TO DESIGN MASTER JIG FOR PETROL AND DIESEL ENGINE BLOCK MOUNTING

A INDUSTRIAL TRAINING REPORT

Submitted in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

in

MECHANICAL ENGINEERING

by

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JAIPUR, RAJASTHAN

(AUGUST 2016)

JUNE, 2016

BONAFIDE CERTIFICATE

This is to certify that this training report submitted in partial fulfillment for the award of the degree of Bachelor of Technology in MECHANICAL ENGINEERING under faculty of engineering & Technology of **JECRC University, Jaipur** during the academic year 2016, is a bonafide record of work done by **SHUBHENDRA PRATAP SINGH (1201021085)** under my guidance and supervision.

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DATE:

ACKNOWLEDGEMENT

This project report is submitted for partial fulfillment for the award of the degree of Bachelors of Technology in Mechanical Engineering at JECRC University. This Internship has been an interesting challenge and a good learning experience for me. Throughout this internship period, people have contributed either directly or by providing support and guidance in the completion of the research. This dissertation not has been possible without the help and support of my family members, and faculty members.

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DECLARATION

I hereby declare that this training report by ***SHUBHENDRA PRATAP SINGH (1201021085)***, is being submitted in partial fulfillment of the requirements for the degree of Bachelor of Technology in ***MECHANICAL ENGINEERING*** under Faculty of Engineering & Technology of ***JECRC UNIVERSITY, JAIPUR*** during the academic year 2016, is a bonifide record of our original work carried out under guidance and supervision of Mr. Neeraj Garg, Manager, Assembly Engine and has not been presented elsewhere.

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APPROVAL

This Project Report on **"*To Design Master Jig for Petrol and Diesel Engine Block Mounting***" by ***SHUBHENDRA PRATAP SINGH*** is approved for the award of the degree of Bachelors of Technology in Mechanical Engineering.

Examiner (s)

Guide (s)

HOD

Date:

Place: Jaipur

ABSTRACT

Jig is a strong and rigid mechanical device which enables easy, quick and accurate locating, supporting and clamping, against cutting tool with an additional feature of tool guidance and result faster and accurate machining and assembling with consistent quality, functional ability. In Assembly engine, Jigs are used to hold engine blocks on trolley of main assembly line. There are two types of jigs are used in production of petrol and diesel engine accordingly. *Master Jig has been designed for Petrol and Diesel Engine Block Mounting,* These master jigs provided solution for both petrol and diesel engine block mounting on same jig instead of using two different jigs. The basis emphasis has been given during design was no part fouling or interfacing. Various 3D models were developed using Autodesk Inventor 2014 and analyze for the best design by rough prototyping with no part fouling. Thus result oriented work has been carried out and improved efficiency of assembly work of engine. This design of master jig overcomes all the disadvantages and problems related to traditional jig. It was observed that master jig reduces takt time of 38.5 sec to 0 sec. and no extra man power will needed on actual implementation of the master jig.

Assembly engine layout proposals were designed to increase the no. engine pallets to be manufactured and better space utilization on further new model changes on existing assembly work area.

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ABBREVIATIONS

HCIL	-	Honda Cars India Ltd.
PDCA	-	Plan-Do-Check-Act
MT	-	Manual Transmission
AT	-	Automatic Transmission
CVT	-	Continuous Variable Transmission
VCM	-	Variable Cylinder Management
CBU	-	Completely Built Unit
AF	-	Assembly Frame
VQ	-	Vehicle Quality AE
-	Assembly Engine OHC	-

Over Head Conveyer

CHAPTER- I

INTRODUCTION

The fundamental objective of Industrial Training is to prepare students for future employment in their chosen engineering discipline. Industrial Training enhances the academic material studied at University by allowing students to practice what they have learned and to develop key professional attributes. Industrial training should provide an opportunity for students to:

1. Experience the discipline of working in a professional engineering organization.
2. Develop understanding of the functioning and organization of a business.
3. Interact with other professional and non-professional groups.
4. Apply engineering methods such as design and problem solving.
5. Develop technical, interpersonal and communication skills, both oral and written.

Industrial training also gives employers an opportunity to assess future employees. A demonstrated commitment and ability to take responsibility, make sound decisions, and apply technical skills will be highly regarded. Industrial training gives students an opportunity to evaluate future employers as well as enabling informed decisions about the discipline and career.

1.1 Goals

1. To gain experience in design, implementation, and evaluation of worksite health promotion programs.
2. To provide awareness of the variety of worksite health promotion approaches (and job opportunities).
3. To understand the marketing/promotion process of health promotion program delivery.
4. To observe interpersonal and organizational dynamics.

1.2 Objectives

1. To participate in routine department functions (i.e. staff meetings, etc.).
2. To participate in program planning meetings and follow-up assignments.
3. Review curriculum and materials used in health promotion programs.
4. To provide research and benchmarking in select health promotion topic areas.
5. Assist in health promotion delivery which includes: behavior modification programs, health screenings and health fairs.
6. Observe a corporate fitness center operation.
7. Enhance written and verbal communication skills.
8. Assist in program or product development.
9. To attend one professional meeting.

1.3 Motivation

There are many reasons why an internship is undertaken-
Internships provide work experience opportunities to university students, recent graduates and people considering career changes. Employers are willing to hire interns with little or no experience, especially if the intern is willing to accept little or no monetary compensation.

GAIN VALUABLE WORK EXPERIENCE
An internship provides the opportunity to gain hands on work experience that you just can't get in the classroom. First time job seekers and career changers aren't usually desirable candidates, but companies are willing to train them as interns and give them the experience they would need to get a job.

HAVE AN EDGE IN THE JOB MARKET

Employers are usually more concerned with your work experience than your qualifications and internships are often the only way to get the work experience you need to secure a job, so they're a vital part of your resume. Many employers prefer or require applicants who have done an internship or relevant work experience and in many of the more competitive job markets it is essential to set you apart from the others.

TRANSITION INTO A JOB

Employers see interns as prospective employees and many finish their internships and continue working with the company full time. Internships are the number one way for employers to find new staff in the US. Think of it as a really long interview, after which you've proved that you are a capable and hardworking employee. Just as you're giving the industry and the company a trial run, they're doing the same for you.

DECIDE IF THIS IS THE RIGHT CAREER FOR YOU

If you're not sure if this is the right career for you, doing an internship is a great way to try it out. Internships are generally short-term, so you can test your future career without committing and find out if it is a career that will satisfy you.

NETWORKING OPPORTUNITIES

Internships are a great way to meet people in your field. Even if you have experience, knowing people never hurts. An internship allows you to meet people who might help you land a job later on and give you the contacts in the industry you're trying to break into.

APPLY CLASSROOM KNOWLEDGE

An internship can be seen as the pinnacle of your undergraduate education and give you the chance to use the skills you've learned in the classroom in a real-world setting. It's a chance to prove the worth of your qualifications and to show that you can perform.

GAIN CONFIDENCE

Getting experience is a great way to build your confidence. What's more, if you have an impressive resume, you will be more confident in your chances of securing a job.

1.4 Methods:

There are many ways in which internship can be carried out-

LEARN ABOUT THE LANDSCAPE

Your first step is to gain a general understanding of the internship arena: “What exactly is an internship? Who is Generation Y, and what should you know about hiring them?” What are interns looking for in a host organization? Using internships as your headquarters, read and research as much as possible about the internship industry.

EVALUATE YOUR ORGANIZATION

Once you get a feel for what an internship program entails, your next step is to conduct an internal assessment of your company's needs and resources. Some aspects to consider are whether you will pay interns, or how you can otherwise compensate intern efforts; whether your company can support multiple interns; the availability of meaningful work for interns; the type of projects that can be assigned; your ideal duration and time of year to host interns; and how your physical space and equipment will accommodate additional individuals.

LEARN ABOUT LEGALITY

Before you design your program, it's wise to get a grasp on the legal ramifications of hosting interns in your state: minimum wage requirements, workers' compensation issues, safety and harassment policies, termination guidelines, and how other traditional employee benefits and business responsibilities do or don't apply to interns.

As a host organization, the best way to cover your bases legally is to consult with your company's legal counsel or contact an employment law professional...*before* you begin the hiring process.

UNDERSTAND COLLEGE CREDIT

It's a common misconception that internships are always in exchange for college or university credit. Yes, an internship *is* a learning experience. But whether or not *educational credit* is obtained is strictly between the student and his or her school.

1.5 Company Profile

HONDA Motor Company

Honda Motor Company, Ltd. is a multinational corporation headquartered in Japan. The company manufactures automobiles, motorcycles, trucks, scooters, robots, jets and jet engines, ATV, water craft, electrical generators, marine engines, lawn and garden equipment, and aeronautical and other mobile technologies. More recently they have ventured into mountain bikes.

Honda is the 6th largest automobile manufacturer in the world as well as the largest engine-maker in the world, producing more than 14 million internal combustion engines each year. In August 2008, Honda surpassed Chrysler as the 4th largest automobile manufacturer in the United States.

The history of the HONDA Company began with the vision of one man SOICHIRO HONDA. His dream was personal mobility for everybody.

In October 1946, SOICHIRO HONDA established the Honda Technical Research Institute in Hamamatsu, Japan, to develop and produce small 2-cycle motorbike engines. Two years later, the HONDA Motor Company was founded in 1948; today HONDA celebrates its 60th anniversary.

HONDA is headquartered in Minato, Tokyo, Japan.

The first production automobile from Honda was the T360 mini pick-up truck powered by a small 356 cc straight-4 gasoline engine.

The first production car from Honda was the S500 sports car.

In 1963 he built his first car, a sporty two seater with a small, highly ordinary passenger cabin.

Honda's introduction of the 1975 Civic CVCC, CVCC being a variation on the stratified charge engine, allowed the Civic to pass emissions tests without a catalytic converter.

In 1989 Honda launched their VTEC variable valve timing system in its production car engines, which gave improved efficiency and performance across a broader range of engine speeds

By 1991, Honda was America's third largest car manufacturer, and Honda Accord its best-selling car.

Honda was the 6th largest automobile manufacturer in the world as well as the largest engine-maker in the world, producing more than 14 million internal combustion engines each year. Currently, Honda is the second largest manufacturer in Japan behind Toyota and ahead of Nissan.

The company is ISO 9002 & ISO 14001. The Company has plans to further raise the capacity to almost 100,000 cars per annum by the year 2010.

The high quality pollution-free production plant & the Administration block are situated in Greater Noida Industrial Development Area. The capacity of this plant is 1, 22,000 cars per annum.

1.6 Honda's Subsidiaries and Products

In INDIA**,** Honda has 3 of its subsidiaries namely,

1. HONDA Cars India Ltd.
2. HONDA Power Products Ltd.
3. HONDA Motorcycles & Scooters India (Pvt.) Ltd.

MOTORCYCLES

From creating engines to power bicycles just over 50 years ago. HONDA has grown to become the world's largest manufacturer of motorcycles having sold approximately 100 million units till date. The portfolio includes scooters & motorcycles, off-road & sport bikes and large touring motorcycles.

POWER PRODUTS

After a humble beginning in 1953, when it started manufacturing engines for agricultural use, HONDA grew rapidly to become a global player in power products such as electric generators, power tillers and outboard marine engines help in improving the quality of people's lives across 150 countries.

AUTOMOBILES

HONDA is amongst the world's foremost automobile manufacturers, producing more than 2 million vehicles annually. HONDA ensured its success by making innovative cars that captured the imagination of people around the world. The HONDA International line-up includes cars, luxury sedans and recreational vehicles.

Following the green revolution the company has gone up to produce hybrid hydrogen fuel cell vehicle(FCX Clarity), first commercial hybrid electric car sold in the US market(1999) , the Honda Insight), The Honda Civic GX, the natural gas vehicle, and lastly in INDIA the CIVIC HYBRID.

1.7 HCIL Company Information

Figure 1. 1 Greater Noida Office

GENERAL INFORMATION

Table 1. 1 HCIL Profile

Name of the Company	:	HONDA CARS INDIA LTD.
Established	:	5th DECEMBER, 1995
Total Area	:	150 ACRES
Covered Area	:	1, 31,794 sq. m.
Capital (initially)	:	INR 4500 Million
Equity Share capital	:	HONDA MOTORS (JAPAN)—99.9%
		Ltd. (INDIA)—.1%
Investment till date	:	16200 MILLION
Installed Capacity	:	1, 00,000 Units/ Annum (2-shift basis)

Product Commencement	:	15 DEC,1997
Indigenization	:	(Start Up) - DECEMBER 1997-57% JULY 2005 - 82%
No. Of Manufacturing Associates	:	2200
Exports	:	HSCI started exporting cars from Dec. 2000. Exports were made to SRI LANKA in Dec.

1.8 Plant Layout – Semi Automated Plant

Situated in the Industrial area of Greater Noida, HONDA SIEL CARS INDIA is sprawled over 6,03,406 sq. meter of which 52744 sq. meter is covered which houses HITEC (Training Center) & the Main block which comprises of the Administrative department, Quality control department, Material division & Accounting department, Assembly line. Utilities are situated outside the main block along with the Water treatment plant, Wastewater treatment plant, Sewage water treatment plant & the generator room.

Figure 1. 2 plant layout

CHAPTER II

LITERATURE REVIEW

2.1 Honda Philosophy

One of the most valuable things, which the founders of HONDA gave to the company, was philosophy that serves as the basis of business endeavors of HONDA now & in future. "*Action without philosophy is a lethal weapon, philosophy without action is worthless*". The center of HONDA philosophy is the company principle, which was written in 1956 under lining the company principle.

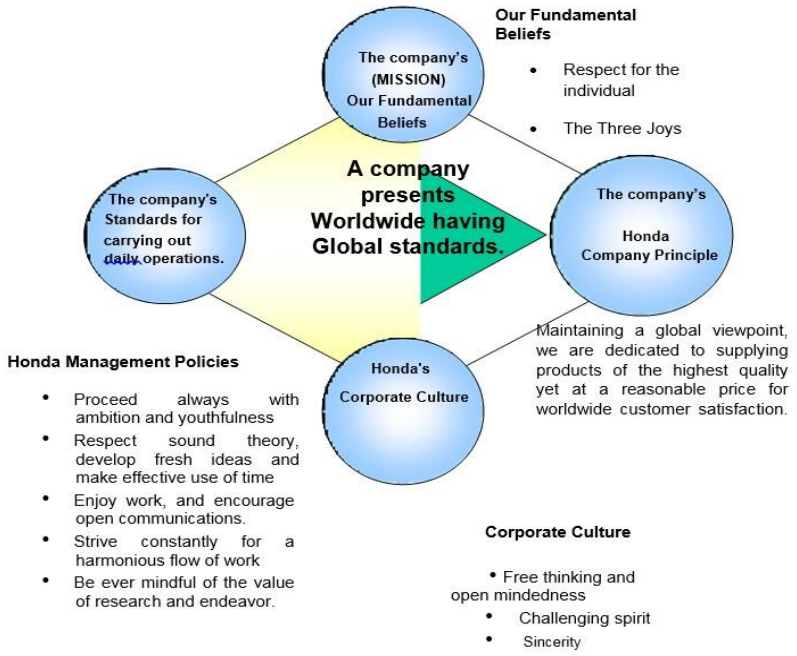


Figure 2. 1 Honda Philosophy

2.2 Fundamental Beliefs at Honda

2.2.1 Respect for the Individual

- **INITIATIVE**: Initiative means not to be bound by preconceived ideas, but think creatively and act on your own initiative and judgment, while understanding that you must take responsibility for the results of those actions.
- **EQUALITY**: Equality means to recognize and respect individual differences in one another and treat each other fairly. Our company is committed to this principle and to creating equal opportunities for each individual. An individual's race, sex age religion, national origin, educational background, social or economical status have no bearing on the individuals opportunities.
- **TRUST**: The relationship among associates at Honda should be based on mutual trust. Trust is created by recognizing each other as individuals, helping out where others are deficient, accepting help where we are deficient, sharing our knowledge, and making a sincere effort to fulfil our responsibilities.

2.2.2 The Three Joys

- **THE JOY OF BUYING**: The joy of buying is achieved through products and services that exceed the needs and expectations of each customer.
- **THE JOY OF SELLING**: The joy of selling occurs when those who are engaged in selling and servicing Honda products develop relations with a customer based on mutual trust. Through this relationship, Honda associates, dealers and distributors experience pride and joy in satisfying the customer and in representing Honda in the customer.
- **THE JOY OF CREATING**: The joy of creating occurs when Honda associates and suppliers involved in the design, development, engineering and manufacturing of Honda products recognize a sense of joy incur customers and dealers. The joy of creating occurs when quality products exceed expectations and we experience pride in the job well done.

2.3 Honda Management Concepts

2.3.1 The concept of 5'S:

- Sort (Sieri):- Distinguishing between needed & un-needed items & disposing of the un-needed items in a systematic manner
- Simplify (Seition):- Arrangement of necessary items into good order so that they can be easily selected for use
- Shine (Seiso):- Cleaning of workplace so that there is no dust in the workplace
- Standardize (Seiketsu):- To cultivate a disciplined workplace where everyone does something on his/her own to maintain a clean environment & correctly understand the 5S philosophy.
- Sustain (Shitsuke):- Sustain refers to training to all & communication to all associates to ensure 5's application 5S is one of the most important working principle followed at HCI Ltd.

Other companies have also started using this principle with some modification. Its modified version is *QCDMS policy*:

Q = Quality
C = Cost
D = Delivery
M = Management
S = Safety

2.3.2 Kaizen:

Kai = Change + Zen = Good / for the better
Kaizen = Continuous Change for the betterment
Kaizen is a Japanese word comprising of two different words joined together.
Kai means Change and Zen means Good (For Betterment) So, Kaizen as a whole means, Continuous change for betterment or simply, Continuous improvement.

2.3.3 HO-REN-SO:

HO: - Report status/ Progress to seniors
Ren: - Inform all those who may be concerned
SO: - Consult to refine one's own thoughts/ideas

2.3.4 PDCA Principle: It stands for PLAN-DO-CHECK-ACT. This is a cyclic process& continues in reiterating if the proposed solution doesn't work or taking up a new problem implementing PDCA.

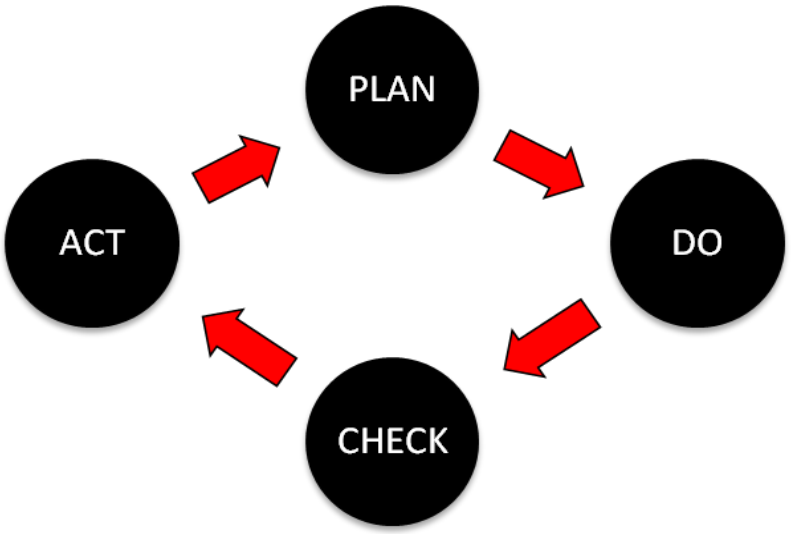


Figure 2. 2 PDCA

2.4 Honda Quality Policy

Honda Cars are best known for their quality & comfort all over the world. Honda Quality Policy states that,

"Maintaining a Global viewpoint, we are dedicated to supplying the products of highest quality, yet at a reasonable price, for worldwide customer satisfaction."

Or simply, Honda strives for:

- Making world-class products;
- Of Highest Quality;
- At reasonable price; and
- Provide complete customer satisfaction.

All the 750-800 parts & over 2000 nuts and bolts used in assembling the car are very carefully and systematically installed so that there is no chance of any problem or sub-standard quality.

2.5 Product Line-Up

Honda City (Ballade) — Launched 1998

Honda Accord — Launched 2001, production temporarily discontinued in early 2014 in anticipation of all-new model)

Honda Civic — Launched 2006, production discontinued in 2012

Honda Jazz (Fit) — Launched in 2009

Honda Brio — Launched 2011

Honda CR-V — Imported since 2003; 2013 model locally assembled

Honda Amaze — Launched April 2013

Honda Mobilio — Launched July 2014

Honda BR-V - Launched May 2016

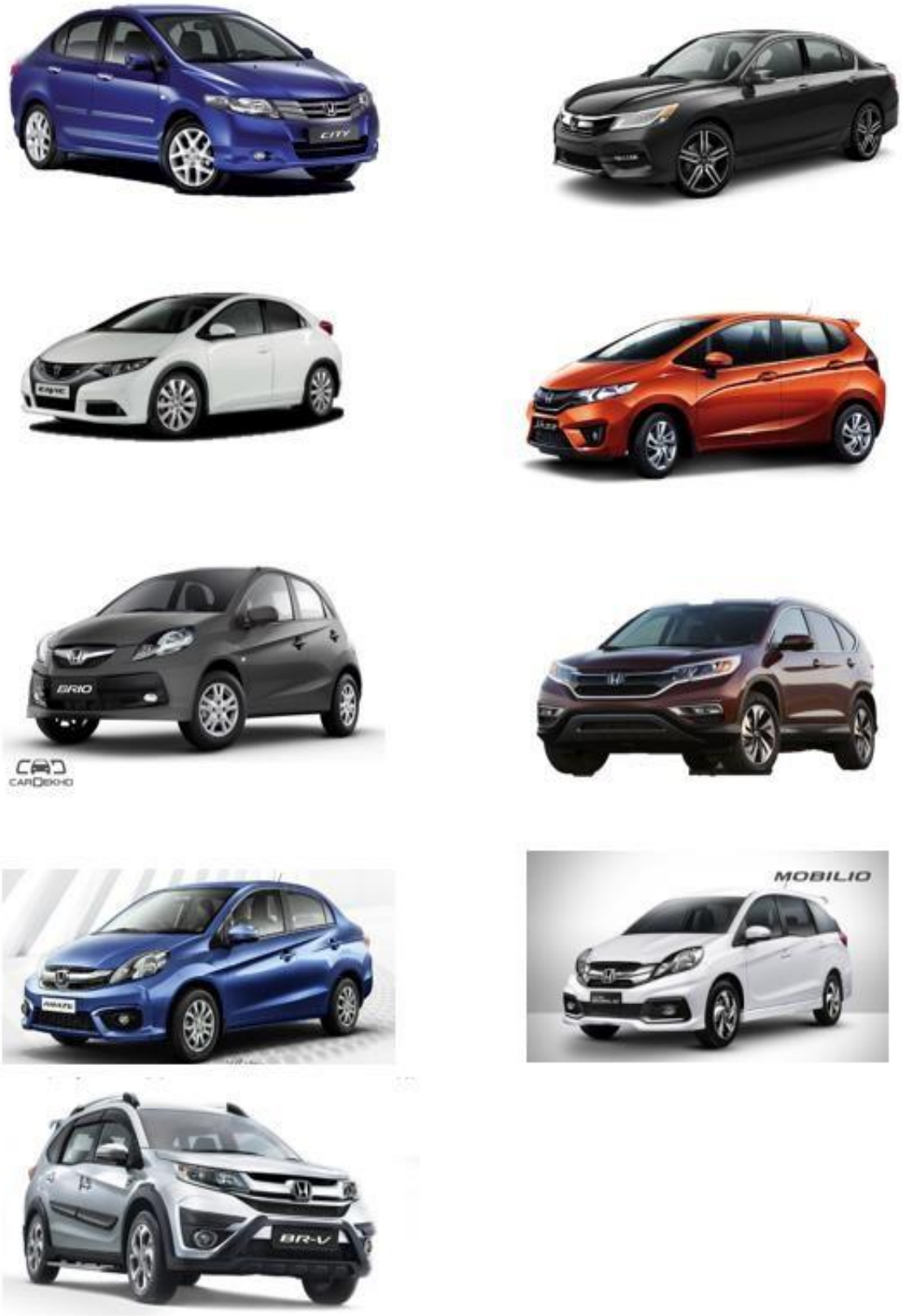


Figure 2. 3 HCIL Products

CHAPTER - III

PRESENT INVESTIGATION

3.1 Pollution & Control Measures

At HONDA, concern for the environment has the cardinal place in achieving any objective, which is proved by the highest quality of engines developed by HONDA over the past decades. The environmental policy at Honda is as follows:

- Incorporate environmental management in all business processes & practices.
- Optimize utilization of resources in the area of energy, fuels, oils, paints, chemicals, water, packaging materials, etc.
- Strive to minimize adverse environmental impact from the products & manufacturing processes by controlling emissions, effluents, waste generation & supporting environmental protection activities.
- Create awareness about the importance of environmental protection throughout the organization & with all other stakeholders such as vendors, dealers & society through adequate & periodic communication of this policy.
- Continuously upgrade operating standards & environmental management systems & to comply with applicable local & national laws.

3.1.1 Water pollution

Primarily from the paint shop in the form of water containing oils heavy metals, thinner, color, phosphates, etc. Honda has developed two treatment plants namely the Waste Water Treatment Plant {WWTP} & the Sewage Treatment Plant {STP}. The quality of water coming out is of the same quality of the water supplied by the Water Board. This treated water is fed to a fishpond designed to test & ensure the quality of the treated water.

The sewage treatment plant is used for treatment of all the sewage from the plant, the final sludge matter is put in incinerators & ash is produced by burning it, which is then transformed into bricks. The treatment capacity of STP is 150 Kl / day but on a daily basis it is treating about 80 Kl / day which clearly illustrates the reduction that Honda has brought about since its time of inception.

3.1.2 Noise Pollution

Although there is no major machinery at HCIL except the DG {Diesel Generator} sets & compressors which cause noise pollution (that too has been kept below the standard level through acoustic design), yet some areas of the paint shop & weld shop have been acoustically designed to reduce the level of noise. Further more stringent guidelines on behavior at the shop floor, which includes no unnecessary talking, or shouting, etc. have helped to keep the levels in the work area below the standard limit.

3.1.3 Air pollution

Air pollution is primarily from the DG sets & includes SPM, NOX & SOX whose emission is kept below the standard limit through the use of advanced DG sets causing less pollution.

Ash

"*Incinerators"* are used to burn down the sludge from the paint shop & the WWTP. Finally the ash produced is made into bricks & or blocks which are stacked & can be used if required. About 22% of the bricks are composed of ash.

Gold Rating in 2004 ISO 14001 in 2001

For Environment Performance

(By RWTUV – Germany)

(By World Bank, CII, and UPPCB)

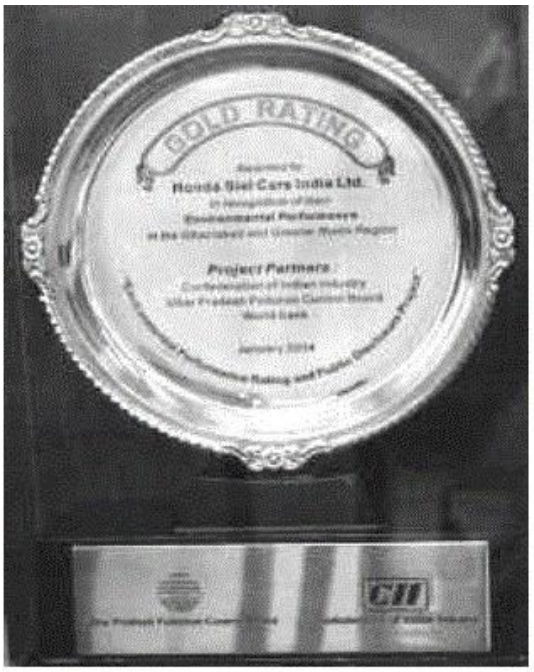


Figure 3. 1 Certificate

3.2 Manufacturing Division

To manufacture a car or vehicle, It hast to be processed in various departments followed by the quality inspection at every stage or predefined quality gate.

The various departments under manufacturing division are:

1. Welding Shop
2. Paint Shop
3. Assembly Frame
4. Vehicle Quality
5. Assembly Engine

3.2.1 Weld Shop

In weld shop complete body of vehicle is welded. The body is welded into different parts like hood, trunk, fuel lid, middle floor, front floor, doors etc. & then these parts are welded to form a complete body. The various types of welding used are spot, MAG, nut & stud welding. There are four welding zones in weld shop named as A, B, C&D zone.

A-zone is also known as floor line. In this zone front & rear floor is welded. Then after this B-zone starts also known as general welding in this side panels left & right are welded. Then next to it C-zone starts is also known as metal finish line .In it door & trunk are welded. After it there is D-zone. In this zone door, hood, trunk are welded to body that has been previously welded.

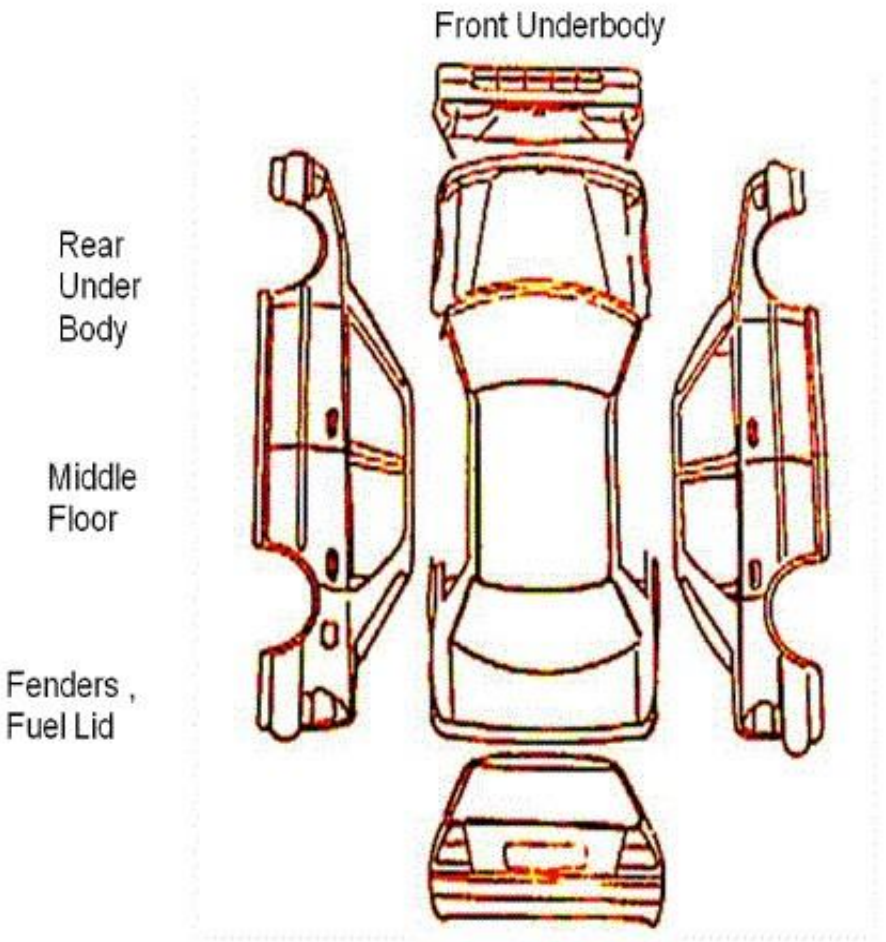


Figure 3. 2 Vehicle welding View

Various Kinds of welding used are:

- Spot Welding
- MIG Welding
- Stud Welding
- Nut Welding
- Sealer Application
- Fittings
- Alignments

Various tools & equipment's used are:

- Jig
- Fixture
- Spot Welding Portable Gun (M/C)
- MIG Welding M/c
- Hamming M/c.
- Sealer Pump and Gun
- Spot Welding Robot

Various welding defects are:

- Dent and Dings
- Door, trunk, Hood Alignment NG
- Gap NG
- NF
- Sealer Application NG
- Shower Leakage
- Sealer Crack during Alignment
- Deformation
- Damage
- Metal Dust

ROBOTS IN OPERATION DURING SPOT WELDING:

Figure 3. 3 Welding Robots

Figure 3. 4 Jigs Used In Welding

3.2.2 Paint Shop

After welding welded body is send to paint shop. Paint used must possess high quality & must long elastic & must have good outer appearance. Because we know that first impression is the last impression. Customer just attracted firstly because of good appearance.

As the body enters in paint shop firstly it is checked completely for weld defect & repaired immediately. After this various processes are done on body. For example there is ED, sealer zone .In ED zone i.e. electrical discharge zone. In which body is dropped inside the electrolyte solution & body is made as cathode. In sealer zone seal is applied to various joints. After it coat is provided. Firstly mid coat & then top coat.

Then after it is checked before sending painted body to AF & minor repairs are done.

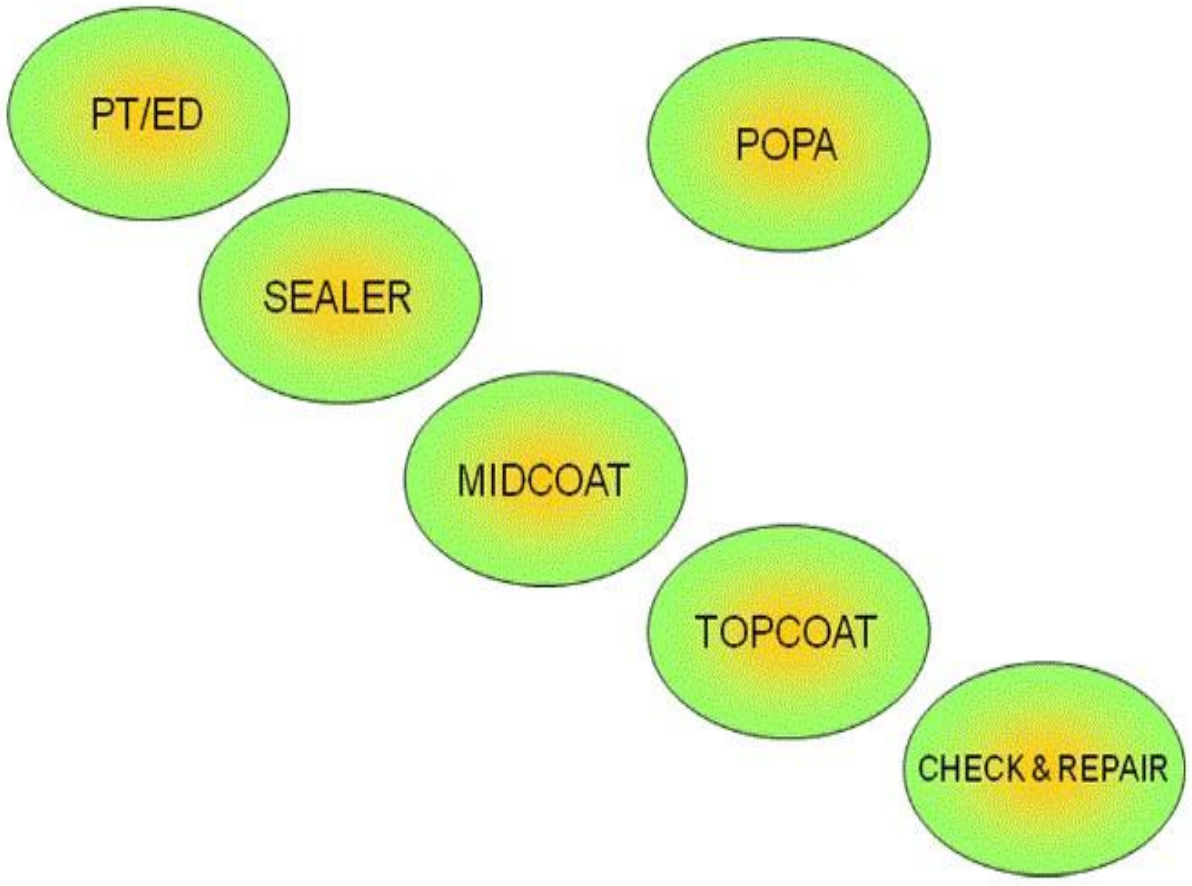


Figure 3. 5 Paint Shop Process Line

3.2.3 Assembly Frame

Manufacture of complete car units with KD, local parts, and other assemblies/subassemblies after receiving painted body sheet and Engine Assemblies. These all are done in assembly frame.

First of all painted body from paint is received is called AF on. After this trim -1 & trim-2 lines are there .All the trim parts are attached air with painted body. In between there is dashboard assembly. In which complete dashboard is assembled. Then there is chassis line & after that there is final line. There is also engine sub assembly. In it some KD & local parts are assembled to it. Then this sub assembly is sent to chassis line.

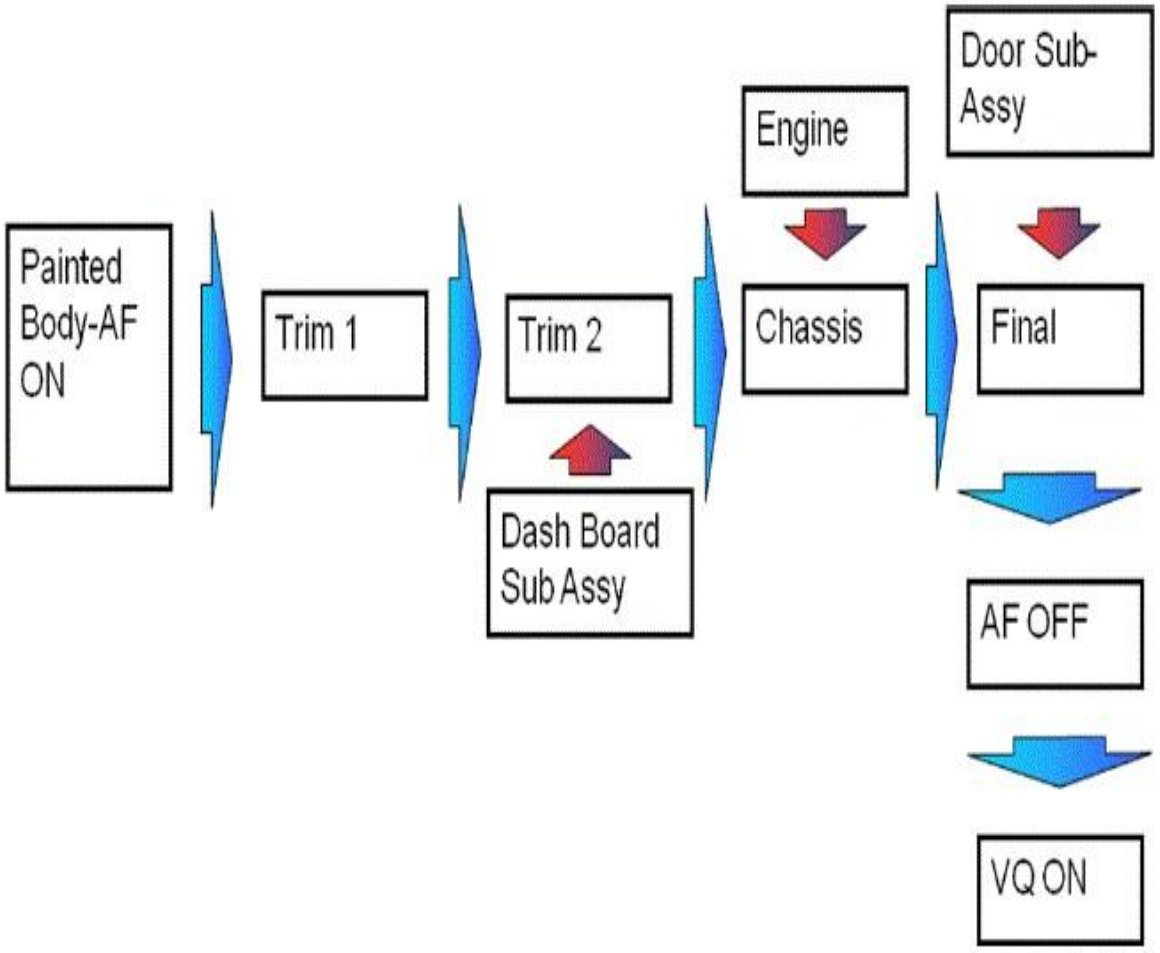


Figure 3. 6 AF Layout

Various Defects in Assembly Frame*:*

1. Part Miss
2. Part Fit NG
3. Part Mismatch
4. Part Damage
5. Dent
6. Scratch
7. Chipp Off
8. Torque not done
9. Route NG
10. Oil/Coolant - Less/High/Leakage

3.2.4 Vehicle Quality

The main objective of this department is to ensure the quality of vehicle in all respect. There are near about ten stations inside the shop. Different tests are carried out at these stations to check quality. The tests conducted are interior-exterior check, paint, glass, central locking, fuel lid, headlight beam adjustment, steering wheel test, brake test, side-slip test, body and engine check and test drive.

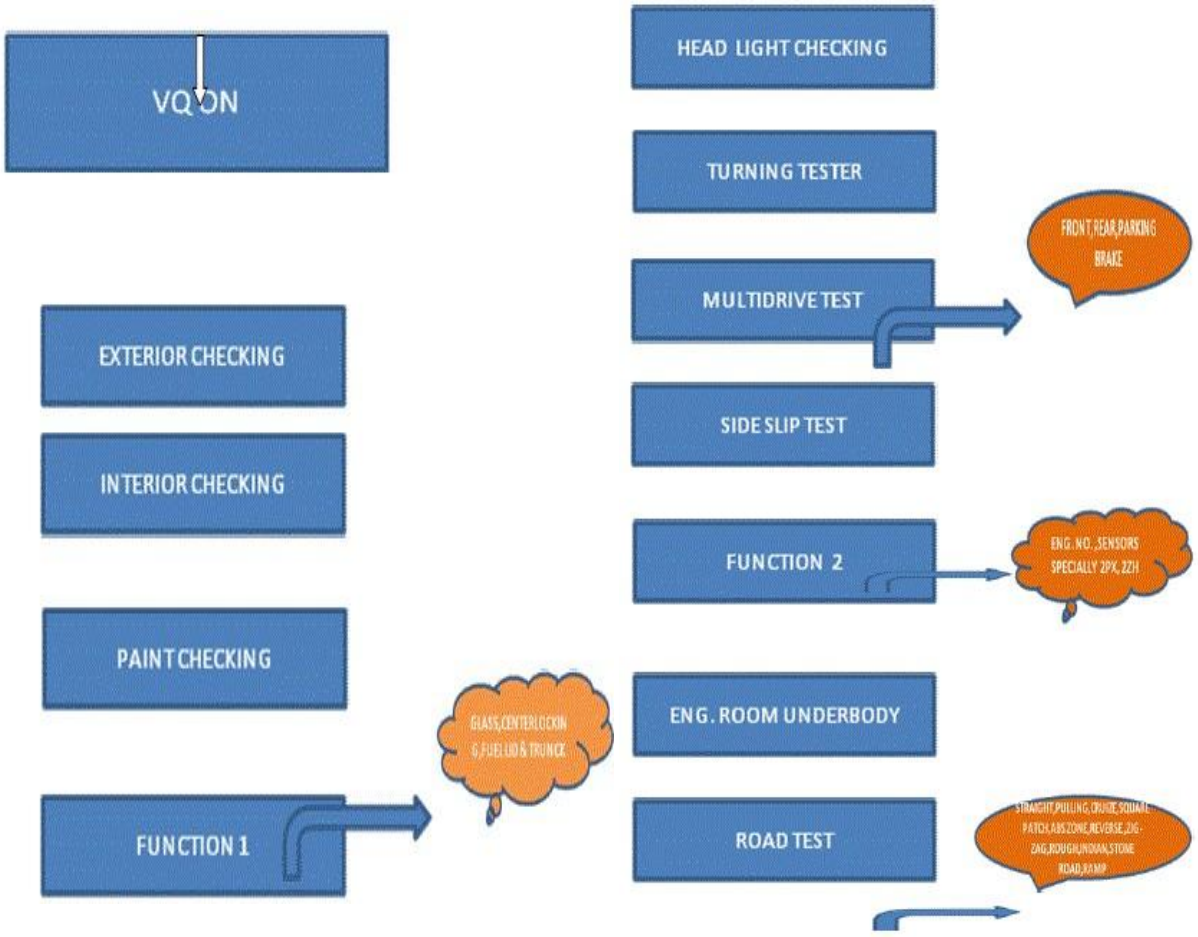


Figure 3. 7 Quality Test

Vehicle Quality Check:

PDI is the final inspection prior to the delivery to the customer. The customer expects a very high level of quality from the product being purchased. The following checks are done on the car in the final step:

- *EXTERIOR INSPECTION* – alignment inspection, parts gap inspection, fitment inspection, flushness inspection
- *PAINT INSPECTION* – dent and ding inspection, dust inspection, crater inspection, sag inspection
- *INTERIOR INSPECTION* – parts fitment inspection, parts gap inspection, parts model mismatch inspection
- *FUNCTION CHECK* – door glass operation, center locking inspection, keyless function inspection
- *R SWAT & HEAD LIGHT* – toe angle adjustment, headlight profile adjustment.
- *TURNING ANGLE* – turning angle check, hazard operation check, side indicators check, and fog lamp inspection.
- *MULTI DRIVE TEST* – speed check, speedometer check, brake force check, ABS & VSA inspection

3.2.5 Assembly Engine

Department Profile

Engine Assembly as the name suggests is involved with fulfilling the daily requirement of the car production with regards to the supply of engine of the various models. The engines in production here in the HONDA manufacturing unit of Greater Noida consist of those of the Brio, Amaze, and Mobilio etc. The daily production target of the Assembly Engine is a total of 445 engines per day comprising of manual and automatic transmission engines of the three models assembled namely City, Amaze, Mobilio.

The Engine Assembly has been divided into one main assembly line and 3 sub-assemblies

The main assembly line consists of 41 stations which include the 33 stations on the main assembly line and the remaining on the overhead conveyer (OHC). In addition to this there is a head sub assembly and a mission sub assembly. The assembly engine gets its requirements of the various parts fulfilled by the M.S. which buy them from local vendors or the parts are directly imported from Thailand and Japan.

There are a total of 12 work stations on the Mission Line and one sub assembly for main shaft and counter shaft and mission case.

The layout of the ASSEMLY ENGINE is shown in the following page.

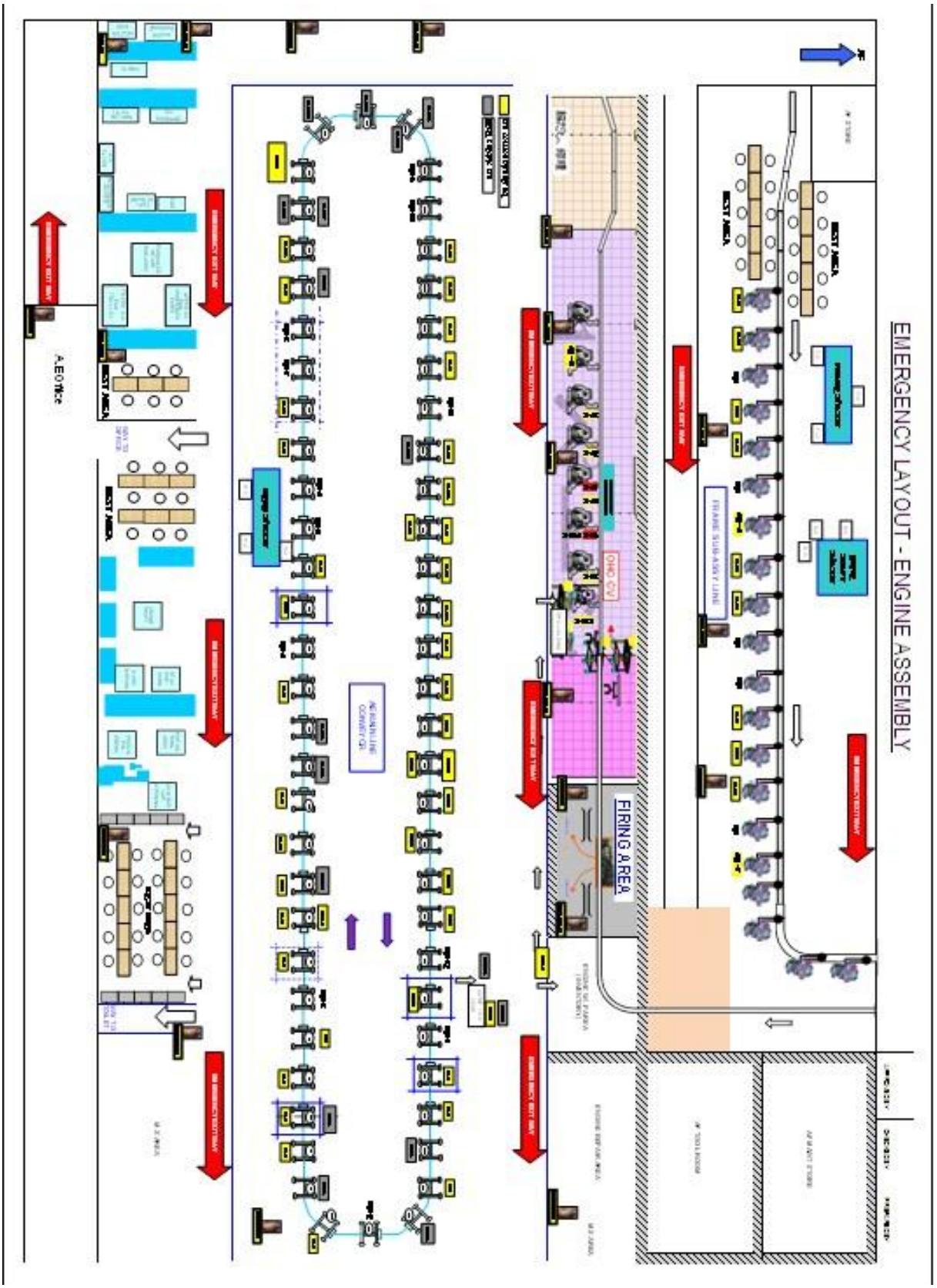


Figure 3. 8 AE Layout

Table 2. 1 Workstations on assembly line

MAIN LINE

Station No. 1:	Cylinder Block Loadiing
Station No. 2:	Engine No. Punching
Station No. 3:	Piston Assy Insertion
Station No. 4:	Bearing Selection
Station No. 5:	Crankshaft Installation
Station No. 6:	Mbc Snug Torque
Station No. 7:	Mbc Angle Torque
Station No. 8:	Oil Seal Installation
Station No. 9:	Flywheel Installation
Station No. 10:	Oil Pan Installation
Station No. 11:	Mission Docking
Station No. 12:	Cylinder Head Gasket Installation
Station No. 13:	Cylinder Head Install
Station No. 14:	Timing
Station No. 15:	Breather Cover Install
Station No. 16:	Chain Case
Station No. 17:	Crank pulley Install
Station No. 19:	Tappet-1
Station No. 20:	Tappet-2
Station No. 21:	Tappet Recheck
Station No. 22:	Spark Plug Installation
Station No. 23:	Head Cover Install
Station No. 24:	Ig Coil Installation
Station No. 25:	Water Leakage
Station No. 26:	ENG Harness Install
Station No. 27:	ACG Install
Station No. 28:	Water Pump Pulley Install
Station No. 29:	Engine Unloading

OVERHEAD CONVEYOR LINE

Station No. 30: Engine Loading On OHC

Station No. 31: Inlet Manifold Install

Station No. 33: MTF Oil Fill

Station No. 34: Crank Sensor Cover Install

Station No. 35: Belt Installation

MISSION LINE

Station No. 1: Mission Stamping

Station No. 2: Bearing Install

Station No. 3: Differential Install

Station No. 4: Main & Counter Shaft Install

Station No. 5: Main Shaft Clearance Measurement

Station No. 6: Shim Selection

Station No. 7: Main Shaft Clearance Verification

Station No. 8: Shift Arm Install

Station No. 9: Breather Tube Install

Station No. 10: Oil Leakage

CHAPTER - IV PROJECT

UNDERTAKEN

Design of Master Jig for Petrol and Diesel Engine Block Mounting On Assembly Engine Line.

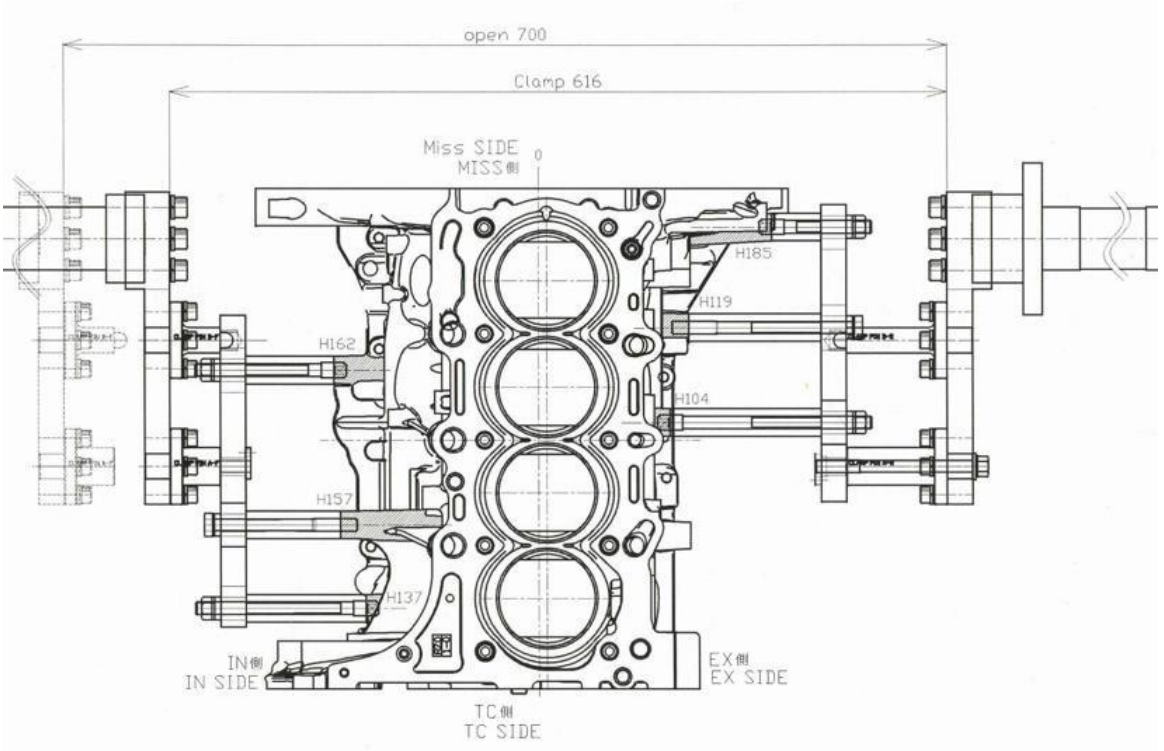


Figure 4. 1 Top view of block mounted on jig

4.1 Problem Statement

At Honda AE department, Jigs are used to hold the engine block on trolley on current assembly line. There are two different kinds of jigs which are used accordingly petrol or diesel model changeover.

The following cases occur at work station no.1 on assembly line:

1. Remove the currently installed jig.
2. Install jig according to changeover of diesel or petrol.
3. One man power is needed.
4. Addition of process timing 38.5 sec in overall production.
5. Rotation of Jig holding arm required on trolley.
6. Worker may face accident in case of dropping of jig from worker's hand.

There are 60 trolleys on main line, if after every 60 engine model changes or changeover take places in repetitive manner then jigs has to be changed for each trolley. This is a wastage of one man power and also addition of its process timing to overall production time.

4.2 Project Description

Jig is a special class of fixture, which in addition to provide all the functions as above, also guides the cutting tool during machining.

The production of the plant was highly systematic. All the workers and the officers helped me understand how the company worked. The various aspects relating to the assembly line like the machines used, takt time etc. were explained to me, which allowed me to have a better understanding of the line.

The major Objective of the respective Departments are to reduce overall process time and improve the process and work quality. In Honda the major technique used for production improvement or betterment is *JAPANESE* technique "*KAIZEN*" which means "*continuous improvement*" and the best practical example of this in HONDA plant is its production capacity 98 units/ day of its first model to 448 units /day (122000 units/year)at present. Considering this thing, which also studied in our curriculum, project was proposed that would be a part of this continuous improvement policy of HONDA.

In automobile industry large workload of the vehicle assembly which accounts for more than 50% of the workload of assembly engine. Jig is installed on work station no. 1 and then assembly of engine is processed. At various work station different processes are being carried out in which different engine parts are assembled to block. One man power is needed at station no. 1 on model changes and it added 38.5 sec.to its overall process timing. Traditional jig has to be replaced for every changeover or model changes from petrol to diesel or vice versa. Selecting an appropriate mater jig design is a critical step towards insuring that a design is usable, safe and easy handling. Master jig provides solution for both petrol and diesel engine block mounting on same jig instead of using two different jigs. The basis emphasis has been given during design was no part fouling or interfacing during various assembling of parts. *"Traditional Diesel Jig"* was made as a reference or base and Pick points of petrol engine block were traced to merge with diesel to make master one. Department previously worked on this project, their research and work on this project was basic guidelines for us. Various 3D models were developed using Autodesk Inventor 2014 and their life and easy of handling analyzed for the best design. And after that some rough prototyping were carried out to check fouling of

parts. Result oriented work has been carried out and improved efficiency of assembly work of engine.

The major objective of the project is to overcome the disadvantages of traditional jig used in assembly engine. Master jig adds many advantages to assembly line like man power reduction, tact time reduction, addition of Safety to workers etc.

4.3 Process Layout of Project

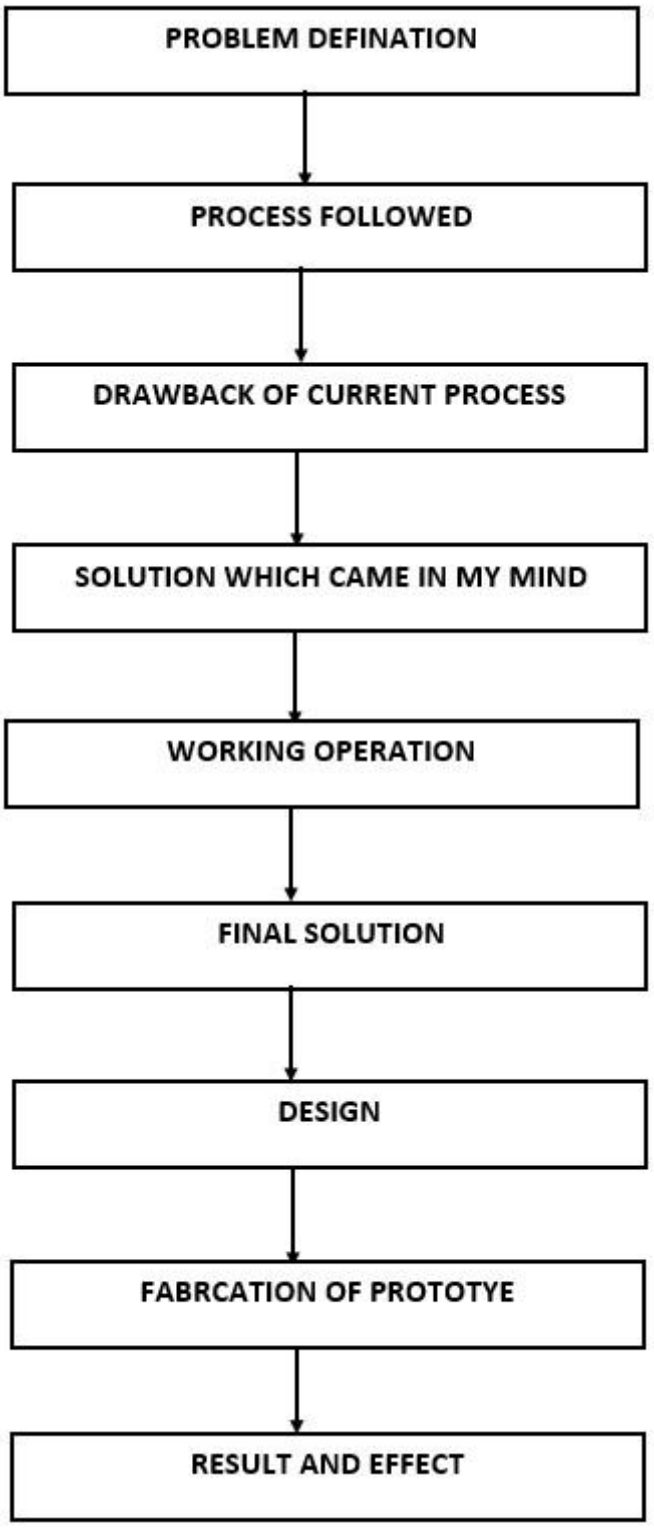


Figure 4. 2 Process layout of project

4.4 Methodology

4.4.1 Jig Design

Method used during the project was purely based on research work of the team and previous work of this project which shared by Mr. Sohan san. Research work has been done to better understand the existing working situation and to find out the specific stations to observe processing of part assembly. After completing this all data was collected.

To start the project work and design, traditional jig design was studied to create the overview and to understand the design of jig parts. Japanese designed drafting was very helpful in designing of master jig. This R&D work was very beneficial in our design.

Diesel Jig was designed with dimensions and drafting provided by the department. Every part was designed with Honda standard and all dimensions, fit, tolerances are considered accordingly. Both exhaust and inlet side diesel traditional jig was designed at first.

Then this design was considered as a base of new design for master jig, it means, worked on diesel jig to modify it to master jig. Diesel jig was chosen only because of weight and complexity of diesel engine was more than petrol. So its arm could not be worked out, it created more complex issues for design if diesel jig arm was made movable. Space envelope was find out on applying both petrol and diesel traditional jig to both petrol and diesel blocks and engines.

Petrol pick points was traced on paper from the engine block and put them to merge with diesel .Then a first design was achieved and after it first rough prototyping was done in the department. This rough prototype was installed to trolley and mounted the engine block on it and analyzes the interfacing or fouling of parts and *oil level pipe* was found to be fouled on station no.17 with this jig. To solve this issue, movable dowel (positioning support) was designed with thread and apply basic knowledge and got success to design an exhaust side master jig.

On mounting block on this exhaust side master jig, petrol pick points were traced of inlet side and again fabricated the rough prototype by welding petrol arms on diesel based jig. Finally the inlet side master jig was designed, which was perfectly matched for diesel engine without any part fouling.

But when we mounted petrol engine then knew that *catalytic converter* from station no. 17 was fouling with this jig. Department had no issue with it because this work station would be shifted from the main line to OHC or with compressor assembly work.

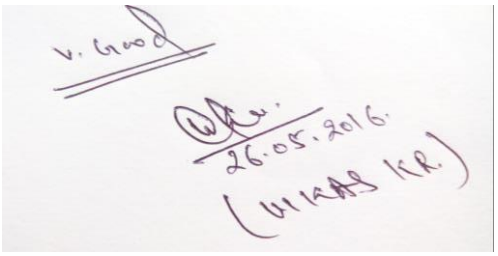
At the end, to solve this issue petrol pick points were shifted to left. Due to this Base plate or jig of inlet side (diesel based) became larger than exhaust side. This project work was successfully completed and approved by supervisor and department also.

Project was approved and department arranged the meeting with supplier *DS Tooling* to discuss the new design, after it the order of *Master Jig* is placed to *DS Tooling* for its prototype manufacturing. First Prototyping would be manufactured using *Nylon.*

4.4.2 Design Layout of Assembly Engine

(Different Project Carried Out During this Period)

Under the guidance of Mr. Vikas Kumar, by using AutoCAD Mechanical 2014 "*New Layout of Assembly Engine*" was designed. For Improvements of Plant capacity on new model change AE layout should be changed because there is not enough space in current layout to support new model change. In designed layouts no. engine pallets increased to be manufactured and space utilization on further new model changes.



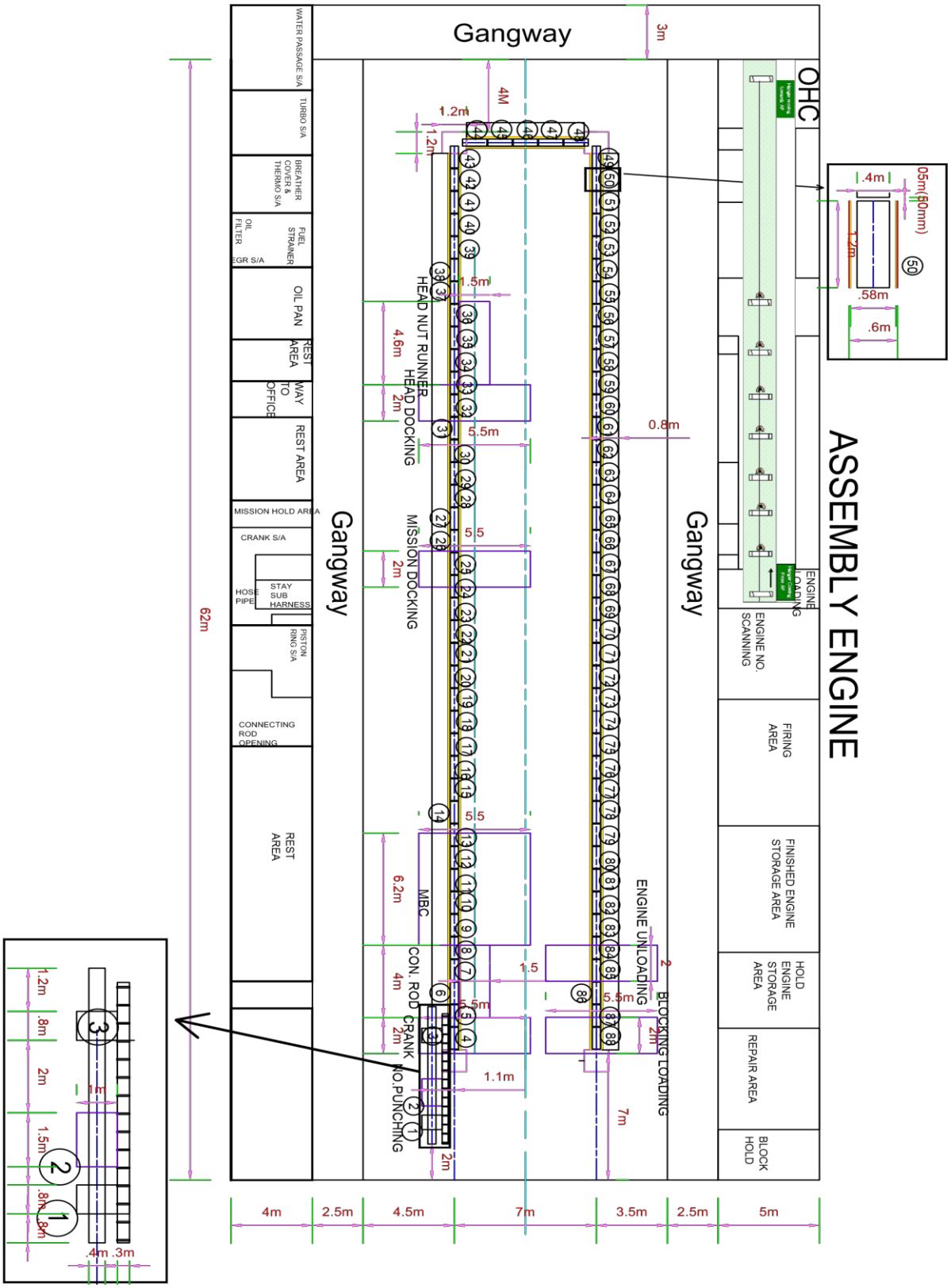


Figure 4. 3 Proposal 1

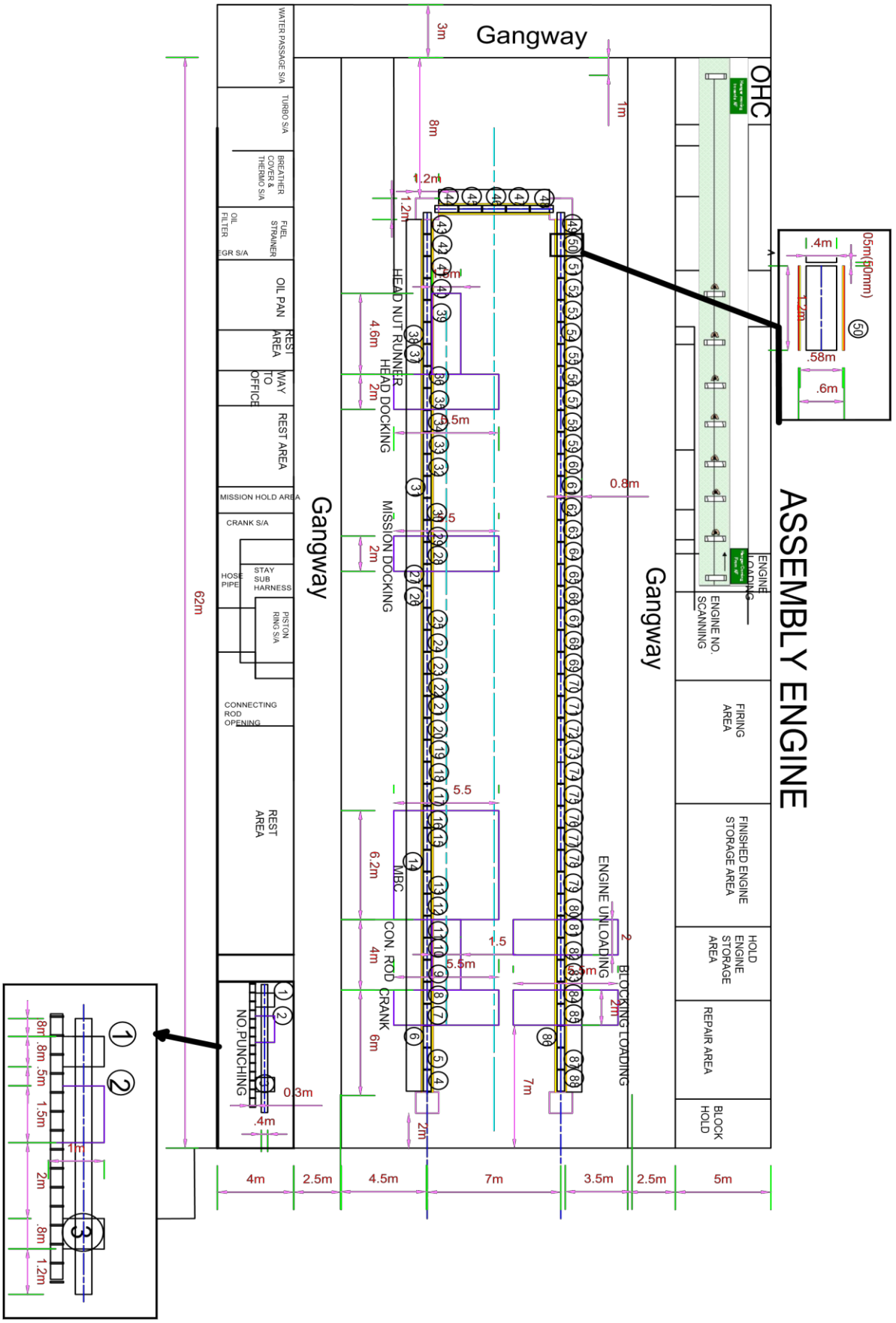


Figure 4. 4 Proposal 2

4.4.3 How to assemble hose pipe

To make worker understand that "*how to assemble hose pipe"*, a video clip has been developed to show the steps involve in assembling of hose pipe. New set tools was going to assemble the hose pipe, for manual working, it was the first step or initials to make understand them their work stations.

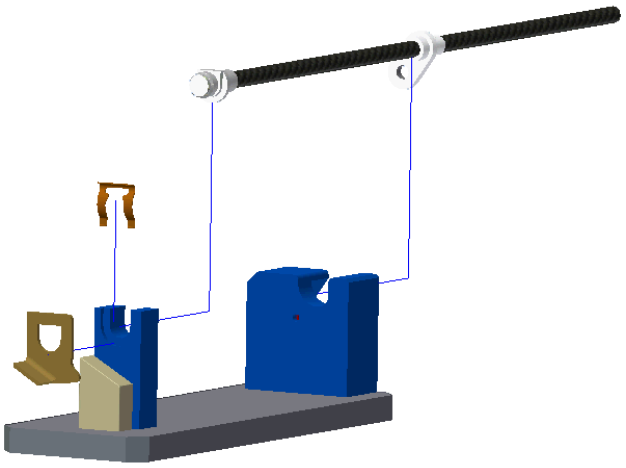


Figure 4. 5 assembling of hose pipe

4.4.4 Hook Design: Hook was designed for unloading the engine from the main assembly line. Dimensions was taken by tracing the existing hook. Truss shaped load bearing bars was added to its curvature to increase its strength.

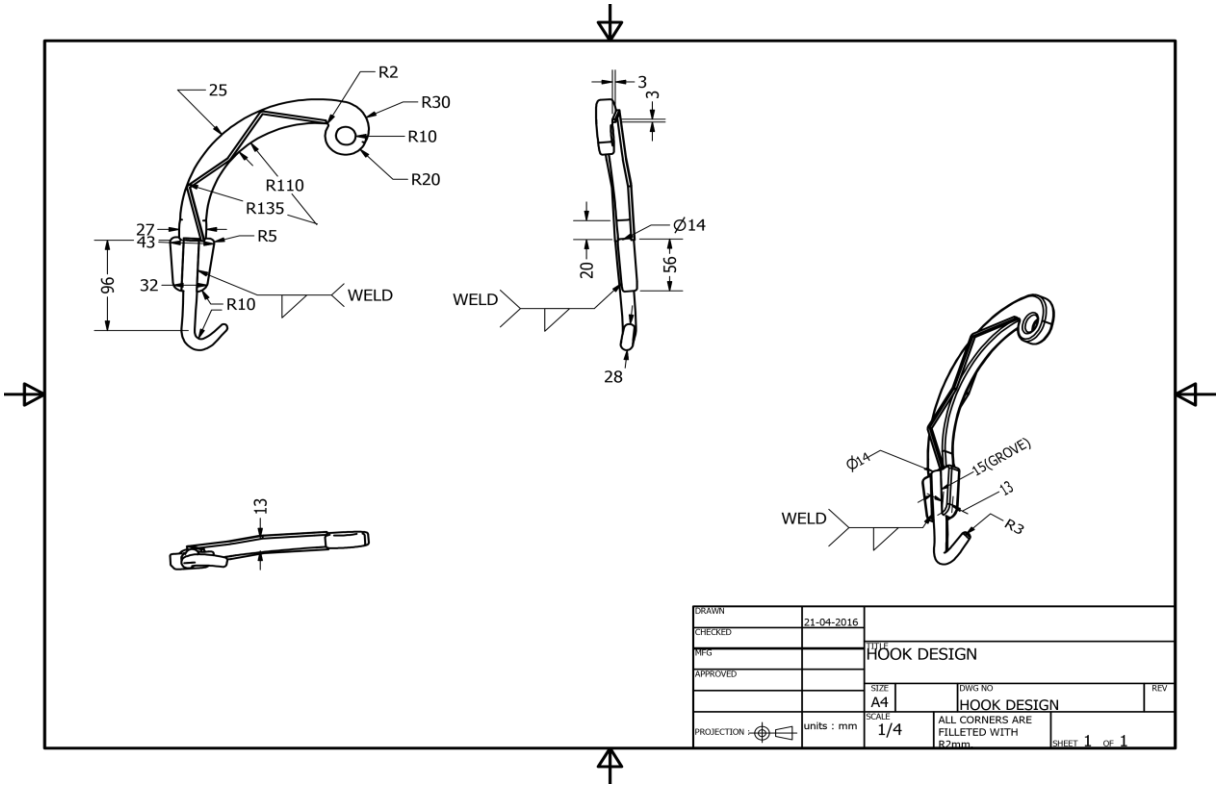


Figure 4. 6 Hook design

4.4.5 Design a System to solve ergonomics issue

Project has been carried out to solve the Ergonomic issue of worker of station no. 19. At this station Process named Cylinder Head Bolt Torqueing carried out on main assembly line. For this there is a main machine for angle torqueing but if in case of non-working of this machine there is one more machine for this purpose. But worker has to pull down the system hold it and after tightening the bolt of head, a cylinder guide is there in the system to support this purpose. It develops stresses in workers hand and shoulders due to this he is not able to do quality work in whole working hours.

To solve this issue automation was proposed with the help of pneumatic cylinder. Coupler and a base plate was designed for this according to ground clearance and dimensions constraints to reach the engine head. SMC Air cylinder, MDBD80- 60-W-M9BL WITH 600 mm stroke is ordered to fulfil this purpose. By the use of PILET VALVE, this station work easily made stress free for workers.

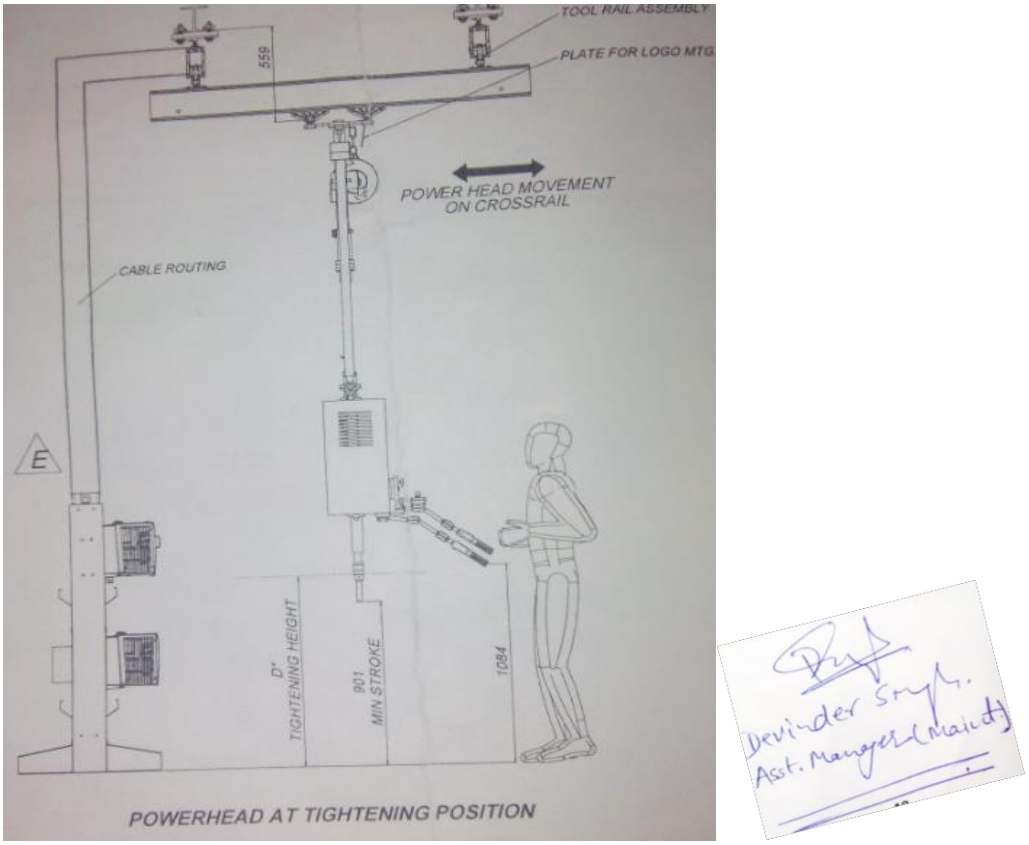


Figure 4. 7 Automation of torqueing machine

4.4.6 Time Study

TO understand the basic processing time taken at every work station, time study of whole main assembly line has been done. To know the over working or burden on any station it is very necessary study. After this study processing time was known for the station no. 1 on jig change.

Table 4. 1 Time study

Station Number	Processes	T1	T2	T3	Average time
1. Jig Install	1) Block jig change	38	38.48	39.02	38.5
	2) Engine block load	41	38.5	39	39.5
2. Cap bolt loose and remove	1) Engine number scanning	3	4	3.5	3.5
	2) Bearing Cap bolt loose and remove	65	66.2	63.8	65
	3) Bolt stud	15	14.8	14.6	14.8
2A. Fuel pump install	1) Starter motor	20.8	22	23.2	22
	2) Pump assembly	18	19	20	19
3. Engine number punching	1) Engine number	62.4	60.2	59.8	60.8
	2) Oil apply	3.8	4	4.2	4
	3) Orifice oil control	2	2	2	2
3A. Piston supply	1) Passage oil assembly	42.8	43.4	42.8	43
	2) Piston code check	1	1	1	1

	3) Piston supply as per block	8.8	9.7	11.5	10
4. Piston assembly insertion	1) Check piston sub assembly and oiling on O-ring	5.3	5.4	4.9	5.2
	2) Piston and conrod insert	33.5	34.1	33.8	33.8
	3) Cleaning of block journal with nylon cloth	2	2	2	2
	4) Conrod and Block bearing reading	10.8	12.6	13.2	12.2
4A. Oil jet assembly	1) Oil jet insert	30	31	35	32
	2) Jet assembly	22.3	20.8	23.5	22.3
	3) Conrod cap bolt loose	9	10	11	10
	4) Cleaning of cap and block journal	13.4	12.3	12.7	12.8
	5) Chain guide bolt	3	3	3	3
5. Bearing selection	1) Thrust washer supply	2	2	2	2
	2) Bearing selection and delivery	85.8	86.5	85.7	86
6. Bearing install	1) Conrod cap remove	8.6	8.8	9.8	9.06
	2) All bearing install	37.8	37.6	39.8	38.4
7. Crank shaft install	1) Oil jet torqueing	4	4	4	4

	2) Oil plug fitment	2	2	2	2
	3) Rocker oil apply	3	3	3	3
	4) Crank shaft install	29.8	29.9	30.9	30.2
	5) Conrod cap install	22.3	21.7	21.4	21.8
8. Conrod snug torque and angle	1) Conrod snug torque	33.8	33.5	34.1	33.8
	2) Thrust washer	3	3	3	3
	3) Conrod angle torque	27	28	32	29
	4) Application of rocoil	2	2	2	2
	5) Bearing cap install	4.6	3.8	3.9	4.1
	6) Engine oil on bolt and install	4.8	4.8	5.1	4.9
9. Bolt bearing cap tight and torque	1) Bolt bearing cap tight and torque	56	57	58	57
	2) Crank sensor temperature install	4.5	4	4.1	4.2
	3) Oil seal and upper oil pan area clean	3	3	3	3
10. Oil seal install	1) Block cap torque recheck	12.1	12.4	12.1	12.2
	2) Sealant application(COMBINED WITH NUMBER 3)				
	3) Oil seal case install	35	34.9	35.4	35.1
	4) Remove extra bond from oil seal topside	8.8	9.1	9.1	9
	5) Crank sensor torquing	1	1	1	1

	6) Bush press and depth check	8.6	8.6	9.2	8.8
QG1.	1) Crank rotation check	6	4	5.3	5.1
	2) QD as per check sheet	10	12	11	12
11. Upper oil pan installation	1) Sealant application	28	27.22	28.4	27.87
	2) Upper oil pan installation	6.3	7.03	7.1	6.81
11B. UP O.P. bolt tight	1) All bolt torque	22.7	23.1	22.5	22.76
	2) Bolt stud	6.4	6.2	6.1	6.23
	3) Bolt stud	2.1	2.3	2	2.13
	4) Sealing bolts	5.4	5.4	5.3	5.36
12. Flywheel installation	1) Flywheel install and torque	49	48.35	48.9	48.75
	2) Oil pump install	4.5	4.9	4.6	4.67
13. Pressure disc/trq con installation	1) Disc comp friction setting and pressure disc	38	40.7	40	39.57
	2) Apply grease to splines	6	5.1	5.3	5.47
	3) Oiling in oil pump	2.3	2	2.3	2.2
	4) Oil strainer install	8	10.4	10	9.47
11A. Fuel pump timing	1) Upper oil bond cleaning	1.5	1.52	1.52	1.513

	2) FP timing, key setting, arm tens, tens assembly and FP chain	81.32	84.69	80	82
13A. Oil pump timing installation	1) Oil pump timing	27	26.51	28	27.17
	2) Guide RR and Guide FR	21	24.75	25	23.58
	3) Oil pump and pump sprocket bolt tight	3.1	3.31	3.4	3.27
	4) Sei surface cleaning	8.4	8.25	8.42	8.36
14. Lower oil pan installation	1) Lower oil pan sealant apply	11.2	12.3	11	11.5
	2) Oil pan install and torque	57.1	53.9	55	55.33
	3) Dowell pin	4.2	3	4.1	3.77
15. Mission docking	1) Mission install TRQ	55.7	60.2	59	58.3
	2) MT-BF and Bracket starter A	4.8	3.8	3.5	4.03
	3) 3 bond cleaning at lower oil pan	3.2	4.1	4.1	3.8
	4) plate partition	4.3	2.2	2	2.83
16. Head gasket installation	1) Cylinder head clean with nylon cloth	2.1	2.3	2.3	2.23
	2) Head gasket selection and install	30	34.4	38	34.13
	3) Piston check	1	1.2	2.1	1.43
	4) Dowell pin install	1.2	1.5	1.9	1.53

	5) Bracket fuel strainer temperature tight	5	6.1	7.8	6.3
17. Cylinder head install	1) Head cover open and place on dolley	5	4.3	5.9	5.06
	2) Cylinder head install	18	20.1	23	20.36
	3) Cylinder head bolt install	7	10.6	11.6	9.73
	4) EGR gasket	0.9	1	2	1.3
18. Cylinder head install	1) Cylinder head assembly torquing	70	80.4	84.5	78.3
	2) O ring install	6	7.2	7.9	7.03
19. Cylinder head bolt recheck	1) FP and OP sprocket bolt torque	4	4.2	4.9	4.37
	2) Crank rotation 2 revolutions in reverse direction	6	6.5	7.9	6.8
	3) Guide arm and bolt chain	11	15.6	17	14.53
	4) Starter cable assembly	17.5	18.5	19.5	18.5
	5) Oiling in lifters hole and valve head	7	8.4	8.9	8.1
	6) Cylinder head cover surface clean	2	2.3	2.9	2.4
A19E. EGR install	1) Cylinder head bolt recheck	10	14.6	19	14.53
	2) Bracket fuel strainer tight and torque	7	7.8	10	8.26
	3) EGR S/A set	3.2	6.5	8	5.9

	4) Stay F eng harness install	10.3	12.2	17	13.17
	5) BKT starter C and cable set	11.2	14.4	19	14.87
	6) Gasket HP EGR valve	1	1.7	2.7	1.8
19A. Lifter and rocker install	1) Lifter install	21	24.5	29	25.83
	2) Rocker setting	19	22.6	27.5	20.03
19B. CAM install	1) Set lower holder	7	9.4	12.6	9.67
	2) Rocoil on all journal and CAM lobe	2	3.9	4.8	3.57
	3) Set IN and EX CAM	11	13.8	14.9	13.23
	4) Upper holder tight and torque	30	35.3	37.8	34.37
	5) BF tight and torque	3	5.9	5.7	4.87
QD-2	1) Fuel pump sprocket bolt torque recheck	7	10.1	13.2	10.1
	2) Oil pump sprocket bolt torque recheck	7	8.2	11.2	8.8
	3) Head and chain case face cleaning	33.2	34.6	31.5	33.1
	4) Starter cable torque recheck	20.36	18.88	22.35	20.53
	5) Visual check	4.6	5.3	3	4.3
19C. Head cover install	1) Sealant application	29.7	32.2	33.8	31.9
	2) Head cover and bolt install	15.68	16.33	15.91	15.97

	3) Bf 6 x 35 - 8 with rubber washer	9.9	10.2	8.44	9.51
	4) Water passage	23.5	24.2	25.6	24.43
19D. Head cover bolt torque	1) bolt install	33.15	32.98	35.6	33.91
	2) Torque all bolts	48.35	49.68	50.74	49.59
	3) Bond cleaning timing side	4.3	3.8	4.8	4.3
20A. Chamber and plate head cover	1) Plate head cover	5.78	6.25	6.87	6.3
	2) Chamber breather	44.2	47.66	41.68	44.513
	3) Cap assembly	13.7	14.21	13.52	13.81
	4) Gauge comp oil level install	23.89	25.28	24.99	24.72
20B. Vacuum pump install	1) Sel. Clean in plug and vacuum pump	16.97	17.23	18.45	17.55
	2) Vacuum pump installation	20.47	22.36	21.98	21.603
	3) Head plug set	4.2	4.5	4.8	4.5
	4) Set heater pipe sub assembly installation	29.37	30.44	27.19	29
	5) Set EGR water in hose on heater pipe	20.16	19.8	18.67	19.543
	6) Gasket EGR outlet	9.3	10.8	11.1	10.4
20. Timing settings	1) Chain set with sprocket c-chain	38.35	37.91	39.1	38.453
	2) Sprocket bolt torque	19.1	19.66	19.5	19.42

	3) Arm c-chain with bolt tensioner pivot	26.8	26.7	26.6	26.6
	4) Oiling on chain	9.85	10.15	10.29	10.097
21. Chain case install	1) Sealant application on chain case and set on engine 55s mark	60.6	61.9	63.44	61.98
	2) Bolt impact and set BF-6x25-5 numbers	41.31	39.36	43.08	41.25
22. Chain case tight	1) Set BF-6x25-5 bolt and impact 20 bolt	45.35	46.29	47.88	46.51
	2) Water passage install and bolt impact	35.98	34.51	36	35.5
23. Chain case torqueing	1) Torque all chain case bolt	31.29	31.39	31.87	31.52
	2) Torque all BF	25.75	26	25.59	25.78
	3) Torque water passage bolt	9.8	9.9	9.7	9.8
	4) Pipe oil apply on O-ring	10.12	8.81	11.53	10.153
24. Crank pulley	1) Engine turning	4.6	5.2	5.6	5.13
	2) Crank pulley install and torque 52-8 mark	14.27	14.79	16.34	15.13
	3) Plate oil pan	16.82	17.33	16	17.72
	4) CAM tens set	4.5	4.85	7.69	17.04
24A. Outlet assembly	1) Mission bolt tight and torque	24.88	25.29	24.72	24.963

	2) Pipe outlet assembly	37.24	37.77	39.24	30.083
	3) Stay outlet	3.76	4.11	3.86	3.91
	4) Set pipe air separation clamp	2.49	3.02	4.85	3.453
24B. Passage air intake	1) Tens bolt tight and torque	4.58	4.97	5.67	5.073
	2) Passage beam sub assembly install	57.25	58.19	60.91	58.543
	3) EGR pipe and heater pipe bolt	4.49	5.07	5.55	5.036
25. TW sensor	1) Check O-ring	14.32	15.97	16.08	15.456
	2) Map-TA and made in india	35.56	36.99	34.25	35.6
	3) Stay C-engine harn and set heater pipe	47.81	48.66	49.73	48.73
26. Fuel pipe and glow plug	1) Glow plug	8.74	9	8.19	8.643
	2) Fuel pipe assembly	41.38	45.26	40.21	42.283
	3) Lower case settings	30.18	31.84	33.74	31.92
27. Injector scanning	1) Glow plug bus bar upper cover setting	12.43	13.87	11.43	12.567
	2) Engine card and injector scanning	21.69	22.38	24.71	22.926
	3) Injector set in engine	13.64	13.55	15.68	14.29
	4) Install bolt spl 7x100-2NOs	3.61	4.28	4.02	3.97
	5) Stay HP pipe	17.83	18.01	20	18.613

27A. HP rail assembly	1) High pressure rail	40.38	40.34	42.03	40.916
	2) Holder fuel hose	4.9	5.1	5	5
	3) Cover comp fuel rail install	6.7	6.9	7.1	6.9
	4) Hose rail fuel return	18.72	19.67	18.81	19.07
	5) Hose pump fuel return	13.95	13.33	14.98	14.086
28. High pressure pipe set	1) Set high pressure pipe	31.73	32.08	31.61	31.806
	2) Setting HP pipe fuel feed	19.31	20.64	21.71	20.53
	3) Injector bolt tightening and smug	8.5	9.5	9	9
	4) TDC sensor	15.91	14.88	16.37	15.72
29. High pressure pipe torquing	1) Angle of injector holder bolt	12.69	14.21	13.88	13.59
	2) Fuel pump torqueing	4.49	5.22	4.57	4.76
	3) Torquing of H.P. pipe nut(injector end)	4.43	5.78	4.65	4.95
	4) Torquing of H.P. pipe nut(rail end)	6.29	7.01	8.95	7.42
	5) Marking and Checking	24.62	25.28	23.74	24.71
30. Hose fuel return install	1) Torquing of H.P. fuel feed pipe nut	21.33	22.69	24.95	22.99
	2) Hose assembly injector fuel return set	13.16	14.91	16.38	14.82
	3) Fuel strainer install and hose set	14.45	14.86	15.66	14.99

QG 3. SW assembly	1) Oil pressure install temperature	108.12	109.33	106.73	108.06
31. Water leakage	1) Stay D Engine harn				
	2) Bolt B	50.51	52.61	50.84	51.32
	3) Bolt sytnd 12x83.8 install				
	4) Water leakage	49.64	50.81	50.72	50.39
32. Fuel leakage	1) Crank pulley torque recheck				
	2) fuel leakage				
	3) Hose assembly injector fuel return locking	78.99	76.31	81.29	78.9
	4) Clamp H pressure 1 and rubber H pressure 1				
	5) oil pressure switch				
	6) Fuel strainer hose clip				
33. Engine harness install	1) Engine harness install	55.28	56.75	55.67	55.9
	2) Bolt-C, Bolt spl 6x20	37.8	38.66	37.42	37.96
	3) Coupier setting HP Rail	27.19	28.64	30.78	28.87
34. ACG install	1) Injector coupler set				
	2) Cap and stay A on ACG	53.86	54.66	56.19	54.9

	3) Install ACG				
	4) ACG terminal	27.9	29.34	28.12	28.45
35. Harness connection		94.35	96.64	95.28	95.42
36. Engine unloading	1) Bolt stud 14x100 impact	8.69	9.32	10.28	9.43
	2) Engine unload and hanger remove	38.4	38.69	39	38.7
	3) Glow cover close after unit torque recheck	10.48	12.37	11.95	11.6
37A. Oil filter	1) Base and oil filter	24.29	25.67	26.33	25.43
	2) Cover comp eng rear torque	48.8	49.37	48.21	48.79
37. Compressor assembly installation	1) Compressor assembly	89.08	90.34	89.71	89.71
37B. Oil leak test	1) Oil leak test	78.47	79.59	78.27	78.78
QG4	1) ACG bolt torque recheck and bolt set				
	2) Fuel pump torque recheck, clip set	93.89	93.27	95.88	94.35
	3) Items check as per check sheet				

4.5 3-D Modeling Of Master Jig

In today's world of engineering, 3-D modeling is vital to the successful design of any product. There are many different types of 3-D modeling software available; each having their strengths and weaknesses. Each of the solid modeling software achieved the same end result, but the journey to the end is different. In this work the solid modeling was done using *Autodesk Inventor 2014*. *Autodesk Inventor 2014* is the state of the art in computer-aided design (CAD). *Autodesk Inventor 2014 represents* an object in a virtual environment just as it exists in reality, i.e., having volume as well as surfaces and edges. This, along with exceptional ease of use, makes *Autodesk Inventor 2014* is a powerful design tool. Complex three-dimensional parts with contoured surfaces and detailed features can be modeled quickly and easily with *Autodesk Inventor*. Then, many parts can be assembled in a virtual environment to create a computer model of the finished product. In addition, traditional engineering drawings can be easily extracted from the solids models of both the parts and the final assembly. This approach opens the door to innovative design concepts, speeds product development, and minimizes design errors. This makes *Autodesk Inventor 2014* a very powerful and effective tool for solid modeling.

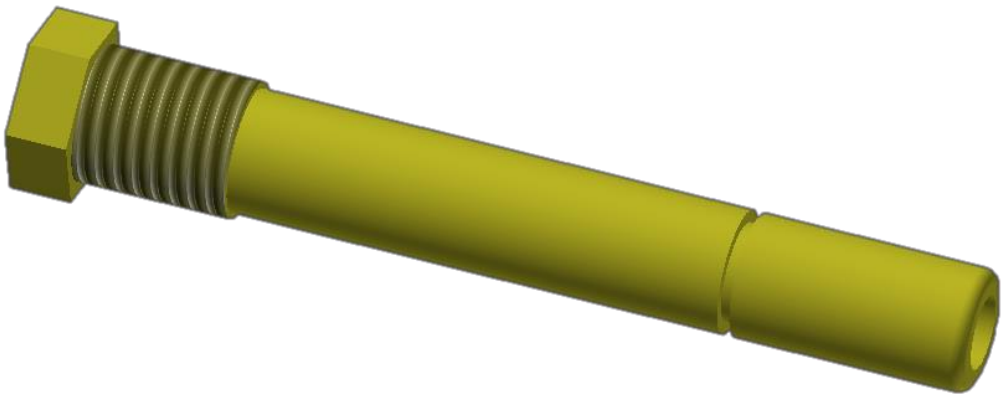


Figure 4. 8 3D Modelling of Adjustable dowel

Various CAD Designs

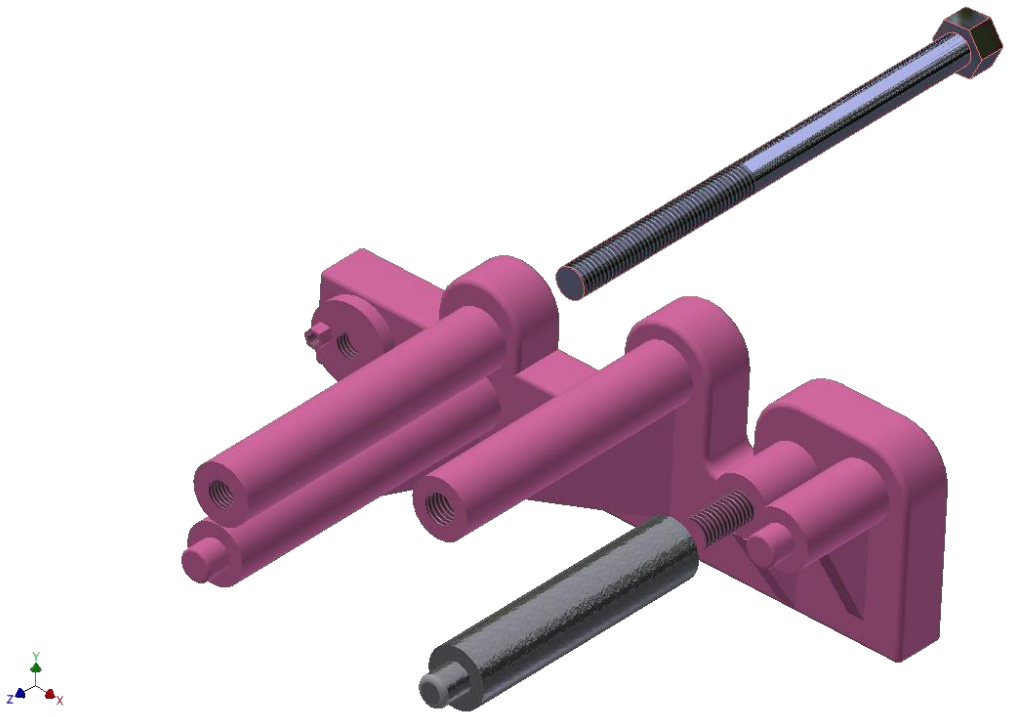


Figure 4. 9 design option 1

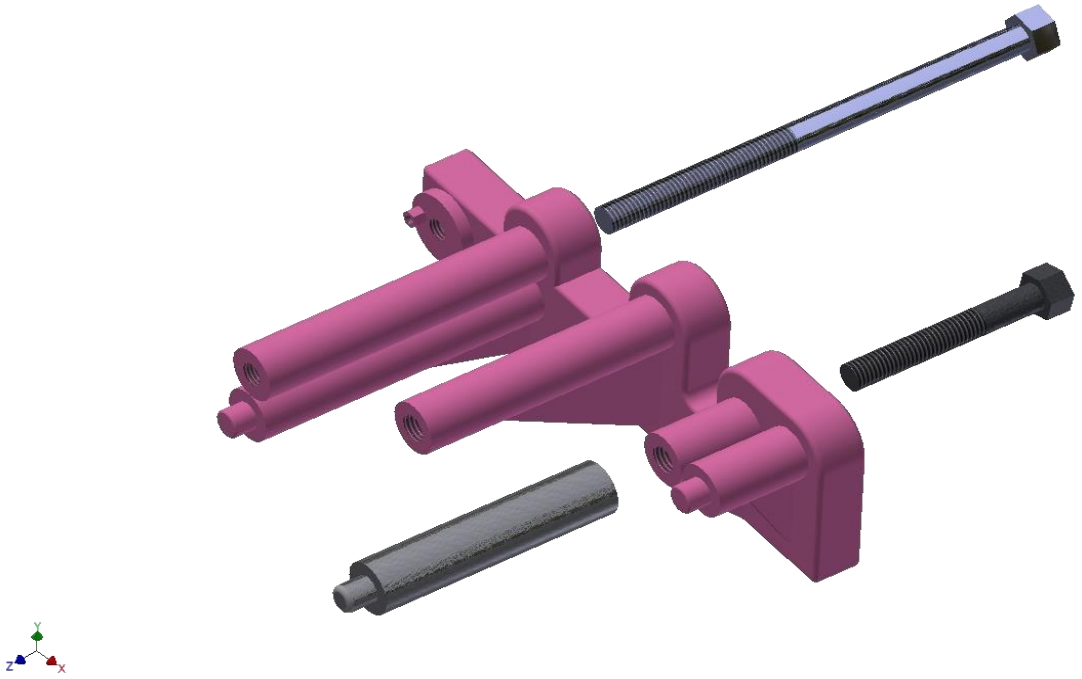


Figure 4. 10 design option 2

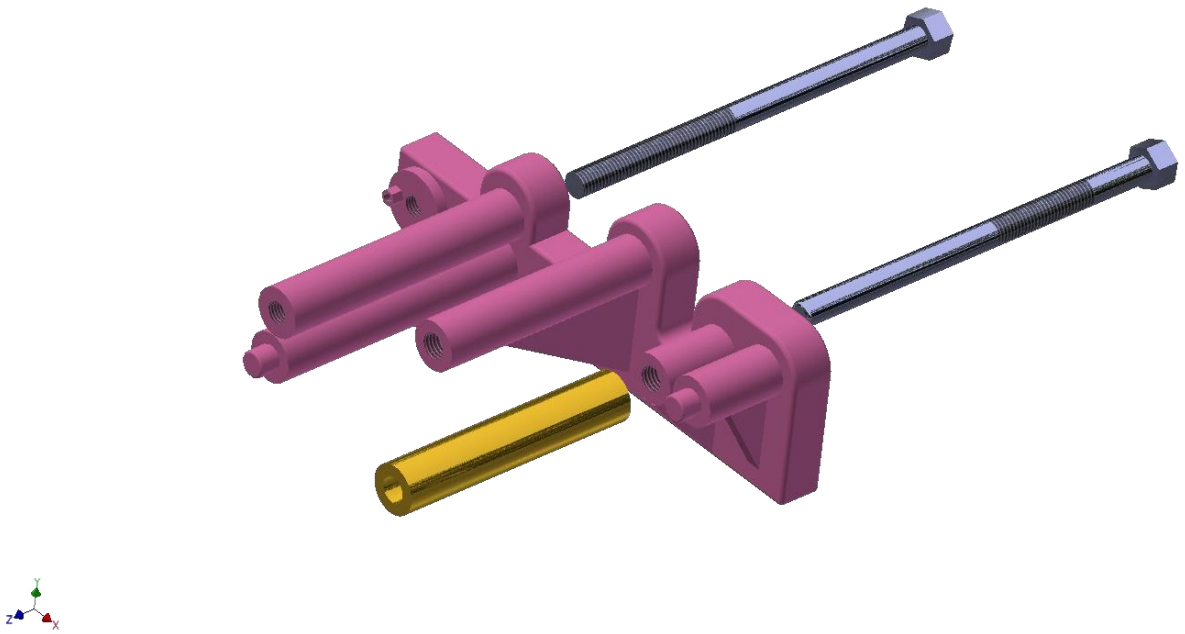


Figure 4. 11 design option 3

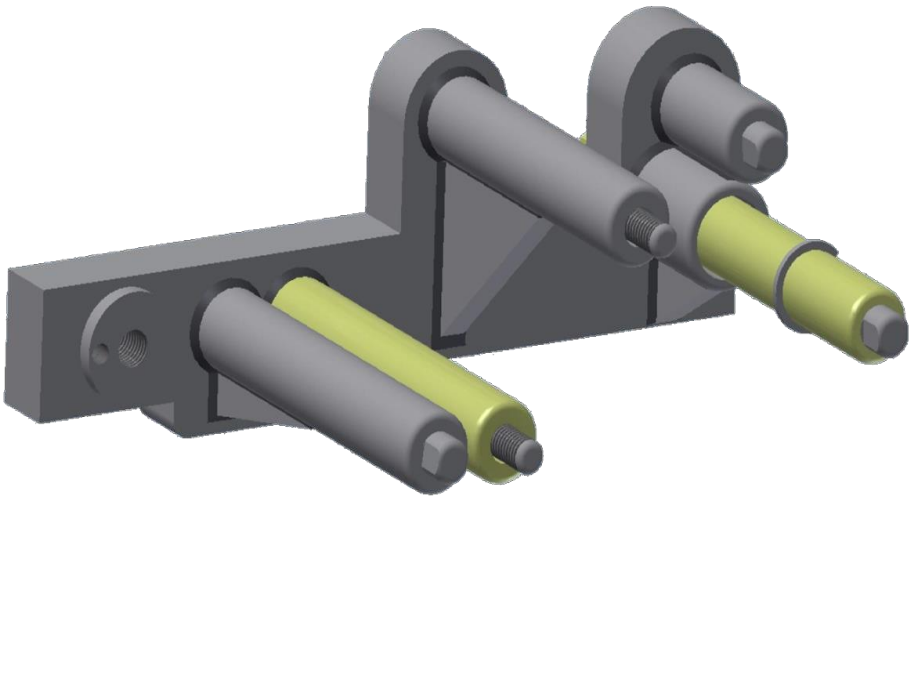


Figure 4. 12 final design

CHAPTER – V RESULT

& DISCUSSION

Both sides Master jig inlet and exhaust has been designed by considering locking position and part fouling. This design of master jig overcomes all the disadvantages and problems related to traditional jig. It is observed that master jig reduces tact time 38.5 sec to 0 sec. and no extra man power will needed.

The major objective and basis emphasis during the design of jig was no part fouling, accuracy in tracing the pick points and merges them with diesel jig. To design it firstly, space envelope has to be decided, diesel was made as a reference of base because diesel engine are heavy so design of adjustable dowel was not possible for diesel arms.

It has be designed in various parts and then assembled all parts to base plate. All arms in design have press fitted and then welded after that heat treated every jig to gain strength. Only one movable or adjustable dowel made with threaded or bolted joint to the base plate. It will use in petrol block mounting, in diesel block mounting it will have to move back so loose its thread and one grooved ring provide to it so it will not fall down and remains in the jig as a one part.

Following table shows the result after implementation of this project:

Table 4. 2 summery of work done

BEFORE	AFTER
One extra Man Power Required	No extra Man Power Required
Takt Time 38.5 sec.	Takt Time 0 sec.
Chances Of Accident	No Chances Of Accident
Rotation Of Arm Required	No Rotation Of Arm Required

(Takt Time 38.5 sec.) *(Takt Time 0 sec.)*

Process (Before) *Process (after)*

5.1 Future Scope

On implementation of this project, no need to change the jig on changeover is required. Project has been completed with great effort of my team. Project was started as to research of work station to design a master jig for assembly engine line. During the processing of project, we only had to consider on no part fouling and pick points location. But in this completion of project one work station will have to shift out from the main line because catalytic converter and its component interfaced with our *INLET SIDE* master jig.

To solve this issue, Petrol Pick Points of both sides has to shift to some distance in one direction. According to my team and mentor this issue will be solved by implementing this design. In meeting, supplier was told to consider this problem but if it would not resolve in prototype, only one will have to modify the base plate of jig in L- type shape like CRV model jig on keeping the pick points at same place.

CHAPTER - VI

CONCLUSION

Project of master jig is concluded as if its prototyping will successful then on implementing this jig to the trolleys of assembly engine, both types of engine block petrol or diesel could be mounted on one jig. It will provide the solution for the jig change on ever changeover. One man power which was required at this station was saved. And also the process timing of 38.5 sec for installing new jig was reduced to 0 sec. All kind of manually accidents in case of dropping of jig to floor, bolt lost issue was resolved.

Also new designed layout of AE was successful for increasing the no. of engine pallets and also space utilization was great. All old structure was remained at their position and set stations accordingly.

The research work of design of JIG will also implemented on this new layout so this both projects was approved, one go for a proposal to Honda management and another to Honda supplier.

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