Length = 1100 mm
Width = 700 mm Height = 763 mm
Diameter of castor balls = 43 mm
Number of castors used = 77 caster balls per table (four castor tables)

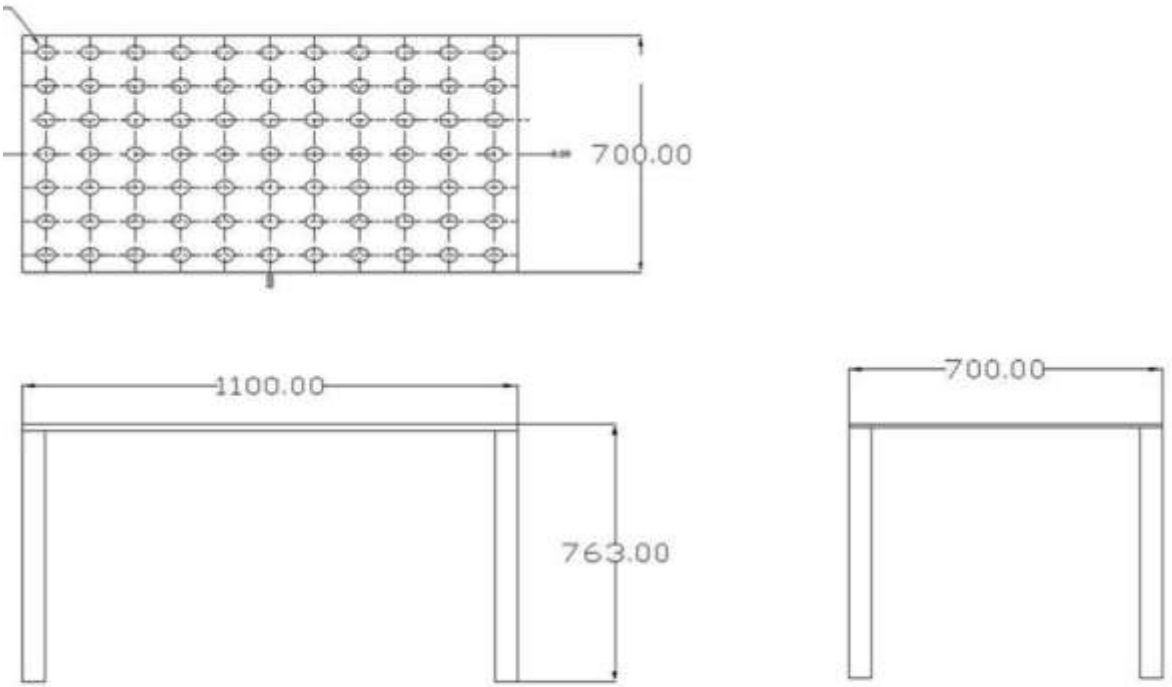
Crane Frame:
Total Height =3000 mm
Rod Height = 175 mm
Rod height = 5400 mm
Thickness of Rod = 115 mm
Total width of crane frame = 5200 mM

Fixture:
Length = 400 mm
Width = 450 mm Number of fixtures required = 5
Holding plate length = 40 mm Holding plate width = 80 mM
Holding plate thickness = 75 mm

Trolley Holder:
Length = 3500 mm
Width = 40 mm
V-shape holder for Trey

Assembly Line:
Height = 3175 mm
Length = 9900 mm
Width = 3500 mm





4. CONCLUSIONS

In this project the study of various stages of assembly line components used in the assembly line and their working was done successfully. The modelling of fixture and assembly line was done. The design of roller and bearing was done. The optimization of the fixture by changing its basic design was the initial work done. Instead of making fixture a projected part of knuckle hub we have made a flat fixture with different accessories to hold different elements of knuckle and hub. The manufacturing of modelled parts was done. The manufactured parts were assembled and the completion of assembly line was done. The inspection of the assembly line was completed in presence of Mr. Nikhil Bhamare (CEO). The final submission of project was completed successfully.

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