KWARA STATE POLYTECHNIC, ILORIN

CONSTRUCTION FABRICATION OF WHEELBARROW

By

BELLO ISRAEL SEYIFUNMI

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CERTIFICATION

The research/construction work has been inspected and has reported has been read and approved as meeting the requirement of the department of Mechanical Engineering Technology. Kwara state polytechnic Ilorin.

____________________ ____________________

ENGR. ADEDOYE E.A **DATE**
(Project Supervisor)

____________________ ____________________

ENGR. ISSA ABDULGANIYU **DATE**
(Project Co-ordinator)

____________________ ____________________

ENGR. AYANTOLA ABDULWAHEED A. **DATE**
(HEAD OF DEPARTMENT)

____________________ ____________________

ENGR DUROJAYE J.A **DATE**
External Examiner

DEDICATION

This project is dedicated to Almighty God, the owner and giver of wisdom and knowledge and to the Holy Spirit, the Great teacher, because man plans his way but, God directs his steps. May his name be highly glorified. Amen.

ACKNOWLEDGEMENT

First and foremost, my gratitude goes to God Almighty, who has been so merciful and generous in my life.

I am highly indebted to my parents who have vowed to leave no stone unturned in their quest to give me formal education. May God bless them.

Last but not the least, when a tedious job has been done, one has to refer back and think who and who contributed towards the success of the job. As a matter of fact, I must acknowledge my debt of gratitude to my project supervisor, **Engr. Adedoye E.A** without whose diligent guidance and advice this study would not have seen the light of the day.

I also wish to place on record the invaluable help and commitment rendered by my friends and well-wishers for the moral and financial support given to me throughout the course of my study.

My sincere thanks go to all those who have assisted me in one way or the other during the collection of materials and data necessary for the research work who in spite of their crowded responsibilities still had time to provide me with a good number of relevant materials for this work.

My prayer is that God will reward those that contributed immensely for me towards this project directly or indirectly.

ABSTRACT

Wheelbarrow can be defined as a machine that is used by labourers, farmes, gardeness, and others for transporting loads to heavy by hand it from one place to another.

However, materials used for construction purpose are bought in standard sizes wither in long bars or standard sheet sizes. Moreover, depending on the type to be constructed, the materials are then reduced to smaller and more convenient sizes. The shapes and forms are changed by filing, drilling, reaming, tapping, broading etc. Also depending on the size of the workshop, some of these operations may be carried out using manual or mechanized processes.

In addition, procedures involved in constructing a locally made "V" shape wheel barrow include MARKING OUT, PATTERN DEVELOPMENT, CUTTING, DRILLING, BORING and WELDING OPERATIONS. High quality materials were used to contruct the wheel barrow that processes the required standard.

The medium was tested with some amount of local to know if its ability was optimum, the machine handle moved freely and smoothly after the handle was lifted.

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CHAPTER ONE

1.1 INTRODUCTION

This is a hand-pushed vehicle, consisting of a dish-shapes body supported on two shafts, arrangal in a "V" shape with handles at the spread end and a wheel and axle at the point. The wheelbarrow at the axle, the serve applied at the handles and coal or resistance between the two in the body. It is used by laborers, farmers, gardeners and others for transporting loads too heavy or bucky to be carried by hand and is similar to hand trucks used by warehouse men and industrial workers expect that the latter has two wheels. Modern wheel barrow are made of wood or of a light metal, such as aluminum, and have a rubber fire on the wheel. A two-wheel vehicle for carrying garden materials is more properly called a garden cart.

The purpose of the production of this machine is to reduce alleviate and possibly eliminate the sufferings, time, money, wastage of man-power and more especially the need for technological break-through and self-reliance, which has been a major concern of the federal government.

Moreover, this project at hand has delved into simplicities and the construction of this machine that can be used to carry different types of heavy load to any distance.

1.2 ORIGIN AND HISTORY

The wheelbarrow like any technology in the common place, was a story to tell.

The west was very slow to invent the wheelbarrow. Do the earliest known European wheelbarrow gleams down from a stained-glass window in charless cathedral.

But the Chinese have had wheelbarrow for millennia. They celebrate a half-mythical inventor named KO Yu. It is not known when he lived but since then, the Chinese have shaped wheelbarrows in enormous variety. They've used them for every kind of task.

It migue help to consider just what an industrial wheelbarrow is. It combines the advantages of both the wheel and the leveler. The load is centered behind a single wheel that way, you have to lift only a small part of the load. The two handles give an intimacy of control you don't have with a four-wheeled cart. If you ever had to use a wheel barrow, you know its easy with the load in the right place. It can be back breaking when the load's too far behind the wheel. Chinese armies made the first use of the wheelbarrows. It give them such an advantage in moving goods that it was kept secret. Early Chinese writings talk about wheelbarrows in code. KO Yu, one ancient text tells us built a "wooden goat" and rode away into the mountains on it. They called a wheelbarrow with handles in front a "wooden ox" one with handles at the back was a "glinding horse"

Long ago, the Chinese invented wheelbarrows with sails that were no idle experiment said driven wheelbarrows became a well-developed and widespread technology. And the sails were prefect miniatures of the ones used in junk.

And we, with all our vaunted technology, have yet to build wheelbarrows with the grace, balance, variety and features of these in China.

It was not until the seventeenth century, when direct contact was made between European and China, as a result of trade, each area had it own distinct form of wheelbarrow, although by this time both were frequently modified to serve other needs than those for which they were designed.

1.3 IDENTIFICATION OFFERED

The purpose of the production of this machine is to reduce difficulties and probably eliminate the suffering time, money, cost of man-power and most especially the need for technological breakthrough and self-reliance which has been a major concern of the human being. Carrying of load on human head has been a tiring problem in the society from this commercial especially towards our loco-parenthesis.

It helps eradicate those problems; this project write up has been delivered into simplifications and the constructions of this machine that can be used in carrying different types of this machine that can be used in carrying different types of heavy objects to different areas.

Wheelbarrow is a machine that makes use of a bowel, made of metal used in carrying loads or is a simple machine that helps us life, pull, increase direction of heavy things change the direction of force and increase force.

CHAPTER TWO

2.0 LITERATURE REVIEW

At a very early stage man released that the means of moving thing about which nature had provided him left much to be desired. He is severally limited in loads; he carries the area he could carry them and the speed at which he could travel. One is right to guess that the physical exertion involved was no more to his liking them, than it is today.

Man started by mean of training suitable animals to enable heavier loads to be carried at far distance, and at high speed than he was capable of attaining and there was an added advantage than most of the effort was provided by animal, while the man could at ease.

Heavy loads were dragged upon sledges until an early and unknown engineer invented the standard barrow. This was made possible because construction material was made of wood upon which heavier loads could be carried more easily.

The draw back to the use of this type of standard wheelbarrow was that it could not carry much heavy loads because of the strength of the materials in which it was made of. The wheelbarrow can't absorb shock, which may probably damage some perishable/breakable good s loaded on it. Above all, it cannot move on the road that is not smooth and hard.

As new materials and manufacturing methods were developed it became possible to improve in standard wheel barrow that are new made up of materials that can withstand shock, carry heavier loads, more in any type of road and above all, have to withstand load.

Other types of wheel activities that can carry load were also developed such as stream engines, electric card and internal combustion engines.

2.1 HISTORICAL REVIEW OF WHEELBARROW

The origin and development of the wheel holds an important place in the history of invention because it's clearly illustrates a phenomenon known as independents invention. Thus, the wheelbarrow has more than a single source of origin and was developed for different purposes.

The earliest form of wheelbarrow was developed in China shortly before AD200, and traditionally its design is attributed to a general in the imperial any, although these probably mere folktale. The map of the Chinese wheelbarrow alone is enough to suggest how it originates. The single wheel is large, often three or four fat in diameter and usually has a dozen or more spokes. It is set between the shafts at a considerable distance from the front end of the barrow, while a boxing or wooden frame is built up from the shaft to encase the upper half of the wheel. Platforms projected from the shaft on both sides. The goods to be carried are loaded on these platforms and on the upper surface of the boxing. If the burden are correctly placed not only would its weight balance on both sides of the wheelbarrow but it would also before and after the axle of the wheel. The weight of the load is barrow could use his energy solely for moving it and maintaining its balance.

This kind of barrow appears to have been developed from two-wheeled handcarts on which, with modification, the pair of wheel. In many parts of China, especially in the wet, rice growing area, field boundaries are often no more than narrow embarkment, the tops of which must also serve as paths.

This wheelbarrow, therefore seems to be an adoption of the hand cart designed to allow it to move along narrow paths. Indeed, early illustration of Chinese wheelbarrows and forward placing apart from pushing and balancing has to lift a large part of the burden. It was totally unsuitable for shifting goods over long distances.

This until the seventeenth century, when direct contact were made between Europe and China, as a result of trade, each area had its own distinct form of wheelbarrow, although by this time both were frequently modified to serve other needs than those for which they were designed.

2.2 THEORY & WHEELBARROW MECHANISM OF OPERATION OF

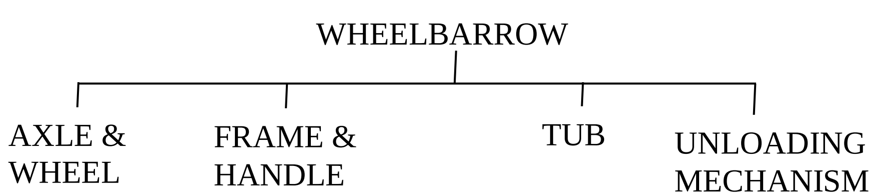
Wheelbarrows are artificial tools in the fields of construction, landscaping, home improvement, and gardening. Most wheelbarrows are designed around the idea of toppling the wheelbarrow over or strenuously lifting the handless to unload it and are typically equipped with a single wheel in front. While this is a simple concept, it can lead to out of control loads and accidental spills. Aspect Engineering designed a new wheelbarrow with the goals of providing the stability, loading capacity, and ease of use that typical wheelbarrows fall to provide. The "Rolling Barrel" has half of a 55 gallon derum mainted on a frame to hold the transportable contents, which can then be related about its center of mass to unload it.

The typical wheelbarrow design has accomplished the ability to transport a large amount of cargo safely and efficiently with some success, but with enough creative engineering and consideration, this concept can be improved. The capabilities of this basic wheelbarrow can be largely surpassed when the bar is raised to new capacities and functionality.

But problems may arise when the wheelbarrow is loaded heavily. The user must lift the handle to rotate the load about an axis far from the load's center of mass. At times, this means the wheelbarrow cannot be unloaded with a single a single wheel for support while transporting contents. The wheelbarrow can easily tip over, especially when the wheelbarrow is heavily evaded to one side, or being rolled across a slope. This can usually be attributed to a high centre of gravity, inadequate lateral supports, and the inability of the wheelbarrow to adjust for such conditions.

DESIGN PARTITION

A junction tree was designed to break up all possible concepts into the required subsystems. This was done to ensure that all aspects of the wheelbarrow are taken into consideration and to ease the design process. The tree show the wheelbarrow subsystems: a tub to contain the materials to be moved, a frame and handles to support and maneuver the tub, an unloading mechanism for removing the materials from the tub, and the wheels and axle to move the materials.



CONCEPTUAL IDEAS

The first two ideas are simple additions to the basic wheelbarrow design. The "pump and dump" design is based on the basic wheelbarrow, but instead of lifting the load by the handles, the operator steps on a lever that flips the load over the front wheel.

The "Adjustable Handle" design is also based on the basic wheelbarrow, but the handle used to move and lift the load can slide up and down for increased leverage while unloading and allows the operator to life using leg muscles rather than back muscles.

The "Splitting Barrel" design has a drum that separates along the bottom to allow the load to fall through to the ground, thereby using the stored potential emery to unload the contents. The operator simply unlatches the barrel quarters from each other at the bottom.

The "Rolling Barrel" design has a drum that is rotated about its center of mass by way of a handle or crank. The barrel is unloaded by applying a small force to rotate it upside down, thereby allowing the stored potential energy to unload the contents.

The final concept is much like a box on wheels. "Old N0.5 has a door on the front that opens, and a mechanism to push/pull the 1contents through the door.

ENGINEERING ANALYSIS

There are two main objectives in these engineering analyses. First, the device must not fail unclear heavy loading therefore, the maximum stress and deflection produced in the cross beam of the wheelbarrow from the load of the drum was investigated. Second, the forces required to unload the wheelbarrow were investigated. The analysis of the crossbeam is presented first.

First a maximum load was defined to be sand that would fill up the barrow and also be heaped above. The volume of sand would approximately be 55 gallons. The density of sand is 2,300kg/m^3. So, the total weight of the sand is 1060 pounds. With two cross beams this weight is divided between the two making the force on one crossbeam 530 pounds.

Next, the maximum value of the moment in the crossbeam was found. The force and moments acting on the crossbeam were defined as a downward force at the center of the beam, and an upward force as well as moment acting on both ends of the beam.

From beam analysis the maximum moment was determined to be:

$$M = \frac{3PL}{8} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Where P is the downward force acting on the center, and L is the length of crossbeam.

The maximum stress occurring in the beam was found from the moment and is:

$$Ơ = \frac{3Plh}{16L} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

In the equation h is the height of the beam and I is the moment of inertia of the beam.

The maximum deflection of the beam occurs at the center. It is related to the downward force by equation 3.

$$Ơmax = \frac{5PL}{192El} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

Young's modules are represented by the variable E. For a solid beam the moment of inertia is given by:

$$I = \frac{bh^3}{12} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

For a hollow beam the moment of inertia is:

$$I = \frac{bh^3 - (b - 2t)(h - 2t)^3}{12} \quad \ldots\ldots\ldots\ldots (5)$$

In both moment of inertia equations, **b** is the width of the crossbeam and **t** is the inner thickness for the hollow beam.

For a 2"x2"x28" steel beam the maximum stress is 4ksi. This stress is well below the yield strength of steel of 36ksi with a safety factor of 9. Also, the downward deflection of the beam at the centre is 0.0078". In a hollow steel beam of the same dimensions with an inner thickness of

0.125" the maximum stress is 10ksi. The safety factor for the hollow beam is 3.6. The deflection at the center is 0.019".

Next, the analysis of the force required to turn the barrel is presented. This analysis is performed for two different designs the first is a simple handle design the second is a gear design.

The handle design consists of a barrel with a simple handle to related the barrel. The distance from the axis of mation to the handle is the same as the radius of the barrel, or half of the with, **W**.

The force required to pivot the barrel is called **Fn** the gear design consists of the barrel with one large gear mounted on the axis of rotation and a smaller gear with a handle.

The force required to rotate the barrel is called **fg**. The ration of the larger gear diameter to the smaller gear is called r. the handle length is **Ln**.

By summing the moments about the axis of rotation, the following relationship between the over all torque, **T**, required to rotate the barrel and the force, **Fn** for the handle design is derived.

$$T = Fn \frac{w}{2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

For the Gear Design, the overall torque, T is a function of the gear ratio, handle length and force, Fg.

$$T = Ln\,Fg \qquad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

By combining equations 6 and 7, a ration of the forces for the two designs indicates the mechanical advantage of the Gear Design over the Handle Design.

$$\frac{Fg}{Fn} = \frac{W}{2rLn} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

The distance from the center of mass to the axis of rotation is called **d**.

$$d = \frac{2W}{3n} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Again, **W** is the width of the barrel so, by summing the moments about the axis of rotation, the static torque, Ts, is a function of G & d.

$$Ts = Gd \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Where **G** is the gravitational force acting on the center of mass of the barrel (including the load).

Substituting for G with product of the density of the medium inside the barrel, p, the volume of the barrel, **v**, and the acceleration due to gravity, g, equation 10 becomes:

$$Ts = pVgd$$

Substituting for the volume with the length, L, and width of the barrel, W, equation 5 becomes

$$Ts = \frac{W^3 Lpg}{12}$$

Next, the dynamic torque required to rotate the barrel was investigated. Neglecting all friction, the dynamic torque to rotate the barrel, Td, is a function of the angular acceleration, x, and the mass moment of inertia of the load in the barrel, J.

$$Td = J\alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

The mass moment of inertia, J, as a function of the density of the medium in the barrel, P, and the dimensions of the barrel, L and W.

$$J = \frac{PLW^4\pi}{64} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

2.3 WHEELBARROW AND OTHER CLASSES OF LEVER

The Lever

The simplest machine, and perhaps the one with which we are most familiar, is the lever. A seesaw is a familiar example of a lever in which one weight balances on the other. You will find that all levers have three basic parts: the fulcrum, F, a force or effort, E, and a resistance, R

First Class Levers:

In the first class lever, the fulcrum is located between the effort and resistance. As mentioned earlier, the seesaw is a good example of a first class lever. The amount of weight and the distance from the fulcrum can be varied to suit the need. An oar is another goal example. The ocerlock is the fulcrum, and the water is the resistance. In this case, the force is applied one side of the fulcrum and the resistance to be overcame is applied to the opposite side; this is a first class lever. Crowbars shears, and pliers are common examples of this class of leavers.

Second Class Levers:

The second-class lever has the fulcrum at one end, the effect applied at the other end and the resistance somewhere between these points. A wheelbarrow is a good example of a second-class lever. If you apply 50 pounds of effort to the handles of a wheelbarrow 4 feet from the fulcrum (wheel), you can lift 200 ponds of weighed 1 foot from the fulcrum. If the load were placed further away from the wheel, would it be easier or harder of lift? Levers of the first and second class are commonly used to help in overcoming big resistances with a relatively small effort.

Third class levers:

Sometimes you will want to speed up the movement of the resistance even though you have to use a large amount of effort levers that help you accomplish there are in the third class of levers.

2.4 USES/IMPORTANCE OF WHEELBARROW

The uses and importance of a wheel barrows are numerous and cannot be over emphasized. It is used in various aspects of work and they are as follows:

a. It is used in the farm to transport farm implements from one place to another, transporting weeds or residues that are to be disposed of their incarnation points; and for short distance, for moving the farm produce to the point they are needed.

b. It is also used in the workshop for moving materials for any purpose from one points to another.

c. It helps reduce the work of man i.e. it helps man to move things around easily.

2.5 MATERIAL SELECTION/MATERIAL OF CONSTRUCTION

This is mostly affected by the non-accountability of suitable materials that would have been best suited for some specific parts, so the material of construction was given serious consideration of the standard wheelbarrow. The materials to be considered for any of the component manufacturer, must have the relative property usefulness and appropriate for the function of that component parts.

Handle cover: It is made of elastic rubber, in order to avoid friction and bruise of the palm.

Stands: Mild steel bar is used in the construction of bowel support bar. The material is chosen because of its relative cheapness, availability. Some other materials like aluminum, cost iron and stainless steel but because of their high cost of production and processing, mild steel is chosen, not minding the other materials; though stainless steel is better because of its ability to withstand corrosion and good finish.

Handle or frame: Steel pipe is normally used because of its corrosion resistance and its light weight.

Wheel: This material is used because of its relative cheapness, it is easily sheared or cut and above all its resistance to corrosion (carbon steel sheet and mild steel).

Bowel: Cudvconised caamon steel is used because it is easy to cut and relatively cheap and resistant to corrosion.

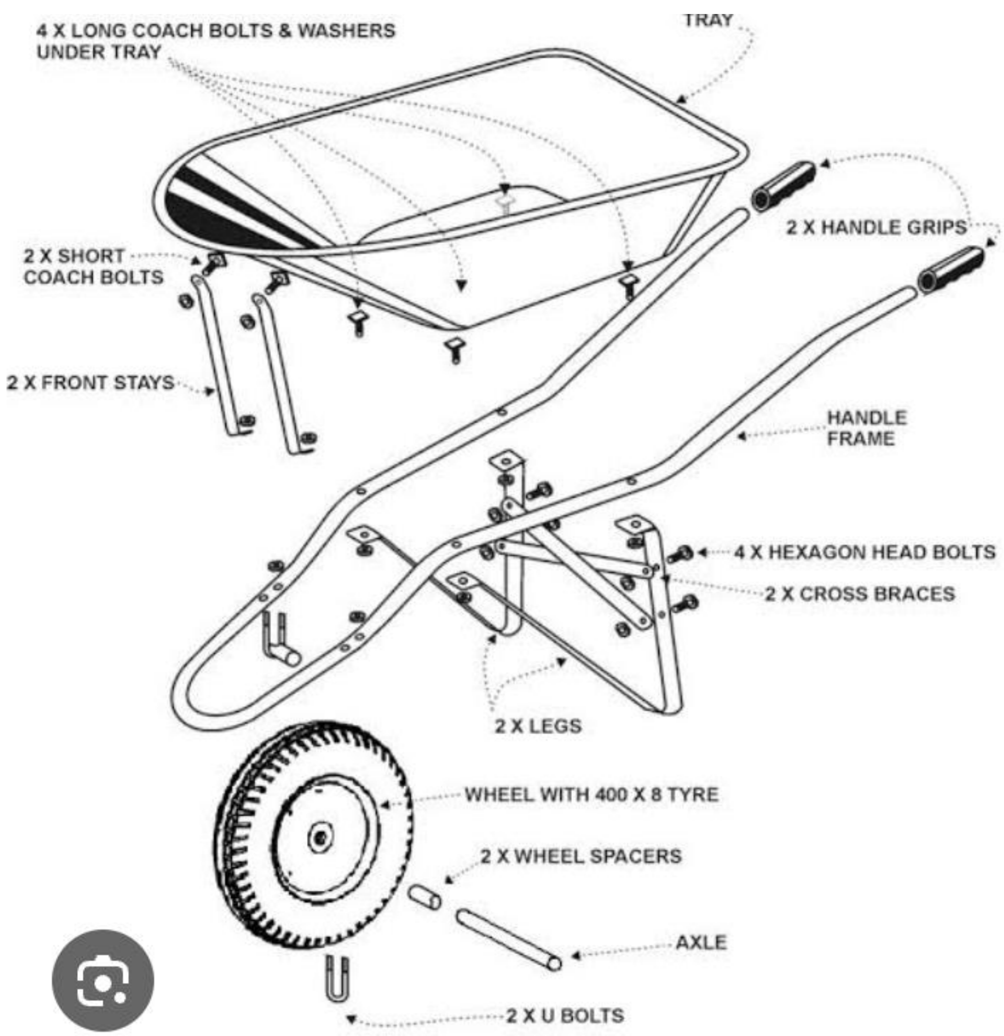
Spindle or shaft: Mild steel is used to construct the spindle as a result of its relative cheapness and easy machinable property.

Ball bearing: There are two in number and are made of sintered metal because it can easily be rolled into balls due to its ductility.

CHAPTER THREE

3.0 METHODOLOGY

This section covers the methods used to address the objectives of the study. The section discusses th procurement of the material for construction, marking out, citting and rolling welding and painting.



3.1 PROCUREMENT OF THE MATERIAL FOR CONSTRUCTION

This talks about the factors that must be considered before the material for the construction is selected. Some of the more important economic factors and physical and mechanical properties that are involved in material and process selection are discussed briefly in the proceeding paragraphs.

"Availability and cost of materials" vary continually and as the change is towards favourable or unfavourable conditions designs will necessarily undergo corresponding alterations for economic reasons. At times certain materials may become unavailable for general industrial use, and the necessity may arise for substitute designs based on procurable materials. A forceful example of this expediency occurs during national emergencies when alternative designs are required to avoid the use of strategic materials as well as processes that are affected by the unavailability of equipment.

"Strength" is necessary to prevent failure of the member by rupture. However, some steels have the describable property of high ultimate strength coupled with low ductility, which may be undesirable in members subject to stress concentration. The use of high-ultimate strength steels. Such as those caused by concentration of mass, surface decarbonization, and quenching cracks.

"Rigidity" is of importance in members whose deflections are limited by service requirement. For instance, the transverse deflection of a shaft of a speed reducer may be limited by the following requirements.

1. Clearance in film lubricated bearing which support the shaft for satisfactory bearing life as relatal so wear.

2. Alignment for instance, of gears mounted on the shaft, as related to gear- teeth wear, and vibration characteristics of the shaft, which depend mostly on the deflection of the shaft rigidity depends upon the modules of elasticity.

"Resistance to fatigue" should be the basis for the design if members that are subjected to cycle loading. This property is measured by the endurance limit. Notch sensitivity and clamping capacity is designed as the energy dissipated as heat by unit volume of the material during a completely reversed cycle of stress.

"Resilience" should be considered when the material is subjected to shock loading. A material with a suitable yield point should be selected and the member should be designed so as to secure a desirable resilience of the part. "Weight" may be important often it is desirable, as in the case of foundations and flywheels; but it is undesirable in other cases, such as aircraft parts, where light metals, such as aluminum, magnesium alloys or titanium may be used.

"Resistance to wear or corrosion" may be determining properties; the former is unlubricated or poorly lubricated friction surfaces. Generally, like materials in contact are not satisfactory for friction surfaces, although there are exceptions. Corrosion resistance is important in members subjected to a corrosive environment. The effect of corrosion is especially serious in the presence of stress concentration in cyclic loading.

"Law friction" is of importance in bearing materials. The friction conditions are affected by the materials in contact and the surface finish. Certain combinations of materials that are in contact in bearing surfaces produce satisfactory results.

3.2 MARKING OUT/CENTRE PUNCHING

This involves the drawing of lines on the metal surface with use of scribers, metal rule dividers etc indicate the profile or outline of the finished compound and making the necessary holes in the material. The tool used for centre punching is a drill but.

IMPORTANCE OF MARKING OUT

1. It helps to define the shape or the outline of the article
2. To keep the wastage of material to a minimum
3. When metal has to be removed from several faces marking out ensures that correct amount is removal from each face.
4. To mark the lines, which will help the machinist set up the work correctly on the machine and to serve as a guide that the correct size has been attained.

5. To indicate precisely the position of holes and similar features.

3.3 CUTTING AND ROLLING

Common sheet metal cutting operations include shearing, blanking, piercing and nothing shearing into long strips are usually done with the ciullctine or manual shearen, while blanking, piercing and not clung are usually done with punches and die that are mounted in a standard type the set. There should be a set of die for each different job.

Rolling occupies the most important position of all back defermation processes. Over 95 percent of all materials that is ever defermed is subjected to rolling.

Flat rolling refers to the process of reducing the thickness of a slab to yield a thinner and longer but only slightly wider product. It is the most important primary dyarmation process, because it allows a high degree of automation and very high speeds, and thus provides starting material for various secondary sheet metal working processes at a low cost.

Shape rolling has a long history, beginning with the rolling of channels of lead for stained glass windows. The largest industrial application is nao in the hot rolling of structural shapes, which is a specialized primary deformation. process, practiced in special purpose mills.

Seamless rings, which are examples of ring rolling, are important constructural elements, ranging from the steel gives of railways car wheels to rotating rings of jet engines and races of ball bearings. After making a hole by any suitable technique, the thick-walled ring is rolled out by reducing its thickness and increasing its diameter.

Transverse rolling can be explained or experiences, when a work piece is placed between two counter rotating rolls with its axis parallel to the roll axes, it suffers plastic deformation during its rotation between the rolls. The consequences of this deformation depends on the shape and angular alignment of the rolls and, as in all compression on the h/l ration.

The projected length of contact between roll and work piece is regarded as L of the jerging tool, and the average height is taken as h. when h/l > I, the in homogeneity of deformation predominates and the pressure multiplying factor is Qi. The roll force is estimated from:

$Pr = LWQi\sigma jm$

When h/l <I, friction effects are over-riding and the pressure - intensification factor is Ơp. The roll force is estimated from:

$Pr = LW\, Qp\, \sigma fm$

Where W is the width of strip and Ơfm is the mean flow stress, used because the strip hardens while it is deformed in the roll gap. In hot working, the flow stress must be taken at the typical average strain rate.

$$Em = \frac{V}{L} \quad in \quad \frac{ho}{hi}$$

The torque required to rotate the rolls can be obtained by assuming that the rolling force acts in the middle of they are of contact. Since there are two rolls to be driven the total torque will be

$$MT = \frac{2PrL}{2}$$

and the horse power requirement is readily calculate from

$$hp = \frac{2PrL\pi N}{33{,}000}$$

where N is rpm, L is in units of feet, and P is in units of pounds. In the SI system the power requirements are calculated in kilowatts units.

$$KW = \frac{2PrL\pi N}{60{,}000}$$

where P is the roll force in newtons, L is in meters, and N is rpm.

3.4 WELDING

In mechanical engineering, welding is extensively employed to manufacture structures from plate rolled stock (reservoirs, tanks, hoppers, coverings, limners, etc.) until from pipes and shaped rolled stock (frame structures, trusses, columns, pillars, etc.). Nowadays housings and base members are also made by welding, including the most massive and stressed parts (for example, the beds of presses and hammers).

In individual and small lot production welded structures are used instead of one-piece forgings when the manufacture of dies is not justified by the scale of production and also as a means to make the manufacture of complicated part less expensive. Low-carbon steel (< 0.25 percent c), low alloy steel with a small content of e and nickel steel weld very well. High-carbon, medium and high-alloy steels are more difficult to weld.

The strength of welds is inferior to that of solid material because of the cost structure of the welded joints with its deneritic and acicular crystallites typical of cast metal.

The strength of welds is inferior to that of solid material because of the cost structure of the welded joints with its deneritic and acicular crystallites typical of cast metal.

The strength and resilience of the material is a weld are impaired by penetration of slay, formation of pores and gas bubbles and also because of chemical and structural changes in the weld (alloying elements bum-out, formation of carbides, oxides and nitrides). If the material of a weld is saturated with air nitrogen even in small quantities the weld will lose much of its plasticity and will become much more brittle.

The mechanical properties of welded joints depend on the welding process and in manual work on the skill of cause defects impairing the life of the weld and its strength. Lots of welded products are tested selectively by cutting up of specimens, by tensioning, bending and flattening them and by investigating their microstructure and chemical composition of the metal in the weld.

3.5 PAINTING

This is one of the processes used for the protection of metal surfaces form corrosion. It is used to coat vast amount of mild steel, not only to protect corrosion, but also to provide an attractive finish. Optimum results are obtained by first "phosphate" the surface of the steel. This involves treating it with a phosphoric acid preparation, which not only dissolves rust, but also coats the surface of the steel with a dense and slightly rough surface of iron phosphate. This affords some protection against corrosion, but also acts as an excellent "key" for the priming paint and the under coat of subsequent paint.

CHAPTER FOUR

4.0 PRODUCTION COST

Due to the depreciation of the value of naira the cost of all materials used is not stable but at the time of construction of this project the cost of the materials is as follows:

S/N	**Materials Description**	**Quantity Used**	**Cost**
1.	One metre square of galvanized carbon steel sheet	All	₦8,500.00
2.	3,250 steel pipe long	All	₦23,000.00
3.	Wheel and Tyre	1	₦39,000.00
4.	Ball bearing 32 crunchier 50.8mm	All	₦5,500.00
5.	Bolt, Nut and washer	14	₦6,100.00
6.	Paint	All	₦7,000.00
7.	Electrode	10 pieces	₦4,000.00
8.	Two plastic handles	All	₦2,200.00
9.	Transport		₦2,500.00
		Total Expenditure	₦97,800.00

4.1 Total Expenditure

This project has cost ₦97,800.00 at the end of construction due to quality of the materials

4.2 Assessment

The construction of this project went successful and we were able to derive additional skills during the course of the construction. One of the major peculiarities of an engineer is that he/she must be able to adopt any piece of information gathered to transform his immediate environment. This can be effected via the use of quality and standardized materials which we have justified.

The wheelbarrow is of a high quality and extremely strong compared to the wheelbarrow produced outside, due to stronger the materials used and some techniques adopted during the process of construction.

Also, in term of aesthetic value, cost and style, the wheelbarrow is completely different from some wheelbarrow produced by welders. This is so because of the knowkedge we acquired in the school on improving technology and also some research carried out on the materials used which make it stronger than those in the market.

CHAPTER FIVE

5.0 RECOMMENDATION AND CONCLUSION

The following recommendations are made on completion of this projects:

1. Power supply must be frequently available for works to progress all the time.
2. The workshop should be supplied with new and modern technological machines because the ones available at our disposal were worn out and absolute.
3. Necessary working tools should be made available for the effective work to be done by students.

We advise that the school management should look into these recommendations to supplement the students effect and the avoid repetition in the near future, and to increase efficiency and safety of students in the workshop.

5.1 CONMCLUSION

Government should encourage technical education and should also try to patronize our locally made mechanical madunes because we look forward to a better tomorrow when our country Nigeria will completely favour the rest of the welding technological advancement.

4. Materials should be provided at the disposal of the students for the project.

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