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SECTION 1 - FUNDAMENTALS OF INDUSTRY

1.1 Sectors and their roles within the Construction and Manufacturing Industries

1.1.1 Industries

Construction; manufacturing, production, design, administration and materials involved in the erection of buildings.

Manufacturing; the production, making or preparing of materials and products for use.

Electrical and Electronic; manufacturing, production or design, of materials concerned with use of electricity of electrical and electronic devices and installations.

1.1.2 The Construction Sectors:

Residential; sector concerned with the construction of dwelling houses; buildings which contain one or a number of dwellings, or one whose sole purpose is to serve as such.

Industrial; sector concerned with the construction of buildings for the production or manufacture of devices, materials, goods and products.

Commercial; sector concerned with the construction of buildings or spaces within a building designated by planning authorities for the practice of business, project or venture set up with the intention of providing goods and services to make a profit.

Civic; sector concerned with the construction of structures and built form of a quality and suitability for an urban setting. (Cities)

1.1.3 The roles of the following in the manufacturing sectors:

Engineering Design; the process or formulating, creating, altering and planning a functional, graphic or mass produced object such as a structure, device, furnishing or fitting through the use of technology

E.g. drafting, architecture, design etc.

Industrial Production; the manufacturing or processing of a device, product or material in a series of predetermined quantity or in a continuous run.

E.g. product assembly, modelling, aviation etc.

Industrial Maintenance; the servicing; the care of a device, building, structure, system or technical installation in order to keep it functioning long term.

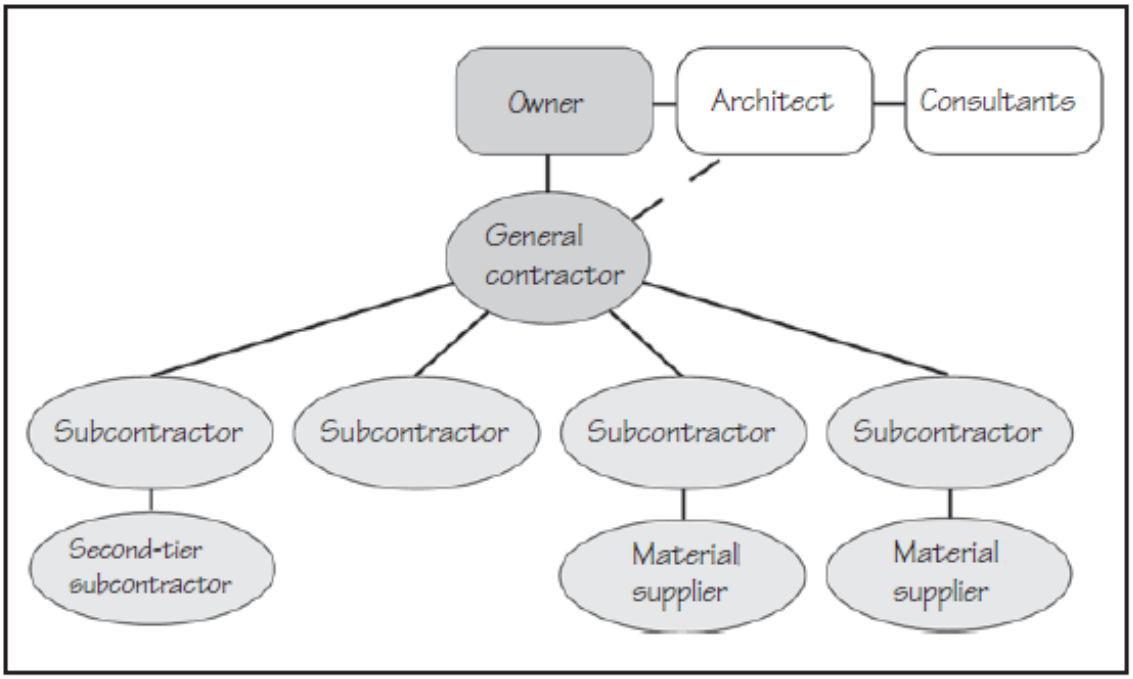
E.g. wiring installation, technical support, communication etc.

1.2 Organisational Structure of the Construction and Manufacturing Industries

Organisational chart of personnel (managers, workers, tasks and relationships):

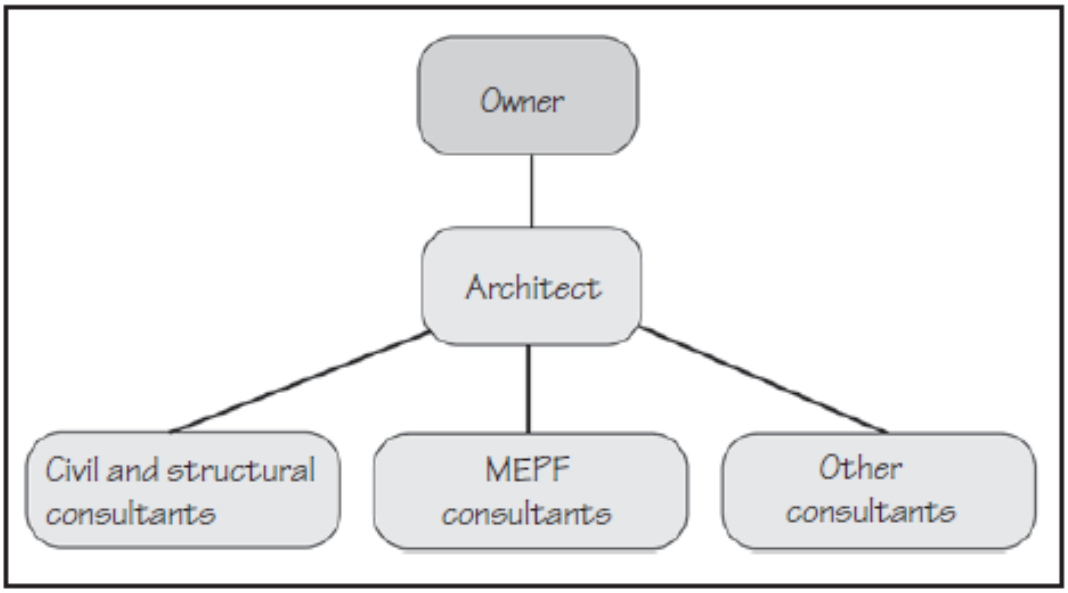
Top-down structure

Organizational change that is initiated by managers



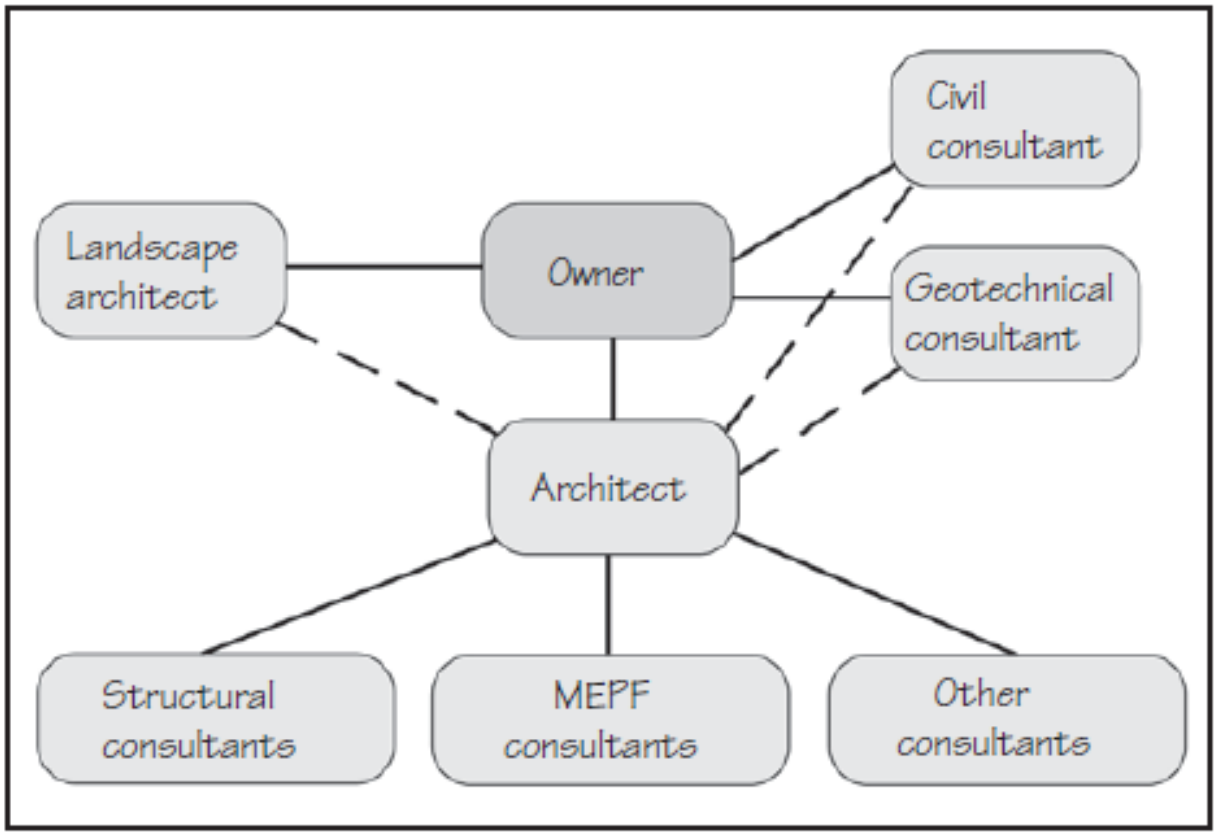
Flat Structure

An organization with relatively few levels in its hierarchy



Matrix

A flexible form of organization structure often used in situation which requires a mix of people with different skills and experience to be focused on a particular task, or an unusual project that crosses existing departmental boundaries in an organization.



1.3 Occupational levels and their functions in the construction and manufacturing industries
Semi-skilled; a construction worker with a level of skill between a tradesman and labourer.

Skilled; a construction worker whose skill is equivalent to that of a tradesman, often one skilled in a modern trade.

Technician (supervisory); a contractor's representative responsible for supervising construction work on site carried out by specific tradesmen/ craftsmen

Technologist/Master Craftsman; a person skilled in a particular job of work, employed on a construction site to direct or to carry out specific skilled work.

Professional; a qualified and duly licensed individual that performs engineering services such as structural, mechanical, electrical, sanitary, and civil engineering.

1.4. Career paths and qualifications in the construction and manufacturing industries

1.4.1 Construction industries:

Self-employment opportunities

Craftsmen /Tradesmen - carpenters, electricians, electronics technicians, masons, plumbers, furniture makers, woodcrafters, upholsterers, painters; welders, machine operators and fitters;

Technical workers - technicians, technologists, finishing technicians; drafting and design technicians;

Professional workers - electrical, mechanical, construction structural, civil and building service engineers, architects, quantity surveyors, construction project managers, planners,

1.4.2 Fundamentals of Entrepreneurship:

Entrepreneurship

Within the building trades, entrepreneurship is the capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit. Successful entrepreneurs have the ability to lead a business in a positive direction by proper planning, to adapt to changing environments and understand their own strengths and weaknesses.

Principles of entrepreneurship;

- **Motivation;** what is the incentive for starting a business? Is it money alone? True, many entrepreneurs achieve great wealth. However, money is almost always tight in the start-up and early phases of a new business.
- **Strategy;** what is the strategy for distinguishing the product or service? Is the plan to compete solely on the basis of selling price? Price is important, but most economists agree that it is extremely risky to compete on price alone. Large firms that produce huge quantities have the advantage in lowering costs.
- **Realistic Vision;** is there a realistic vision of the enterprise's potential? Insufficient operating funds are the cause of many failed businesses. Entrepreneurs often underestimate start-up costs and overestimate sales revenues in their business plans.

Goal setting;

Long-term Goal – something you want to achieve in the future

Short-term Goal – something you might do right away

Decision making skills:

1. *defining your problem*
2. *gathering information and resources,*

3. *listing options*
4. *weighing and comparing options*

Business plan; is a document that presents basic idea for the venture and includes descriptions of where you are now, where you want to go, and how you intend to get there.

The basic elements of a standard business plan include:

- ✓ Title Page
- ✓ Table of Contents
- ✓ Executive Summary
- ✓ Company Description
- ✓ Product/Service
- ✓ Market and Competition
- ✓ Marketing and Selling Strategy
- ✓ Operating Plan
- ✓ Management/Organization
- ✓ Financing
- ✓ Supporting Documents

Success factors:

- **Marketing and promotion**; the process of researching, promoting, selling, and distributing a product or service. Marketing covers a broad range of practices, including advertising, publicity, promotion, pricing, and packaging.
- **competitiveness;** providing a product or service that is seen by its target market as better than those of competitors
- **Leadership;** is the ability to create rules and to set goals. It is the capacity to follow through to see that rules are followed and goals are accomplished.
- management of production and efficiency;
- quality control;
- **customer satisfaction:**
    1. Providing the most basic benefits of the product and/or service—the elements that customers expect all competitors to deliver
    2. Offering general support services, such as customer assistance setting up a system to counteract any bad experiences customers may experience
    3. Delivering extraordinary services that excel in meeting customers' preferences and make the product and/or service seem customized

Government legislation; legislation regarding health and safety, labelling and product safety designed to protect consumers. The legal system provides protection for a business' marketing assets through trademarks, patents, copyrights, performance clauses and trade rights.

Lending institutions;

- **Banks** are very conservative lenders. Many entrepreneurs simply do not have enough assets to get a secured loan from a lending institution.
- **Government programs:** Many national and regional governments offer programs to encourage small- and medium-sized businesses. In Antigua the Development Bank and Small Business Association assist small firms by acting as a guarantor of loans made by private institutions for borrowers who may not otherwise qualify for a commercial loan.

Benefits;

- **Being your own boss.** When you start a business and are self-employed, you are your own boss and ultimately control your own destiny.
- **Income.** Whether you view starting a business as an economic necessity or a way to make some additional income, you might find it generates a new source of income.
- **Flexible hours.** Owning your own business is hard work and often requires long, odd hours. In some cases, having your own business may allow you to have more flexible hours. Many skilled tradesmen and craftsmen, for example, choose to become entrepreneurs.

Risks; as a project progresses to the appointment of contractors, the client's overall financial commitment becomes better defined. More risk can also be transferred to third parties if the client so wishes. Whilst under most procurement routes the client is required to accept risks associated with design performance, they will generally seek to transfer commercial and construction risks to the contractor through some form of a fixed price, lump sum contract.

1.5. Codes and Standards

The objective of a building code is to ensure that all new construction and renovated buildings provide a minimum level of safety, health, and welfare to the occupants and public at large. Although under no legal obligation to do so, the owner or the designer may choose to exceed the requirements of the code. The objective of a building code is to ensure that all new construction and renovated buildings provide a minimum level of safety, health, and welfare to the occupants and public at large. Although under no legal obligation to do so, the owner or the designer may choose to exceed the requirements of the code.

1.5.1 Occupational Health and Safety Standards

Industry health and safety regulations:

The Building Regulations; this is a Statutory Instrument which sets out the minimum performance standards for the design and construction of buildings and where applicable to the extension of buildings. The regulations are supported by other documents which generally give guidance on how to achieve the required performance standards. A standard should not be confused with a building code provision. Although a code specifies the design criteria or the required properties of a

component, the standard specifies the procedures and equipment required to verify the criteria or measure the properties.

Legal responsibilities of Employers;

In the industrially developed countries, there exist very well defined and highly stringent punitive codes and statutes, which are designed to maintain and improve safety, health and welfare of employed persons. These laws at their best only impose a minimum standard of conduct defining them to be the absolute duty of the employer.

General Duties of Employees

Every employee is under a moral, and often also a legal, duty to take the maximum care for his or her own safety and that of fellow employees.

"Tool-box briefing"; a five- to ten-minute session with the supervisor just prior to starting a task gives the workers and the supervisor a chance to talk about safety problems likely to be encountered and potential solutions to those problems. This activity is simple to implement and it may prevent a serious accident.

"Safety check"; a check by workers that the environment is safe before starting an operation may allow them to take remedial action to correct an unsafe situation that could later endanger them or another worker.

Environmental Safety Practices

- Compliance with all applicable environmental, health, and safety laws and regulations.
- Continual improvement in environmental, health, and safety performance with the ultimate goal of zero injuries and zero emissions of toxic and hazardous materials.
- Design and operation of plants and facilities in a manner that protects the environment and the health and safety of employees and the public.
- Development and production of products that can be manufactured, distributed, used and recycled or disposed of in a safe and environmentally sound manner.
- Open discussion of our environmental, health, and safety practices and performances.

Safety and Maintenance Standards

National laws and regulations are often based upon international conventions, agreements, declarations and programmes. These have been drawn up by different United Nations organizations including the International Labour Organization (ILO) and the World Health Organization (WHO). In 1988 the ILO adopted the Safety and Health in Construction Convention (No.167), and the accompanying Recommendation (No.175), which provide a foundation of law on which safe and healthy working conditions can be built.

Health and Wellness Standards

These standards deal with the means of egress, accessibility, and interior environment, including lighting, ventilation, sanitation, and sound control. Good welfare facilities not only improve workers' welfare but also enhance efficiency. Welfare facilities such as the provision of drinking-water, washing, sanitary and changing accommodation, rest-rooms and shelter, facilities for preparing and eating meals, temporary housing, assistance in transport from place of residence to the work site and back, all help to reduce fatigue and improve workers' health. The facilities may be provided and maintained by one contractor for all workers or by individual contractors.

Standards for Fire Prevention and Response

These standards deal with fire-resistive materials and construction, fire-resistive interior finishes, and fire protection systems. Fire protection systems include those that detect and suppress fires.

Basic First Aid standards

First aid is the emergency care you give to sick or injured persons. It consists only of providing temporary assistance or treatment until medical help is available.

Basic emergency response standards

Procedures for handling an emergency:

1. The chain of command must be set up so that responders and communications are controlled through an Incident Command System (ICS). (ICS is a system developed within the fire service to identify hazardous conditions and to designate appropriate controls and procedures during an emergency.)
2. Emergency responders shall use a buddy system -- working in teams of two or more in the hazardous zone.
3. Certain employees may play a role in an emergency even though they are not emergency responders. These employees need to be briefed on what chemical hazards are involved, on what they as skilled support personnel are expected to do during an emergency, and instructed on the wearing of any required PPE.
4. Workers shall also receive appropriate safety and health training for the tasks they are expected to perform during clean-up following an emergency operation.

1.5.2 Electrical Installation and Electronics

IEEE (Institute of Electrical and Electronics Engineers) is an association of technical professionals with more than Institute of 400,000 members in chapters around the world. Its objectives are the educational and technical advancement of electrical and electronic engineering, telecommunications, and computer engineering and allied disciplines.

NEC (The National Electrical Code) or NFPA 70, is a regionally adoptable standard for the safe installation of electrical wiring and equipment in the United States.

Safety against electrical hazards

Following precautions must be observed while working on electrical works to protect against shocks;

- Avoid contact with live parts by insulating all live parts and placing them out of reach by using barriers or temporary barriers.
- Check and inspect all cables and equipment for damage before using them.
- PAT test all portable equipment.
- Use only low voltage or battery tools.
- Use a secure electrical isolation procedure before beginning work as described earlier in this chapter.

Electrical Material

New (Harmonized) Fixed Cable Core Colours

Single-phase supplies – brown line conductors, blue neutral conductors and green combined with yellow for earth conductors (just like the existing flexible cords).

Three-phase supplies – brown, black and grey line conductors, blue neutral conductors and green combined with yellow for earth conductors. These are the cable core colours to be used from 31 March 2004 onwards. Extensions or alterations to existing single-phase installations do not require marking at the interface between the old and new fixed wiring colours. However, a warning notice must be fixed at the consumer unit or distribution fuse board.

The following factors are checked to ensure the correctness of an electrical installation:

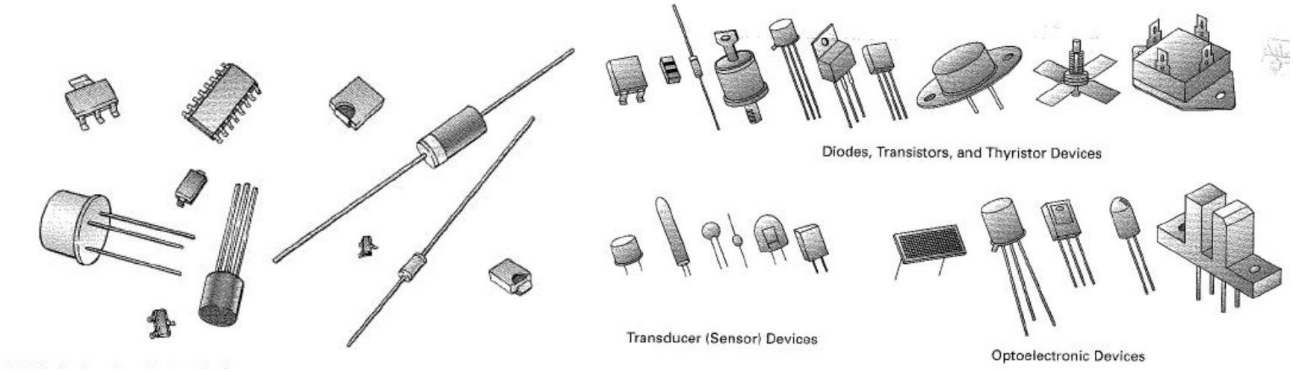
- **polarity:** to ensure that the various elements, such as sockets, lights, etc., are wired up correctly
- **earthing:** to ensure that a proper and continuous earth has been established
- **insulation resistance:** to ensure that insulation of the cables is in good order
- **wiring circuit continuity:** to ensure that the earth, neutral and live wires are all properly connected and continuous

Semi-conductor Materials and Devices

Modern electronic devices use the semiconductor properties of materials such as silicon or germanium. The atoms of pure silicon or germanium are arranged in a lattice structure. The outer electron orbits contain four electrons known as valence electrons. These electrons are all linked to other valence electrons from adjacent atoms, forming a covalent bond. There are no free electrons

in pure silicon or germanium and, therefore, no conduction can take place unless the bonds are broken and the lattice framework is destroyed.

To make conduction possible without destroying the crystal it is necessary to replace a four valent atom with a three- or five-valent atom. This process is known as doping.



1.5.3 Engineering Production

The Process Engineering Function

Process: It is simply a method which products can be manufactured from raw materials. It could also be described as a method for shaping raw materials into usable product forms. The term process, applies to the shaping of metal, plastic or rubber in the raw material states.

General Manufacturing Processes

- Casting and Moulding
- Machining or Cutting
- Forming or Deforming
- Assembly

In addition to the process for shaping raw materials, finishing operations are used to obtain the final quality desired. These processes include: Cleaning, Painting, Buffing, Plating, Polishing, Deburring, Heat treatment etc. Nearly all products manufactured require at least two or more of the five general processes. Therefore process engineering deals with all five general processes

Product Engineering

The product to be manufactured is first conceived by the engineer. This engineer determines the need for a product. It may be an entirely new product or new model of the old product. Experimental designs are made, and scale models are made and tested. Finally a production design is created after all faults have been corrected. Part prints are drawn to illustrate the product graphically. All dimensions and specifications required are included on the print. The material to be used in the

product is specified, and product name and number is included. Functions of a product engineering department can be itemized as follows:

A.)Design Product for Function

1. Build model for testing
2. Provide part prints:
   a) Physical dimensions
   b) Material
   c) Special process required such as painting plating, heat treatment, testing etc.
3. Provide tool design and construction aids:
   a) Master layouts
   b) Templates
   c) Master models.
4. Provide specifications or standards manual
   a) Material specification
   b) Specification for testing and inspection
   c) Procedures for testing and inspection
   d) Specification for threads, gears, keys, splines etc.
   e) Procedures and specifications for joining process

B.) Design the Product for Customer Satisfaction

1. Sales appeal
   a) Appearance
   b) Improvements
   c) Design to meet the needs of the customer
2. Durability and life expectancy

C.) Design the Product for Cost

1. Cost should be low enough to compete in market
2. Cost should be high enough to provide profit
3. Cost should be in correct relationship with durability and life expectancy

D.) Design the Product for ease of Maintenance and Assembly

1. Ease of repair
2. Ease of assembly and disassembly
3. Provide drawing for maintenance and assembly

The product engineer must transmit the Information to the process engineer so that work may continue. Paper work passing from product to Process engineer includes:

A. Paper prints
B. Engineering releases
   i. Production rate per year
   ii. Sub-assembly and assembly numbers
   iii. Release date-date on which processing, tooling and all planning may start.
   iv. Part name, number and material.
C. Change in part prints when revision are made
D. Change in engineering releases

Process Engineering

Process engineering takes place directly after product engineering has completed the design of product. It takes the information from product engineer and they create the plan for manufacture Processing is then the function of determining exactly how a product will be mode

A. To determine the manufacturing process to be used
B. To determine the order of sequence of operation necessary to manufacture the part
   - Operation routing or line up
   - Process pictures
C. To determine and order the tooling and gauges needed to manufacture the part
   1. Orders to design
   - Orders to build
   - Orders to buy
D. To determine, select and order the equipment needed to manufacture the part
E. To determine need for and originate orders for all process revisions necessary when part print changes occur
F. To follow up the tooling and equipment to determine if all if all is functioning as planned and if not, make the necessary revisions
G. To provide estimates of cost of tooling and equipment needed to manufacture new products
H. To determine part changes necessary to ease manufacture or reduce cost and request part print changes
I. To take part in product study groups to assist the product engineer in the design of a product that will be feasible and economical to make

Failure to use a better, low cost or safer process due to ignorance may result into drastic losses. Codes and standards are governed by the ASME, ILO AND ISO.

1.5.4 Building Construction

The word **standard** is used here as a qualifier for words such as the properties, test methods, or the method of installation. Thus, a standard, in fact, refers to one of the following:

Standard specification; this deals with the quality of materials, products and components.

Standard test method; this determines the particular performance of a product or system through a test including methods of sampling and quality control.

Standard method of practice-construction practice, installation practice, or maintenance practice; this includes specific fabrication, installation, and erection methods of a component, including its maintenance.

A standard should not be confused with a building code provision.

By far the largest and most referenced standards-producing organizations are those whose main function is to produce standards. In countries other than the United States, this task is normally handled by a single umbrella organization at the national level. In Britain, there is the British Standards Institution (BSI), in Australia, the Standards Association of Australia (SAA), and in Germany, the Deutsches Institute fur Normung (DIN). Three primary standards-producing organizations in the U.S. are

• American National Standards Institute (ANSI)

• American Society for Testing and Materials (ASTM)

• Underwriters Laboratories (UL)

Founded in 1918, ANSI is a nongovernmental and privately financed body, obtaining its funding primarily from membership dues and the sale of its publications. However, it represents the United States in the International Standards Organization (ISO).

CUBIC; Caribbean uniform building code governs construction standards within the Caribbean. This includes Antigua and Barbuda, Jamaica, St.Kitts and Nevis, Montserrat, Dominica, St. Lucia, St. Vincent, Grenada, Barbados, Trinidad and Tobago, Guyana and Belize. However, standards are not fully adopted.

According to ***CUBIC*** standards for hurricane and earthquake resistance the designed building must be:

1. a simple diaphragm building;
2. a low-rise building;
3. enclosed and conform to the wind-borne debris provisions;
4. a regular shaped building or structure;
5. not classified as a flexible building;

6. not assessed as having unfavourable aerodynamic characteristics and not having an unfavourable site location;
7. of a structure with no expansion joints or separations;
8. not subject to unfavourable topographic effects;
9. Of an approximately symmetrical cross section.

Standards

During the early stages of design, an architect generally needs to obtain a rough idea of the total volume of the building, its massing, and the building's location on the site. This requires determining the maximum allowable area of the building and its maximum allowable height, as per the building code. The allowable area and height of a building are a function of the following four factors:

- Building's occupancy
- Building's type of construction
- Width of accessible open spaces around the building (frontage)
- Whether or not the building is provided throughout with automatic sprinklers

Sometimes, the total area and height of the building are already established by the building's lot. In that case, the architect would determine the minimum type of construction required to satisfy the code and whether or not to provide added safety measures.

1.6 Practising occupational health, safety and welfare standards

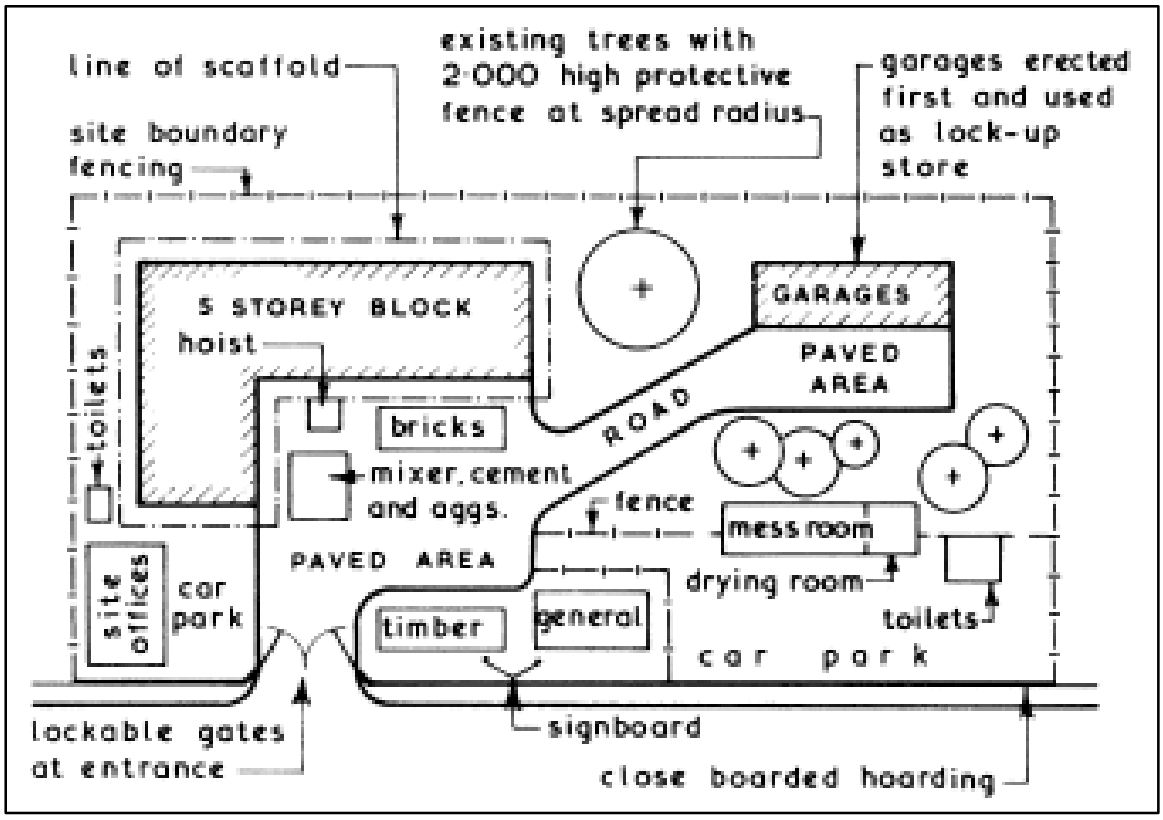
1.6.1 Practising safety standards for workshop and worksite:

Inventory of materials, tools and equipment;

- Worksheets and log books are essential for transparency and reconstruction of the inventory.
- Adequate, updated and correct inventory records are to be set up and maintained in each organization offices.
- All transactions of all inventory are to be properly documented and sufficient audit trail is to be submitted.
- In the classification of the items, the same definitions should be used. These guidelines should apply to all Non-expandable and attractive items.

Workshop/worksite layout diagrams;

These are used to promote safe storage and handling of machines, materials and equipment.



Hazard Points

Various techniques are available to control hazards on the worksite;

Mechanical hazards may be engineered out of the process, or effectively enclosed by means of fixed guarding. Alternative forms of guarding involve the use of interlocked guards, light-sensitive barriers or pressure-sensitive mats. Trip devices and other form of emergency stops may also be incorporated.

Hazard from the working environment may be controlled by effective ventilation system, adequate heating and lighting, and general provision of good working conditions.

Chemical hazards may also be controlled by effective ventilation, regular monitoring, substitution of material, change of process, purchasing controls and the use of protective equipment. A necessary corollary of hazard assessment is the establishment of safe system of work and training for the work force to make them aware of the hazards in their work areas, and of the methods for the control of such hazards.

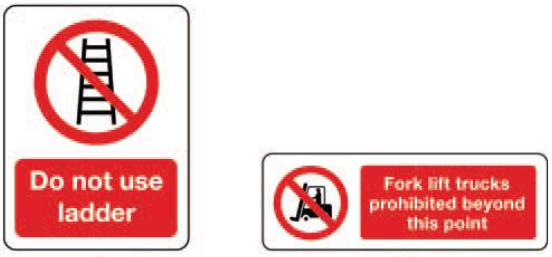
Safety Signs and Symbols

The rules and regulations of the working environment are communicated to employees by written instructions, signs and symbols. All signs in the working environment are intended to inform. They should give warning of possible dangers and must be obeyed.

Prohibition Signs

These are must not do signs. These are circular white signs with a red border and Red Cross bar. They indicate an activity which must not be done.

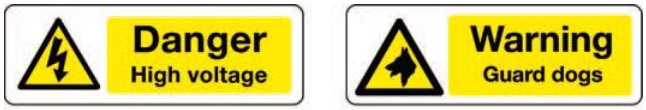
(a) (b)



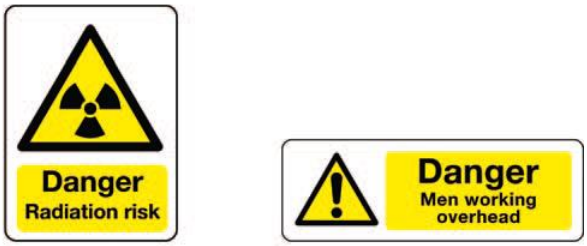
(c) (d)

Warning Signs

Warning signs give safety information. These are triangular yellow signs with a black border and symbol. They give warning of a hazard or danger.



(a) (b)



(c) (d)

Mandatory Signs

These are must do signs. These are circular blue signs with a white symbol. They give instructions which must be obeyed.

(a) (b)

(c) (d)

Advisory or Safe Condition Signs

These are square or rectangular green signs with a white symbol. They give information about safety provision.

(a)

(b)

(c)

(d)

Marking Out Safety Lanes

Safety lanes provide access for workers on and around the site. Lanes should be free from obstruction and from exposure to hazards such as falling materials, materials-handling equipment. They are usually marked by arrows and appropriate signs.

Safety Manuals

Safety Manuals help to inform employees of safety, health and welfare conditions on construction sites in your country and to learn about possible solutions to the problems you encounter. They cover all aspects use of related tools, equipment and regulations for workshops and worksites including:

- Safety organization and management
- Site planning and layout
- Excavations, scaffolding and use of ladders
- Hazardous processes
- Movement of materials
- Working positions, tools and equipment
- The working environment
- Personal protective equipment
- Welfare facilities

The Principles of Ergonomics

1. Management involvement demonstrated through the priority placed on eliminating the ergonomic hazards.
2. A policy which places safety and health on the same level of importance as production.
3. Commitment to assign and communicate responsibility.
4. Commitment to provide adequate authority and resources.
5. Commitment to ensure that [all are held] accountable for carrying out [their] responsibilities.

Personal Protective Equipment

The working conditions in construction are in most cases such that, despite all preventive measures in project planning and work design, some personal protective equipment (PPE), such as a helmet, hearing and eye protection, harness, boots and gloves, is needed to protect workers.

1.6.2 Environmental safety practices:
Types of Wastes

Environmental laws protect the environment in which we live by setting standards for the control of pollution to land, air and water. Listed as:

- Chemical pollution control by Local Authorities
- Wastes on land
- Litter
- Carcinogenic Substances (asbestos)
- Genetically modified organisms
- Miscellaneous, including contaminated land.

Waste Disposal

On site you are responsible for the waste that you produce, even after you have passed it on to another party such as a Solid Waste company, a Scrap Metal dealer, recycling company or local authority;

- Make sure that waste is only transferred to an authorized company.
- Make sure that waste being transferred is accompanied by the appropriate paperwork showing what was taken, where it was to be taken and by whom.
- Segregate the different types of waste that your work creates.
- Label waste skips and waste containers so that it is clear to everyone what type of waste goes into that skip.
- Minimize the waste that you produce and do not leave waste behind for someone else to clear away. Remember there is no time limit on your Duty of Care for waste

Recycling

Reduce, reuse, and recycle are considered to be the three most important tenets of sustainable construction. These tenets are listed in order of their importance. The first tenet (reduce), in fact, far outweighs that of the other two in importance. Although a great deal of stress is currently being placed on reusability and recyclability, the same level of concern is lacking for appropriate sizing of buildings, automobiles, and other items of human consumption. Regardless of how successful we are with reusability and recyclability, sustainability will not be achieved without seriously addressing reduction.

1.6.3 Safety and Maintenance Standards:

Using equipment, tools and materials associated with electrical installation, electronics, building construction and metal work engineering:

There are basic considerations in selecting, using and maintaining hand tools:

- avoid static load at the shoulder or arm due to the continuous holding of a tool at a raised position or the gripping of a heavy tool;
- avoid awkward wrist angles while using tools such as snips and pliers;
- reduce uncomfortable pressure on the palm or joints of the hand, e.g. from pliers that are too small;

- select the correct weight, size and tool for the job;
- use only tools of good-quality steel – tools made of inferior steel chip and may even shatter when struck, tool heads mushroom, tool jaws open out and cutting tools lose their edge;
- handles should have a smooth finish, should be easy to grasp and should have no sharp edges or corners;
- tools should be firmly fixed and should be regularly checked for splits and cracks; wedges should be checked for tightness of fit;
- tools should be kept free of grease and dirt, and moving and adjustable parts should be well oiled;
- cutting edges should be kept sharp for accurate working and to avoid the need for unnecessary pressure;
- for work on or near electrical apparatus only properly insulated tools should be used;
- tools should be properly stored in boxes, racks, holders or pocket belts and should not be left so that they can fall, roll or be tripped over; cutting edges should be sheathe
- damaged tools should be immediately repaired or replaced

Safety rules for maintaining, using and storing materials, tools and equipment;

- avoid static load at the shoulder or arm due to the continuous holding of a tool at a raised position or the gripping of a heavy tool;
- avoid awkward wrist angles while using tools such as snips and pliers;
- reduce uncomfortable pressure on the palm or joints of the hand, e.g. from pliers that are too small;
- select the correct weight, size and tool for the job;
- use only tools of good-quality steel – tools made of inferior steel chip and may even shatter when struck, tool heads mushroom, tool jaws open out and cutting tools lose their edge;
- handles should have a smooth finish, should be easy to grasp and should have no sharp edges or corners;
- tools should be firmly fixed and should be regularly checked for splits and cracks; wedges should be checked for tightness of fit;
- tools should be kept free of grease and dirt, and moving and adjustable parts should be well oiled;
- cutting edges should be kept sharp for accurate working and to avoid the need for unnecessary pressure;
- for work on or near electrical apparatus only properly insulated tools should be used;
- tools should be properly stored in boxes, racks, holders or pocket belts and should not be left so that they can fall, roll or be tripped over; cutting edges should be sheathed;
- damaged tools should be immediately repaired or replaced.

Using Testing, Measuring and Safety Devices;

1. First connect the test device to the supply which is to be isolated. The test device should indicate mains voltage.
2. Next, isolate the supply and observe that the test device now reads zero volts.
3. Then connect the same test device to a known live supply or proving unit such as that to 'prove' that the tester is still working correctly.
4. Finally secure the isolation and place warning signs; only then should work commence.

If the fault finding and testing can only be successfully carried out live then the person carrying out the fault diagnosis must:

- be trained so that they understand the equipment and the potential hazards of working live and can, therefore, be deemed ' competent ' to carry out that activity;
- only use approved test equipment;
- Set up appropriate warning notices and barriers so that the work activity does not create a situation dangerous to others.

Carrying Out Risk Assessments

A record of all significant risk assessment findings must be kept in a safe place and be made available to a Health and Safety warden if required. Information based on the risk assessment findings must be communicated to relevant staff and if changes in work behaviour patterns are recommended in the interests of safety, then they must be put in place. So risk assessment must form a part of any employer's robust policy of health and safety. However, an employer only needs to 'formally' assess the significant risks. He is not expected to assess the trivial and minor types of household risks. Staff are expected to read and to act upon these formal risk assessments and they are unlikely to do so enthusiastically if the file is full of trivia. An assessment of risk is nothing more than a careful examination of what, in your work, could cause harm to people. It is a record that shows whether sufficient precautions have been taken to prevent harm.

Step 1

Look at what might reasonably be expected to cause harm. Ignore the trivial and concentrate only on significant hazards that could result in serious harm or injury. Manufacturers' data sheets or instructions can also help you spot hazards and put risks in their true perspective.

Step 2

Decide who might be harmed and how. Think about people who might not be in the workplace all the time – cleaners, visitors, contractors or maintenance personnel. Include members of the public or people who share the workplace. Is there a chance that they could be injured by activities taking place in the workplace?

Step 3

Evaluate what is the risk arising from an identified hazard. Is it adequately controlled or should more be done? Even after precautions have been put in place, some risk may remain. What you have to decide, for each significant hazard, is whether this remaining risk is low, medium or high. First of all, ask yourself if you have done all the things that the law says you have got to do. For example, there are legal requirements on the prevention of access to dangerous machinery. Then ask yourself whether generally accepted industry standards are in place, but do not stop there – think for yourself, because the law also says that you must do what is reasonably practicable to keep the workplace safe. Your real aim is to make all risks small by adding precautions, if necessary.

If you find that something needs to be done, ask yourself:

(i) Can I get rid of this hazard altogether?

(ii) If not, how can I control the risk so that harm is unlikely?

Only use PPE when there is nothing else that you can reasonably do. If the work that you do varies a lot, or if there is movement between one site and another, select those hazards which you can reasonably foresee, the ones that apply to most jobs and assess the risks for them. After that, if you spot any unusual hazards when you get on site, take what action seems necessary.

Step 4

Record your findings and say what you are going to do about risks that are not adequately controlled. If there are fewer than five employees you do not need to write anything down but if there are five or more employees, the significant findings of the risk assessment must be recorded. This means writing down the more significant hazards and assessing if they are adequately controlled and recording your most important conclusions. There is no need to show how the assessment was made, providing you can show that:

1. A proper check was made,
2. You asked those who might be affected,
3. You dealt with all obvious and significant hazards,
4. The precautions are reasonable and the remaining risk is low,
5. You informed your employees about your findings.

Risk assessments need to be suitable and sufficient, not perfect. The two main points are:

1. Are the precautions reasonable?
2. Is there a record to show that a proper check was made?

File away the written Assessment in a dedicated file for future reference or use. It can help if an HSE Inspector questions the company's precautions or if the company becomes involved in any legal action. It shows that the company has done what the law requires.

Step 5

Review the assessments from time to time and revise them if necessary.

Completing a Risk Assessment

Step 1

List only hazards which you could reasonably expect to result in significant harm under the conditions prevailing in your workplace. Use the following examples as a guide:

- Slipping or tripping hazards (e.g. from poorly maintained or partly installed floors and stairs).
- Fire (e.g. from flammable materials you might be using, such as solvents).
- Chemicals (e.g. from battery acid).
- Moving parts of machinery (e.g. blades).
- Rotating parts of hand tools (e.g. drills).
- Accidental discharge of cartridge operated tools.
- High pressure air from airlines (e.g. air powered tools).
- Pressure systems (e.g. steam boilers).
- Vehicles (e.g. fork lift trucks).
- Electricity (e.g. faulty tools and equipment).
- Dust (e.g. from grinding operations or thermal insulation).
- Fumes (e.g. from welding).
- Manual handling (e.g. lifting, moving or supporting loads).
- Noise levels too high (e.g. machinery).
- Poor lighting levels (e.g. working in temporary or enclosed spaces).
- Low temperatures (e.g. working outdoors or in refrigeration plant).
- High temperatures (e.g. working in boiler rooms or furnaces).

Step 2

Decide who might be harmed, do not list individuals by name. Just think about groups of people doing similar work or who might be affected by your work:

- Office staff
- Electricians
- Maintenance personnel
- Other contractors on site

- Operators of equipment
- Cleaners
- Members of the public.

Pay particular attention to those who may be more vulnerable, such as:

- staff with disabilities,
- visitors,
- young or inexperienced staff,
- People working in isolation or enclosed spaces.

Step 3

Calculate what the risk is – is it adequately controlled? Have you already taken precautions to protect against the hazards which you have listed in Step 1. For example:

- Have you provided adequate information to staff?
- Have you provided training or instruction?
- Do the precautions already taken
- meet the legal standards required,
- comply with recognized industrial practice,
- represent good practice,
- Reduce the risk as far as is reasonably practicable.

Step 4

Further action – what more could be done to reduce those risks which were found to be inadequately controlled? You will need to give priority to those risks that affect large numbers of people or which could result in serious harm. Senior managers should apply the principles below when taking action, if possible in the following order:

1. Remove the risk completely.
2. Try a less risky option.
3. Prevent access to the hazard (e.g. by guarding).
4. Organize work differently in order to reduce exposure to the hazard.
5. Issue PPE.
6. Provide welfare facilities (e.g. washing facilities for removal of contamination and first aid).

Any hazard identified by a risk assessment as high risk must be brought to the attention of the person responsible for health and safety within the company.

1.6.4 Standards for fire prevention and response:

When working in locations containing stored flammable materials such as petrol, paraffin, diesel or bottled gas, there is always the risk of fire.

Rules for fire prevention in the workshop and on a worksite;

- Take account of the risk assessment before work commences
- keep the area well ventilated,
- locate the fire extinguishers,
- secure your exit from the area,
- locate the nearest fire alarm point,
- follow a safe working procedure and put adequate emergency arrangements in place before work commences

Fires are divided into four classes or categories:

Class A – wood, paper and textile fires.

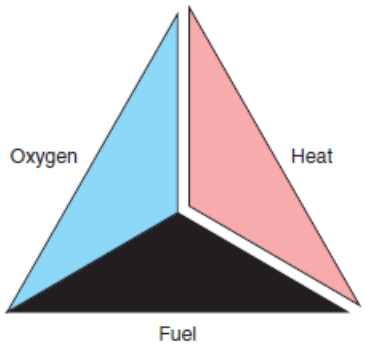
Class B – liquid fires such as paint, petrol and oil.

Class C – fires involving gas or spilled liquefied gas.

Class D – very special types of fi re involving burning metal.

Rules for handling the different types of fires:

Fire is a chemical reaction which will continue if fuel, oxygen and heat are present. To eliminate a fire one of these components must be removed. This is often expressed by means of the fire triangle all three corners of the triangle must be present for a fire to burn.



In the event of fire you should:

- raise the alarm;
- turn off machinery, gas and electricity supplies in the area of the fire;
- close doors and windows but without locking or bolting them;
- remove combustible materials and fuels away from the path of the fire, if the fire is small, and if this can be done safely;
- attack small fires with the correct extinguisher

Fire extinguishers

The base colour of all fire extinguishers is red, with a different coloured flash to indicate the type.

Type of fire extinguisher / Type of fire	(i) Water Signal red flash on red	(ii) Foam Pale cream flash on red	(iii) Carbon dioxide gas Black flash on red	(iv) Dry powder French blue flash on red	(v) Vapourizing foam Emerald green flash on red
Class A. Paper, wood and fabric	✓ Yes	✓ Yes	✗ No	✓ Yes	✓ Yes
Class B. Flammable liquids	✗ No	✓ Yes	✓ Yes	✓ Yes	✓ Yes
Class C. Flammable gases	✗ No	✗ No	✓ Yes	✓ Yes	✓ Yes
Electrical fires	✗ No	✗ No	✓ Yes	✓ Yes	✓ Yes
Motor vehicle protection	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes

1.6.5 Health and wellness standards:

Under the Health and Safety at Work Act an employer has a duty to care for the health and safety of employees. To do this he has a responsibility to ensure that:

- The working conditions and standard of hygiene are appropriate;
- the plant, tools and equipment are properly maintained;
- safe systems of work are in place;
- safe methods of handling, storing and transporting goods and materials are used;
- there is a system for reporting accidents in the workplace;
- the company has a written Health & Safety Policy statement;
- the necessary safety equipment – such as personal protective equipment (PPE), dust and fume extractors and machine guards – are available and properly used;
- The workers are trained to use equipment and plant safely.

Employees have a duty to care for their own health and safety and that of others who may be affected by their actions.

- take reasonable care to avoid injury to themselves or others as a result of their work activity;
- co-operate with their employer, helping him or her to comply with the requirements of the act;
- not interfere with or misuse anything provided to protect their health and safety

1.6.6 Basic First Aid standards:
Definitions:

First Aid

- is the treatment of minor injuries which would otherwise receive **no treatment** or do not need treatment by a doctor or nurse ' or '
- is treatment for the purpose of preserving life and minimizing the consequences of an injury or illness until such help is obtained ' . 'or'
- is the initial assistance or treatment given to a casualty for any injury or sudden illness before the arrival of an ambulance, doctor or other medically qualified person..

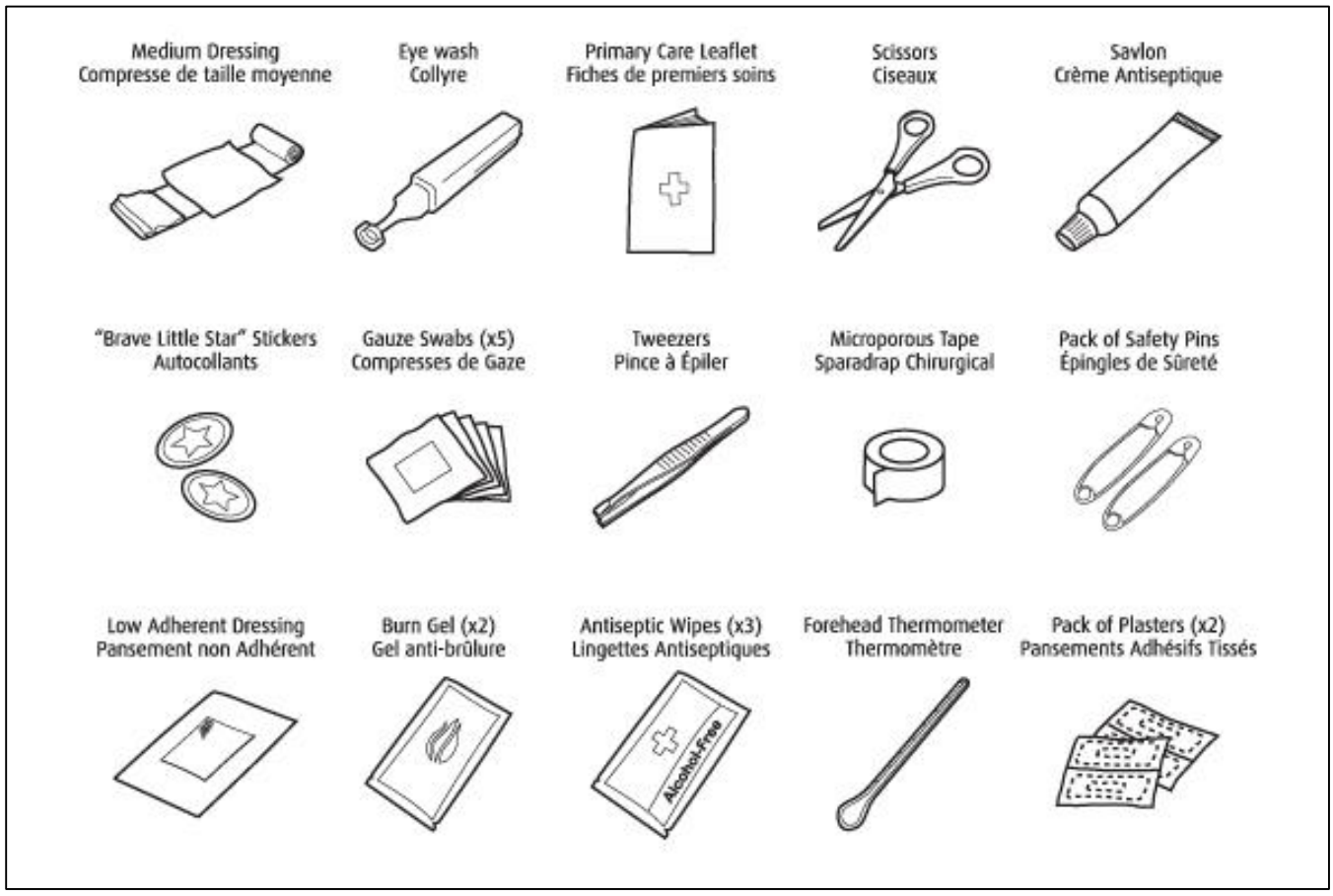
First Aider; is someone who has undergone a training course to administer first aid at work and holds a current first aid certificate. The training course and certification must be approved by the relevant authorities. The aims of a first aider are to preserve life, to limit the worsening of the injury or illness and to promote recovery.

First Aid station; is an area established to provide aid supplies to employees or medical first aid and provisions during work hours, emergency response situations, or PPE distribution. Aid stations may be divided into sections where the station serves both medical and non-medical functions. A first aid station should be clearly signposted, easily accessible and contain:

(i) a sink and drinking water;
(ii) first aid materials (which may include protective equipment and blankets);
(iii) a cot/ bed
(iv) a telephone or other communication equipment;
(v) A record book for recording incidents.

First Aid kit;

Recommended contents



First aid procedures which should be practised under expert guidance before they are required in an emergency.

Bleeding

If the wound is dirty, rinse it under clean running water. Clean the skin around the wound and apply a plaster, pulling the skin together. If the bleeding is severe apply direct pressure to reduce the bleeding and raise the limb if possible. Apply a sterile dressing or pad and bandage firmly before obtaining professional advice. To avoid possible contact with hepatitis or the HIV virus, when dealing with open wounds, first aiders should avoid contact with fresh blood by wearing plastic or rubber protective gloves, or by allowing the casualty to apply pressure to the bleeding wound.

Burns

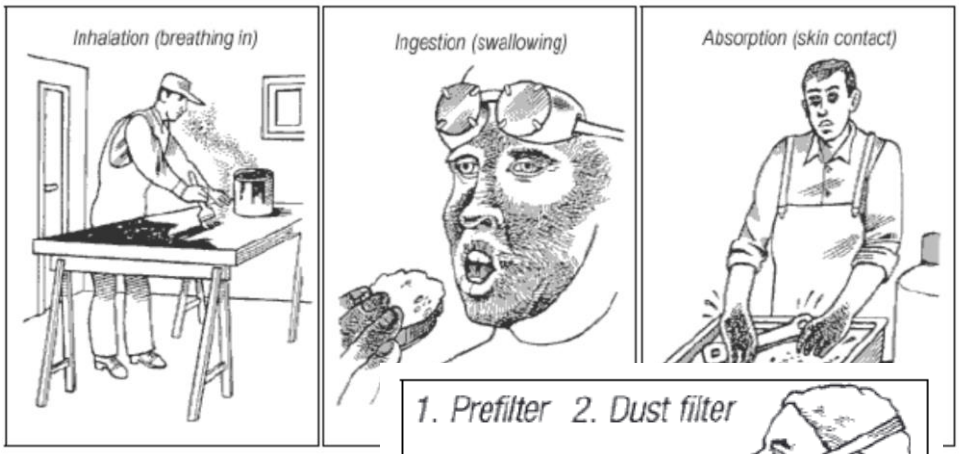
Remove heat from the burn to relieve the pain by placing the injured part under clean cold water. Do not remove burnt clothing sticking to the skin. Do not apply lotions or ointments. Do not break blisters or attempt to remove loose skin. Cover the injured area with a clean dry dressing.

Broken bones

Make the casualty as comfortable as possible by supporting the broke limb either by hand or with padding. Do not move the casualty unless by remaining in that position he is likely to suffer further injury. Obtain professional help as soon as possible.

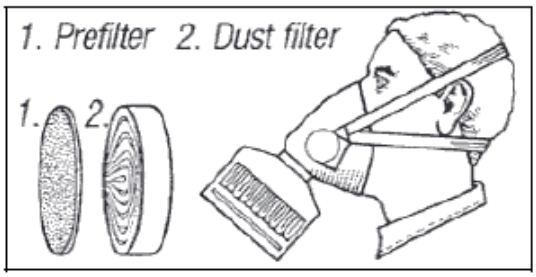
Contact with chemicals

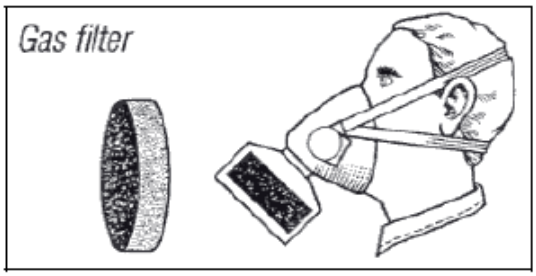
Wash the affected area very thoroughly with clean cold water. Remove any contaminated clothing. Cover the affected area with a clean sterile dressing and seek expert advice. It is a wise precaution to treat all chemical substances as possibly harmful; even commonly used substances can be dangerous if contamination is from concentrated solutions. When handling dangerous substances it is also good practice to have a neutralizing agent to hand.

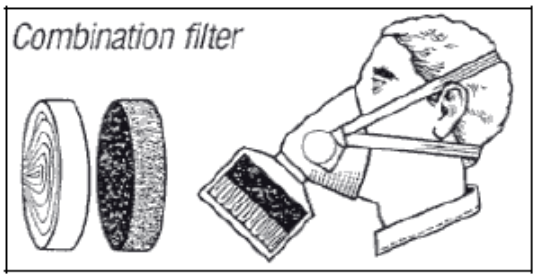


Exposure to Toxic Fumes

Get the casualty into fresh air quickly and encourage deep breathing if conscious. Resuscitate if breathing has stopped. Obtain expert medical advice as fumes may cause irritation of the lungs.







Asphyxiation

Asphyxiation is a condition caused by lack of air in the lungs leading to suffocation. Suffocation may cause discomfort by making breathing difficult or it may kill by stopping the breathing. There is a risk of asphyxiation to workers when:

- working in confined spaces,
- working in poorly ventilated spaces,
- working in paint stores and spray booths,
- working in the petro-chemical industry,
- working in any environment in which toxic fumes and gases are present

Sprains and bruising

A cold compress can help to relieve swelling and pain. Soak a towel or cloth in cold water, squeeze it out and place it on the injured part. Renew the compress every few minutes.

Breathing stopped – Resuscitation

Remove any restrictions from the face and any vomit, lose or false teeth from the mouth. Loosen tight clothing around the neck, chest and waist. To ensure a good airway, lay the casualty on his back and support the shoulders on some padding. Tilt the head backwards and open the mouth. If the casualty is faintly breathing, lifting the tongue clear of the airway may be all that is necessary to restore normal breathing. However, if the casualty does not begin to breathe, open your mouth wide and take a deep breath, close the casualty's nose by pinching with your fingers, and, sealing your lips around his mouth, blow into his lungs until the chest rises. Remove your mouth and watch the casualty's chest fall. Continue this procedure at your natural breathing rate. If the mouth is damaged or you have difficulty making a seal around the casualty's mouth, close his mouth and inflate the lungs through his nostrils. Give artificial respiration until natural breathing is restored or until professional help arrives.

Heart stopped beating – chest compressions

This sometimes happens following a severe electric shock. If the casualty's lips are pale, the pupils of his eyes widely dilated and the pulse in his neck cannot be felt, then he may have gone into cardiac arrest. Act quickly and lay the casualty on his back. Kneel down beside him and place the heel of one hand in the centre of his chest. Cover this hand with your other hand and interlace the fingers. Straighten your arms and press down on his chest sharply with the heel of your hands and then release the pressure. Continue to do this 15 times at the rate of one push per second. Check the casualty's pulse. If none is felt, give two breaths of artificial respiration and then a further 15 chest compressions. Continue this procedure until the heartbeat is restored and the artificial respiration until normal breathing returns. Pay close attention to the condition of the casualty while giving heart massage. When a pulse is restored the blueness around the mouth will quickly go away and you should stop the heart massage. Look carefully at the rate of breathing. When this is also normal, stop giving artificial respiration. Treat the casualty for shock, place him in the recovery position and obtain professional help.

Shock

Everyone suffers from shock following an accident. The severity of the shock depends upon the nature and extent of the injury. In cases of severe shock the casualty will become pale and his skin become clammy from sweating. He may feel faint, have blurred vision, feel sick and complain of thirst. Reassure the casualty that everything that needs to be done is being done. Loosen tight

clothing and keep him warm and dry until help arrives. Do not move him unnecessarily or give him anything to drink.

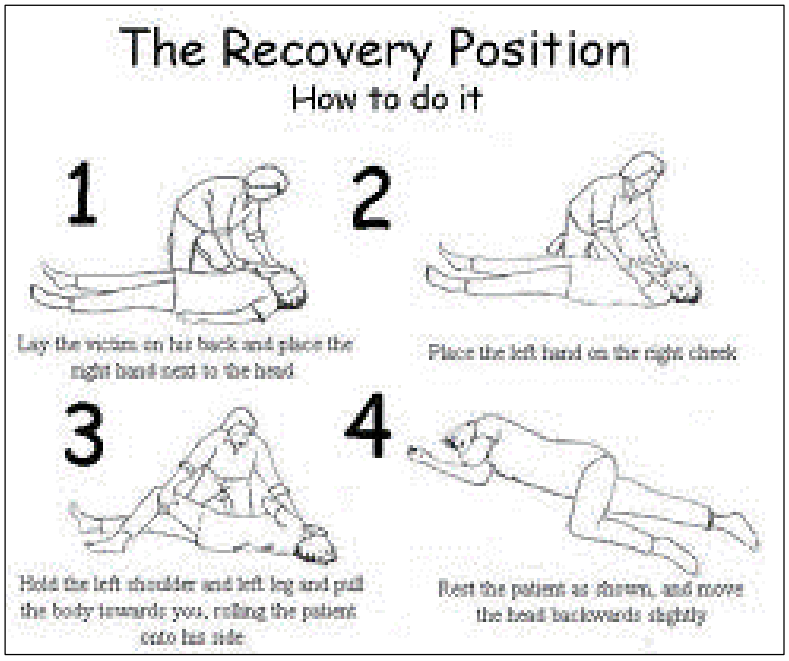
Electric Shock

- Switch off the supply if possible.
- Alternatively, remove the person from the supply without touching him, for example, push him off with a piece of wood, pull him off with a scarf, dry towel or coat.
- If breathing or heart has stopped, immediately call professional help by dialling 999 or 112 and asking for the ambulance service. Give precise directions to the scene of the accident. The casualty stands the best chance of survival if the emergency services can get a rapid response paramedic team quickly to the scene. They have extensive training and will have specialist equipment with them.
- Only then should you apply resuscitation or cardiac massage until the patient recovers, or help arrives.
- Treat for shock.

Reporting an accident and getting assistance;

When you call 999 or 911 you will be asked what service you require and also:

- your telephone number
- the address you are at
- what is wrong with the casualty and are they unconscious, not breathing or bleeding
- You may be offered advice as to how to assist the casualty until help arrives.



Mouth-to-mouth resuscitation

Preparing an Accident Report

Every accident must be reported to an employer and minor accidents reported to a supervisor, safety officer or first aider and the details of the accident and treatment given suitably documented. A first aid logbook or accident book such as shown below, containing first aid treatment record sheets could be used to effectively document accidents which occur in the workplace and the treatment given. Failure to do so may influence the payment of compensation at a later date if an injury leads to permanent disability.

They will require the following information:

- The name of the person injured.
- A summary of what happened.
- A summary of events prior to the accident.
- Information about the injury or loss sustained.
- Details of witnesses.
- Date and time of accident.
- Name of the person reporting the incident

In addition to recording the above information, the employer or his representative should:

- Sketch diagrams of how the accident occurred, where objects were before and after the accident, where the victim fell, etc.
- Take photographs or video that show how things were after the accident, for example, broken stepladders, damaged equipment, etc.
- Collect statements from witnesses. Ask them to write down what they saw.
- Record the circumstances surrounding the accident. Was the injured person working alone – in the dark – in some other adverse situation or condition – was PPE being worn – was PPE recommended in that area?

1.6.7 Basic emergency response standards.

National laws and regulations are often based upon international conventions, agreements, declarations and programmes. These have been drawn up by different United Nations organizations including the International Labour Organization (ILO) and the World Health Organization (WHO).

1.6.8 Getting professional help when an accident occurs:

An industrial accident may be defined as an event, detrimental (harmful) to the health of man, suddenly occurring and originating from external sources, and which is associated with the performance of a paid job, accompanied by an injury, followed by disability or even death. Assessing

and controlling hazardous substances – spillages and leakages of chemicals and other hazardous substances;

Evacuation procedures

When the fire alarm sounds you must leave the building immediately by any one of the escape routes indicated. Exit routes are usually indicated by a green and white 'running man' symbol. Evacuation should be orderly, do not run but walk purposefully to your designated assembly point.

Exit routes are usually indicated by a green and white '**running man'** symbol. Evacuation should be orderly, do not run but walk purposefully to your designated assembly point. The purpose of an assembly point is to get you away from danger to a place of safety where you will not be in the way of the emergency services. The purpose of an assembly point is to get you away from danger to a place of safety where you will not be in the way of the emergency services. It also allows for people to be accounted for and to make sure that no one is left in the building or on site. You must not re-enter the building/ site until a person in authority gives permission to do so. An evacuation in a real emergency can be a frightening experience, especially if you do not really know what to do, so take time to familiarize yourself with the fire safety procedures where you are working before an emergency occurs.

1.6.9 Types of workshop hazards:
Accidents and Preventative Procedures

Falls and slippages

As a worker you can make a major contribution to safe working conditions on site by attention to tidiness. There are many accidents due to tripping, slipping or falling over materials and equipment which have been left lying around, and stepping on nails which have been left projecting from timber.

Be sure you take the following steps:

- Clean up as you go – do not leave rubbish and scrap for the next person to clear.
- Keep gangways, working platforms and stairways clear of equipment and materials not in immediate use.
- Clean up spilled oil and grease
- Deposit waste material at a recognized disposal point.
- Remove or hammer down any nails you see projecting from timber

Strains

Almost one-quarter of work injuries occur during manual handling, most of which are strains to the hands, legs, feet and back. Much construction work involves heavy manual labour and workers not in good physical condition tire easily and are more susceptible to injury. The size, shape and structure

of the material will largely determine how easy or difficult manual handling will be. Well-designed and well-placed handles are of great help. Whenever you lift a load, follow the following procedure:

- Stand close to the load on a firm footing and with feet about 30 cm apart.
- Bend the knees and keep your back as straight as you can.
- Take a firm grip on the load.
- Breathe in and throw the shoulders backwards.
- Straighten the legs, continuing to keep the back as straight as you can.
- Make sure that your view is not obstructed by the load.
- Keep the load close to the body.
- Lift slowly and smoothly.
- When carrying a load, avoid twisting the spine to turn; move your feet instead.
- If two or more of you are lifting, one should give instructions to ensure that the team works together.

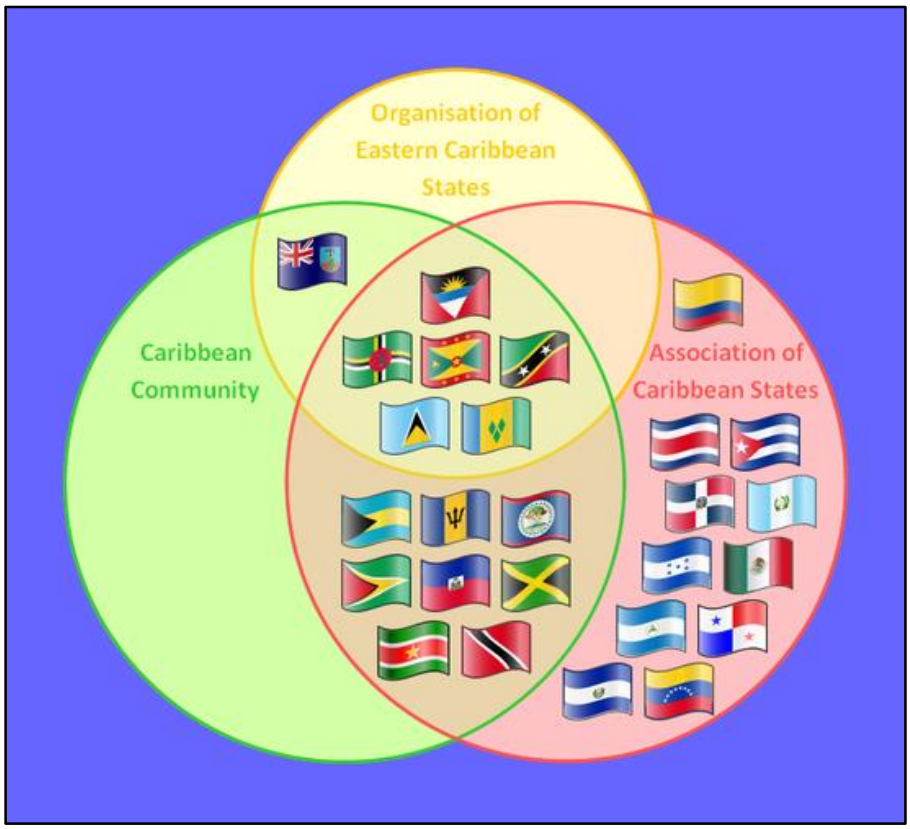
Improper use of machines, tools and equipment include:

1. Unsafe mechanical design or construction
2. Hazardous arrangement (pilling, over-loading, etc.)
3. Improper machine guarding.
4. Unsafe apparel
5. Defective devices
6. Improper material handling
7. Leaking valves
8. Untested boilers or pressure vessels, inhalation of toxic fumes.

1.7.1 Social and economic impact of industries in the Caribbean

7.1Trade Blocks:

(i) CARICOM; The Caribbean Community is an organization of 15 Caribbean nations and dependencies. CARICOM's main purposes are to promote economic integration and cooperation among its members, to ensure that the benefits of integration are equitably shared, and to coordinate foreign policy. Its major activities involve coordinating economic policies and development planning; devising and instituting special projects for the less-developed countries within its jurisdiction; operating as a regional single market for many of its members (Caricom Single Market); and handling regional trade disputes. The secretariat headquarters is based in Georgetown, Guyana. Members;



1. Antigua and Barbuda
2. The Bahamas
3. Barbados
4. Belize
5. Dominica
6. Grenada
7. Guyana
8. Haiti
9. Jamaica
10. Montserrat
11. Saint Lucia
12. St. Kitts and Nevis
13. St. Vincent and the Grenadines
14. Suriname
15. Trinidad and Tobago

CARICOM ASSOCIATE MEMBERS

1. Anguilla - 4 July 1999
2. Bermuda - 2 July 2003
3. British Virgin Islands - 2 July 1991
4. Cayman Islands - 15 May 2002
5. Turks and Caicos Islands - 2 July 1991

CSME; CARICOM Single Market and Economy or Caribbean Single Market and Economy is an integrated development strategy envisioned at the 10th Meeting of the Conference of Heads of Government of the Caribbean Community (CARICOM) which took place in July 1989 in Grand Anse, Grenada. The Grand Anse Declaration had three key Features:

1. Deepening economic integration by advancing beyond a common market towards a Single Market and Economy.
2. Widening the membership and thereby expanding the economic mass of the Caribbean Community (e.g. Suriname and Haiti were admitted as full members in 1995 and 2002 respectively).
3. Progressive insertion of the region into the global trading and economic system by strengthening trading links with non-traditional partners.

CARIFORUM; is a subgroup of the African, Caribbean and Pacific Group of States and serves as a base for economic dialogue with the European Union. It was established in 1992. Its membership comprises the 15 Caribbean Community states, along with the Dominican Republic.

1.7.2 Entrepreneurial opportunities that lead to self-employment:

Productivity and Wealth Creation

Entrepreneurs create social and economic wealth through the creation of companies and jobs, as well as frequently innovating through the development of new products and services

Career and employment opportunities

New process-based ventures often revolve around simple, organisational improvements rather than the launch of a new product.

Personal advancement

Individuals with entrepreneurial mind-sets are often drawn to opportunities, innovation and new value creation. This refers to a specific state of mind which orientates human conduct towards entrepreneurial activities and outcomes. Set goals or benchmarks that define the end-points, strategies or plans for reaching goals, measurement and assessment of progress, levels or stages that define milestones along a development path, and a feedback system to provide information on changes.

Entrepreneurial opportunities

An Entrepreneurial opportunity emerges at the nexus of individual aspirations with economic and social conditions perceived as favourable to create a new product or service, either in an existing market or a new one.

SECTION 2 - DESIGN PRINCIPLES AND PROCESSES

2.1. The design principles

1. **Line;** An element of design, which refers to, the continuous mark made on a surface by a moving point, i.e., 2-dimensisonal pencil marks on paper or 3-dimensional wire lines. (Line is often an outline, contour, or silhouette.
2. **Direction;** real or imaginary lines that point from one element to another or that connect different elements. The lines don't need to be visible:
    - **Uniform connectedness**
      The lines connecting elements have direction. An eye gaze creates an imaginary line between the eye and whatever the eye is gazing at.
    - **Continuation**
      This principle relates to elements arranged along a line or curve, as though they are moving in the direction of the line or curve.
    - **Common fate**
      Elements seen as having a common fate are those that move or appear to move in the same direction.
    - **Parallelism**
      In order for elements to be seen as parallel, their internal axes (the same ones that impart direction) must be established.
3. **Style;** manner or process of employing tools and materials in a work of art in such a way as to communicate the personality of an artist, school, or group; artists whose thoughts, words, or style demonstrate a common influence or unifying belief.
4. **Shape and size;** the element of design that has two dimensions: length and width. The relative size of elements against each other can attract attention to a focal point. When elements are designed larger than life, scale is being used to show drama.
5. **Colour;** an element of art with properties of hue (the colour name, i.e., red, blue, etc.), intensity (the purity and strength of the colour, i.e., bright red, dull red, etc.), and value (the lightness or darkness of a colour).
6. **Texture;** an element of design referring to surface qualities; the look or feel of objects. Visual texture is the illusion of the surfaces peaks and valleys, like the tree pictured. Any texture shown in a photo is a visual texture, meaning the paper is smooth no matter how rough the surface perceives it to be.
7. **Space;** a design element that can be described as two- or three-dimensional in reference to the distance or area between, around, above, below, or within objects. (Volume refers to the space within a form.)
8. **Form;** three-dimensional (having height, width, and depth) and which encloses volume, i.e., cubes, spheres, pyramids, and cylinders; the configuration or shape of an object in two

dimensional or three-dimensional space; and art marked by a distinctive style, form, or content.

2.2 The design elements

2.2.1 Line:

Weights

Line width means line thickness. Choose line widths according to the size of the drawing from the following range: 0.13, 0.18, 0.25, 0.35, 0.5, 0.7 and 1 mm. BIS recommends two line widths on a drawing. Ratio between the thin and thick lines on a drawing shall not be less than 1 : 2.

Line Types

No.	Line description and Representation	Applications
01.1	Continuous narrow line B ———	Dimension lines, Extension lines
		Leader lines, Reference lines
		Short centre lines
		Projection lines
		Hatching
		Construction lines, Guide lines
		Outlines of revolved sections
		Imaginary lines of intersection
01.1	Continuous narrow freehand line C ~~~	Preferably manually represented termination of partial or interrupted views, cuts and sections, if the limit is not a line of symmetry or a center line [a].
01.1	Continuous narrow line with zigzags A —/\/\—	Preferably mechanically represented termination of partial or interrupted views, cuts and sections, if the limit is not a line of symmetry or a center line[a].
01.2	Continuous wide line ———	Visible edges, visible outlines
		Main representations in diagrams, maps, flow charts
02.1	Dashed narrow line D — — — — — —	Hidden edges
		Hidden outlines
04.1	Long-dashed dotted narrow line E ——— . ——— . ———	Center lines / Axes, Lines of symmetry
		Cutting planes (Line 04.2 at ends and changes of direction)
04.2	Long-dashed dotted wide line F ——— . ——— . ———	Cutting planes at the ends and changes of direction outlines of visible parts situated in front of cutting plane

2.2.2Colour.

Colour can play a large role in the elements of design. Colour can aid organization so develop a colour strategy and stay consistent with those colours. It can give emphasis to create a hierarchy to the design of building giving focus to specific features.

Uses

Colour can aid organization so develop a colour strategy and stay consistent with those colours.

Hue

Values and tints and shades of colours that are created by adding black to a colour for a shade and white for a tint. Creating a tint or shade of colour reduces the saturation. Saturation gives a colour brightness or dullness.

2.2.3 Shades:

Hatching; small, grouped lines made in drawing or engraving.

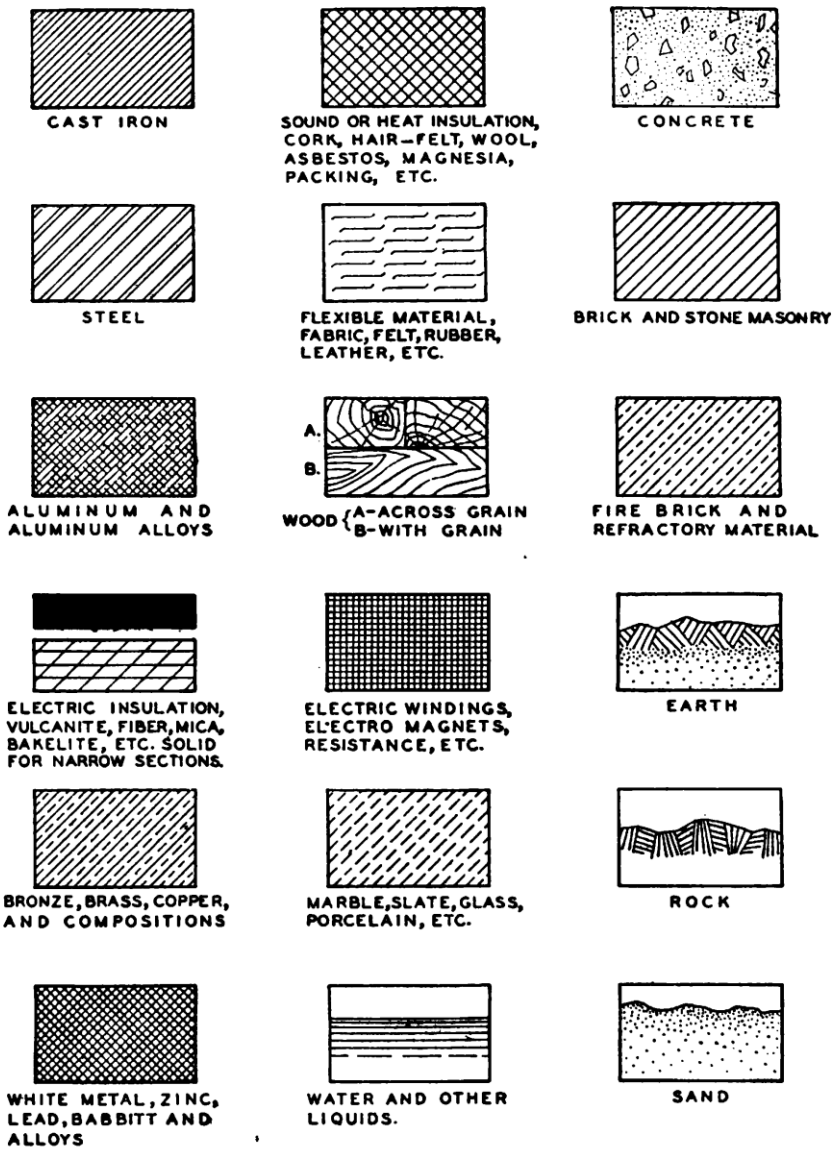
2.3 The design processes

The five steps used for solving design problems are:

1. Define the problem; listing of the product or customer requirements and specially information about product functions and features among other things.
2. Gather pertinent information; relevant information for the design of the product and its functional specifications is obtained.
3. Generate multiple solutions; test, manufacturing, and marketing teams generate multiple alternatives to achieve the goals and the requirements of the design.
4. Communication of the design ideas; a survey regarding the availability of similar products in the market should be performed at this stage
5. Development of working drawings; once the details of the design are clearly identified, the design team uses design data to produce drawings for the purpose of manufacturing or construction of a prototype.
6. Analyse and select a solution; considering cost, safety, and other criteria for selection, the more promising alternatives are selected for further analysis. Detail design and analysis step enables a complete study of the solutions and result in identification of the final design that best fits the product requirements.
7. Test and implement the solution; a prototype of the design is constructed and functional tests are performed to verify and possibly modify the design.

Codes and Conventions

Material conventions



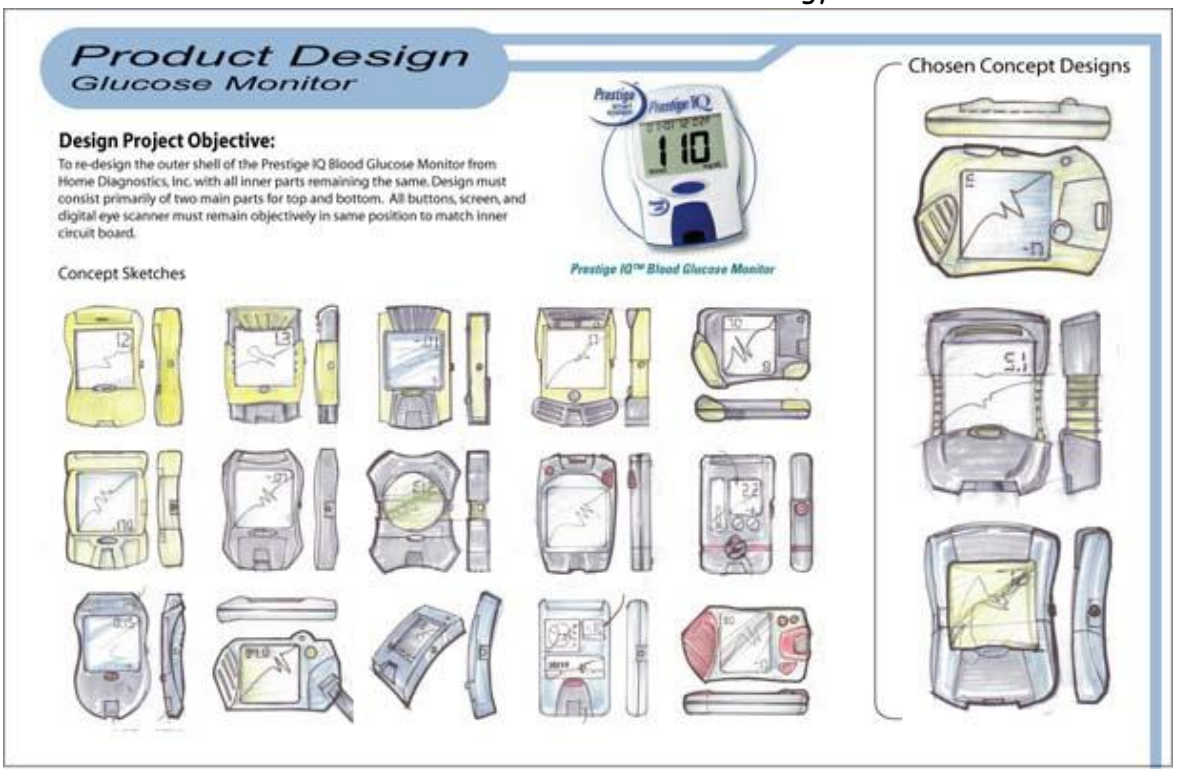
2.4. Factors that Determine the Appropriateness of a Design

1. **Aesthetics.** For designers the aesthetic appeal of a product is often top of the selection criteria. Internal and external finishes are dependent upon the materials used.
2. **Functionality;** purpose, designed chiefly from the point of view of use, whether the building is functional from the viewpoint of the client is quickly established; whether or not it is functional for the building users will take a little longer to establish.
3. **Economics;** financial factors. Good design is rarely possible within fees offered by clients. Designers also make use of standard components to reduce costs. Savings can also be made by carefully selecting the best material and manufacturing process for the item being designed.
4. **Environment;** when designing products the designer must consider the effect on pollution levels that their design will have. The product and its manufacture may also be influenced by legislation which controls pollution outputs. There has also been a major shift in public interest in environmental issues and many people will take this into account when purchasing a product.
5. **Ergonomics;** is the art and science of designing the work to fit the worker to achieve optimum productivity and cost efficiency, and minimum risk of injury.
6. **Suitability of Material;** when choosing the materials for a product the designer must consider a number of factors
   - use of product
   - quantity to be manufactured
   - market niche (cost)
7. **Innovation;** products which appear on the market sometimes do so as the result of technological innovation. Sometimes the new technology has an obvious application and sometimes not. Sometimes technology is transferred from one application to another.
8. **Decoration;** the choice of finish of a product is influenced by similar factors to those affecting the choice of materials, i.e.
   - use of product
   - quantity to be manufactured
   - market niche
9. **Anthropometrics;** Anthropometrics is the science concerned with the measurement of humankind. Inevitably it is bound up with statistics, as people vary considerably in most dimensions. Anthropometrics is of crucial importance to architects as the ultimate basis of the design of most buildings must be the size of the people using them.
10. **Selection of Material;** the selection of material has to take into account how the product/component will be used and what environment(s) it will be used in.

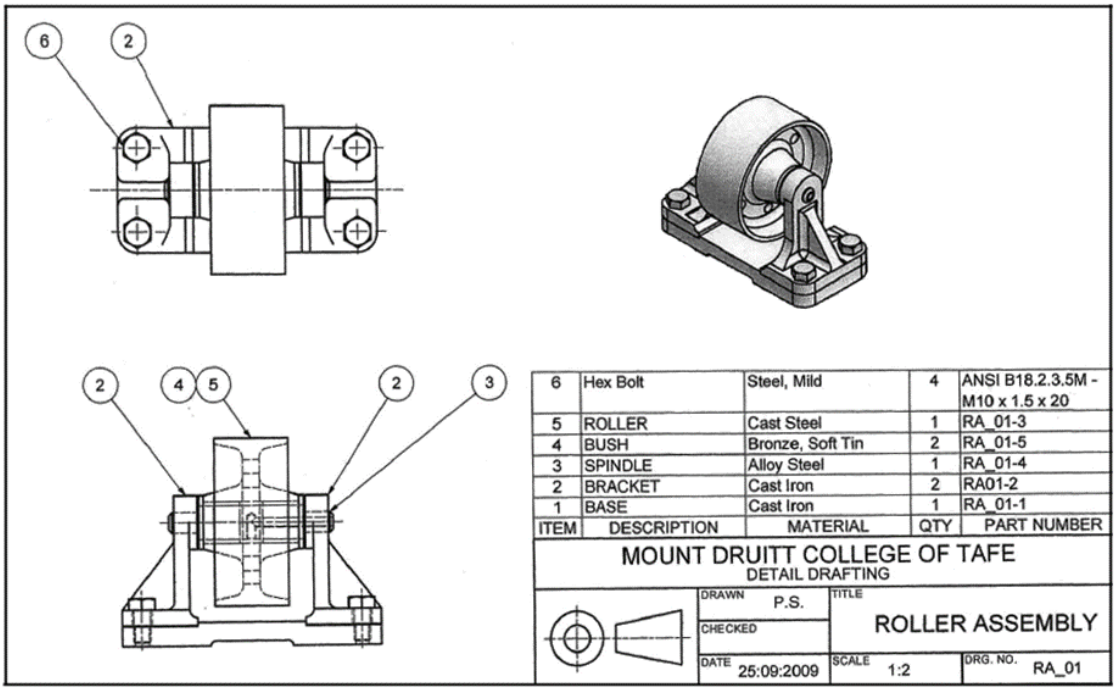
2.5. The Principles, Elements and Processes of Design

2.5.1 Using sketches to design a simple product

Electrical and Electronic Technology;



Mechanical Engineering Technology



ITEM	DESCRIPTION	MATERIAL	QTY	PART NUMBER
6	Hex Bolt	Steel, Mild	4	ANSI B18.2.3.5M - M10 x 1.5 x 20
5	ROLLER	Cast Steel	1	RA_01-3
4	BUSH	Bronze, Soft Tin	2	RA_01-5
3	SPINDLE	Alloy Steel	1	RA_01-4
2	BRACKET	Cast Iron	2	RA01-2
1	BASE	Cast Iron	1	RA_01-1

MOUNT DRUITT COLLEGE OF TAFE
DETAIL DRAFTING

DRAWN P.S. | TITLE ROLLER ASSEMBLY
CHECKED
DATE 25:09:2009 | SCALE 1:2 | DRG. NO. RA_01

Building and Furniture Technologies;

2.5.2 Analysing a simple manufactured product:
Preparing the Analysis Report

Criteria

When analysing a product first prepare a list of questions, this is known as a criteria. Look at the table (above). For example, the criteria listed below could apply to the table when it is being analysed.

Ergonomics

Is the table the right size(height, length and width). Will a potential customer need to stretch too far when using the table? Will this make it uncomfortable for the customer?

Cost

How much will it cost to manufacture the product and how much will it sell for in the shops?

Aesthetics

Does the product look good? Is it stylish? Is the style to the customers liking?

Construction Method

How has the product been made? What joining methods/ techniques have been used? Is the product well-constructed (will it fall apart when in use? Will it scratch easily? etc.)

Client Requirements

Is the product what the customer wants? What changes are required to make the product suitable for the client/customer? Does the customer like the product?

Health and Safety

Is the product safe? Does it fulfil Health and Safety Laws?

Colour and Texture

Is the colour/texture of the product effective? Or is it what the customer wants?

Materials

Are the materials suitable for this type of product? Are they quality materials or do they make the product look cheap?

Environmental Impact

What is the environmental impact of the product? Is it manufactured from materials supplied by sustainable sources? For example, if manufactured from natural woods have they been supplied from sustainable forests? Can the materials be recycled or reused?