

Federal University of Technology Minna, Niger State, Nigeria
Department of Industrial & Technology Education
2017/2018 SESSION

Course: WKS 110 (Workshop Practice)

Credit Units: 1

WORKSHOP PRACTICE

Workshop: A workshop can be referred to as a place, a building or area where practical activities are carried out. In a workshop, practical activities are of various types and can lead to various outputs. The practical activities in a workshop can be carried out to produce a product or to get result from a test sample. Another name for a school workshop is laboratory. In industrial settings, a workshop can also be called plant or factory.

Workshop Practice: Workshop practice can be described as all the behavioural characteristics and activities involved in carrying out a practical task in the workshop. Workshop practice encompasses the behavioural attributes of the students working in a workshop towards personal safety, safety to tools, equipment, machineries, and materials as well as safe work habit geared towards preventing sudden accident in the workshop and maximizing production time or time allocated to practical activities.

Safety: Safety is the art or practice of avoiding or preventing sudden accident while working in the workshop. Safety can also be defined as the method of working without harm, danger or injury. It is the removal of hazards to both man and machines. It is worthy to note that a workshop can alternatively be called a laboratory, factory, production plant or simply a plant. In any workshop, safety comes first. In most standard workshop, to ensure that workers are always conscious to remember to adhere to safety practices, there are various safety symbols and slogans displayed in strategic places where workers can see them and are conscious of observing safety.

In this course (WKS 110), some of the slogan developed to create consciousness in students towards observing safety rules and regulations include:

1. "Safety Comes First".
2. "Use the Right Tool, For the Right Job".

Thus, all WKS 110 students on hearing the word "**Safety**" should be able to response as "**Comes First**". Also on hearing the phrase "**Use the Right Tool**" students should be able to response as "**For the Right Job**". This and several other slogans used in school laboratories as well as industrial workshops are meant to create a consciousness in students towards observing safety rules and regulations while working in the workshop. Observing and being conscious of safety slogans is very important to avoid sudden workshop accident.

Safety in workshop practice is of paramount importance. Safety work habits should be learnt and observed by force of habit. Safety in working with materials in any type of workshop laboratory can be divided into two main topics of concern, namely:

- (1) Protection against personal injury and (2) Prevention of damage to tools, equipment and machines.

SAFETY PRECAUTION: Safety precaution refers to the rules and regulations observed in the workshop or laboratory to avoid sudden accident which may be harmful to the workshop personnel (students), tools, equipment (machineries) and materials. In this course, the necessary safety precaution to be observed to prevent sudden accident is explained to cover the under listed basic workshop areas such as : (1) Automobile technology workshop (2) Building technology workshop (3) Computer workshop (4) Electrical electronics technology workshop (5) Metalwork technology workshop, and (6) woodwork technology workshop. Safety precautions for specific tools and machines should be learnt and observed in each case. The discussion here is on personal safety.

Safety Devices

All safety devices are generally referred to as 'Personal Protective Equipment' (PPE). Personal Protective Equipment includes clothing, equipment and substances designed to be worn by a person to protect them from risks of injury or disease. Below is a list of Personal Protective Equipment (PPE) commonly used in general technological workshop:

S/N	PPE	Function
1	Safety glasses or goggles or eyelids	To protect the eyes from flying debris during grinding, welding, drilling and other particle removal operations in the workshop.
2	Overalls (Lab coats, leather apron)	To protect the clothes and body or skin from damage resulting from contact with harmful chemicals. Leather apron protects the body and clothing from burns generated from welding.
3	Gloves	To protect the hands from harmful solvents and fluids. Leather gloves protect hands and arms from burns generated from welding.
4	Face shield or welding mask	To protect eyes and face from flying materials created when grinding, drilling or welding operation.
5	Steel capped boots	Protects feet/toes from injury caused by dropping heavy items.
6	Ear muffs (ear plugs)	Used to reduce hearing damage caused by loud noises such as noise from machines operation, chisel and hammering jobs.
7	Respirators (Nose cap)	Protects lungs from inhalation of dust and fumes.
8	Hair net or cap	Reduces risk of hair getting caught in rotating equipment such as drills and grinders.
9	Helmet	To protect the head from objects falling from a height.
10	Sand bucket	To extinguish (quench) fire when there is fire outbreak in the absence of fire extinguisher.
11	First aid box	To provide immediate treatment to an accident victim before the arrival of a doctor or before being taken to the hospital.

Workshop Accidents

Workshop Accidents: Workshop accidents or accidents in the workshop are unexpected and unplanned events which could lead to bodily injury, loss of body parts, death, and damage to materials, tools and equipment or machines. Workshop accident can also be refer to as any unexpected occurrence that can delay or interrupts the orderly plan of workshop activities and may have adverse effect on workshop personnel, (students), tools, equipment (machines) and materials inside the workshop.

Possible Causes of Accidents in a Workshop

There are four major causal factors for accidents in a workshop namely:

1. Human factor (Student factor).
2. Tools and Equipment factor.
3. Management factor.
4. Environmental factor.

1. Human factor : Human factor as a cause of accident refers to accidents caused by the student or other student involved in the workshop activities due to carelessness, poor vision, poor mental state, bad behaviour in the workshop, emotional problems leading to loss of concentration, fatigue , sudden sleep, stress, use of damaged tools and machines as well as loss of concentration due to tiredness. Human factor as a cause of accident can further be divided into two namely:

- (A) **Individual Student Factor:** Individual student factor refers to accidents arising from carelessness of individual student or the student involved in the accident. Example is failure to use safety devices, Use of damaged tools and machines..
- (B) **Other Student Factor:** This refers to the accidents arising from the carelessness on the part of other students whose careless practice could result to accident affecting other innocent students.
- Human causes of accident which relates to personnel or student factor include lack of skill, improper judgment, being in a hurry, lack of patience, selfishness, mental or physical fatigue, worry, emotional instability, carelessness, not being attentive and use of alcohol and other drugs.

- 2. Tools and Equipment factor.** This refers to causes of accidents arising from poor design of tools and equipment, poor maintenance of tools and equipment, poor use of tools and equipment, equipment failure, as well as using the wrong tool for the wrong job.
- 3. Management factor:** Management factor as a cause of accident refers to causes of accidents resulting from the inability of school management team and administrators to provide conducive workshop buildings as well as adequate materials, tools and equipment for practical activities.
- ~~ability of management to provide conducive workshop buildings, as well as adequate materials, to support practical activities~~

(alternative) exit route or door as well as undersized (smaller) workshops that cannot adequately accommodate the entire population of students in a single class or department during practical activities in the workshop. Other management problems include: lack of provision of safety devices; inadequate lighting and congestion, over congestion of working area.

4. Environmental factor: Environmental factor is a cause of accident arising from bad whether condition or climatic condition that can obscure vision or influence student preparedness to participate actively in workshop activities. Example of such climatic condition that may cause accident include: fog, whether, harmattan, haze. Heavy down pour or unfavorable climatic condition.

Accident Preventive Techniques

- (a). Always work under the supervision of an instructor or laboratory attendant or workshop attendant.
- (b). Observe all safety rules.
- (c). Always use safety devices.
- (d). Sand buckets and fire extinguishers must be placed in position to arrest any fire outbreak.

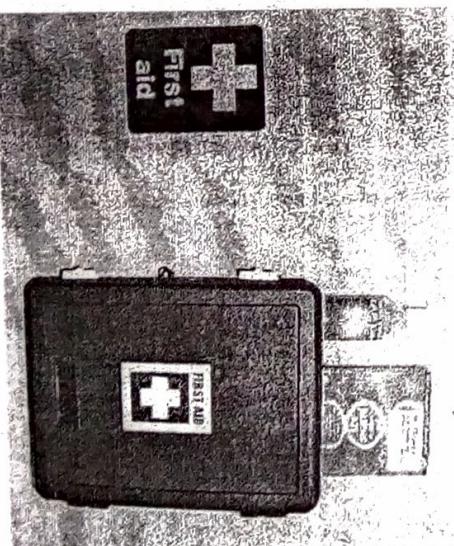
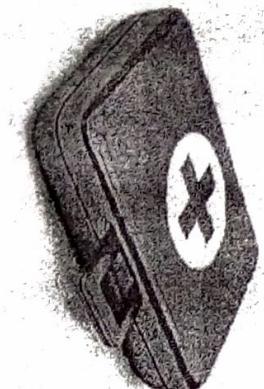
FIRST AID

First aid is the immediate treatment or assistance given to an accident victim or an injured or sick person before the arrival of a doctor or before being taken to a hospital. First aid can also be describe as the immediate treatment or assistance given to someone injured or who gets ill suddenly, before the arrival of a doctor or before the person is taken to hospital for further treatment. In its most basic form, First Aid is the initial assistance given to a victim of injury or illness. Basic First Aid knowledge is comprised of relatively simple techniques and procedures

2. First Aid skills can be applied in the home, the workplace or in public locations, therefore the more First Aid certified people there are in a community the safer that community becomes.

Also the more First Aid certified students there are in a school, the safer that school becomes.

3. Becoming First Aid certified person not only benefits you as an individual but it extends to your family, friends, co-workers and even the community as a whole. As unpleasant as it is to talk about, accidents and emergency situations are not completely preventable or unavoidable.
4. If an accident happens in the workplace, in your home or in a public space, being a helpless witness to an emergency situation can potentially worsen the situation. This is why it is very important for as many people as possible to have at least a basic knowledge of First Aid so that they can be useful in rendering emergency help to save lives.
5. It allows those trained with the potentially lifesaving ability to assist an injured or ill person during a variety of emergency situations.
6. Knowledge in First Aid benefits the individuals themselves regardless of whether an emergency affects them directly or involves people they live and work with. First Aid can and often lessens the severity of an emergency in a given time and place.
7. While everyone can benefit from First Aid knowledge and training it is an even greater benefit to those working or living with individuals who require ongoing special attention or treatment such as children, persons with physical or mental disabilities, persons with chronic illness, persons with disorders such as epilepsy, the elderly, persons involved in recreational activities such as swimming or people working in dangerous environments such as a factory or construction site.
8. First aid knowledge and skills provides additional advantage to graduating students when seeking for job opportunities in the labour market.



First Aid Box: A First aid box is a small container that contains all the materials needed to administer a first aid treatment.

Materials inside a first aid box

1. Cotton wool: this is used as an absorbent material or as a pad.
2. Scissors: we use scissors for cutting. The scissors should be blunt ended to avoid injury.
3. Bandages: they are used to protect wounds from dirt, restrict movement of parts of the body, and maintain pressure on dressing or reduce swelling. Bandages used to cover wounds should be clean.
4. Adhesive dressing plaster: this is used to cover minor wounds.
5. Safety pins and clips: they are used to secure the bandage or dressing.
6. Disposable gloves: they are used for protecting the hands against contamination during dressing and disposal of waste materials.
7. Drugs: like paracetamol and panadol which help to reduce pains, headaches and fever.
8. Iodine: it is used in disinfectant preparations for cleaning wounds.

FIRE as a Source of Accident in the Workshop

Fire is a rapid combination of two or more elements resulting in the production of heat, smoke,

*Oxygen is the oxidizing agent and oxygen is found in the atmosphere (21% of air).

*The ignition temperature (or heat) is the amount of thermal energy applied to combustible material in order to allow combustion to take place.

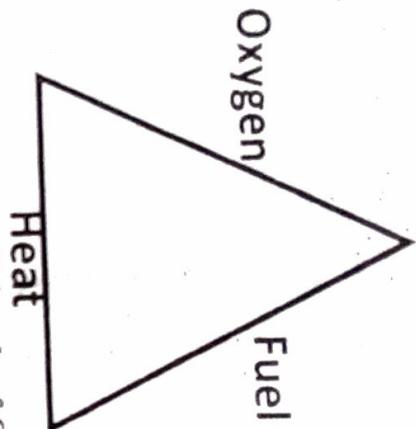
*Fuel refers to any combustible material whether organic or inorganic such as grass, glass, petrol, wood and oils.

CAUSES of FIRE

- 1) Fire is mostly caused by carelessness by people.
- 2) Wrong connection or installation of electrical appliances.
- 3) Wrong handling of inflammable liquid or materials
- 4) Careless hanging of clothes near heater and naked flames.

* Combustion means burning. **Combustible materials** refer to materials that can burn easily.

Combustion can be denoted scientifically with a triangle called **triangle of combustion** or **Fire triangle** in which each element that makes up fire takes one arm of the triangle. The **Triangle of Combustion** or **Fire triangle** is a three sided geometrical representation of the three basic factors necessary for fire to occur.



Fire Triangle or Triangle of Combustion

FIRE FIGHTING: Fire fighting refers to the extinguishing or putting out of fire. The method used to extinguish fire is to eliminate one of the arms of the fire triangle through starvation or cooling or smothering.

1) **Starvation:** is the removal of fuel (combustible materials) from the area of combustion or the place where the burning is taking place.

2) **Cooling:** is the removal of heat from the area of combustion usually by the use of water or other cooling agent to lower the temperature of the area of combustion below ignition temperature.

3) **Smothering:** is the removal of oxygen from the area of combustion usually by preventing access of free air to the area of combustion. Example of smothering is the use of thick blanket to eliminate air flow from the area of combustion.

***** Extinguishing agents, medium and device for fire**

Extinguishing agents, medium and device for fire are: water, fog, foam, carbon dioxide, metal powder, dry sand, powdered soda ash, chemical powder fire extinguisher and by cutting off supply of electricity.

CLASSES OF FIRE

There are various ways of classifying fire by different authors and researchers based on specific criteria of interest at a particular time. For the purpose of this course (WKS 110), fire is classified into five groups: Class A, Class B, Class C, Class D, Class E (Electrical Fire) and Class F fire.

Class A Fire: Fire that involves ordinary combustible solid materials. Examples of such materials are: wood, rags, paper, or solid trash. Extinguishing agent: water.

Class B Fire: Fire that involves flammable liquids and liquefied solids. Examples of such materials are: Gasoline, oil, grease, paints, and thinners.

Extinguishing agents: water, fog, foam, carbon dioxide and chemical powder fire extinguisher.

Class C Fire: Fire involving flammable gases and liquefied gases. Example of such gases are natural gas, liquefied natural gases.

Extinguishing agents: Foam, fog and chemical powder.

Class D Fire: Fire that involves combustible metals. Example of such metals are: powder aluminum and magnesium

Extinguishing agents: Metal powder, powdered soda ash and dry sand.

Class E Fire (Electrical Fire): Class E fire or Electrical fire are fire involving live electrical apparatus, devices or electrical materials. Electrical fires normally involve classes of fire A – D. Extinguishing agents or approach: The normal procedure of extinguishing electrical fire is to first cut off the supply of electricity and use the appropriate extinguishing method to appropriate to the item that is burning. For electrical fire, it is advisable to use extinguishing agents that are non conductors on electrical fire.

Class F Fires – are fires involving cooking oils.

Types of Fire Extinguishers and their Uses

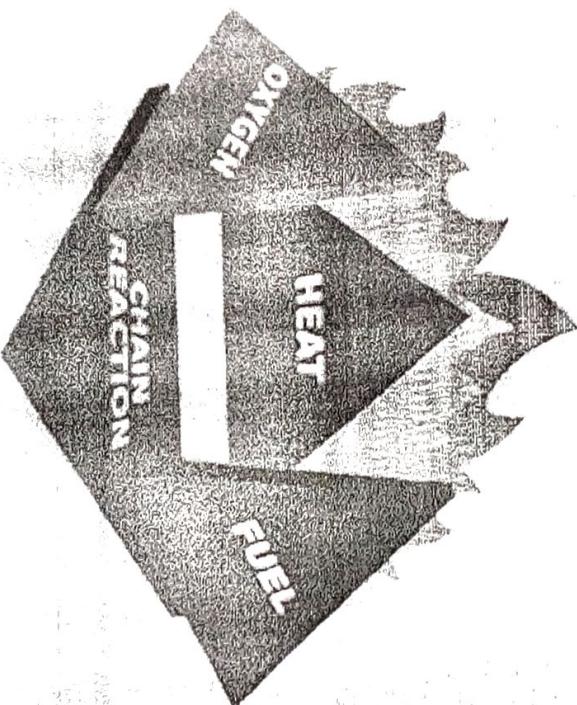
- A. **Foam**—instead of spraying stream into the burning liquid, allow foam to fall lightly on the fire; use for class A or class B fires.
- B. **Carbon dioxide** – Direct discharge as close to fire as possible, first at the edge of flames, then gradually forward and upward; use for class B or class C fires.
- C. **Pump tank** – Place foot on foot pump and direct stream at base of fire; use on class A fires only.
- D. **Dry chemical** – direct at base of the flames and with a class A fire, follow up by directing the dry chemicals at remaining materials that is burning; use for class B or class C fires.
- E. **Halon** – stand back ten feet, hold upright, and direct at the base of fire, sweeping from side to side; use for class C fires.
(NOTE: halon is a clean, liquefied gas which does not leave a residue.)

FIRE PREVENTION

1. Know the location of the nearest fire alarm and the nearest fire exit.
2. Know the location and learn the use of fire protection equipment in the building or workshop.
3. Keep only rags or waste in closed metal containers to avoid possible fire from spontaneous combustion.
4. Containers of inflammable materials like paints or oils should be closed and returned to proper storage after use.

FIRE TETRAHEDRON: In recent years, fire experts have redefined the triangle to a tetrahedron, adding an actual **chemical chain reaction** component to the three components already present in the fire triangle. The **fire tetrahedron** is a four-sided geometric representation of the four factors necessary for fire: fuel (any substance that can undergo combustion), heat (heat energy sufficient to release vapor from the fuel and cause ignition), oxidizing agent (air containing oxygen), and uninhibited chemical chain reaction. The fire tetrahedron is composed

of four basic variables: fuel, heat, oxygen and chemical chain reaction. Basically, while the three classic components are still needed, an actual chemical reaction must take place in order for the fire to ignite. Once a fire has started, the resulting exothermic chain reaction sustains the fire and allows it to continue until at least one of the elements of the fire is blocked. As with the fire triangle, as soon as one of the four elements of the tetrahedron is removed, combustion stops and the fire is extinguished.



Fire Tetrahedron

1. AUTOMOBILE TECHNOLOGY WORKSHOP

General Safety Precaution in the Automobile Workshop

1. **CLOTHING:** The cloth to be worn by an automobile mechanic, technician or student working in the automobile workshop should be a well tailored overall or laboratory coat. Ceremonial clothes, necklace, metal wrist watch, fashion spectacles, and other metallic materials should not be worn in the workshop because these materials can cause accident in the workshop. Also avoid wearing loose clothes.
2. **TIDINESS:** The automobile mechanic, technician or student working in the automobile workshop should always be neat, the workshop should be tidy. Tools and component should not be left where someone may fall over them. Oil or **grease** on the workshop floor should be covered with sand or sawdust to prevent accident resulting from slippery floor.
3. **OPERATING MACHINE:** An automobile mechanic, technician or student working in the automobile workshop should know how to control and stop a machine before using it. Do not wear loose clothes when operating a machine because the clothes can easily be caught by the machine causing the operator great injury.

4. BENCH WORK: Always use the correct tools when working on the bench. Avoid using chisels with large burrs to avoid accidents. Carry all shapes edged pointing tools with the sharp edge pointing downward.

5. LIFTING AND SUPPORTING: Before jacking up a vehicle ensure that the hand brake is on or the wheels are prevented from rolling by placing wooden blocks in front of the front wheel, or behind the rear wheel as the case may be.

*Always place axle stands beneath the axles to ensure against failure of the jack.
*Never use a jack to lift a load heavier than that for which it was designed.

6. OPEN PITS: Always keep the pit clean. A movable guard rail placed round the pit when not in use may prevent someone from falling in. An automobile mechanic, technician or student working on the upper part of the vehicle must take care that no tools, fall onto anyone working below. Keep the pit it clean always.

Before working beneath a vehicle on a hydraulic hoist, check that the hoist is functioning properly. Never use a hoist or a crane to lift a load heavier than that for which it was designed.

7. ELECTRICITY: Automobile electrical tools should not be carried by the cable because tension applied might cut the cable. All portable electrical tools and lamps must have a three wire system, i.e positive (or live), neutral and earth. The earth connection is of vital importance to ensure the safety of the operator of the automobile electrical tools.

Automobile-electrical hand tools should be 110 volts and lamps 12 volt if 100% safety is to be assured.

*Avoid working on electrical equipment when standing on damp or wet floor.

8. COMPRESSED AIR: Do not blow compressed air tangentially into the balls or rollers of races while the centre track is supported in the finger because the speed attained by the outer track is high enough to cause serious injury to the finger.

*Do not joke to aim the nozzle of compressed air equipment at workmates as the practice is dangerous to normal health.

9. GREASING: When greasing, the grease nipple must be at the particular area you intend to grease before pressing the triggers. Do not put a finger over the jet while holding the trigger; never point the grease gun at another person.

10. WELDING: When welding, use goggles or a shield to protect your eyes from glare. Protective clothing should be worn to reduce the risk of burns.

Learn how to use the welding equipment properly; oxygen bottle and fittings as well as oxy-acetylene sets if not handle correctly can be dangerous.

11. FIRE AND FUMES: All traces of petrol or fuel oil must be removed before applying heat to a petrol tank because even a small quantity of petrol left in the tank can result to a fire during heating.

- * There should be no smoking in the workshop.
- * The workshop should be well ventilated by opening all windows and doors and by installing heat extractor machine at strategic locations in the workshop.
- * Before using a hammer, make sure that the head is firmly attached to the handle.
- * When using a drilling machine to drill holes in a metal, make sure both the tool and work are securely clamped.

Maintenance

Maintenance is any operation that will keep the vehicle in good working condition, which is aimed at reducing wear of part, cutting down consumption of oil and fuel, identifying and eliminating any defects in due time; thereby promoting the safety and extending the service life of the vehicle.

Daily routine maintenance

1. Checking the radiator to see the coolant level and topping when necessary
2. Checking the engine oil level and topping the engine oil when necessary to the maximum level on the dip stick
3. Checking the pressure of the tyres and ensure that all the tyres are gauged
4. Checking the lighting system (break light, side lamp, and head lamp e.t.c) to the safety of traffic and other road users.
5. Checking the horn to ensure that it is good working order for the safety of traffic and other road users.

3. A center punch is used to mark the material before drilling. It leaves a small u-shaped hole that in aligning the drill bit. It may also be used to mark parts so that they will be assembled in the correct position.
4. The box and wrench are completely closed on both end they fully surround and grip the head of a bolt or nut. It should be used to lose an extremely tight rusted or partially round bolt or nut head.

2.

BUILDING TECHNOLOGY WORKSHOP

Hand Tools use in building construction

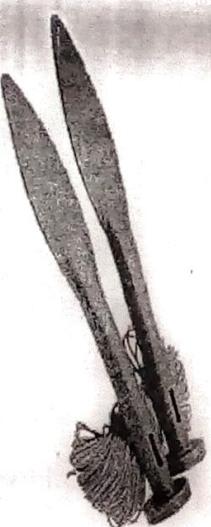
- 1) **Trowel:** - This consists of a steel blade and handle into which a wooden handle is fixed, it is used to lifting and spreading mortar onto a wall, for forming joints and for cutting bricks. It is the major tool of the block layer.



- 2) **Straight edge:** - This is a piece of wood of about 75mm x 13mm x 1000mm, that has paralleled edges used for testing the straightness of brick or block.



- 3) **Line and pins:** - The line measures up to 30m long and is wound round two steel pins. It is used to maintain the correct alignment of courses of bricks or blocks.



- 4) **Square:** - This may be made of steel and wood or it may be made entirely of steel. It is used for setting out right angles from the face of a wall, testing perpendiculars, and for squaring bricks or blocks before cutting.

5) **Spirit level:** - This may be made of wood or metal and is fitted with three spirit tubes. It is used in conjunction with the straight edge, for obtaining level horizontal surfaces.



6) **Club hammer:** - Club hammers come in two sizes those weighing 1.35kg and those weighing 1.81kg. together with the bolster the hammer us used for accurate cutting away chasing. It is also used in conjunction with the cold chisel.



7) **Wooden hawk or hand board:** - This is a 225mm by 225mm by 13mm board fitted with a stamp handle in the center and use for holding small quantities of mortar during pointing operations.



8) **Pointing trowel:** - This is smaller than the trowel used for lifting and spreading mortar. It is used for placing mortar in joints during pointing the process of placing mortar between block or brick.

- 9) Frenchman: - This is a discarded table knife, the blade of which is cut to a point and 10mm of which is bent at right angles to the blade and used for tuck pointing.



- 10) Jointer: - The jointer consists of a steel blade 50mm to 150mm long, the edge of which may be flat grooved concave, convex or rounded; it is used for jointing and pointing brick work and block work.



Set of Drawings for Residential House

The drawings which are ordinary included in a set of residential house plans are as follows:-

- 1) The site plan: - This shows the relation between where a building project is to be executed and the existing topography of the area.
- 2) The plot plan: - Shows the exact area and the derogation of land in which a building is to be constructed.
- 3) The floor plan: - Shows detail layout of each compartment or rooms in a particular residential house.
- 4) The foundation: - Shows the kind of foundation to be use in a building.
- 5) The elevations: - Shows the visible features that can be seen within each side of the building.
- 6) Electrical plan: - Shows the electric fittings, in a building such as the switches, socket, fan, etc.
- 7) The construction details: - Some time refers to a sectioning, it shows how the construction is carried out and the material used for the construction of parts of a building

Teams involved in a Building Process

The following teams are involved in a building process

- 1) Client team: - Provides all the necessary information in the form of drawing and also provide fund for the payment of contractor open completion of the project.
- 2) User team: - This is a group of people in which their function is to utilize the building for the purpose it being made up.
- 3) Design team: - This involved the architect that does the drawing and the structural engineer that does the mathematical aspect involve in the drawing.
- 4) Research team: - This group of people involve in the improvement of building structure and finding a way of solving building problems
- 5) Legislative team: - This is group of people in which their function is to enact building law
- 6) Manufacturing team: - This concern with the production of building fabric
- 7) Construction team: - This group of people deals directly with the executing or transforming what they drawing on the paper to the ground.
- 8) Maintenance team: - This concern with the corrective measure to be taken periodically on a building as a result of long usage which causes damage on the building fabric.

Means of Communication in a Building Process

The means of communication in a building process are as follows: -

- 1) Technical data: - Involve the following i.e dimensioning in the drawing positioning of parts, notes etc.
- 2) Drawing: - Which include the floor plan, elevations, sectioning, pictorial etc.
- 3) Specification: - The exact measurement or detailed plan about how each operation is to be made such as thickness of the wall, window size, door size, roof etc.
- 4) Tender documents: - Which include letter of offer, which content bill of quantity and letter of acceptance from the client.
- 5) Contracts: - An agreement between the client and a contractor to carry out a building project under certain condition and time.
- 6) Programme of work

Bonding of Brickwork

Bonding is the arrangement of brick in which no vertical joint of one course is exactly over the one in the next course above or below and having a greatest possible amount of lap which is usually $\frac{1}{4}$ the length of brick.

Choice of Brick Bond

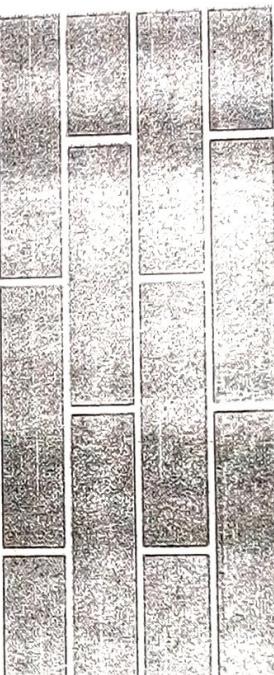
Factors which influence the choice of brick bond are: -

- 1) Thickness of the wall
- 2) The strength characteristics
- 3) The function of the wall

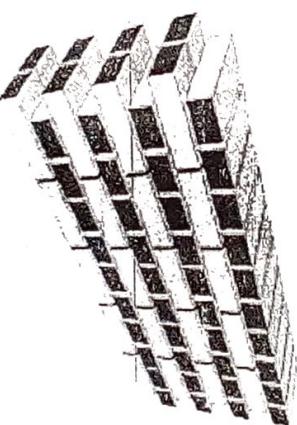
- 1) To give maximum strength and to adequately distribute loading over the wall.
- 2) To give lateral stability and resistance to side thrust for decoration

Types of Bond

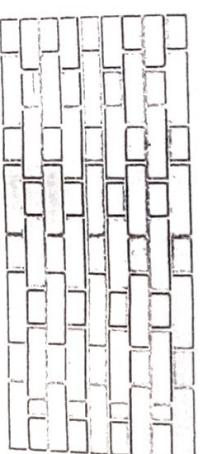
- 1) Stretcher bond: - A wall of stretcher bond has all bricks laid as stretches on every course to avoid continuous vertical joints a half but is used to commence or finish alternatives courses. This type of bond is used for walls that are half a brick thick.



- 2) Header bond: - This is normally used on one brick thick-wall, the wall is so built that every brick shows a header face on each side of the wall.



- 3) Flemish bond: - This consists of alternative header and stretcher faces in every course. This bond offers an alternative appearance and is reasonably strong.



- 4) English bond: - This consists of alternative courses of headers and stretchers. It is a very strong bond.



AGGREGATES

Aggregates constitute the largest single material by weight and volume used in building construction. The term aggregate is a broad term used to refer to stones, sand, gravels, broken bricks/blocks. Aggregates are classified according to the sizes of the particles in them. These are:-

- 1) Fine aggregates: - Consist mainly of sand and fine quartz. Fine aggregates are used in mortar and concrete to enhance the binding power by providing gritty surfaces for contact with cement and bricks or blocks.
- 2) Coarse aggregates: - Are used to achieve greater volume of construction materials and to improve strength. They could also be used to increase or reduce the weight of concrete, coarse aggregate also used to be washed before being used in concreting in order to increase their adhesion to cement.

Uses of Aggregates

- 1) Aggregates are used in making concrete
- 2) They are used as hardcore in flooring
- 3) They are used as surface gravels
- 4) They are used with cement binder as joining material for pipes

3. COMPUTER WORKSHOP

Safety Measures or Precaution when Using Computers

Every student, computer professionals and users should be aware of safety precaution to be taken when using the computer in the workshop (computer room), laboratory or at home. To avoid health problems and accidents in the computer room the following safety measure or precaution should be considered :

Good Ventilation: Air conditioner is necessary in the computer room to make the computer performs well. The computer generates a lot of heat, hence the need for the air conditioner or fan. It is also necessary for the computer user to be comfortable. The design of workstations should be such that people are maintaining neutral posture.

Setting Computers: When setting a computer room the following must be taken into consideration:

1. The computer must be space apart.
2. There must be free entry and exit.
3. All wires connecting the system should be properly disposed.
4. A computer library should be closed to computer room.

Dust free environment: Dust should be prevented as often as possible in the computer. The floor must always be kept clean the computer and its peripheral should be covered using the dust cover after use.

Protection from power problems: The surge protectors, the use of stabilizer and UPS must be upheld to prevent any form of damage caused by power fluctuations.

Good Lightening: The computer room should be well illuminated, use of florescent tubes and bulbs to provide light to make the room bright for all the activities carried out by the computer uses is essential.

Computer Security: This involves putting in places a reliable security measures to protect and to prevent crime such as:

1. Provision of secured guards to control access to the center.
2. Provision of log register to monitor staff.
3. Provision of UPS and generator to prevent accidental loss of data.
4. Ensuring that waste documents are properly burnt.
5. Ensuring that equipments are switched off when not in use.
6. Solid construction of the computer center with secured windows.

Logical Security: This means building software check/control into the system to disallow unauthorized access. These are achieved through the use of passwords and access codes. The following logical measures will assist to prevent crime:

1. Provision of passwords for authorized users.
2. Provision of data encryption method.
3. Provision of a system to monitor the activities of all login users.
4. Provision of regular audit to all computing resources.
5. Provision of security software to restrict the permission of the users to read only ie he cannot modify the data or copy the information.
6. Provision of an alarm system when an attempt is made to break into the program
7. Provision of protection software to limit the user's activities to specified directory or program

Precautions in the Computer Room : The following rule and regulations must be observed when in the computer room:

1. There should be no noise or fighting in the computer room.
2. Handle the equipments with care.
3. All computers should be cover after use
4. Do not receive visitors in the computer room
5. There should be strong security around the computer room to prevent theft.
6. The system should be shut down or turned off after use.

CARE OF THE COMPUTER

1. Computer and related devices are not heat friendly; therefore do not operate computer in a poorly ventilated environment.
2. Never switch off computers but shut down properly to avoid creating irreparable errors on your hard disk.
3. Do not leave computer or related devices while they are not being used.
4. Always cover computers and other devices with their cover when they are not in use to prevent them from dust.
5. Always follow the shutdown procedure and never turn off the computer until a screen message tells you to do so.
6. Do not shake the desk or table while the computer and the other related devices are working to interrupt.

4. ELECTRICAL AND ELECTRONICS TECHNOLOGY WORKSHOP

Types of Hand Tools and Equipment in Electrical Workshop

A. Pliers

1. Long nose chain pliers (NOTE: These are commonly called needle nose pliers.)
2. Diagonal cutting pliers
3. Lineman's side cutting pliers
4. Combination slip joint pliers

B. Saws

1. Hacksaw
2. Hole saw

C. Screwdrivers

1. Flat blade (slot-head) screwdriver
2. Philips head (cross-point) screwdriver
3. Star head screwdriver

D. Adjustable wire strippers

E. Electrician's six-in-one tool

F. Wrenches

1. Adjustable wrenches
2. Hex and spline wrench

G. Nut driver

H. Hemostat clamp

I. Ball peen hammer

J. Files

1. Flat file
2. Half-round file
3. Precision file

K. Punches

1. Center punch
2. Square hole punch
3. Round hole punch

L. Mechanical wire strippers

M. Thermal wire strippers

- N. Soldering iron stand
- O. Heat sink
- P. Component lead cleaner
- Q. Solder sucker
- R. Shrink tubing
- S. Insertion or removal tool
- T. Drill and drill bits
- U. Wire gauge
- V. Soldering vise
- W. Crimping tool (open barrel)

Hand Tools and Equipment and their Uses

- A. Long nose chain pliers
 - 1. Holding components
 - 2. Heat sink
 - 3. Shaping and forming small conductors
- B. Diagonal cutting pliers
 - 1. Cutting wire and component leads
 - 2. Stripping insulation from wire
- C. Lineman's side cutting pliers
 - 1. Cutting heavier conductors and cables
 - 2. Cutting small screws
 - 3. Stripping insulation from wires
 - 4. Forming large conductors
- D. Combination slip joint pliers
 - 1. Loosening small to medium size nuts and bolts
 - 2. Holding and turning
- E. Screwdrivers – removing or tightening screws and bolts
- F. Hacksaw
 - 1. Cutting chassis metal
 - 2. Cutting bolts or metal parts
- Example: Antenna installation parts, or screws and bolts too large to cut with side cutting pliers
- G. Electrician's six –in-one tool
 - 1. Crimping solderless connection
 - 2. Cutting wire
 - 3. Stripping insulation from wire
 - 4. Shearing bolts
 - 5. Thread gauges
 - 6. Length gauges for stripping
- H. Nut drivers
 - 1. Holding nuts or bolt heads
 - 2. Tightening or loosening nuts or bolts
- I. Hex and splint wrenches
 - 1. Tightening or loosening socket cap screws
 - 2. Tightening or loosening set screws
- J. Hole saws and hole punches
 - 1. Cutting holes up to four inches in diameter
 - 2. Punching round or square holes in metal
- K. Mechanical wire strippers- for cutting and pulling insulation from ends of conductors

I. Thermal wire strippers - for removing wire insulation by heating and melting the material; prevents wire strands, but cannot be used on insulation that will not melt.

M. Soldering iron stand - for supporting a hot soldering iron when not in use

N. Soldering vise - for clamping and holding a printed circuit board or other component during soldering or other repair operations.

O. Crimping tool - for making a strong mechanical connection to certain sleeve-type terminals

P. Shrink tubing - for preventing electrical connections from becoming shorted to adjacent connections

Q. Heat sink - for drawing heat from soldered connection to prevent damage to components.

R. Component lead cleaner - for removing oxides and other films from component leads.

S. Insertion or removal tool - for inserting or removing integrated circuits without bending pins.

Factor to Consider when Selecting Hand Tools

(NOTE: when in doubt about what tools are best, consult a practicing electronics specialist in your area)

A. Tool size should be matched to the work most frequently encountered.

B. Tools should be specifically designed for electronic use when possible.

Examples: insulation on handles of pliers and screwdrivers

C. Know the specification before purchasing a tool

Examples: pliers long chain nose, 5", with plastic, grip handles, and separated jaws.

Tool Maintenance Procedure

1. Keep the tools and equipment clean and rust free
2. Keep cutting edges sharp and smooth
3. Lubricate moving parts that need to be lubricated.
4. Repair or replace damaged handle insulation
5. Use a right tools for right job

Electricity Is Dangerous

Whenever you work with power tools or on electrical circuits there is a risk of electrical hazards, especially electrical shock. Anyone can be exposed to these hazards at home or at work. Workers are exposed to more hazards because job sites can be cluttered with tools and materials, fast-paced, and open to the weather. Risk is also higher at work because many jobs involve electric power tools. Electrical trades workers must pay special attention to electrical hazards because they work on electrical circuits. Coming in contact with an electrical voltage can cause current to flow through the body, resulting in electrical shock and burns. Serious injury or even death may occur. As a source of energy, electricity is used without much thought about the hazards it can cause. Because electricity is a familiar part of our lives, it often is not treated with enough caution. As a result, an average of one worker is electrocuted on the job every day of every year!

Electrical Current

Basically, electrical hazards can be categorized into three types. The first and most commonly recognized hazard is electrical shock. The second type of hazard is electrical burns and the third is the effects of blasts which include pressure impact, flying particles from vaporized conductors and first breath considerations.

Electrical Shock

Electric shock occurs when the body becomes part of an electrical circuit. Shocks can happen in three ways.

1. A person may come in contact with both conductors in a circuit.
2. A person may provide a path between an ungrounded conductor and the ground.
3. A person may provide a path between the ground and a conducting material that is in contact with an ungrounded conductor.

The terms high voltage and low voltage are relative terms. In transmission-line terminology, "low voltage" is much higher than the 600 volts. At home, you would not think of 600 volts as being low voltage. Even when applied to 120-volt circuits, the term low voltage is deceiving. To some people low voltage means low hazard. Actually, low voltage does not necessarily mean low hazard, because potential difference is only one factor making up the dangerous effects of electricity. For purposes of this Lesson, you can think of "low voltage" as being a potential difference of 24-600 volts.

The extent of injury accompanying electric shock depends on three factors.

1. The amount of current conducted through the body.
2. The path of the current through the body.
3. The length of time a person is subjected to the current.

The amount of the current depends on the potential difference and the resistance. The effects of low current on the human body range from a temporary mild tingling sensation to death. An electric shock can injure you in either or both of the following.

1. A severe shock can stop the heart or the breathing muscles, or both.
2. The heating effects of the current can cause severe burns, especially at points where the electricity enters and leaves the body. Other effects include severe bleeding, breathing difficulty, and ventricular fibrillation. In addition, you may strike something, or have some other accident as a result of your response to the shock. The effects of electric current are listed below:

Current in milliamperes	Effects
1 or less	No sensation; probably not noticed
1 to 3	Mild sensation not painful
3 to 10	Painful shock.
10 to 30	Muscular control could be lost or muscle clamping
30 to 75	Respiratory paralysis
75mA to 4 amps	Ventricular Fibrillation
Over 4 amps	Tissue begins to burns. Heart muscles clamp and heart stops beating.

Effects of Electrical Current on the Human Body

Current is the killing factor in electrical shock. Voltage is important only in that it determines how much current will flow through a given body resistance. The current necessary to operate a 10 watt light bulb is eight to ten times more current than the amount that would kill a person. A pressure of 120 volts is enough to cause a current to flow which is many times greater than that necessary to kill.

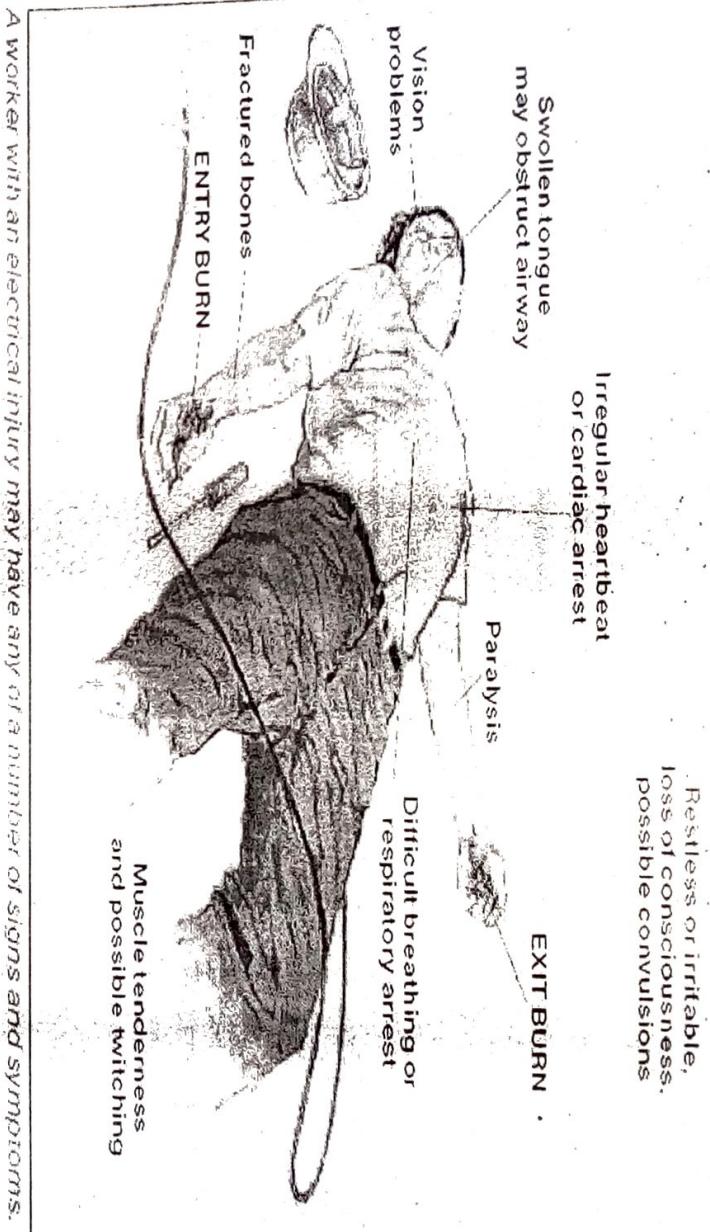
The following values are given for human resistance to electrical current:

Type of Resistance	Resistance Values
Dry skin	100,000 to 600,000 Ohms
Wet skin	1,000 Ohms
Hand to Foot	400 to 600 Ohms
Ear to Ear	100 Ohms

Resistance Values

With 120 volts and a skin resistance plus internal resistance totaling 1200 Ohms, we would have 1/10 ampere electric current that is 100 milliamperes. If skin contact in the circuit is maintained while the current flows through the skin, the skin resistance gradually decreases. During this time, proper first aid can mean the difference between life and death. Sufficient circulation can sometimes be maintained by heart compression, which should always be supported with mouth-to-mouth resuscitation.

Worker with an Electrical Injury



Electrical Rescue Techniques

Approaching the accident:

1. Never rush into an accident situation.
2. Get the aid of trained electrical personnel if possible.
3. Approach the accident scene cautiously.

Examining the scene:

1. Visually examine victims to determine if they are in contact with energized conductors.
2. Metal surfaces, objects near the victim or the earth itself may be energized.
3. You may become a victim if you touch an energized victim or conductive surface.
4. Do not touch the victim or conductive surfaces while they are energized.
5. De-energize electrical circuits if at all possible.

Methods to de-energize:

1. An extension or power cord probably powers portable electrical equipment.
2. Unplug portable electrical equipment to remove power.
3. Open a disconnecting device or circuit breaker to de-energize fixed electrical equipment.

Hazards and solutions:

1. Be alert for hazards such as stored energy, heated surfaces and fire.
2. If you can't de-energize the power source use extreme care.
3. Ensure that your hands and feet are dry.
4. Wear protective equipment such as low voltage gloves and overshoes if available.
5. Stand on a clean dry surface.
6. Use nonconductive material to remove a victim from the conductor.

High voltage rescue:

1. Special training is required for rescues if high voltage is present.
2. Protective equipment such as high voltage gloves and overshoes must be worn.
3. Special insulated tools should be used.

Insulated tools:

1. Insulated tools, with high voltage ratings, are a lifesaver!
2. Use devices such as hot sticks or shotgun sticks to remove a victim from energized conductors.

In some cases, nonconductive tape or cord may be used to remove a victim from a conductor.

Rescuing the victim:

1. Stand on a dry rubber blanket or other insulating material if possible.
2. Do not touch the victim or conductive material near the victim until the power is off.
3. Once power is off, examine the victim to determine if they should be moved.
4. Give "First Aid."

First Aid:

1. A victim may require Cardio-Pulmonary Resuscitation (CPR).
2. If the victim is breathing and has a heartbeat, give first aid for injuries and treat for shock.
3. Ensure the victim gets medical care as soon as possible.
4. Provide medical personnel with information on voltage level, shock duration & entry/exit points.
5. The treating/attending physician must have detailed specific information to properly diagnose and care for the victim.
6. The physician must determine whether the victim should be sent to a "Trauma or Burn Center."

Safety Color Coding

A. Green

1. Applied to nonhazardous part of marching and equipment surfaces, like nameplates and bearing surfaces
2. Designates safe areas of equipment, and is also used to show location of safety equipment and first-aid materials

B. Yellow

1. Applied to operating levers, wheels, handles, and hazardous parts that may cause stumbling, falling, snagging, or tripping
2. Designates caution

C. Orange

1. Applied to electrical switches, interior surfaces of doors, fuses and electrical power boxes, and movable guards and parts
2. Indicates dangerous parts of equipment which may cut, crush, shock, or otherwise physically injure someone.

D. Red

1. Applied to buttons or levers of electrical switches used for stopping machinery, and to all equipment, such as gasoline cans, which are fire hazards.
2. Designates fire hazards and fire-fighting equipment
(NOTE: the color red is also applied to other fire-fighting equipment, such as fire alarms, fire axes, and emergency exits.)

E. Blue

1. Used to identify equipment which is being repaired or is defective and should not be operated
2. Designates "out of order" or "defective"

F. Ivory

1. Applied to table edges, vise jaws, and edges of tool rests where extra light reflection is important.
2. No particular designation except to help show tool and equipment moving edges more clearly.

General Safety Rules in Electrical and Electronics Technology Workshop

- A. Keep all hand tools clean and in safe working order.
- B. Report any defective tools, test equipment, or other equipment to the instructor.

- C. Do not remove any safety devices, (i.e. ground traps; switch covers, etc.) without the permission of the instructor.
- D. Do not operate or energize any circuit that could be hazardous without first receiving instruction on how to do so safely.
- E. Report all accidents to the instructor regardless of nature severity.
- F. Turn off power before leaving test equipment or circuits being worked on.
- G. Do not use any solvent without first determining its properties, and how to use it safely. (note: solvent should be used only in well-ventilated spaces)
- H. Keep the laboratory floor clean of scraps and litter.
- I. Clean up any spilled liquids immediately.
- J. Isolate line (power) voltages from ground by means of isolation transformers.
- K. Check all line (power) cords before using and if the insulation is brittle and/or cracked, DO NOT USE and report to the instructor.\
- L. When measuring voltages with a meter and test probe, be careful not to connect yourself to a voltage of any value.
- M. Be certain that floor is insulated either by tiles, rubber mats, the wearing of rubber-soled shoes.
- N. When measuring voltages expected to be greater than 30 volts, turn off or disconnect live circuit before connecting test equipment, or follow manufacturer's recommended procedures. (NOTE: always treat voltages with great respect.)
- O. It is recommended that only equipment with a polarized (3-prong) plug be used.
- P. Do not carry sharp-edged or pointed tools in your pockets.
- Q. Do not defeat the purpose of any safety device such as fuses, circuit breakers, or interlocks; shorting across these devices could cause excessive current flow, and destroy or seriously damage equipment being worked on, as well as cause a fire.
- R. Do not indulge in horseplay or play practical jokes in any work area.
- S. Wear safety glasses when required
- T. Do not wear rings or jewelry when working with electrical devices.
- U. Wear proper clothing
- V. Exercise good judgment and common sense

reveal that some characteristic groups of dangerous parts are acting as common sources of accidents in workshops. Many such major sources are as under.

1. Revolving parts, viz. pulley, flywheels, worms, worm wheel, fan, gears, gear trains, gear wheels etc.
2. Projecting fasteners of revolving parts; like bolts, screws, nuts, key heads, cotters and pins etc.
3. Intermittent feed mechanisms, viz., tool feed of planer; table feed of a shaper, ram feed of power presses and similar other applications.
4. Revolving shafts, spindles, bars, mandrels, chucks, followers and tools like drills, taps, reamers, milling cutters, and boring tool etc.
5. Rotating worms and spirals enclosed in casings, such as in conveyors and revolving cutting tool, like milling cutters, circular saw blade, saw band, circular shears and grinding wheels, etc.
6. Reciprocating tools and dies of power presses, spring hammer, drop hammers, and reciprocating presses, reciprocating knives and saw blade such bow saw, shearing and perforating machines and the cutting and trimming machine and power hacksaws etc.
7. Moving parts of various machines, like those of printing machines, paper-cutters and trimmers, etc.
8. Revolving drums and cylinders without casing, such as concrete and other mixers, tumblers and tumbling barrels, etc.
9. High speed rotating cages such as in hydro-extractors.
10. Revolving weights such as in hydraulic accumulator or in slotting machines for convector

General Safety Rules for Machine Users

1. Do not play with the switches of a machine.
2. Ensure that the working environment in the metalwork workshop is well lighted and ventilated.

3. Do not operate any machine you don't have knowledge about.
4. Do not be allowed to be distracted while operating a machine.
5. Always switch off machines after use and remove them from the socket.
6. The workshop floor should not be littered with dangerous objects.

Safety Rules for Work Bench Users

1. Do not use files or chisels without handles.
2. Learn to use tools in the proper way and keep them in a safe place.
3. When using the bench vice there should be no horseplay.
4. Wear protective shoes with toe cover.
5. Wear goggle or eyelids while filing, cutting and welding.
6. Do not carry any sharp object in your pockets.
7. Do not wear overflowing garments, bangles and chains in the workshop.
8. Do not wear neck ties while working on the bench or any machine.

Safety Precautions while Working with Different Hand Tools

Screw Drivers

1. When working on electrical equipment use only a screw driver with an-approved handle
2. One should wear goggles when re-sharpening screw-driver tips.
3. Screws with burred heads are dangerous and must be replaced or the burrs removed with file or an abrasive cloth.
4. One should use the correct tip of screw drivers while screwing. Too arrow or too wide tip will damage the work.

Wrenches

1. One should not hammer a wrench to loosen a stubborn fastener, unless the tool has been specially designed for such treatment.
2. Always pull on a wrench. One can have more control over the tool if pulling instead of pushing and there is less chance of injury.
3. It is dangerous practice to lengthen the wrench handle for, additional leverage. Use a larger wrench.
4. Choose a wrench that fit properly. A loose fitting wrench may slip and round off the corners of the bolt head and nut.

- When using wrenches clean grease or oil from the floor in the work area. This will reduce the possibility of slipping and losing balance.

Hammers

- One should not operate the hammer unless its head is tightly fixed to the handle.
- Place the hammer on the bench carefully. A falling hammer can cause serious foot injuries.
- Never strike two hammers together. The faces are very hard and the blow might cause a chip to break off.
- Never hold the hammer too far on the handle when striking a blow.
- Unless the blow is struck squarely, the hammer may glance off the work.

Safety Precautions while Working with Different Cutting Tools

Files

- One should always use a file card to clean the file. Never use your hand. The chips may penetrate in hand and cause a painful infection.
- One should not use a file without a handle.
- Short burns formed in filing may cause serious cuts. Always use a piece of cloth to wipe the surface being filed.
- Files are highly brittle and should never be used as a hammer otherwise the file will break.
- Never hammer on a file. It may shatter and chips fly in all directions.

Chisels

- One should always hold the chisel in such a manner that the hammer blow may not miss the chisel to injure your hand.
- Edges of metal cut with the chisel are often sharp and cause bad cuts.
- Flying chips are dangerous. Wear transparent plastic safety goggles and use a shield when using a chisel, to protect yourself and those working near you.
- Sharp edges of chisels are removed by grinding or filing.
- Mushroomed head of the chisel should be removed by grinding.

Saws

- One should not test the sharpness of the blade by a running a finger across the teeth.
- One should not brush away the chips with your hand.
- All hard blades can shatter and produce flying chips. Wear your toggles.
- One should not be sure that the blade is properly tensioned.
- Store the saw so that you will not accidentally reach into the teeth when you pick it up.

If the blade breaks while you are on cutting stroke, your hand may strike the works and cause an injury. Therefore saw operator should work carefully.

Reamers

1. One should remove all bars from the reamed holes.
2. Never use your hands to remove chips and cutting fluids from the reamer and work.
3. One should use a piece of cotton waste.

Taps and Dies

1. One should use a brush to clean away chips formed by hand threading. Never use your hand.
2. One should always wear goggles if the tap, die or threaded piece is to be cleaned with compressed air.
3. Tap operator should also be careful that other person working in the area also wearing goggles.
4. Handle broken taps as you would handle broken glass. They are sharp edges and are dangerous to handle.
5. Wash your hands after using cutting fluid. Skin-rashes caused by some cutting fluids can develop into a serious skin disorder if they are left on the skin for a long period.
6. Take care of any cuts immediately. Infection may occur when injuries are not properly treated.

Abrasives

1. If the lathe is used for polishing make sure that the machine is protected from the abrasive grains that fall from the polishing wheels during polishing. They can cause rapid wear of the precision parts.
2. One should not rub fingers or hand across a piece that has just been polished by abrasive.
3. Cuts and burns should always be treated immediately by using first aid facility.
4. One should remove all abrasive particles by washing them thoroughly after the polishing operation.

General Safety Precautions while Working in Machine Shop

The following safety precautions or guidelines are generally adopted for every metal cutting or machining shop. They must be strictly followed for safety. Specific safety guidelines for some of the machine process like lathe, drilling, shaping, planning, slotting, grinding, milling, and finishing operations are also described in the following sections.

1. One should use the correct tools and work holding devices recommended for the process.
2. One should hold the work piece and tool securely on the machine.

3. One should clamp the tool correctly. An overhanging tool may cause catastrophic failure of the tool, work piece or the machine tool.
 4. One should not try to remove chips from the machine with your hands.
 5. Never use compressed air from mouth. Use brush.
 6. One should not touch a job-piece with bare hands while doing inspection or removing it from the machine. Use gloves always.
 7. One should operate the machine at recommended operating conditions based on work material and tool material combination and other cutting conditions specified.
 8. One should use recommended coolant depending upon work-tool material combination.
 9. During machining ductile materials, use chip breakers and chip guards.
 10. One should re-sharp the tools immediately when it starts producing rough surfaces on the job-piece or produces chatter.
 11. One should not run the machines at speed higher than recommended. It may produce vibrations and chatter and damage job-piece, tool, or both.
 12. Provide sufficient approach and over travel distances wherever necessary.
 13. In case of power failures, switch off the machine and retrieve tool from the work piece.
 14. One should wear goggles to protect eyes from flying chips.
 15. Machines are governed by the old clinch garbage input, garbage output. The skill of the operator is often the limiting factor for the machining operation.
 16. Stop machine before attempting to clean, removing tool or work piece.
- ### HAZARDS AND WHAT TO DO ABOUT THEM
1. Report all injuries no matter how slight
 2. Get first aid as soon~~s~~as possible. Slight or moderate cuts should be allowed to bleed for a few moments to flush out infectious particles from the wound before stopping the bleeding. Severe wound should receive the immediate attention of a doctor.
 3. Treat burns properly. In first degree burns, the skin is merely reddened, treat by applying cold water and a sterile dry bandage. In a second degree burn, the skin is blistered while there is skin charring in third-degree burn burn. Second and third degree burns should receive a doctor's attention immediately.
 4. In any injury or illness get professional help as soon as possible.
- ### BASIC METAL WORKING TOOLS
- Metal working may be defined as the art of giving shape, value, function and aesthetic to metals. Variety of processes exists by which these are accomplished. A number of these processes calls for the use of basic tools commonly referred to as Hand and/or Bench Tools. These tools may be classified into Marking and Measuring, Forming/Shaping tools, or Holding and Cutting tools depending upon their conventional application.

MARKING AND MEASURING TOOLS

The Primary step in metal working is to measure and mark out where we are intending to work on in order to ensure accuracy. The following are the essential tools and instruments.

Scriber: Sharp pointed metal used for scribbling other metals. It may be single ended or double as shown. There are brass, steel and iron tip plate, zinc and aluminum. Point angle is about 30° .

CENTRE PUNCH



DOT PUNCH

Used for marking the positions of holes to be drilled. The point is ground to about 90° . A Dot Punch is similar with the point angle about 60° and used for marking the position at lines.

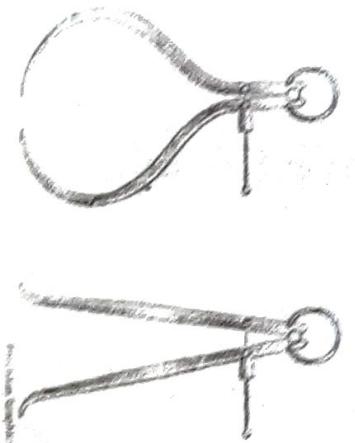


BELL PUNCH



A punch in a sliding fit in a bell used to mark the centre of a shaft as shown. Its use saves all the time which would otherwise be spent in marking out a centre.

Calipers



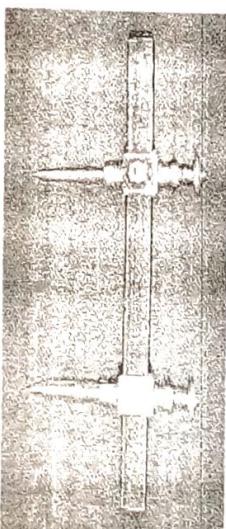
Calipers are used for taking or transferring measurements. They may be (a) Outside Calipers, (b) Inside Calipers, or (c) Oddlegs/Hermaphrodite/Jennies Calipers. The Outside Caliper is used on the external diameters of bodies, the inside caliper for internal measurements and the oddlegs for centering bars, taking distances from the edges of holes or plates and marking straight lines parallel to the edge of sheet or plate metals.

DIVIDERS



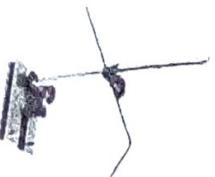
Dividers are used to transfer measurements from the rule to the job or vice versa and to throw circles and arcs.

TRAMMELS: Used for scribing circles of larger radii than may be drawn with dividers and for marking off lengths.



SURFACE GAUGE/SCRIBING BLOCK

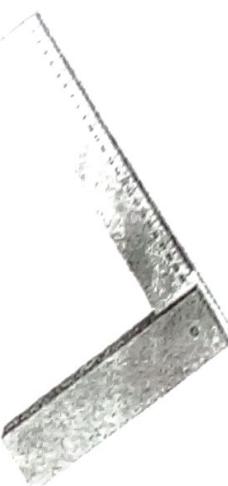
Used for marking off and measuring heights. It is always used on a surface plate.



SURFACE PLATE

A Slab of Cast Iron ribbed underneath for strength and with accurate face used for testing and marking out.

TRY SQUARE



The Try Square is used for setting and checking lines or surface which are required to be at right angles to some other plane.

The blade may be graduated.

PIN PUNCH

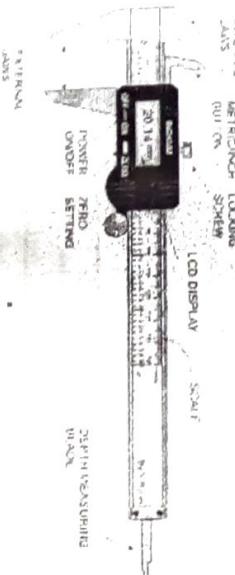


Similar in construction to a centre punch except that it has a flat surface on the end of a long taper. It is used for removal of rivets, studs or broken taps from holes.

RULER: Available in 15, 30 and 60cm lengths for linear measurements



THE VENIRE CALIPER



A Precision instrument that makes use of two scales (fixed and sliding Vernier that makes measurements possible to the hundredth of a millimeter.

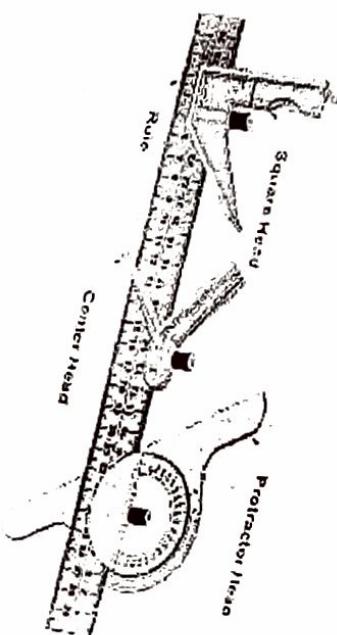
MICROMETERS



These are screw gauges that are capable of reading to the hundredth of millimeter. Micrometers may take many shapes according to whether they are for internal use, depth gauges or for measuring screw threads. They are available in ranges of 25mm i.e. 0 to 25mm and so on.



THE COMBINATION SQUARE



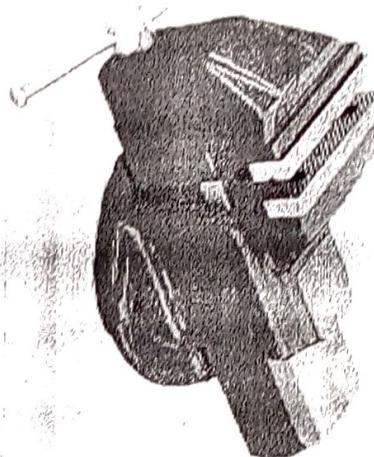
An extremely useful tool incorporating the essential features of the Try Square, Protractor and Centre Square. It uses include all of the uses of the Try Square, the Protractor. The Centre Square and may also be used as a Depth Gauge.

DEPTH GAUGE

Used for measuring the depth of holes, shoulders etc. Special forms of gauges may have micrometer readings on them.

HOLDING AND CUTTING TOOLS: When a piece of job has been carefully laid out by measuring and marking the next step usually is cutting to size or shape. Metals are generally hard materials that require special hand tools and clamping devices to enhance work on them. Such tools and clamping or holding devices include the following.

ENGINEER'S VICE:



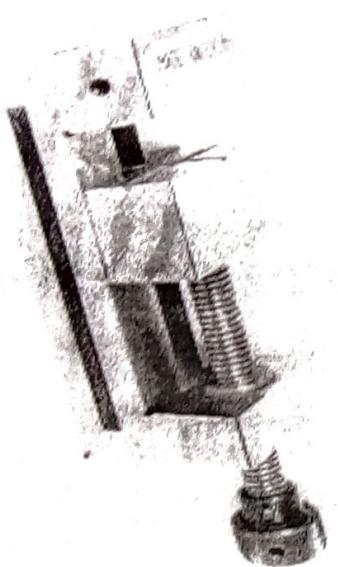
HAND VICE



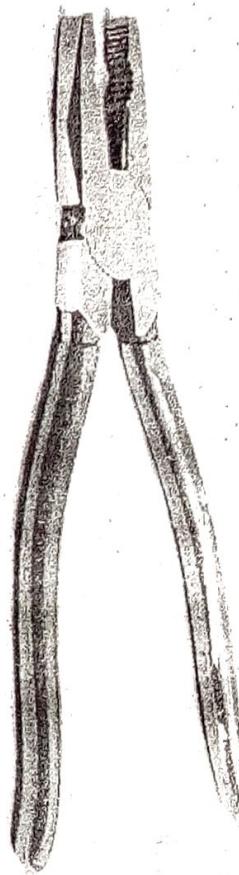
A light-duty vice that can be used to hold small work such as holding sheet metal for drilling etc.

Used mainly by tool makers to hold two parts of a job together while working on them.

TOOLMAKER'S VICE

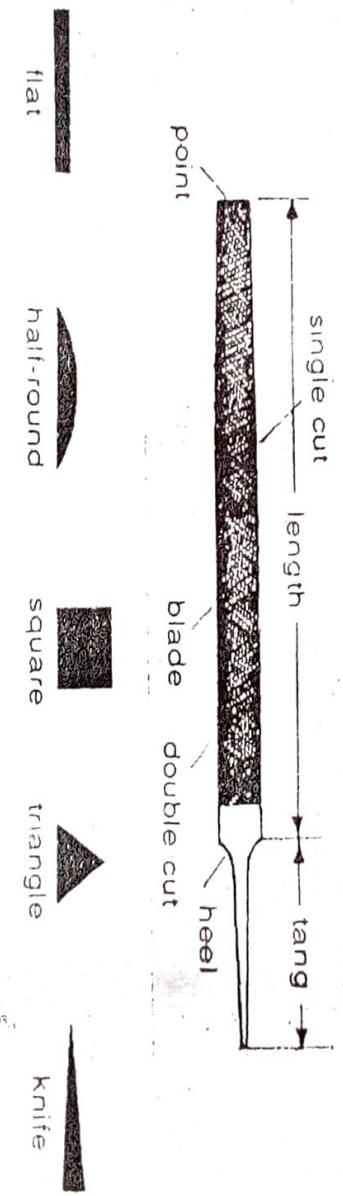


COMBINATION PLIERS



Used for holding small objects and for cutting wire, other types of pliers are flat-nose, round-nose and slip joint pliers with some variations on their gripping jaws.

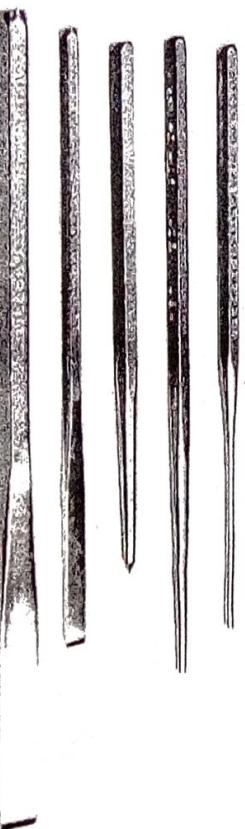
FILES: Files are probably the most important tools in the metal workshop. They are used to remove, smoothly and fairly accurately by hand, excess metal. There are a variety of files in shape, size and cuts to suit various types of work to be done. Some common file shapes are the following: they must always be used with handles firmly fixed.



A cross-section of different types of files

Used to scrape excess metal and bring surface to a smooth or fine finish. They are classified according to their cross-sectional shapes.

CHISELS: relatively important tools in the engineering workshop used for a variety of purposes like cutting sheet-metal to size, removing the hard skin from cast before fitting, removal of rivet heads before extracting them, cutting slots and grooves etc. The following are the most common types in general use.



HACKSAW:

These are cutting tools consisting of a blade held firmly in a frame with a handle attached. The handle may be wooden or pistol grip.

SNIPS:



Snips are used in light sheet and tinplate work to cut. They may be straight or curved.

FORMING AND SHAPING TOOLS: The various functions for which the tools already discussed are used are all preparatory to forming and shaping. The most common forming tools used in metal working are the following:

Ball Peen Hammer – a general purpose hammer used for striking blow into metals. The ball pane is used mainly to spread rivet heads before finishing up with the snap.



Cross Peen Hammers – Used for working in a narrow place and for wiring edges of tinplate work. The heavier ones may be used to draw down rods or shafts.



Straight Peen Hammers – Used in similar circumstance with the cross-pane but where it is more convenient for the pane to the straight.