ACKNOWLEDGEMENT

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Our vocabulary fails to get words expressed for our respect and sense of gratitude to our beloved parents, colleagues and friends who always wanted our success, inspired us with their love and affection sand for the sacrifice made by them to shape our career.

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Abstract

An engineer is always focused towards challenges of bringing ideas and concepts to life. Therefore, sophisticated machines and modern techniques have to be constantly developed and implemented for economical manufacturing of products. Advanced researches approaches a topic of actuality in the machine manufacturing field, by combining the modern trends in the manufacturing processes (surfaces' lapping) in processing some special materials (ceramics, composites) in conditions of minimum cost/ maximum quality, with modern technologies. Machine lapping is meant for economic lapping of batch qualities. In machine lapping, where high accuracy is demanded, metal laps and abrasive powder held in suitable vehicles are used. Bonded abrasives in the form wheel are chosen for commercial lapping. Machine lapping can also employ abrasive paper or abrasive cloth as the lapping medium. New machines and techniques are being developed continuously to manufacture various products at cheaper rates and high quality. So, we are going to make a machine for Double Disc Lapping Machine and make it multipurpose & should be used as Micro Finishing machine is simple to maintain easy to operate. Hence, we tried our hands on "Double Disc Lapping Machine." Lapping machine is one of the principal machines in industry. It is mainly used as the name indicates to micro polishing the material surfaces.

Keywords: *Micro Finishing, Lapping, both sides, low-cost machine.*

1. INTRODUCTION:

Quality of surface is an important factor to decide the performance of a manufactured product. Surface quality affect product performance like assembly fit, aesthetic appeal that a potential customer might have for the product. A surface is defined as the exterior boundary of an object with its surroundings, which may be any other object, a fluid or space or combination of these. The surface encloses the object's bulk mechanical and physical properties. Lapping and polishing is a process by which material is precisely removed from a work piece (or specimen) to produce a desired dimension, surface finish, or shape. The process of lapping and polishing materials has been applied to a wide range of materials and applications, ranging from metals, glasses, optics, semiconductors, and ceramics. Lapping and polishing techniques are beneficial due to the precision and control with which material can be removed. Surface finishes in the nanometer range can also be produced using these techniques, which makes lapping and polishing an attractive method for materials processing. A surface is what we touch, when we held a manufactured object. Normally dimensions of the object are specified in its drawing relating the various surfaces to each other. These nominal surfaces, representing the intended surface contour of the manufactured part, are defined by line in the drawing (machine). The nominal surfaces of the object are represented by perfect straight lines, perfect circles, round holes, absolute perpendicular and straightness. A variety of processes are used to make the designed parts. In totality the manufacturing result is wide variations in surface characteristics. It is important to know the technology of surface generation. Only then the root causes of deviations can be determined and fixed to get the good results.

The project work assigned here with us is of building a multipurpose machine that is capable of different lapping operations on job. Also, it is pre-assigned work to furnish the same machine along with an automation unit as previously mentioned. As simple layout and tricky operational enables this type of machine to work practically at low cost, low maintenance, low capital investment in less space. It may be forecasted that in future this machine may have its unparalleled place in the industry mentioned previously. The work is carried out using angle at making frame. Also, some connecting components which are used for lapping machine.

1.1. Problem statement of project:

The lapping is the major operation performed in industry, and to perform this operation manpower is required which results in a high cost of production, more time require to complete the operation and , affect the accuracy of product so needs to be develop new system in lapping/polishing. The lapping machine available can perform the work of lapping at only one side & after doing lapping second side is to turn for performing lapping which results in increase time, efforts & cost of production. It is required to focus on new machine to reduce problems in the existing system. The statement of project is **“Double disc lapping machine”** for the lapping of different sizes of cylindrical machine parts as per requirements for the industry.

1.2. OBJECTIVE:

1) To reduce the efforts & man power during machining.
2) To maintain the accuracy in lapping process.
3) To reduce capital cost and maintenance cost.
4) To performed the most rigid operation with high speed at a time for both side of job surface.

1.3. Methodology to solve problem:

As the main problem founded which is regard with quality and times consume to perform the desire operation so to develop the machine is best solution to overcome the same problem. These machines will give maximum production with help of both side lapping at a time. The below flow chart shows the sequential operation/steps that will be performed during the project process.

1.4. Description of Methodology:

We have proposed a methodology to solve the problems. Our methodology is divided in different parts, under different titles.

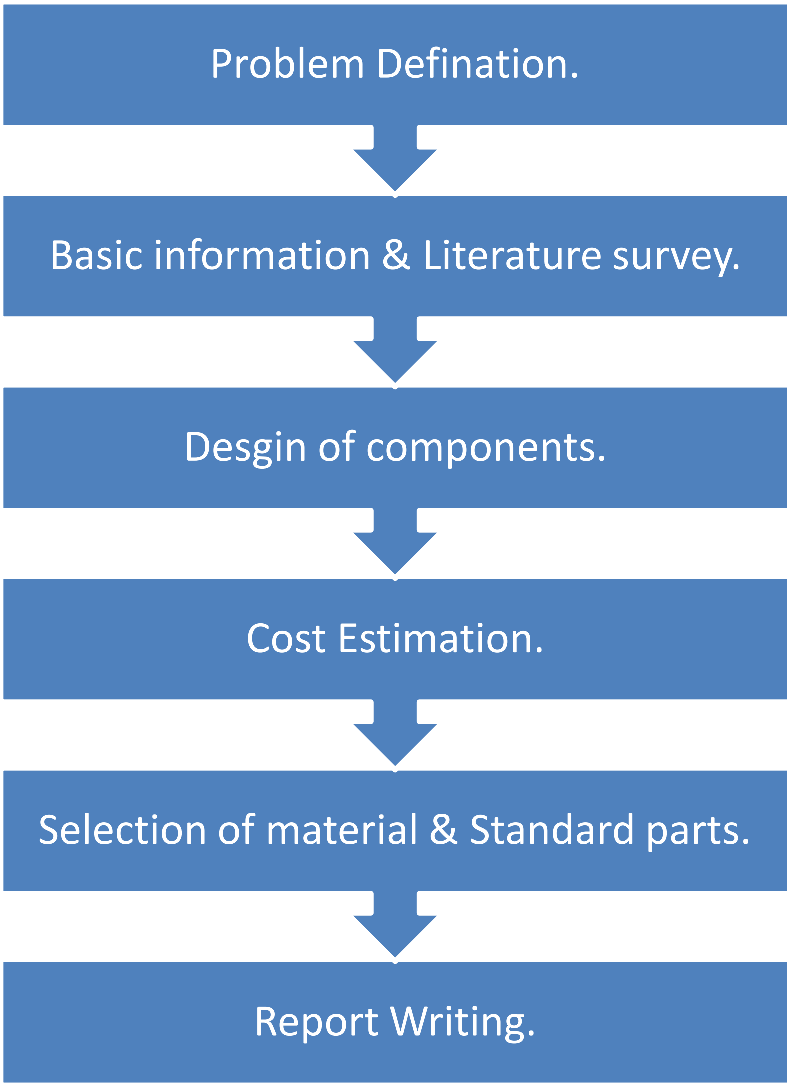

Fig. 1.1: Flowchart of Methodology

2. LITERATURE SURVEY

Tiberiu Dobrescu, et.al. done the work on, Optimization Criteria of Plane Lapping Machines, according to his work, this paper reviews experimental research regarding brittle materials processing with super finishing machine the main criteria for determining the characteristics of superfinishing machines can be grouped into: energy consumption criterion, technologically criterion and dynamic criterion can be determined and the main criteria optimization plan lapping machines. The optimization of the characteristics of brittle materials superfinishing machine is very important because they directly influence the quality of workpieces surfaces. The performances of the superfinishing machine linkages are increasingly higher, due to the following requirements: very high-quality workpieces surface, reduced time for feed workpieces to machine tools, better interconnections between machine tools are used in the technological process, high flexibility.

Silicon wafer lapping with abrasive particles of 18 μm has been obtained as a result of the arithmetic average surface roughness having a value closed at the different specific pressing force of the lapping (standard 80%, 60% and 40%). These forces of specific lapping pressure which provide different material removal rates, with the possibility of choosing depending on the needs and characteristics of the machine. To obtain the less arithmetic mean roughness value Ra with the specific pressure on lapping standard it lasts five minutes. This is very important from the point of view of productivity. In the case of abrasive particles lapping of 4 μm to 8 μm - there was an optimum specific pressing force of lapping between the specific pressing forces of lapping used in the experiment cases (in the case of the use of particles of 8 μm the specific optimum pressure force of lapping is 80% from the specific pressure force of standard lapping, and in the case using particle of 4 μm the specific optimum pressure force of lapping is 80% from specific pressure force of standard lapping). The existence of a specific pressure force of optimal lapping for each size of abrasive grains is due to the different action of the mechanism of removing of the material with each specific pressing force of lapping.

Ashraf Q,et.al. done the work on, Design & Fabrication Of Valve Lapping Machine, according to his work, Automobile maintenance is a major area in the industry ofautomobile and also a major income to the business. Present, engine maintenance can be stated as a very important section in automobile maintenance and the valve lapping process that is subjected in this thesis is done during engine maintenance. Methods used in most automobile maintenance for valve lapping process are not effective and consume a lot of working hours. 'Valve lapping Machine is a machine designed to overcome these problems by minimizing the human involvement in process. It consists of the background in designing the machine, results obtained by data analysis in order to optimize the design and design of the valve lapping machine. Lapping is a machining process in which two surfaces are rubbed together, by hand movement or using a machine. This can take two forms. The first type of lapping involves rubbing of brittle material such as glass against surface such as iron with an abrasive such as aluminium oxide and jeweller's rouge. This produces microscopic conchoidal fractures as the abrasive rolls between them and removes material. The other form of lapping involves a softer material such as pitch or ceramic for the lap. The softer material, which holds it and permits it to score across and cut the material. Taken to a limit, this will produce a surface such as with a polishing cloth on an automobile, or a polishing cloth. The problem of holding engine valves was solved by designing valve holding pieces. Valve lapping mechanism was impleme affects product performance like assembly fit and aesthetic appeal that a potential customer might haveping mechanism was designed as a assembly of several parts easing any maintenance to the machine. All the designs could be completed successfully.

Pankaj Pujari, et.al. done the work on, Design and Development of Valve Lapping Machine, according to his work, Design and development of valve lapping machine is minimize the human efforts for lapping and also reducing time consumed for valve lapping process. In the development of automobile sector advanced methodology and techniques are very important for increasing efficiency of machines. The current methods used in most automobile maintenance businesses for valve lapping process are not effective and consume a lot of working hours. 'Valve lapping Machine for Internal Combustion Engines' is a machine designed and development to overcome these problems by minimizing the human involvement in the process. To observe the functionality and the efficiency of the valve lapping machine, it is needed to be developed. This has The problem of holding engine valves was solved by designing valve holding pieces. Valve lapping mechanism was implemented replacing manual labour. Cylinder head supports have eased the moving of cylinder heads horizontally. Vertical height adjustment problem was solved by extension piece. 20 RPM DC motor is able to handle the torque necessary to valve lapping process. Valve lapping mechanism was designed as a assembly of several parts easing any maintenance to the machine. Structural integrity of machine bed, machine stand, cylinder head supports, tension spring and cam against loads and torques were fine and the designs are successful To observe the functionality and the efficiency of the valve lapping machine, it is needed to be developed.

S. M. Fulmali & R.B.Chadge, done the work on, Need of Lapping Machine for Valve Component: A Case Study, according to his work, Lapping process is characterized by its low speed, low pressure, and low material removal rate. This process is used in achieving finer surfaces and closer fits, correction of minor imperfections, and maintaining close tolerances. During the process of lapping, the mechanisms of surface formation and removal rate are decisively influenced by the movement type of the individual grains within the lapping abrasive. A gate valve is used to start and stop the flow of fluid. So the wedge and seat ring of a valve are in continuous pressure of fluid flow and due to opening and closing of valve these component get wear and they need lapping during reconditioning. This paper will share the need, requirement and application of lapping during the reconditioning of valve. This paper will explore the current working condition of lapping machine in valve industry. It will elaborate the effect of abrasive partials, working speed, surface roughness and other related parameters. What are the difficulties they are facing during the valve reconditioning related to lapping, will be discussed? Current set up and the changes required in this model are suggested with the proposed model. The above research work and the proposed model can provide benefit in the lapping of valve component. Model will provide portability and reduce the set-up time for lapping to some extent. The paper shows the importance of lapping operation in a valve industry. It shows the size and type of abrasive used for valve lapping. As compared to the available machine for lapping, this proposed model will be the cheaper model. It will prove to be an economical model.The number of labour’s require to operate this machine is only one and less skilled labor can operate this model.
Seong-kyum Kim and Haeng-muk Cho, done the work on, A Study on the Grind ability of

Ceramics by Wet Lapping, according to his work, the recording industry is one of the dominant users of new ceramics such as alumina, silicon carbide and zirconia. An experimental method are conducted into the lapping of alumina, silicon carbide and zirconia using diamond powder abrasive to study the effect of process parameters such as grain size, lapping pressure, lapping velocity and surface roughness. As a result, the size of the abrasive is proportional to the specific stock removal and surface roughness. The lapping volume increasing with the lapping velocity that is permitted within the limits of the critical lapping velocity (υc = 250 m/min). Also, wear of the lapping abrasive and surface topography have a retro effect on the contact conditions, the stress collective, and matching of the active partners (shape, size). When lapping new ceramics [Alumina (Al2O3), Silicon Carbide (Sic), Zirconia (ZrO2)], machinability by wet-lapping with a diamond (or silicon carbide) abradant was studied in order to obtain the following conclusions.

1) If surface roughness is above 1μm in silicon carbide (SiC) ceramic, the bending strength was shown to decrease sharply.

2) When lapping Al2O3 ceramics, surface roughness and the rate of stock removal increases in proportion to the size of diamond particle.

3) When considering wear volume according to grinding velocity or distance, there are critical velocity (approximately 100mm/min) or critical offset amount (approximately 80), where the volume increases or decrease around the critical values.

4) Observing the lapped surface shows that plastic deformation occurs at TiC, ZrO ceramics than ZrO2, Al2O3. While there is a slight mark of scratch, the surface is clean.

Andrea Deaconescu and Tudor Deaconescu, done the work on, Improving the Quality of Surfaces Finished by Lapping by Robust Parameter Design, according to his work, obtaining special quality surfaces as well as higher dimensional and geometrical precision entails deployment of surface smoothing processes, one of which is lapping. A lapping process is strongly influenced by a number of input parameters, the most important ones being machining speed, pressure, duration of lap plate – abrasive paste –workpiece contact, kinematics of the machine-tool etc. The paper presents a study on the influence of machining speed in lapping on the roughness of metal surfaces. The paper discussed a study on the influence of machining speed on the quality of lapped surfaces. The method utilized for the optimization of machining was robust parameter design, with the purpose of rendering the analysed system insensitive to the action of noise factors, by identifying an adequate combination of input factor set points. Utilization of fractioned orthogonal factorial arrays of experiments lead to obtaining optimum values for the main system input quantities. The values measured by experimenting with these optimum settings of the input quantities, which ensure the robustness of machining system, allowed the plotting of roughness Ra versus machining speed variation diagrams.

Tudor Deaconescu and Andrea Deaconescu, done the work on, Developing an Analytical Model and Computing Tool for Optimizing Lapping Operations of Flat Objects Made of Alloyed Steels, according to his work, Lapping is a finishing process where loose abrasive grains contained in slurry are pressed against a workpiece to reduce its surface roughness. To perform a lapping operation, the user needs to set the values of the respective lapping conditions (e.g., pressure, depth of cut, the rotational speed of the pressing lap plate, and alike) based on some material properties of the workpiece, abrasive grains, and slurry, as well as on the desired surface roughness. Therefore, a mathematical model is needed that establishes the relationships among the abovementioned parameters. The mathematical model can be used to develop a lapping operation optimization system, as well. To this date, such a model and system are not available mainly because the relationships among lapping conditions, material properties of abrasive grains and slurry, and surface roughness are di cult to establish. This study solves this problem. It presents a mathematical model establishing the required relationships. It also presents a system developed based on the mathematical model. In addition, the each of the system is also shown using a case study. This study thus helps systematize lapping operations in regard to real-world applications. Flat surface lapping is a finishing machining process meant to ensure special form and dimensional precision, low roughness, and superficial material layers unelected thermally. Although known for thousands of years, this method of processing materials does not benefit from thorough theoretical support. To this day, lapping is performed empirically. The quality of the machined surface often dyers from one operator to the other, the output quantities depending on the selection based solely on personal experience of the values of the system input parameters. In order to ensure the predictability of lapping results thorough study concerning the interlinking of numerous input quantities is called for, as well as computer-aided working tools.

Rushikesh Shahane ,et.al. done the work on, Design and Fabrication of Valve Lapping Machine, according to his work, Automobile maintenance is a major area in the industry of automobile and also a major income to the business. In present, Internal Combustion engine maintenance can be stated as a very important section in automobile maintenance and the valve lapping process that is subjected in this thesis is done during IC engine maintenance. The current methods used in most automobile maintenance businesses for valve lapping process are not effective and consume a lot of working hours. “Valve lapping Machine for Internal Combustion Engines” is a machine designed to overcome these problems by minimizing the human involvement in the process. The thesis consist of the background in designing the machine, methodologies used, results obtained by data analysis in order to optimize the design of the valve lapping machine. Lapping is a machining process in which two surfaces are rubbed together with an abrasive between them, by hand movement or using a machine. This can take two forms. The first type of lapping involves rubbing a brittle material such as glass against a surface such as iron or glass itself with an abrasive such as aluminium oxide, jeweler’s rouge, optician's rouge, emery, silicon carbide, diamond, etc., between them. The proposed model can provide benefit in the lapping of valve. Valve lapping mechanism is implemented replacing manual labour. There is no presence of human intervention in the mechanism. The mechanism can be used automatically. The various components required for the machine are designed. The dimensions of machine bed and spring are calculated. C.Y. Wang,et.al. done the work on, Study on Machining Process of Lapping for BK7 Glass, according to his work, BK7 optical glass is used as the object of study in this paper. The different parameters such as lapping time, load, slurry flow, slurry concentration, abrasive grain sizes, rotating speed effect on surface roughness and material removal volume are studied. Using the way of orthogonal experiments for seeking optimization parameters to gain the smoothness surface and consume the minimum machining time. The empirical formulas of surface roughness and material

removal rate are found by orthogonal test. The article studied the effects of processing parameters on surface quality and material removal of the BK7 optical glass by Single factor experiment. The machining Experience Formula of surface roughness and material removal is derived by orthogonal experiment.. In addition, we studied on the surface topography of BK7 optical glass before and after processing, and reached the conclusions as following. On BK7 optical glass material, the surface roughness reduced with the processing time increased, reduced at the initial stage and then increased with processing pressure increased, increased at the initial and then decreased with the slurry concentration or rotating speed increased; the material removal is almost linearly increased with the processing time increased, increased to a certain extent and then kept a approximating constant with processing pressure increased, increased with the slurry concentration increased, increased at the initial and then decreased with rotating speed increased, the smaller abrasive particle size, the lower surface roughness, less abrasive flow rate, less the amount of material removal, the smaller the surface roughness, material removal increased at the initial and then decreased; in orthogonal lapping test, Surface roughness can be decreased by optimizing the lapping process parameter. In addition, the empirical formula of surface roughness and material removal derived from orthogonal test can guide the actual lapping process.

Viorel Cohal, done the work on, Advanced Researches Concerning Lapping Process, according to his work, the paper present advanced researches approach a topic of actuality in the machine manufacturing field, by combining the surfaces' lapping in processing some special materials (ceramics, composites) in conditions of minimum cost/ maximum quality, with modern technologies. There will be monitories, during the experimental researches: evolution of the chip removal forces' size; evolution of the temperature in the processing area; evolution of the vibratory phenomena; on line evaluation of the processed surface's roughness by the method of acoustic emission and/or by measuring the lapping solution's PH. Elaboration of mathematical models for the following aspects, extremely important for a finishing process: modelling of the economic (optimum) domain for lapping, which, by establishing an objective function (minimum cost, minimum roughness etc.) and some restrictive functions (imposed by the technological system – speed, feed rates etc. and by the productivity, wear ratio etc.) to allow the determination of the optimum value (values) of the cutting speed (speed of the lapping disk), feed rate, for which the processing is done with minimum costs; estimation of the exploiting behavior for the abrasive powder or paste by FEA on the stress, temperature, having as main objective to obtain the safety in exploiting; mathematical modelling of the roughness for the processed surface, modelling based on the chip removal physics; elaboration of some models for the wear of the lapping disk engrained with abrasive powder, at lapping some ceramic and composite materials.

2.1. Lapping:

Lapping uses loose abrasives to finish the surface. It works on three body abrasive wear principle in which finishing action takes place through abrasion by hard particles trapped between work piece surface and a relatively soft counter formal surface called lap. After introducing abrasive slurry between work piece and lap surface, the work piece is held against lap and moved in random paths under pressure. Simple three-dimensional shapes and curved surfaces (concave, convex etc.) to some extent can be finished by designing compliant lap. As this process is generally employed for improving surface finish and accuracy, the amount of material removed is insignificant.

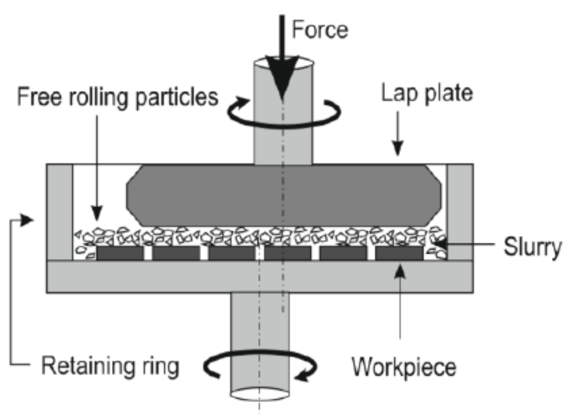

Fig. 2.1. Principle of lapping.

Compared to other surface machining processes, lapping stands out by a number of characteristics:

1) Highest requirements related to plainness and roughness can be satisfied;

2) The reduced heat quantity developed during machining influences the structure of the superficial layer only to a small;

3) Lapped surfaces retain minimal stress and are burr-free;

4) Most work pieces can be machined without special clamping devices.

5) Several parts can be machined simultaneously. Lapping processes are strongly influenced by numerous input parameters, the most important ones being machining speed, pressure, duration

of lap plate – abrasive paste –work piece contact, kinematics of the machine-tool etc.

Lapping speed is one of the working parameters with particular impact on obtaining small roughness surfaces with a superficial layer as little as possible affected thermally. Compared to other machining processes, lapping involves smaller speeds, between 20 and 150 m/min. The smaller speed values of this range (20 … 40 m/min) are used for finishing, while the greater ones are applicable for preliminary lapping. Excessive increase of the machining speed causes an overheating of the processed surface and a diminishing of its quality. Experiments confirmed that machining productivity increases with speed. This increase in productivity is however not unlimited, as with growing lap plate speed the centrifugal forces reach values that cause the abrasive slurry to be evacuated from the working area. Too high cutting speeds further affect the planeness of the machined surface, as a consequence of uneven distribution of the lapping paste in the working gap.

3. MATERIAL SELECTION AND FINISHING PROCESSES

3.1. Material Selection for Construction of Machine:

The machine is basically made up of mild steel.

Reasons:

1) Mild steel is readily available in market.
2) It is economical to use.
3) It is available in standard sizes.
4) It has good mechanical properties i.e. it is easily machinable.
5) It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure.
6) It has high tensile strength.
7) Low co-efficient of thermal expansion.

Properties of Mild Steel:

M.S. has carbon content from 0.15% to 0.30%. They are easily wieldable thus can be hardened only. They are similar to wrought iron in properties. Both ultimate tensile and compressive strength of these steel increases with increasing carbon content. They can be easily gas welded or electric or arc welded. With increase in the carbon percentage weld ability decreases. Mild steel serve the purpose and was hence was selected because of the above purpose.

3.2. Approach to Mechanical Design of System.

In design the of parts we shall adopt the following approach;

Selection of appropriate material.

- Assuming an appropriate dimension as per system design.
- Design check for failure of component under any possible system of forces.

3.3. Mechanical Design: In mechanical design the components are listed down and stored on the basis of their procurement in two categories.

- Design parts
- Parts to be purchased.

For designed parts detailed design is done and dimensions there obtained are compared to next dimensions which are already available in market. This simplifies the assembly as well as the post production and maintenance work. The various tolerances on work are specified. The process charts are prepared and passed to manufacturing stage. The parts to be purchased directly are selected from various catalogues and are specified so as to have case of procurement. In mechanical design at the first stage selection of appropriate material for the part to be designed for specific application is done. This selection is based on standard catalogues or data books; e.g.: - (PSG DESIGN DATA BOOKS) (SKF BEARING CATALOGUE) etc.

3.4. Advanced Finishing Processes (AFPs):

There are many advances taking place in the finishing of materials with fine abrasives, including the processes, the abrasives and their bonding, making them capable of obtaining nanometer order surface finish. Earlier there has been a limit on the fine size of abrasives (~a few μm) but today, new advances in materials syntheses.have enabled production of ultra-fine abrasives in the nanometer range. Abrasives are used in a variety of forms including loose abrasives (polishing, lapping), bonded abrasives (grinding wheels), and coated abrasives for producing components of various shapes, sizes, accuracy, finish, and surface integrity. The electronics and computer industries are always in demand of higher and higher precision for large devices and high data packing densities. The ultimate precision obtainable through finishing is when chip size approaches atomic size (~ 0.3nm) to finish surfaces in nanometer range; it is required to remove material in the form of atoms or molecules individually or in the groups. Some processes like Elastic Emission Machining (EEM) and Ion beam Machining (IBM) work directly by removing atoms and molecules from the surface. Other processes based on abrasive wear remove them in clusters. Based on energy used, the advanced finishing processes (AFPs) can be broadly categorized into mechanical, thermoelectric, electrochemical and chemical processes. The performance and use of certain specific process depend on work piece material properties and functional requirement of the component. In mechanical AFPs, very precise control over finishing forces is required. Many newly developed AFPs make use of magnetic/electric field to externally control finishing forces on abrasive particles. Chemo Mechanical polishing (CMP) utilizes both mechanical wear and chemical etching to achieve surface finish of nanometer and planarization. CMP is the most preferred process used in semiconductor industry for silicon wafer finishing and planarization. Since the material removal in fine abrasive finishing processes is extremely small, they can be used successfully to obtain nanometer surface finish,and very low value of dimensional tolerances. Advanced abrasive finishing processes belong to a subset of ultra-precision finishing processes which are developed for obtaining nanometer order surface finish. A comparison of surface finish obtainable from different finishing process is given in Table. This chapter discusses about the principles of working and potential applications of such processes in following paragraphs.

One of the elements defining product quality is the degree of finishing of work piece surfaces. For this reason, special emphasis needs to be placed on the study of surface Smoothing processes, given their decisive role in determining high dimensional and geometric precisions. One of the most widespread surface smoothing processes is lapping. Lapping operates by abrasive erosion; the tooling allowance being removed by means of grains located at the transfer object (lap plate) and work piece interface. Lapping falls into the category of cutting processes deploying tools with undefined cutting edges. . It is a final processing method where the abrasive grains are freely dispersed in a holding fluid, while cutting is conducted typically by a form transmitting counter-part known as transfer object presents the principle of surface lapping.

Table No 3.1. Comparison of surface finish obtainable by different finishing processes

Sr.No.	Finishing Process	Workpiece	Ra value(nm)
1.	Grinding	-	25-6250
2.	Honing	-	25-1500
3.	Lapping	-	13-750
4.	Abrasive flow machining((AFM) with SiC abrasives	Hardness steel	50
5.	Magnetic abrasive finishing(MAF)	Stainless steel	7.6
6.	Magnetic Float Polishing (MFP) with CeO_2	si_3N_4	4.0
7.	Magneto rheological Finishing(MRP) with CeO_2	Flat BK7 Glass	0.8
8.	Elastic Emission Machining(EEM) With ZrO_2 abrasives	Silicon	<0.5
9.	Ion Beam Machining (IBM)	Cemented carbide	0.1

There are several techniques used for removing material from a particular work piece (also called specimen in this discussion). Grinding, lapping, polishing, and CMP (chem.-mechanical polishing) are all techniques used for precise removal of material. A brief discussion of terms is needed to understand the basics of what is being referred to when these topics are discussed. The tooling allowance is removed by inducing a relative motion between the lap plate and the work piece in the presence of slurry, consisting of abrasive powder unsuspension in a fluid. For erosion to take place, a certain pressure generated by a downward oriented force is required between the lap plate and the work pieces.

3.5. Chem.-mechanical Polishing (CMP):

Chem.-mechanical polishing (CMP) is a technique that combines both chemical and mechanical polishing principles to achieve uniform removal rates of a highly composite specimen (such as integrated circuit device fabrication). CMP is typically done using a hard-polyurethane polishing pad combined with slurry of finely dispersed alumina or silica particles in an alkaline solution. CMP combines theselectivity of chemical polishing with the mechanical removal properties of standard mechanical polishing techniques. The two combined give excellent selectivity and planarity and can be tailored to many different materials.

3.6. Abrasive Material Used:

There is a wide selection of abrasives to choose from when selecting a lapping and polishing process. Selecting an abrasive is dependent upon the specimen hardness, desired surface finish, desired removal rate, lifetime, and price. There are four basic types of abrasives that are used in lapping and polishing processes: silicon carbide (Sic), aluminum oxide or alumina (Al2O3), boron carbide (B4C), and diamond (C). All of these abrasives have distinct properties and are used for different materials and applications.

1) **Sic:** Sic is hard and generally has a needle or blocky structure. SiC is used in many applications where rough lapping is required. It seldom is used for polishing or applications that require smooth surface finishes.

2) **Al2O3:**Al2O3 is relatively hard and has a sharp, angular structure. Alumina is commonly used where fine surface finishes are required as it breaks down over time and gives excellent surfaces during lapping and polishing. Alumina is also relatively inexpensive.

3) **B_4C:**B_4C is harder than most other abrasives (excluding diamond) and has a blocky crystal structure. B4C provides excellent removal rates and is typically used when fast removal with moderate surface quality is needed.

4) **Diamond:** Diamond is the hardest material known and has a sharp, angular structure. Diamond is extremely useful in lapping and polishing due to it's removal rates and

surface finishing qualities. Diamond can produce excellent surface finishes combined with high removal rates.

3.7.Lapping and Polishing Equipment:

Equipment used for lapping and polishing can vary from application. Typically, what is required for lapping and polishing are the following:

1. A lapping and polishing machine with variable speed.
2. A polishing jig for holding specimens precisely.
3. Various lapping plates for different applications.
4. Workstations for controlling lapping fixtures and conditioning equipment.
5. Conditioning equipment for maintaining plate flatness.

There are various methods available to accomplish these tasks. South BayTechnology, Inc. has developed a series of equipment designed for this purpose and isdescribed below.

3.8. Lapping and Polishing Machines:

Lapping and polishing machines vary extensively depending upon the manufacturer. SBT has designed a set of instruments that are specifically designed for universal lapping and polishing applications. The Model 920 Lapping and Polishing Machine incorporates a precision spindle assembly housed in a solid cast aluminum casting to provide stable Operation in any laboratory environment. Stability when lapping is critical in producing flat, precisely controlled tolerances on a given specimen. The motor is a high torque, variable speed motor that allows a wide range of speeds to be

employed. Flexibility in speed control allows the instrument to be used as a grinding machine, high quality lapping machine, or polishing machine. During grinding high speeds are required, whereas lapping and polishing applications are generally completed at low speeds.

Fig.3.1. Lapping and Polishing Machine

The Model 920 also incorporates workstations, which allow for the use of Precise Lapping and Polishing Fixtures. Each workstation has its own speed control, allowing the user to precisely rotate the lapping fixtures or the conditioning ring. Lapping plates are held into place with three locating pins and are easily removable, allowing maximum flexibility in processing specimens. Various materials can be selected for the lapping plates, ranging from aluminum, cast iron, and glass. Below is an image showing the Model 920 with a typical setup for lapping and polishing applications.

4. CONSTRUCTION & WORKING

Main Parts of Lapping Machine are given below:

1) Induction Motor: 8600 RPM, 50watt.
2) Variable Speed Drive.
3) Pedestal bearings.
4) Drive shaft.
5) Fasteners: Nut & Bolts.
6) V- Belt drive.
7) Supporting frame structure.
8) Polish/Lapping wheels.

In lapping process, it consists of two M.S. plates, mounted on stand. In between two plates there is job holding fixture is place. The plates having lapping wheels are attached at top and bottom side of upper & lower plate. On the supporting frame we have mounted induction motor and with the help of belt the shaft with job holding fixture is rotate. When this job holding fixture is rotate with full speed friction takes places on the surfaces of jobs under processing and the mounted job gets polished by removal its chip of work piece gets super finish. The lapping plate's surface made with the abrasive material which is used for the lapping process. Plate alignment is important for lapping applications where flatness and parallelism of the specimen will easy. Specimen quality is a direct result of plate condition & alignment therefore proper maintenance of the lapping plate is crucial in preparing high quality specimens. Double-sided processing is a, batch-type method which uses rotary action of job holding fixture.

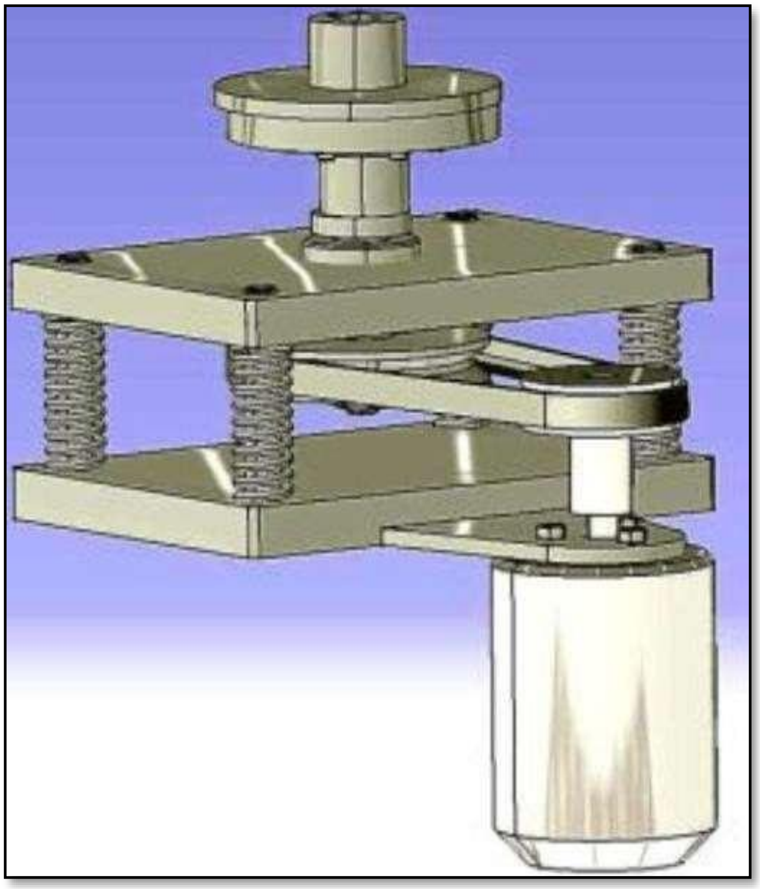

Fig.4.1. Concept of Double disc lapping machine

5. DESIGN

5.1. Motor Selection:

We know that, Frictional force F (N)

Coeff. Of friction of disc. μ Normal reaction force R_N (N)$F = \mu . R_N$

$= 0.12 \text{ X } 9.81$

F = 1.1772 N.

Radius of rotation from center of plate r = 50 mm.

$T = F \text{ x } r$

$= 1.1772 \text{ x } 0.05$

T = 0.0588 N-m.   At motor shaft.

Thus, selecting a motor of the following specifications

Single phase AC

motorPower = 50

watt

Speed= 0-8600 rpm (variable)

Motor is a Single-phase AC motor, Power 50 watt; Speed is continuously variable from 0 to 8600 rpm. The speed of motor is variation by means of an electronic speed variation. Motor is a accumulator motor i.e., the current to motor is supplied to motor by means of carbon brushes. The power input to motor is varied by changing the current supply to these brushes by the electronic speed variation; thereby the speed is also is changes. Motor is foot mounted and is bolted to the motor base plate welded tothe base frame of the indexer table

Motor Torque

$$P = \frac{2\pi NT}{60}$$

$$T = \frac{60 \times 50}{2\pi \times 8600}$$

T = 0.055 N-m

5.2. Design of Open Belt Drive:

Note: All Calculations are taking at full speed of motor.

Power is transmitted from the motor shaft to the input shaft by means of an open beltdrive,

Torque at IP rear shaft = 2 x 0.055= 0.11 Nm

Speed of IP _ shaft pulley = 8600/2
=4300rpmMotor pulley diameter **d** =
30mm

IP _ shaft pulley diameter **D** = 60 mm

Reduction ratio = 2

Coefficient of friction = 0.23

Center distance **c**= 200

Let,

t= Thickness of belt= 5 mm

b= Width of belt=6mm

Velocity of belt is given by;

$$\mathbf{V} = \frac{\boldsymbol{\Pi}(\mathbf{d}+\mathbf{t})\ \mathbf{n}}{\mathbf{60\ X\ 1000}}$$

$$V= \frac{\Pi\,(30+5) \times 8600}{60 \; X \; 1000}$$

V=15.76 m/s **Linear velocity of open belt drive**

To find out tension in the belt is;

$$\mathbf{P= \frac{(F1-F2)\;V}{1000}}$$

$$50\; X\; 10^{-3} = \frac{(F1-F2)\; X\; 15.76}{1000}$$

F1 − F2 = 3.172 N ---------------------------------(1)

F1 = 6.379 N

Mass of belt per unit length is given by;

$$\mathbf{m = \frac{\rho \; x \; b \; x \; t \; x \; 1}{10^6}}$$

ρ= density of belt material = 950 kg/m^3

$$m = \frac{950 \; x \; 6 \; x \; 5 \; x \; 1}{10^6}$$

m= 0.0285 kg/m

Centrifugal force in belt is given

by,Fc = mV^2

=0.0285 X $(15.76)^2$

Fc = 7.078 N

5.3. Design of Shaft (ASME Code).

Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for reduce the harmful effects of load fluctuations. According to ASME code permissible values of shear stress may be calculated from various relations.

For commercial steel shaft, Actual shear stress τ_{act}= 425 MPa ……..

T = π/16×τ_{act}×d

$$\tau_{act} = \frac{16 \times T}{\pi \times d^3}$$

$$0.11\times 10^3 = \frac{16\times425}{\pi\times d^3}$$

D = 19.67 mm {we assumed that diameter is 20mm}

Assume d= 20mm. Ref: - PSG Design data book.

5.4. Selection of Shaft Ball Bearing:

In selection of ball bearing the main governing factor is the system design of the drive i.e.; the size of the ball bearing is of major importance; hence we shall first select an appropriate ball bearing. Taking into consideration convenience of mounting of ball bearing. As shaft diameter is 20mm to it & selected a pedestal ball bearing having shaft outer dia-20mm ball bearing to support the shaft of 20mm.

Total radial load on bearings are = F1 + F2 +Weight of radial disc + weight of shaft.

= 6.379 + 3.207 + 9.81 + 9.81

Total radial load on bearings **= 29.209 N. (Assume = 30 N)**

Radial load on each bearing's **Fr** = 30/2 **= 15 N.**

Equivalent dynamic

loadPe = V.Fr. Ka

= 1 X 15 X 1.5

Pe = 22.5 N

Bearing life is,

$$L^{10} = \frac{L_{h10} \times 60 \times N}{10^6}$$

L_{h10} from graph 4.6 PSG Design data book for 16000 rpm maximum speed of ballbearing is 315000 Hours.

$$\boldsymbol{L_{h10} = \frac{31500 \times 60 \times 10^6}{43000}}$$

L^{10} = 8127 millions of revolutions.

$$\boldsymbol{L^{10} = \left(\frac{C}{P_e}\right)^{\frac{10}{3}}}$$

C= $(L_{10})^{0.3} \times P_e$

C = (8127) (0.3) X 22.5

C = 335.09 KN

(As per design procedure we selected pedestal bearing)

6. PROCESS SHEET

Part Name:-Shaft

Part size **: -** **Ø**20mm x 300 mm

Part WT **: -** 1 kg

Part Qty **: -** 1

Part Material: - M.S.

Table No: 6.1 Processes on Shaft

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as Required size.	Cutting m/c	Cutting Blade	20 min
2	Turning shaft to make **Ø**20mm.	Lathe m/c	Turning Tool	20 min
3	Facing side ends.	Lathe m/c	Facing Tool	15 in

Part Name: -End round Plates

Part size **: -Ø**280mmX2 mm.

Part Qty **:** - 2

Part Wt **: -**3 kg

Part Material: - M.S.

Table No: 6.2 Processes on Round Plates

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as our required size	Gas cutter	Gas nozzle	25 min
2	As in center M20 drill	Drilling machine	Drilling Bit 20mm	15min
3	Drilling four holes	Drilling machine	Drilling bit 10mm	15 in

Part Name: -Job holding Plate

Part size : -Ø 230mmX2 mm.

Part Qty : - 2

Part Wt. : -2 kg

Part Material: - M.S.

Table No: 6.3 Processes on Job holding Plate

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as our required size	Gas cutter	Gas nozzle	25 min
2	Drill center M20 drill 4 Nos.	Drilling machine	Drilling Bit 20mm	35min
3	Drilling four holes for Plate fitting.	Drilling machine	Drilling bit 6 mm	15 min

Part Name: -Base Square Plate.

Part size:-280mmX280mmX2mm.
Part Qty : - 1

Part Wt. : -2 kg

Part Material: - M.S.

Table No: 6.4 Processes on Base Square Plate

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as our required size	Gas cutter	Gas nozzle	25 min
2	Grinding the faces of tool	Grinding m/c	Grinding Tool	15min
3	Drill center M20 drill	Drilling machine	Drilling Bit 20mm	15min

Part Name: - supporting frame

Part size:250mmX250mmX380mm.

Part Qty : - 1

Part Wt. : -8 kg

Part Material: - M.S.

Table No: 6.5 Processes on Supporting Frame Part

Sr. No	Operation	Machine	Tool	Time
1	Cutting the material as per our required size 250 X250 X400mm	Saw machine	Saw machine blade	65 min
2	Welding the Frame	Welding machine	Arc Welding torch	75 in

7. COST OF MATERIAL

Table No: 7.1 Total Cost of Material:

Part Name	Material	Wt. in kg	Rate / kg	Total Rate
Round plate Ø250 X3 mm	M.S	3	100	300
Round plate Ø200 X3 mm	M.S	2	100	200
Base Square Plates	M.S	2	100	200
Shaft	M.S	1	60	60
Supporting frame	M.S	8	60	48

TOTAL COST OF MATERIAL = 808 /-

Table No: 7.2 Cost of Machining:

Machine Name	Using Time (min)	Rate /hr	Total Rate Rs/-
Gas cutting	30	200	100
Lath m/c	35	500	300
Power Hacksaw	160	200	500
Welding	75	400	550
Grinding	30	100	50
Drilling	95	200	350

TOTAL COST OF MACHINENING = 1,850/-

Table No: 7.3 Cost of Standardgyu78i90- Part:

Sr. No.	name	Qty.	Cost	Total Cost
1	Motor	1	1500	1500
2	VFD	1	700	700
3	Nut	8	15	120
4	Bearing	2	150	300
5	Big pulley	1	80	80
6	Small pulley	1	30	30
7	Belt	1	25	25

COST OF STANDARD PART = 2,755/-

Cost of Transportation & Overhead = 1,500/ -

Cost of material **+** Cost of machinating **+** Cast of STD part + Cost of transportation &overhead

= 808 +1850 + 2755 +1500

= 6,913/- Rs.

8. ADVANTAGES & LIMITATIONS, APPLICATION

8.1 Advantages:

- Machine work on the low power consumption as compared to the old Lappingmachine.
- It provides multiple polishing sizes of metallic Jobs.
- The operation of the new lapping machine is well controlled.
- Complex shapes can be finished as per requirement easily.
- Very thin material can remove easily.
- Well balanced system.
- It approximately having higher efficiency that of old lapping machine in low costapplication machine.
- It minimizes misalignment & less floor space is required.
- Only simple support structures are required design & fabrication is easy.
- It is a faster process of lapping.
- Wide variety of materials can be polished easily.
- Highly accurate profiles and good surface finishing can be easily obtained.
- Metal removal cost &Initial investment is low.
- Operation is noiseless

8.2 Limitations:

- Dimensional accuracy of cutting lapping depends on the clearance of the lappingsheet to the job.
- Production rate for lapping is depend on the speed of the motor.
- Constant monitoring is required to avoid material scrap.
- Balancing problem of the lapping die may affect the surface finishing of the job.
- Depth of surface finishing is depending on the abrasive sheet height approximately.

8.3 Application:

- It is used for Surface finish for ball and roller bearings racers.
- Surface finishing for Gears surfaces.
- It is used in Engine valve finishing.
- It is used in lapping of Press work dies.
- It is used in metrology and quality department to obtain required surface finishing of job.

9. CONCLUSION

From this, it can be concluded that the double disc lapping machine has improved its efficiency about 50% compared to the conventional lapping machine. A double disc lapping machine causes the lapping process on the workpiece on both sides simultaneously, so the time required for the lapping process is less compared to the previous process time. This double disc lapping machine fulfills 80% of objectives. Another advantageous factor is the cost of equipment is less as compared to earlier. In the future with some modifications, this system can perform much better performance that the current machines.

9.1 FUTURE SCOPE

As work was successful in studying & completing the results of this lapping m/c with solving other types of conventional lapping machine problems associated with machines that can be implemented from higher to lower unit's cost. Its lowermost requirement of maintenance can again be beneficial for keeping costs down. This machine uses less electricity during operation. These few out of a very large no of rows can project this m/c across the investment. As per Indian content is concerned this machine can be very beneficial for virtually all types of lapping units as it has a very low capital investment. This machine may form a simple solution for lapping in the future. This machine also can be controlled by using automation in the system. In this way machine can be used in the industry for lapping special-purpose metal bushes, and pins. Pipes end etc.

The manual-operated lapping machine can directly be replaced with an automatic double-sided machine. This machine preferably will get attach at the end of production line on whenever required depending on plant layout production process, production type etc.

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ANNEXURE

Fig:-Front View of Fabricated Machine

Fig: - Side View of Fabricated Machine