UNIT 2 ANATOMY OF TECHNICAL WRITING

Structure

2.1 INTRODUCTION

Efficient technical communication can be achieved by developing the relevant skills addressing the various categories/departments into which a technical writing divides itself. Defining a concept, a thing or a circumstance; describing a situation, a result, or an action; and using graphic aids to put across an idea, concept, or a plan, or describing a thing – comprise the broad features of the anatomy, i.e. the structure of any technical writing.

It is important to note that *researching* about your topic, i.e. *investigating* with a view to collecting the relevant data, facts, and all the necessary information is, in fact, the first step while proceeding for report writing (i.e. technical writing). One should not forget that writing of summaries/abstracts of a given technical material also form a part of the overall the exercise in technical writing; and, very often a technical person is called upon to frame instruction manuals for the guidance of those who are engaged in carrying out some technical tasks.

Objectives

After studying this unit, you should be able to

- identify, evaluate, and use the relevant information,
- write appropriate descriptions,
- frame self-contained abstracts of given technical materials,
- frame instructions, manuals, and nomograms, and
- efficiently design and use visual aids and formatting.

2.2 RESEARCHING

This is an age of information technology; and, therefore, every professional has to make continuous efforts to remain abreast of the frontiers of knowledge in his/her field of specialisation. The person should develop the skill/ability to access the needed information and be able to use this fund of knowledge in the best interests of the task in hand. Now-a-days a tremendous volume of information can be accessed through the use of World Wide Web, yet the traditional modes of finding and using the printed information cannot be ignored if completeness, depth, and variety are aimed at.

Therefore, researching, i.e. investigation, experimentation and evaluation of information, allows appropriate and comprehensive interpretation of facts, and parameters and assumes the prime importance in case a useful technical report is to be produced. Under this scheme of things the following departments of researching can be listed :

(a) Use of library (i.e. printed matter),

(b) Personal interviews with knowledgeable persons,

(c) Response to skillfully drafted questionnaires, and

(d) Response to letters of inquiry (sent to the concerned/relevant quarters).

Use of Library

One has to, in addition to the list of references you may have collected on your own, search for the appropriate material in the library. The person on spot is the *librarian* himself/herself who could help you find out the source materials(s) – and, the task is further eased out due to the compurterisation of such information.

Card catalogues, which most libraries maintain, is basically a list of all the library sources. Sometimes, *periodicals* are listed on separate "serials" catalogue, or otherwise are clubbed together with books. Now-a-days many libraries have, instead of age-old card catalogues, developed *microfiche* (i.e. a sheet of microfilm containing rows of microimages of pages of printed matter), or/and computer generated formats. Also, some have completely switched over to on-line catalogues that facilitates easy physical effort at searching – even though there are a number of on-line catalogue systems, these all are based on the standard accessing categories of authors, title and subject.

Reference Books

Reference books form a part of the collection of books, etc. in any given library. These books are treated as a separate group of the collection, and are not, generally (except through a special permission), allowed to be taken out of the library – these can, of course, be consulted in the library itself. Reference books are given call numbers proceeded by the abbreviation *"ref"*.

Periodicals

Periodicals (popularly known as *magazines* or *journals*) are published at regular intervals (say, monthly, six monthly, . . . annually) by scientific/any technical organisations. These contain the latest articles, data, related information. Periodicals comprise a rich source of latest/or even earlier information, vis-a-vis, most research outputs, and often valuable discussions/criticisms of the concerned subjects. These also offer a fund of references/cross references that can be consulted if necessary.

Periodical index *(a listing of articles according to title, subject, and authors) helps the prospective reader/user to differentiate about the journal that is wanted to be located.*

Abstract Journals

This genre of printed materials has its own special use. These contain information for the listed articles. They also provide abstracts, i.e., brief summaries of the articles, important significant results and conclusions. Obviously, the abstract enables the user to know whether to search out the full article (i.e. the article whose abstract it is).

Previous Material

Technical departments kept copies of all the reports, till date, that have been prepared – may concern all possible topics, and problems that have been tackled so fast.

It is a very useful exercise to peruse these reports [that may or may not directly concern the problem at hand] to gain an idea about the format, pattern, and extent of coverage one may adopt in writing the report that one is called to do.

Personal Interviews

The first interview that sets the direction and momentum for your report writing is your boss(es), or your client. Here you get to know what is wanted of you, and therefore how to proceed further in your task. Later, as per necessity and requirement, you can seek further interviews from other relevant experts and concerned personnel. All this effort yields good dividends in the form of rich guidance and reveals important sources of information on the concerned subject that can be tapped. Personal interviews have a role, different than professional literature, that effectively equips you to do justice to the task. Once your mind has profiled what you need and want to find out, personal interviews prove to be very helpful. However, interviewing people itself is a matter of skill that you have to cultivate.

It is a good practice to write out before hand what to ask and how to ask questions while interviewing a source person. Further explanatory or/and probing questions that need be asked will occur to the interviewer while the interview is on. One must not, it may be stressed, hesitate to call for more than one interviews with the same source person if necessary for gathering as much information and guidance as possible.

Questionnaires

It is not in every technical-report writing that information need to be gathered through responses to the questionnaire you have framed. This procedure is adopted when it is required to solicit information, vis-à-vis, a research oriented problem, or general-interest oriented task, from a large group of people, or who are scattered over a large area. And, questionnaire framing in itself is a task that calls for lot of thinking and imagination on the part of the seeker of information.

Letters of Inquiry

A letter of inquiry is a useful and appropriate alternative (or extension) to a personal interview : but, precedence is to be given to the latter. This communication is supposed to provide helpful answers, clues, and further directions one may explore beneficially. However, it has its limitations in the difficulty it poses in asking follow up questions. Yet, it is understandable that an inquiry letter can always cap up the earlier held interview.

2.2.1 Using the Available Information

It is a beneficial habit to always, first evaluate the credentials of the available source material (books, journals, etc.) before intensely deliving deep into it for the extraction of information you fed to be important, appropriate, and crucial for your report writing. This evaluation involves the checking of the standing/reputation, position, and competence of the author, together with assessing the name and fame of the publisher. Scanning other

books and articles written by authors should offer enough insight into the depth and sweep of their knowledge and analysis of facts and figures.

Generally reputed publishing houses, generate by the mere mention of their names, confidence and hope in the one who is in search of standard material. If a journal is sponsored by a university or any professional body, the credibility of this type of literature is enhanced. However, an information in a book (not necessarily a journal) or an article in any technical field that is on the average five to six years old may need updating, and therefore further search through the relevant material is called for.

Skimming

To skim a book read the preface and introduction. This will give you a basic idea of the writer's approach and methods. Read the table of contents carefully to get an idea of the scope and organisation of the book. To skim an article, focus on the abstract. Check the notes and references as you would for a book. Read the headings. For both books and articles, sample a few paragraphs from different pages of the text to gauge the quality and relevance of the information. Skimming will not assure you that a book or article is going to be useful; however, skimming will help you in discarding the material which will not be useful.

Taking Notes

If you have access to a word processor make your notes with it. If you do not have one, use note-cards of two sizes. On the smaller cards record the bibliographic information for each source. On the larger cards record the notes. Write on one side of the card and limit each card to a narrow subject or a discrete concept so that you can easily record the information to suit the needs of your document. To help make a good plan or outline for the report, these note-cards can then be compiled under the major headings. By planning the note-cards in a logical order of development of the report, you are organised and ready to write the outline.

Example 2.1

Prepare an abstract of the experimental programe run in the laboratory for the study of *dispersion* and *diffusion* of pollutants in a rough rectangular open channel – the work is to be later on submitted as a full-ledged thesis.

Note : *The purpose of this exercise is to impress upon the student the importance of the skill/art of stating things in a concise form whenever asked for–and, therefore, afford a glimpse of what to expect in the full report.*

Solution

Abstract (in fact what is given here is a summary of the actual abstract)

The first phase of the study consisted of dispersion and diffusion experiments in a flume having smooth bed as well as smooth sides, with a view to test the validity of the methodology adopted – the results obtained compared well with those of Fischer (1966(b)), and others.

The second and third phase of the experimental programme consisted of dispersion and diffusion studies, respectively, on rough bed and rough-side channel.

In the case of rough beds it was observed that the non-dimensional dispersion coefficient $\left(\frac{D_L}{RU}\right)$ is a function of Chezy's non-dimensional roughness coefficient $\left(\frac{C}{\sqrt{g}}\right)$ and the micro structural details of roughness elements (in this case : wooden cleats). Similar results were obtained for side-spur cases.

Finally, a generalized roughness co-efficient (P_r) was proposed for the unification of dispersion data, and the data of other investigators.

Lastly, it was observed that the non-dimensional diffusion coefficient $\left(\frac{D_L}{RU}\right)$ $\left(\frac{D_z}{Wu}\right)$ – for all smooth, rough bed and rough side channels is primarily a function of $\frac{C}{\sqrt{G}}$ and aspect ratio $\left(\frac{W}{Y}\right)$ for lower values of these parameters, i.e. when the channel is rougher . . . . . .

Sample of List of References

(1) Aris, R., 'On the Dispersion of, a Solute in a Fluid Flowing Through a Tube", Proc. Royal Society of London, Series A, Volume 235, 1956, pp. 67-77.

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(12) Biery, P. F. and J. W. Delleur, discussion of 'Roughness Spacing in Rigid Open Channels', by W. W. Sayre and M.L. Albertson, Proc. . . . ASCE, JHD, Volume 87, No. HYS, 1961, pp. 231-238.

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(28) Fischer, H. B., 'Longitudinal, Dispersion in Laboratory and Natural Streams,' Report No. KH – R-12, W. M. Keck Lab. Of Hyd. And Water Reso., California Inst. of Technology, Pasadena, California, 1966(b).

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Note : There are two write-ups of Fischer in 1966 hence the 1966 (b) tag.

Example 2.2

The Assistant Engineer in-charge of Ujh River Sub-basin (J & K state) was given the task of doing initial research about the literature available to help prepare a report on the hydrometeorology of this river sub-basin.

He dug out the references to the relevant literature and submitted the following list of references.

Solution

(1) India Meteorological Deptt., 'Manuual of Hydrometeorology (Part 1)', 1972, IMD Publication.

(2) Mutreja, K. N. 'Applied Hydrology', 1988, Tata McGraw-Hill Publishers, New Delhi.

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(5) Ramashastri, K. S., 'Processing and Analysis of Precipitation Data', course material for 'workshop' NIH Roorkee.

(6) "River Behaviour Management and Training", CBIP Publication, Volume I, New Delhi.

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(8) 'Ujh Storage Project Report,' Directorate of Design and Planning, PWD, Jammu (Tawi).

SAQ 1

Write a comprehensive note on what are some of the basic methods of finding information to help frame a technical report.

2.3 PROFILE OF DESCRIPTIONS – OF OBJECT AND OF MECHANISM

A technical writing often deals with the description of *aims and objectives, objects, mechanisms,* and *processes* (or procedures). In general, a description is either a visual or verbal profile (representation) of a phenomenon. In fact, a description forms an integral part of an overall (i.e. larger, complete) technical report – say, a maintenance manual of a steam (or diesel) road roller, or a complete maintenance manual of a boiler system can (rather should) begin with the description of the working mechanism of the equipment. It helps understand in a better way the operation of the system, and hence its adequate maintenance.

Any description, may be of the object or mechanism, etc. has a basic structure that helps in conveying to the reader the essential information in an orderly fashion, such as :

- An *introductory paragraph*, or more than one paragraph – it introduces the subject by way of outlining the subject/item. It also briefly gives the objective of the write-up, i.e., it defines the purpose. This part of write-up is, sometimes, referred to as *definition/classification*.
- The main body of the description (known as *partition*) which *describes* the item *part by part*. Its length (sub-divided into as many units/paragraphs as required) depends on the requirements of a complete description.
- *The conclusion*

  It is that part of the description, which is its last portion, and, logically speaking, summarises the description and tells how the parts work together – after all a mechanism is an object that consists of a number of parts that work in juxtaposition (with one another) as a system.

2.3.1 The General Introduction

While writing an introduction of the intended description of an item, one can keep in mind the frame work within which to cast it – define its definition, function, how it appears to the observer, its working, and what constitute its important (principal) parts.

Definition

A sentence or two (or a compound one) should define the item – this is known as *sentence definition*. Here, similar items are named, and then the targeted item is distinguished from these similar items :

(a) *A flywheel is a solid wheel that stores kinetic energy and releases it back to the system whenever required to balance its flow*.

(b) *A flip flop is a circuit containing active elements that can assume either one or two stable states at any given time*.

(c) *A canal head regulator gate is a solid heavy barrier (generally rectangular) at the entry point of the river water into it, used to regulate the entry of flow*.

Its Function

This part of the introduction should state clearly what the item does :

(a) *Electron microscopes are used to magnify the objects that are smaller than the wavelength of visible light.*

(b) *Silt excluders in a canal system trap silt flowing in water, and then allow its ejection.*

Note : Mark the combination of basic definition and function description as given above in the case of a flywheel and canal regulator gate. Here, the function forms a part of the sentence definition.

Appearance (Look)

A paragraph (or more) about the look of the item as well as a sketch, drawing, or a photograph (if it helps elucidate the thing) should meet the requirement. If felt necessary, for better effect (or, in case giving the illustrations is not possible), use a comparison with an item that would be familiar to the readers. Mention the material, texture, colour, etc.

The device has a stylus attached to it, that it looks like a hard-pointed pen-shaped attachment needed for marking lines, etc.

Mode of Working

It is appropriate here to begin with a clear statement of the working principle of the item, and then describe its working :

(a) *The steam road-roller works by the energy of the expanding steam that is generated by heating water through the use of fuel. The expanding steam works the links that move the drum-wheels of the roller, and the loosely spread-out metal on the road begins getting consolidated.*

(b) *"The water having large hydraulic energy is made to strike the runner of the turbine and thus causing it to rotate. This rotation of the turbine runner is passed on to the generator by coupling the generator and turbine together through the turbine shaft. This results in rotating the generator armature, and thus producing electrical power".*

Principal Parts of the Item

At the commencement of this part of introduction/description, first write about just the principal parts. Take help of graphic aid – sketches, photographs, and drawings – it will help the detailed description of all the parts.

Experience in writing such a material orients the writes to blend the above mentioned parts of the introduction into one whole in his/her unique way – therefore, one can dispense with the strict compartmentalisation as outlined above.

2.3.2 Part by Part Description

This part of the description is somewhat like the introduction, each part is defined and if applicable this is followed by a description of its function, operating principle and appearance (shape, dimension, material and physical details like colour and texture). How sub-parts are described would depend on the audience and purpose of the description. The parts however should be described in a logical sequence. Sometimes the sequence reflects the way an object works. On a stereo cassette player, for example, the "sound" *begins at the turn table and travels through the amplifiers into the speakers*. Another common sequence is based on the physical structure of the objects from top to bottom, outside to inside, etc.

Graphic aid should be used to illustrate each major part. You may use photographs to show external surfaces, line drawings to emphasize particular items on the surface, and cutaways and exploded diagrams to show details below the surface. Other kinds of graphic aids, such as, graphs and charts are often useful. However, innovations are always possible.

2.3.3 Conclusion

A brief conclusion (or, a little detailed one as per necessity) in fact summarises the description given earlier – may it be a whole mechanism or source objects. It requires some thought and skill to frame a crisp and impressive conclusion. Practice helps.

Example 2.3

A young engineer-in-the-making (i.e. an engg. student) visited a construction site where a jaw crusher and a portable aggregate-processing plant were installed. He was asked to report to his parent institution describing these two facilities put up at the site.

Solution

Jaw Crusher

Introduction

The production of crushed-stone aggregate involves drilling, blasting, loading, transporting, crushing, screening, handling, and storing the aggregate.

While operating a quarry and a crushing plant, it is imperative that the drilling pattern, the quantity of explosives, the size of the power shovel (for loading the stone), and the size of the primary crusher are all harmonised (coordinated) to permit all the stone coming from the quarry to pass through the opening of the crusher. Here, it is recommended (as a desirable practice) to approximately equalize the loading capacity of the shovel and the capacity of the crushing plant. Information, in standard Tables, is available about the recommended minimum sizes of jaw crushers required to handle the stone passing through power shovel dippers of the specified capacities.

Working

It is a very popular primary crusher. It operates by allowing stone to flow in to the space between two jaws (1) and (2) – [Figure 2.1]. The distance between these jaws decreases as the stone slides down under the effect of gravity, as well as of the movable jaw. Ultimately the stone passes through the lower opening. The movable jaw exerts a high pressure, sufficient to crush the hardest rock.

The Blake-type (Figure 2.1) is a double-toggle crusher. The movable jaw is suspended by means of a shaft that is mounted on bearings set on the crusher frame.

The crushing process is set into operation by rotating an eccentric shaft, that raises a lowers the connecting rod (pitman), which actuates the two toggles. With the raising of toggles (by the pitman), a high pressure is generated near the bottom of the movable jaw, and the opening between the bottoms of the two jaws is partially closed. With the rotation of the eccentric shaft, this operation is repeated.

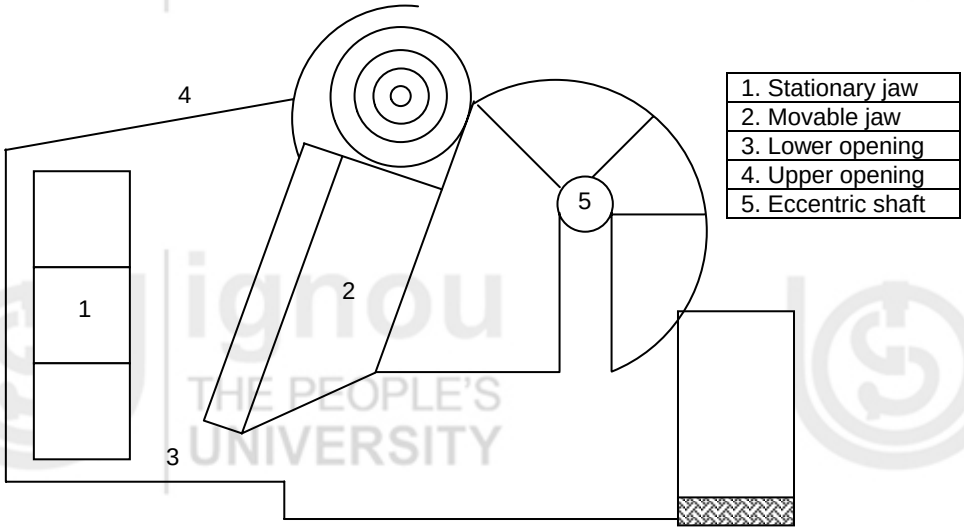


Figure 2.1 : Blake-type Jaw Crusher – a Sketch

Make-up

The jaw plates, which are made of manganese steel can be removed, replaced, or, in some cases, reversed. The jaws are generally smooth, but, in the circumstances of the stone breaking into slabs (i.e. flat configuration), corrugated jaws can be used to remedy the situation. The movable jaw (also, known as swing jaw) may be straight, or curved to reduce the chances of choking.

Conclusion

It is a very efficient machine, and its maintenance costs are reasonable. It is an indispensable equipment on medium- and large-sized projects.

Portable Aggregate Processing Plant

Introduction

After stones are crushed, the final product is an admixture of stone, chips, and sand. These items need segregation into these size ranges for the appropriate use of each item.

Flow Diagram

Figure 2.2 gives a flow diagram for a portable aggregate-processing plant – it is a self-explanatory sketch. Passing the stones from the quarry over a screen, before feeding the mass to the primary crusher, permits the selection of stone within the specified range of sizes. This arrangement helps increase the output of the plant.

Working

The conveyor belt (surge bin side) conveys the desired material to the deck vibrating screen that feeds the bins for sand, stone and chips. Rest of the material goes to the jaw crusher and then through the belt conveyor system to the other screen, and again undergoes segregation. And, the process is repeated.

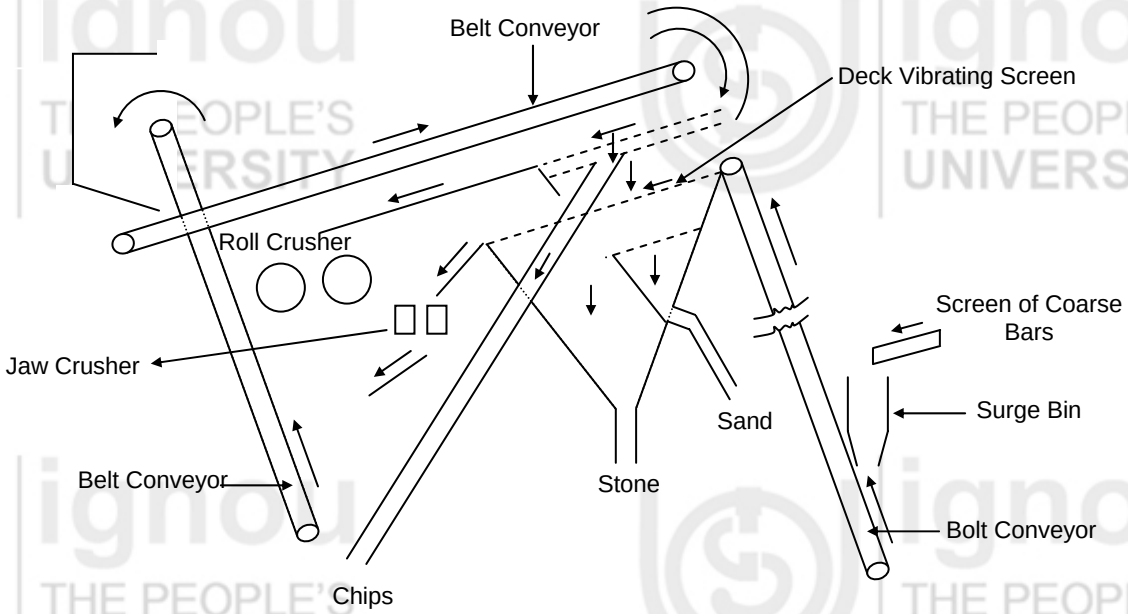


Figure 2.2 : Flow Diagram – Portable Aggregate Processing Plant

Conclusion

In large-sized projects such arrangements are essential to :

- save time,
- dispense with a large labour force, and
- ensure smooth and comparatively hassle free work environment.

Activity

Visit a construction site, and study the equipment in use there. Draw their sketches; and describe the items and their working.

2.4 DESCRIPTION OF A PROCESS

The structure of the description of a process is essentially the same as that of an object or a mechanism. However, in part 2 (The body) of the write-up a step by step description of the process is given instead of "description of the parts":

General Introduction

What the process is and what it is used for?

Body

A step-by-step description of the process.

Conclusion

Summarizes the description and describes how the steps work together.

2.4.1 The General Introduction

In the introduction the following six questions are answered :

- What is the process? Again, this can be best done by providing a sentence definition – "*Debugging is the process of identifying and eliminating any errors within the program"*. This may be followed by an elaboration if required.
- What is the function of the process? Make sure that your readers know why the process is required.
- Where and when does the process take place? State clearly the location and occasion for the process.
- Who or what performs the process? Most processes are performed by people, by natural forces, by machinery or by some combination of the three. In many cases you need not state the agent, and many descriptions are written in the passive form.
- How dies the process work? In a few sentences define the principle or the theory of operation of the process.
- What are the principal steps of the process? These may be named in sentences or in a list, but strictly in the order in which they are undergone/performed.

Again, process definitions are enhanced by clear graphic aids in the introduction. Flow charts that identify the major steps of the process are particularly common.

2.4.2 Body (The Step-by-Step Description)

Here you may treat each step as a new process, and answer the questions stated in the introduction.

The structure of the step-by-step description should be chronological, and the relationship between the steps (e.g. cause and effort) needs to be identified. The steps should be described in the present tense unless you are writing about a process that occurred in the remote part (e.g. Evolution of Man).

Whenever possible, use graphic aids to clarify each point. Additional flow charts are useful and photographs, drawings graphs could be incorporated.

2.4.3 The Conclusion

Process descriptions do not require long conclusions. Sometimes a short paragraph summarizing the principal steps will suffice. For long descriptions, a discussion about the implications of the process may be more appropriate.

Here is a description of the stages involved in the process of design followed by architects :

Process of Design
Design is a problem-solving activity. Architectural design even though creative and artistic, cannot be considered self-contained and mysteriously evolved. There is indeed a process by which we all think and this process helps us to solve problems. At the very beginning is the problem, which needs to be stated, defined, understood. The problem in this case is to design a building which will satisfactorily contain several functions. For example, if it is a house it will have a living room, a dining room, one or two bedrooms, a toilet, a kitchen, etc. It should also have proper light and ventilation. It should have proper connection with the road and surroundings. It should be firmly constructed with durable materials, it should be easy to maintain, and finally it should be good to look at. All these are problems that need to be solved. The list of problems for a school building will be quite different.

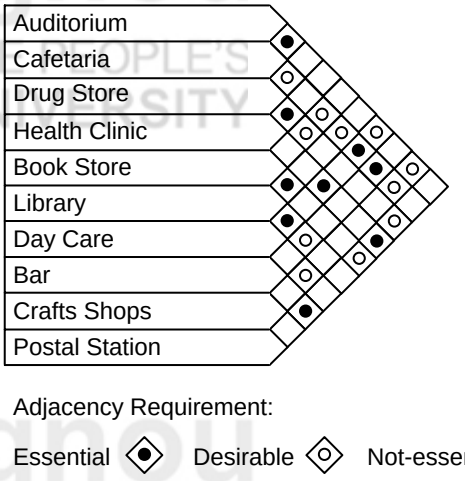


Figure 2.3 : Programme Analysis Matrix for a Community Centre

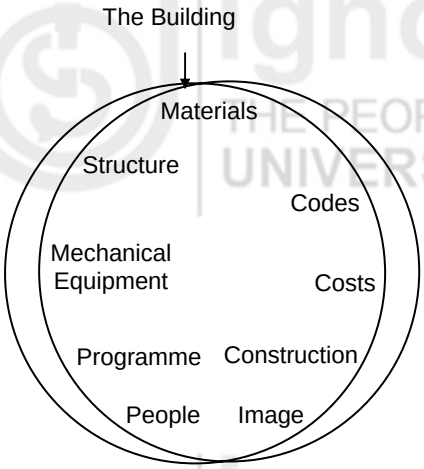


Figure 2.4 : The Building – A List of Problems

What an architect has to do in the beginning is to make a comprehensive list of the problems to be solved. The client will give his requirements, his budget, his site and a few other things. The first set of problem-solving may begin with these. The starting point for an architect is therefore a *building program*. A building program not only lists all the requirements of the building but also quantifies them. Most often clients give their requirements but are not able to quantify them. It is, therefore, the task of an architect to take the list of requirements from the client, add or subtract a few things while discussing with the client, assign sizes (areas) to each of these, work out the total size in terms of area, volume, floors, etc., to take care of clients' requirements and check if the plot and budget assigned for it will be adequate. The list of requirements is often revised to suit site conditions and budget.

The next step is a very important one is architect's work. This is where one studies the list of requirements or the building program and begins to make sketches. This act of sketching is actually a process of converting the requirement into some abstract diagrams which are conceptual ideas about how he perceives the problems. In this process something that is on paper is first perceived by the designer, he then forms a mental image out of this and draws a new and fuller image on paper. This cycle may go on several times. At the end of this process an architect arrives at a few conceptual solutions to the problem as he sees it. Having arrived at an abstract conceptual diagram of the problem, the next stage is to manipulate and extend it to include the relationships, collect additional supporting information, and working out alternative configurations of the relationships among various components.

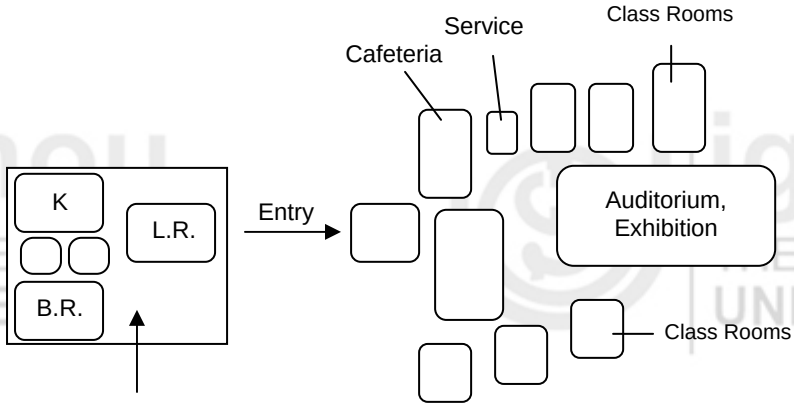


Figure 2.5 : Preliminary Sketches

One of the simplest and most commonly used devices employed by architects at this initial stage of abstraction is the bubble diagram. Bubble diagrams help designers in many ways. They may be used as models of physical space, program requirements or existing conditions. The main use of this is in representing relationships between various components in the plan. Different bubble diagrams may represent different relationship possibilities. This device is most commonly used in building industry.

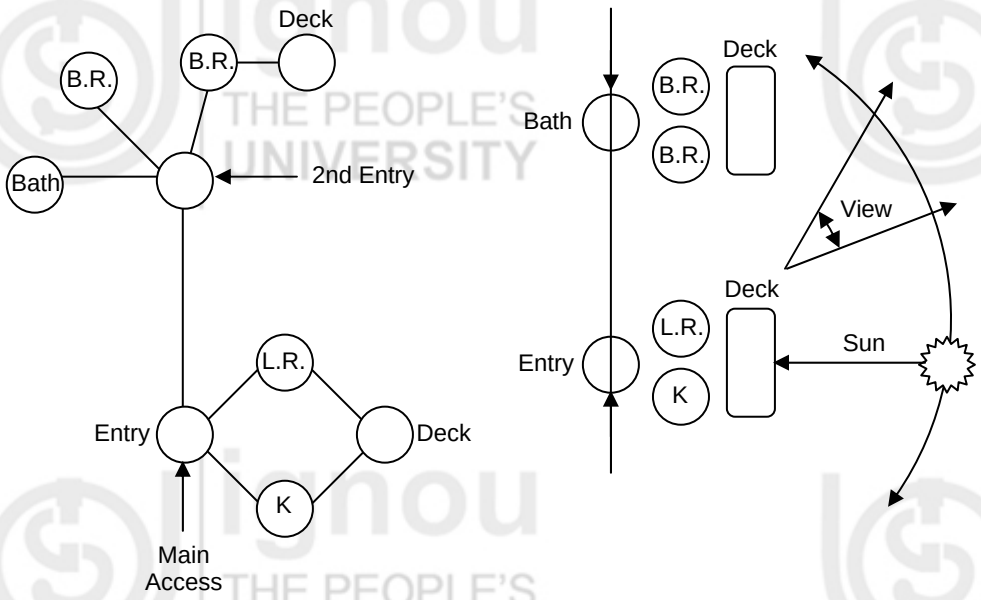


Figure 2.6 : Bubble Diagram

The initial bubble diagrams developed by an architect are generally processed to building drawings in order to make them understandable to the public or client [Figure 2.6(a), (b), (c) and (d)]. Figure 2.6(a) represents the abstract diagram and in Figure 2.6(b), the position of different rooms is established by taking into consideration other parameters such as site orientation, view, access, etc.

Figure 2.6(c) takes into account the size and shape of the rooms, layouts of the rooms and the types of spatial experience. Some notion of scale is also introduced at this stage.

Figure 2.6(d) shows the final stage which tightens the plan by taking into consideration some structural system and type of enclosure. At this stage, one is ready to prepare hardline drawings. Various details and sections can also be considered. *In this way a bubble diagram has been converted from the general to the particular.*

At this stage, design priorities and the hierarchy of spaces is also set. Design decisions based on the budget of building as well as the overall desirable look of the building with respect to proper relationships are broadly taken at this stage.

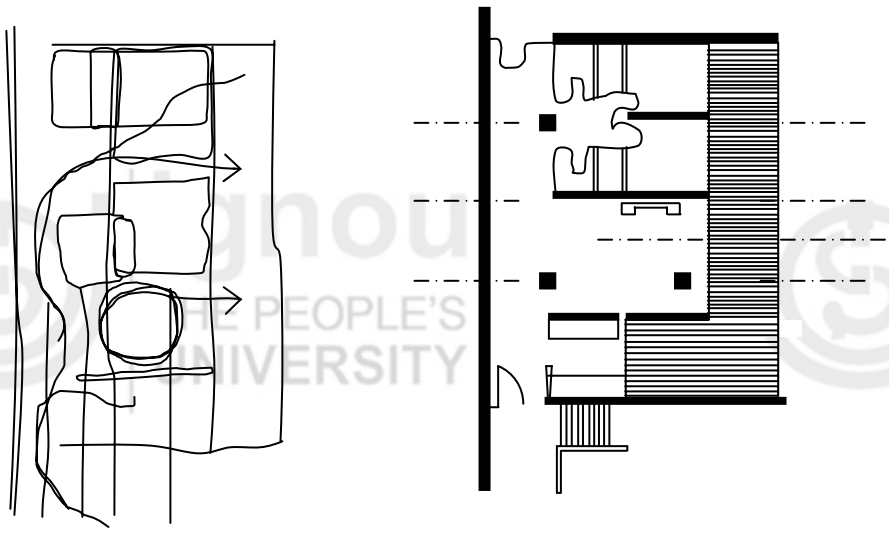


Figure 2.6 : Preliminary Sketch Design

The site conditions are also taken into consideration at this stage so as to place each room in a desirable position with respect to wind, sun and the view it provides. With the above considerations several alternatives are prepared and evaluated.

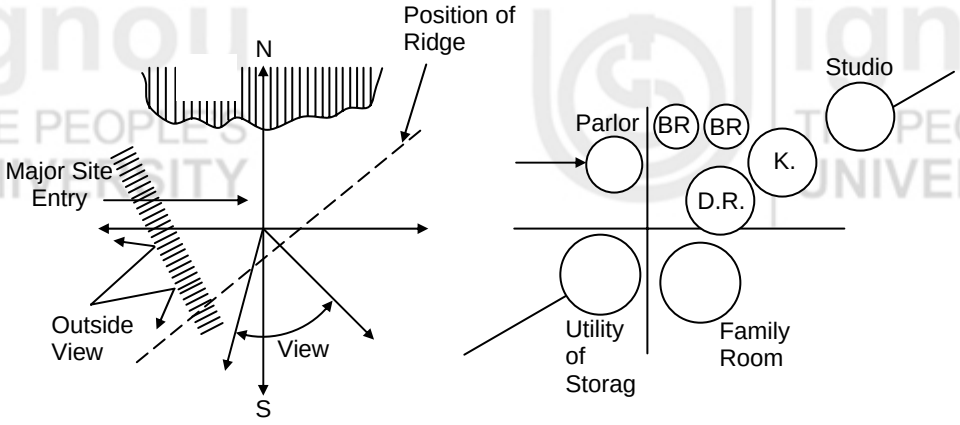


Figure 2.7 : Orientation with Respect to Site Conditions

Different main activity spaces are connected with link elements or link spaces. So while making a bubble diagram, the architect takes into consideration the link elements as well as the intensity of relationship between elements and shows them on the bubble diagram by changing the thickness of lines connecting the bubbles.

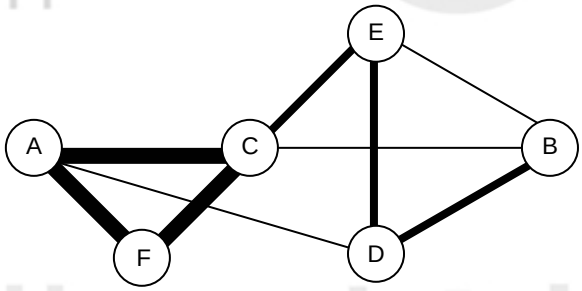


Figure 2.8 : Link Elements

While generating concepts one goes from an abstract idea to some idea of plan and form of a building. Now the architect is ready with some alternative solutions to discuss with the client. Apart from the functional aspects the client would also like to know at this stage how his building might look. For this purpose, the architect often makes *perspective drawings* or *models* to create a simulation of the building that will be constructed.

The alternative design solutions are then evaluated and compared to arrive at the best and the most feasible solution taking into consideration the site conditions, means of construction and the cost implications.

The next important stage for the architect is to convert his design into reality. For this purpose detailed working drawings and bills of quantities are prepared which correctly convey the design to the contractors who would execute the building.

This in a nutshell is the sequence and process of design that an architect generally follows in order to design a building which, when built, will not only satisfy the functional requirements of the client but also make him feel happy and proud of having constructed a beautiful building. There are many other activities which the architect has to perform after completing the *working drawings* until the building is completed.

We have seen here that an architect goes through a rigorous process of creative problem-solving to designing a good building which satisfies the functional requirements as well as is aesthetically pleasing. You may however keep in mind that the process explained above is not a standard blue print of procedure followed by all architects. While most architects follow the above mentioned process and sequence broadly, there are variations in working details which depend upon the temperament, the working style, the practical experience and preferences of different professionals.

SAQ 2

In what way does a Process Description differ from the Description of an object? Give concrete examples of your own.

Example 2.3

Describe briefly the process of soil stabilization, vis-à-vis, a civil engineering project.

Solution

Introduction

Many types of soils suffer differential expansion and shrinkage due to their changing moisture content. Also, there are soils that move and form ruts (furrows) when stressed by moving wheel loads. Therefore, if pavements and roads are to be constructed over these soils, it is necessary to stabilize them so that these experience least volume changes, and strengthen them enabling carrying the imposed loads satisfactorily, even if they are saturated.

Thus, expectedly, stabilization comprises some treatment of the soil with a view to make it more stable. These are two kinds of *stabilization* of soil that are usefully used – *mechanical* and *chemical* stabilization. In civil engineering practice a soil is treated (i.e. added with) with an inexpensive admixture (i.e. a stablization agent) that changes its chemical composition, rendering it more stable, and then the soils is compacted – this whole process being encompassed under the term *stabilization*.

Methods of soil stabilization mainly include, amongst others, the following operations any (one being adopted) :

- Blending and properly mixing different heterogeneous soils so as to obtain a more homogeneous soil mass,
- Adding lime or lime-fly ash to soils,
- Blending asphalt with the given soil,
- Mixing cement (with or without fly ash) with those soils that are mainly granular,
- Incorporating various salts into the soil mass,
- Mixing certain chemicals (on the basis of test reports) with the soil, and
- Compacting the soil after anyone of the above methods is completed.

Blending and Mixing Soils

If a soil mix is meant to be used to cover a fill, and the constituent soils are heterogeneous in their original state (say, in a barrow pit), as they are mixed (during excavation) using a power shovel or a deep cutting belt loader so as to excavate through several layers (of different compositions) in one operation. Such a material, after placing in a fill, could be further blended by several passes with *a disk harrow* (Figure 2.9).

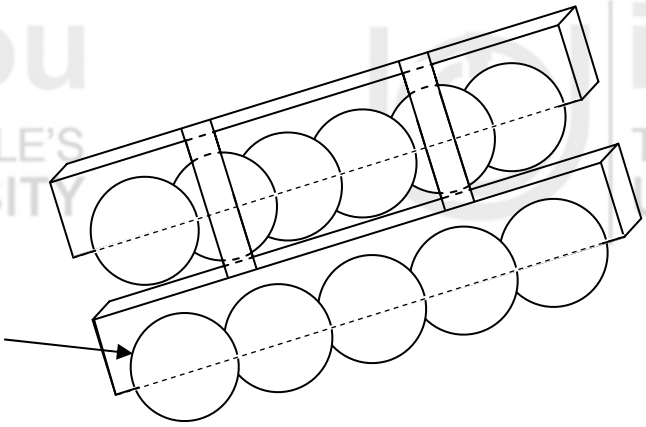


Figure 2.9 : Two Rows of Disk Harrow. Driven by Appropriate Motive

Stabilizing Soils with Lime

Stabilization of soil with lime, and then its compaction is also one of the methods followed to improve a given soil. Treatment with lime involves a chemical process. Troublesome soils like clays and silty clays (with plasticity indices greater than about 10) are usually stabilized with lime. Without stabilization such soils are rendered very soft in the presence of water.

Lime, when hydrated [$Ca(OH)_2$], causes rapid *cation* exchange and flocculation (agglomeration) when intensely mixed with the soil mass. This treatment induces a clay-type soil to behave to a large extent like a silt-type soil. The slow increase in soil-mass strength with time allows flexibility in manipulation of the soil. After the first treatment, several days to several weeks later the soil can be remixed and compacted to form a dense stabilized layer that continues to gain its strength over many years. Such stabilized soils are extremely durable – usually adopted in runways and taxiways.

Lime-Fly Ash Stabilization

Fly ash is a by-product in the production of electricity using coal as fuel. Well-pulverized coal produces an extremely fine size powder (often finer then Portland cement) and contains the silicates and aluminates necessary to combine with the lime in soil stabilization. Fly ash, of appropriate quality, can replace a part of the lime needed to stabilize a clay-type soil. Due to lime being costlier and fly ash quite inexpensive, lime-fly ash stabilization is gaining popularity.

However, here due to the use of two stabilizing agents (lime and fly ash), more manipulation of the soil is called for, which also enhances the chance of committing errors, this method is sametimes taken as cumbersome.

Asphalt-Soil Stabilization

Asphalts, like an emulsion or a cutback, are mixed with granular soils (usually amounting to 5 to 7 percent of the volume the soil mass to be stabilized) to give a better durability and stability of the soil. Sometimes better results are obtained by adding finer soil to the mass (to fill the interstices in the mass) and then mixing this blend with asphalt.

It is important to have the moisture content of the soil low at the addition of asphalt. Also, it is appropriate to allow the volatile oils to evaporate off from the bitumen before finishing and rolling of the soil mass is undertaken.

Soils treated in this way are generally used as finished surfaces for low-traffic density roads, also they may serve as base courses for a high type pavements.

Cement-Soil-Stabilization

Stabilizing soils with cement is a very effective way of strengthening some soils – particularly, when soils are mainly granular. On the average, those soils which have plasticity index (PI) about 10 are best suited for this type of treatment. Soils with greater percentage of fine (clay-sized) particles are hard to manipulate and mix thoroughly with cement before the setting of cement begins. The amount of cement that is usually added is about 5-7 percent (by weight) of the soil mass. Bricks prepared with such treated soils have been seen to do well as lining material of canals.

As is well known, fly ash is becoming easily available at many places – and it can be effectively used as a replacement for cement. Replacement percentages on an equal weight basis or on a 1.25 : 1.0 (fly ash/cement) basis have been used.

Construction method can be outlined as given below :

- spread the cement over the soil surface,
- mix it with the soil with a pulverizer-type machine, to a specified depth, and
- do fine grading and compaction.

If the moisture content of the soil is low, sprinkle the surface with water during the operation.

The material must be compacted within 30 minutes after mixing operation is done – using tamping or pneumatic rollers. Finally use smooth-wheel rollers.

It may be felt necessary to apply a seal of asphalt (or another in-vogue material) to the finished surface to allow the retention of the moisture in the mix.

Note : Addition of various salts/chemicals, etc. is done for very limited areas, and their manufacturers provide enough literature regarding the techniques used in the operations.

2.5 WRITING INSTRUCTIONS AND MANUALS

A set of instructions is a process description written to help the reader perform a specific task. A manual (a set of instructions and necessary information) is a document consisting primarily of instructions. Often it is printed and bound.

Manuals can be classified according to functions :

- Procedures manual,
- Installation manual,
- Maintenance manual, and
- Repair manual.

While writing instructions and manuals you must ensure that your readers will be able to understand them and perform the task without causing harm to themselves or the equipment. *Clarity*, *accuracy* and *completeness* are therefore of utmost importance.

The Instructions

Instructions can be brief – a small sheet of paper, or a brochure of 20 pages or more. Most instructions, regardless of their length are structured like process descriptions. The main difference is that the conclusion of instructions is an explanation to ensure that the reader has followed the instructions correctly. One can examine instruction booklets, say, for TV sets, Refrigerators, Washing Machines, etc. for getting a feel about its make-up.

Most sets of instruction contain the following three components :

A general introduction which gives the readers the preliminary information they will need to follow the instructions easily and ensure safety during on-hand experience. The introduction should attempt to answer the following questions :

Why should this task be carried out?

What safety measures should the reader take?

What background information is necessary before he/she begins the process?

What tools and materials will be needed?

The step-by-step instructions are essentially like the steps in a process description. However, some points should be remembered :

- The instructions should always be numbered. Each step should define a single task that the reader can carry out easily without having to refer back to the instructions. Do not overload the step.
- The instructions should always be stated in the *imperative mode* – "Attach the red wire..." Make sure your sentences are grammatically parallel. Avoid the passive voice (e.g. A red wire is attached by...)
- The instructions should be kept simple and direct.
- Graphic aids should be included. In some cases you may be required to provide a diagram for each step.

Conclusion

Instructions generally do not require conclusions. Sometimes, however, the instructions conclude with maintenance tips, or a troubleshooters' checklist.

Manuals

Manuals require more careful planning than instructions. Manuals are generally written collaboratively. Writing a manual requires skills in different areas – technical, writing, artistic, legal – that one individual may not have.

Though there is no single way to structure a manual, including the following (three) components make the manual easier to use and therefore more effective :

- The front matter
- The body
- The back matter

The front matter includes :

- Cover or title page
- Table of contents
- Preface
- How to use this manual section.

The front matter should try to address certain basic questions :

- Who should read this manual?
- What product, procedure or system does it describe?
- What is its purpose?
- What are its major components?
- How should it be used?

The body

The body of a manual in terms of its structure, style and graphics will depend upon its audience and purpose. The writing style in a manual must be clear. Simple, short sentences and common vocabulary may be used.

Graphic aids help to break up the text and in many cases are easier to understand than words.

The Back Matter

Again, the audience and purpose of the manual will determine what makes up the back matter. However, two items are common :

- A glossary (alphabetical list of definitions of crucial terms used in the document).
- An index which will help the reader to have quick access to different information in the manual.

SAQ 3

What is a Manual?

Example 2.4

After visiting a medium-sized civil engineering project and observing the various construction activities at that site draft an instruction sheet about :

(a) Handling crushed-stone aggregate

(b) Proportioning concrete mixtures, and

(c) Handling and batching concrete materials.

Solution

Stone forms the basic source for one of the ingredients of a concrete mixture. Stone is used in its crushed form and its handling, proportioning, and mixing with sand and cement, and water comprise the basis of all the concreting operations.

Handling Crushed – Stone Aggregate

After stone stands crushed and screened, obtaining the required size ranges, it is imperative to handle it carefully disallowing segregation (separation) of sizes that would lead to the destruction of the intended blend in size. If aggregate is allowed to flow freely down off the end of a belt conveyor, say at some height above the storage bin, the material is bound to get segregated by sizes (Figure 2.10). A strong enough cross wind causes the separation of smaller sizes from the larger sizes. So, the material should be allowed to fall freely from the discharge-end of the conveyor. Figure 2.11 illustrates the common method to prevent the above mentioned segregation.

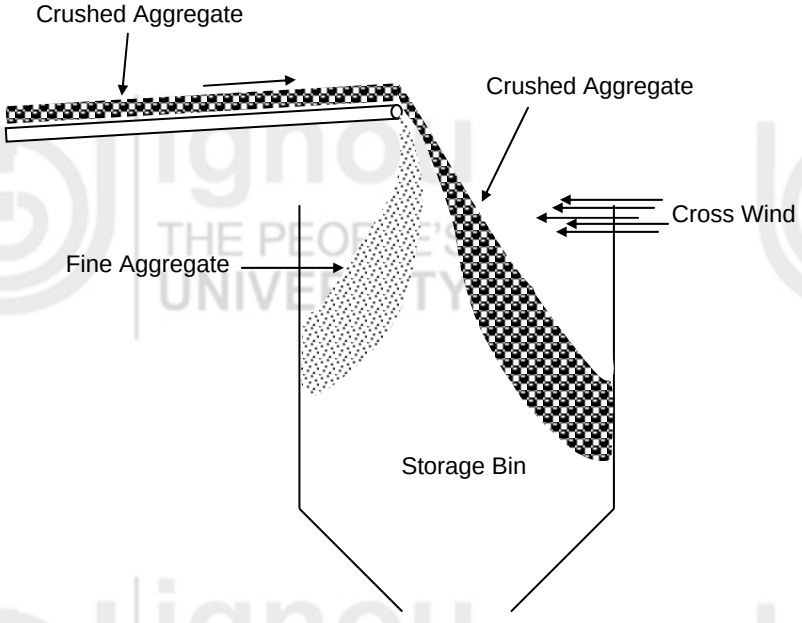


Figure 2.10 : Segregation of Aggregate while Handling, vis-à-vis, A Belt Conveyor

The end of the belt conveyor should be kept as low as possible, and the aggregate directed through a rock ladder. Figure 2.12 depicts a pile of aggregate that is severely segregated.

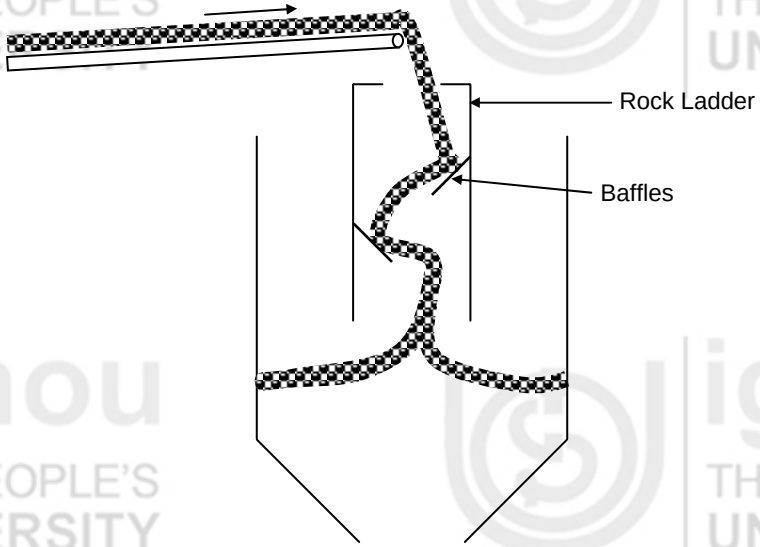


Figure 2.11 : Use of Rock Ladder Preventing Segregation of Aggregate

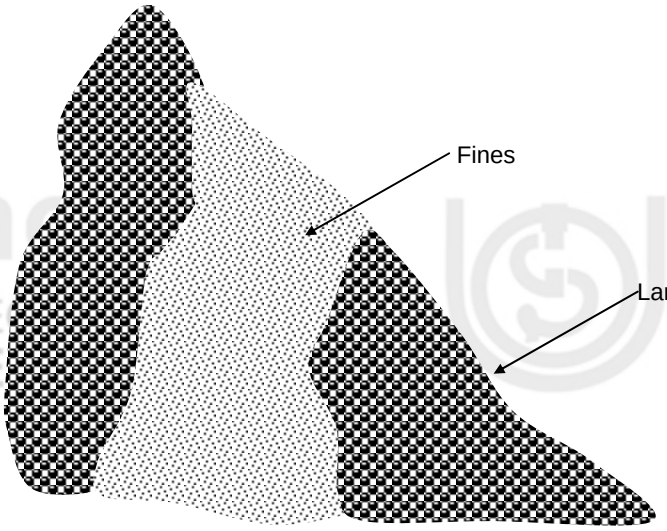


Figure 2.12 : Severely Segregated Aggregate

Proportioning Concrete Mixtures

For a useful utilization of concrete, the mixture has to be appropriately proportioned. The basic concepts that underlie the design of a concrete mix, over and above the specific details of proportioning (a matter of manual preparation), can be summarised as under :

- Higher the water-cement ratio, lower the resulting strength and durability,
- The more water that is used (not to be confused with water-cement ratio), the higher will be the slump,
- The more aggregate that is used, the lower the cost of the mix,
- Larger the maximum size of coarse aggregate, lesser the amount of cement paste that is needed to coat all the particles of aggregate, and provide necessary workability,
- Greater the consolidation of concrete, better it becomes,

- Use of properly entrained air enhances the properties of the mix. There would be no/or little decrease in its strength if the mix proportions are accordingly adjusted, and
- Surface abrasion resistance of the mix is largely a function of the properties of fine aggregate.

Handling and Batching Concrete Materials

Concrete batches are designed on the basis of absolute volumes of the ingredients; yet, these are controlled, in the batching process, by weight measure. Hence, the necessity of knowing the weight-volume relationships of all the ingredients. This highlights the importance of accurate weighing – batching equipment performs the weighing measurement.

Handling of Cement

Cement bags must be stored in a dry place on pallets (small hard surfaces) until used in concrete mixes. If the batching of concrete requires one or more whole bags of cement, the use of bag cement simplifies the batching operation.

Bulk cement (in very big projects) is unloaded and stored in overhead silos or bins. Figure 2.13 depicts an over head silo. Cement is transported to the storage bin (silo) through screw conveyor. A weighing hopper beneath the silo measures the appropriate amount of cement.

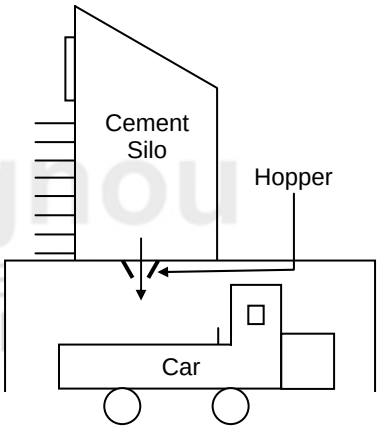


Figure 2.13 : Silos for the Storage of Bulk Cement

Batching of Concrete

Specification usually require the concrete to be batched with aggregate having at least two size ranges (coarse and fine), up to as many ranges as designed for. Figure 2.14 illustrates the proper method of filling the bin with concrete.

Slope of Aggregate Bin Bottoms

Vertical Drop of Material into Bin Directly over the Discharge Opening 1

Figure 2.14 : Proper Method of Concrete Batching

Aggregate from each size range has to be accurately measured. The aggregate, water, cement, and admixture (if any) are introduced into a concrete mixer and mixed for the prescribed time to yield an adequate blend.

For large-sized works two types of concrete mixing procedures are available – job-batched and central-batched concrete. Portable concrete plants for the purpose are available.

2.6 WRITING AN ABSTRACT

An abstract is a brief technical statement of the contents of an article or a report that comes before the article or report, as pointed out earlier.

It may exist independently of the article or report. Often abstracts are collected under subject headings, e.g. chemical abstracts.

The abstract is directed primarily to readers who are familiar with the technical subject and have to decide whether to read the full document. For managers who want a summary focussing on the managerial implications of a project, many reports also contain an executive summary together with an abstract.

The format of an abstract is traditionally one paragraph, typed single spaced with a maximum of 200 words. Sometimes two or three paragraph formats may be used.

The abstract is often written after the article/report is complete. The writer selects the most important points and then expresses them in a clear, concise language.

The abstract should include brief statements of the following :

- Objectives
- Results
- Conclusions
- Implications.

It may also give an indication of the theoretical or experimental framework.

A good abstract serves two basic purposes :

- It presents sufficient information so that those interested in the subject can decide whether to read the original paper.
- It gives, those readers only peripherally involved in the subject, sufficient information so that they will not need to read the original work.

There are two types of abstracts: indicative (also called descriptive) and informative.

The descriptive/indicative abstracts are actually a sort of table of contents in narrative form. They describe what the report is about. They do not provide the important results, conclusions or recommendations. These abstracts are used for reviewing book-length works.

The informative abstracts actually provide a distillation of the information in the document, a condensed account of the – objective, procedure, results, conclusions, implications and recommendations. Thus, they contain the principal ideas and data, unlike the indicative abstracts which are generalized and do not have qualitative or quantitative data.

The basic structure of the informative abstract includes three elements :

- *The Identifying Information* : The name of the report, the writer and perhaps the writer's department
- *The Problem Statement* : One or two sentences that define the need or the problem that led to the project.

- *The Important Findings* : This is the biggest portion of the abstract that states the crucial information the abstract contains. This may include results, conclusions, recommendations and implications for future projects.

Here are an Informative Abstract and a Descriptive Abstract for the same project report.

AN INFORMATIVE ABSTRACT

ABSTRACT
"Design of an Arch Dam in the XYZ Gorge"
Arch dam design is not as simple as the design of a concrete gravity dam. Its design involves the method of finite-element analysis, in which modern computers are a great help. This report describes the suitability of arch dam construction, at this site, because of the very strong rocks forming the flanks of the gorge.
Moreover, this report incorporates the design of a power house integral with the dam mass, as well as the ski-jet, spillway that disposes of the spilling water efficiently.

A DESCRIPTIVE ABSTRACT

"Design of an Arch Dam in the *XYZ* Gorge"
An arch dam design involves finite element analysis that can easily be handled by modern-day computers : a lot of trail and error procedure being involved. Each elementary element of the dam is thought to be subjected to bending actions in too orthogonal directions – and matching the two actions forms the crux of the design procedure.
This report gives a detailed analysis of the flanking rocks (i.e. on both sides of the gorge) on the basis of field and laboratory tests – the results testified to the suitability of the site for an arch dam to be built there. The dam is 80 m high spanning the gorge width of 150 m.
The state-of-the-art design of an integral power house (50 mw-capacity) and of a ski-jump spillway is given in detail. This type of spillway is best suited for narrow gorges where power houses are incorporated, discharging 10 cumecs at its peak discharge capacity.

2.7 GRAPHICAL AND PICTORIAL AIDS : VISUAL ELEMENTS

Visual elements, comprising diagrams, charts, graphs, (slides also, if a presentation is to be made particularly before a technical audience), and tables, help in conveying the ideas directly, clearly, and with ease, when used along, with the written text. Formatting of the written (printed) material – indenting and use of white space – renders the matter pleasing to the eye. An ancient Chinese saying stresses the power of visual aids : conveying the message that the impact and memorability of a text is enhanced tremendously through such aids. Verbal presentation becomes much more effective with the use of slides that are projected onto the screen at appropriate junctures during the presentation.

Graphic aids have to be imaginatively and skillfully prepared so that these are :

- Appealing to the eye,
- Direct and ease to follow, and therefore also to remember, and
- Effective in demonstrating relationships, results, and conclusions.

The utility of graphic aids is enhanced if these are :

- Reflecting appropriately the writing situation,
- Well labelled and logically numbered,

- Placed at appropriate points (locations) in the text – thus, becoming organically integrated with the text.

In fact visual aids add to the flavour and effectiveness of a technical write-up. Deviations from a standard trend or a numerical value, or profiling a variation of a parameter with respect to some factor (say increase in the strength of a concrete cube with time) are best depicted by a graph, etc. Visual aids may consist of *pie charts, bar graphs* or *line graphs.* Here, again proper numbering and labelling is very essential to avoid any possible confusion or a mix-up. Units of measurement should be clearly stated (Figures 2.15 and 2.16), and every parameter clearly marked.

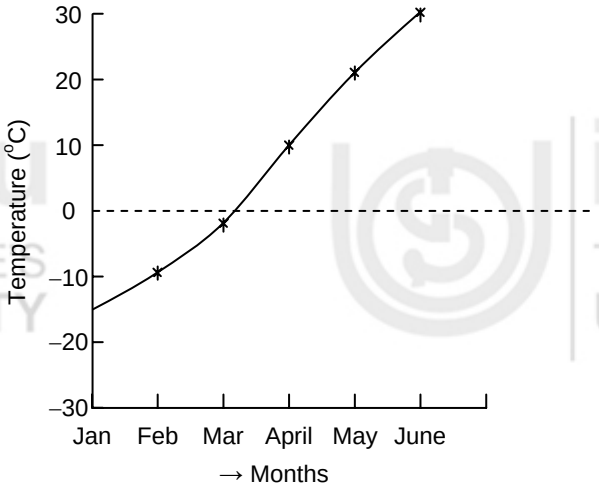


Figure 2.15 : Temperature Variation with the Passage of Months at Hill Station – ABC (Jan to June, 1999)

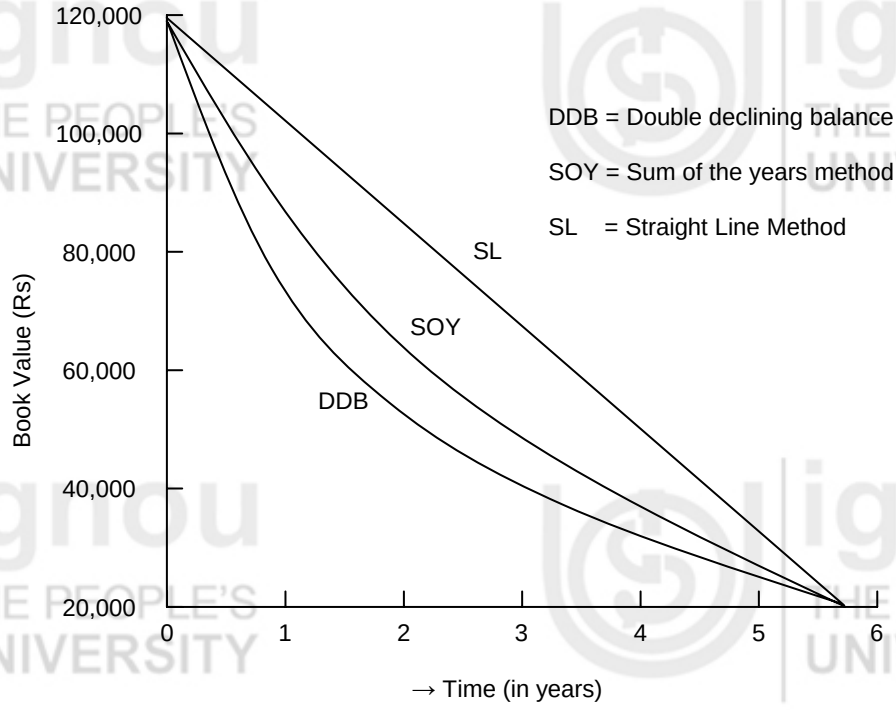


Figure 2.16 : Allowable Depreciation for Three Methods of Depreciation

It is understood that every visual aid should be put directly after the point, under discussion, is made in the text – or, sometimes as near as possible. There are, however, occasions when the visual could appear in an Appendix, such as when this information only supports/elaborates a point that is already clear. A visual to be an organic part of the text, should be introduced (and defined) clearly at just before it is placed at the envisaged location in the write-up, or immediately after the thing is described.

2.7.1 Visual Aids and Computers

Advances in computerized graphic packages have made the generation of graphic aids easy. An additional benefit is that a writer has greater control over the document he is producing. With word processing and graphics software one is able to create whatever kind of graphic one wants, in any colour, and put it exactly where one wants it after trying out a number of organisational patterns.

Types of Graphic Aids

The graphic aids used in technical documents can be classified as :

Tables

Which are list of data – usually numbers – arranged in columns.

Figures

These include graphs, charts, diagrams, photographs, etc.

2.7.2 Tables

Tables easily convey large amounts of information, especially quantitative data, and often provide the only means of showing several variables for a number of items. Tables lack the visual appeal of drawn Figures, but they can handle much more information with complete accuracy. For example, to compare maximum permissible shear in rivets and bolts, we may add the following table :

Table 2.1 : Maximum Permissible Stress in Rivets and Bolts

Description of Fasteners (*f*)	Axial Tension σ_{tf} (MPa)	Shear τ_{vf} (MPa)	Bearing σ_{pf} (MPa)
Power-driven rivets	100	100	300
Hand-driven rivets	80	80	250
Close tolerance and turned bolts	120	100	300
Bolts in clearance holes	120	80	250

You may provide footnotes for any information that needs to be clarified, also, at the bottom of the tables; and also at the source of the information (if it has not been generated by you).

2.7.3 Graphs

Following types of graph may be used :

Bar graphs provide a simple effective way of representing different qualities so that they can be compared at a glance. The principle behind bar graphs is that the length of the bar represents the magnitude of the quatity. The bars can be drawn horizontally or vertically as per convenience. Horizontal bars are generally preferred for showing different items at any given moment whereas vertical bars show how the same item varies over time (Figure 2.17).

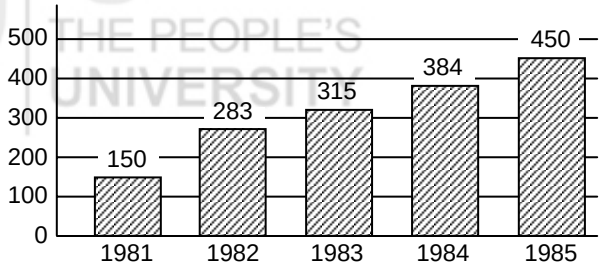


Figure 2.17 : Bar Graph

The grouped Bar Graph (Figure 2.18) lets you show two or three quantities for each item you are representing. Another way to show this information is through the subdivided bar graph. You may also use the 100 percent bar graph, which enables you to show the relative proportions of the elements that make up several items.

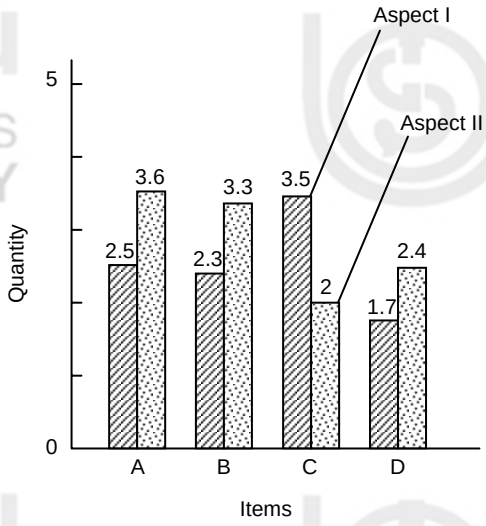


Figure 2.18 : Grouped Bar Graph

Pictographs are simply graphs where the bars are replaced by a series of symbols that represents the items (Figure 2.19). These are used to enliven statistical information for the non-specialist reader.

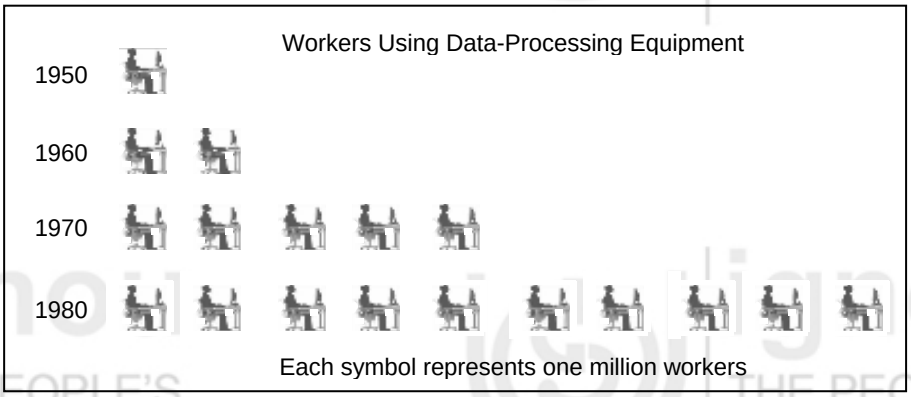
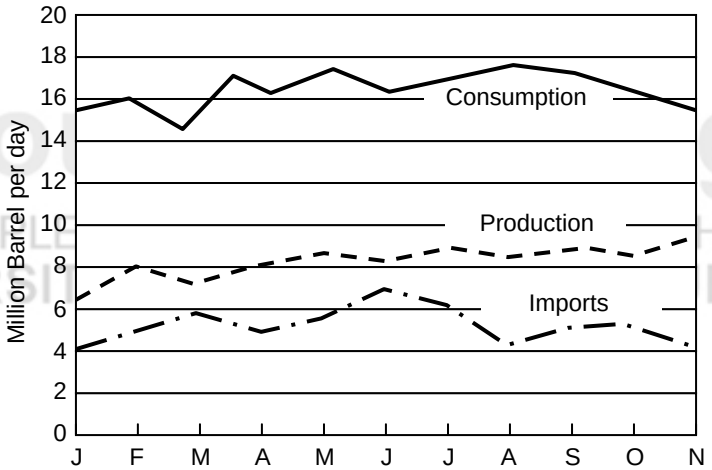


Figure 2.19 : Pictograph

Apart from these you may use the conventional **line graphs** (Figure 2.20). A line graph focuses. The readers attention on the change in quantity, whereas a bar graph emphasise the actual quatities themselves. An additional advantage of the line graph for demonstrating changes is that it can accommodate much more data. Because 3 or 4 lines can be plotted on the same Figure, so trends can be compared easily.



Petroleum Consumption, Production and Imports, January-November 1998

Figure 2.20 : Multiple Line Graph

A ratio graph (Figure 2.21) is a line graph used to emphasise percentages of change rather than change in real numbers (i.e. absolute numbers).

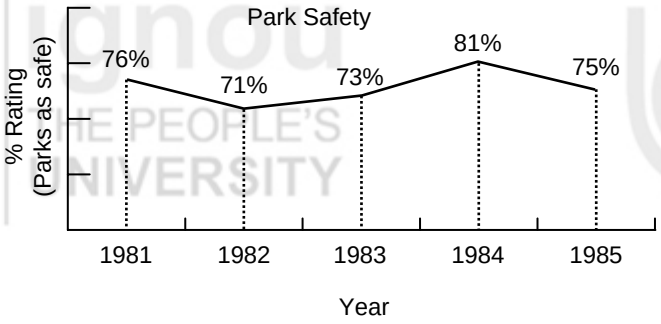


Figure 2.21 : Ratio Graph

2.7.4 Charts

Tables and graphs present statistical information. Charts convey relationships that are more abstract such as CAUSALITY OR HIERARCHY (the pie-chart is the only exception). For example, a chart showing the classification of knots (a type of timber defect) on the basis of form and quality is given below:

Classification of Knots on the Basis of Form and Quality

SI. No.	Type of Knot	Remarks
1.	Dead knot	The fibres of knot are not properly interconnected with those of the surrounding wood. Hence, it can be easily separated out from the body of wood. It is not safe to use wood, with such a knot, for engineering purposes.
2.	Decayed knot	It is also known as an unsound knot and it is formed by the action of fungi on wood.
3.	Live knot	It is also known as a sound knot. It is free from decay and cracks. It is thoroughly fixed in wood and hence, it cannot be separated out from the body of wood. Presence of such knots makes wood difficult to plane. However, wood containing such knots can be used for engineering purposes.
4.	Loose knot	It indicates preliminary stage of dead knot. The fibres of this knot are not firmly held in the surrounding wood.
5.	Round knot	Cross-section of this type of knot is either round or oval. It is obtained by cutting the knot at right angles to its long axis.
6.	Tight knot	It indicates the preliminary stage of a live knot. The fibres of knots are firmly held in the surrounding wood.

The *Pie-chart* (Figure 2.22) is used for showing the relative size of the parts of a whole. To create a pie-chart begin with the largest slice at the top of the pie and work clockwise in decreasing-size order.

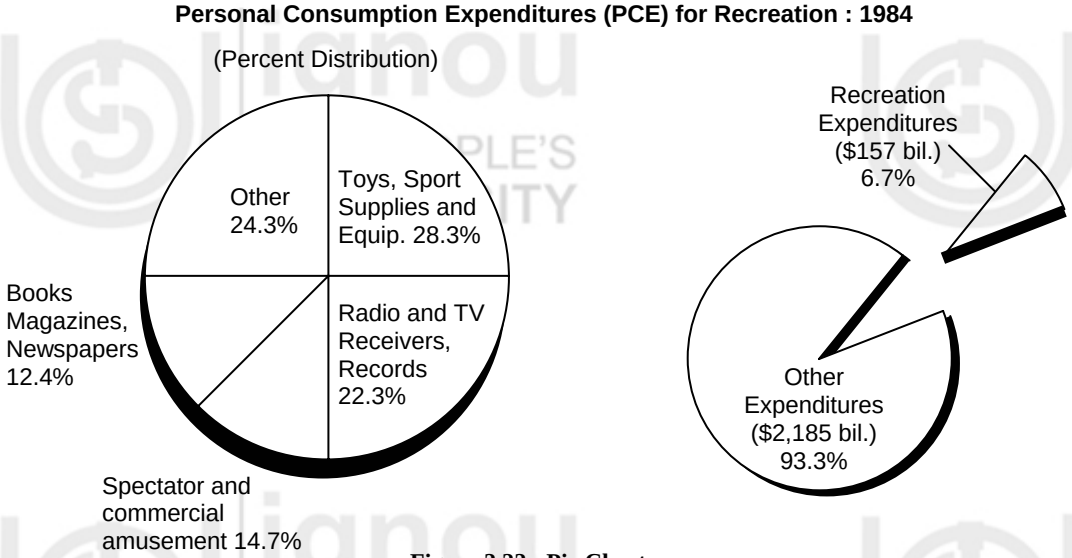


Figure 2.22 : Pie Chart

The **Flow-chart** (Figure 2.23) shows the stages of a procedure or a process. These are also useful for summarizing instructions that the reader is to carry out. The flow-chart portrays stages with labelled rectangles or circles. Pictorial symbols may also be used.

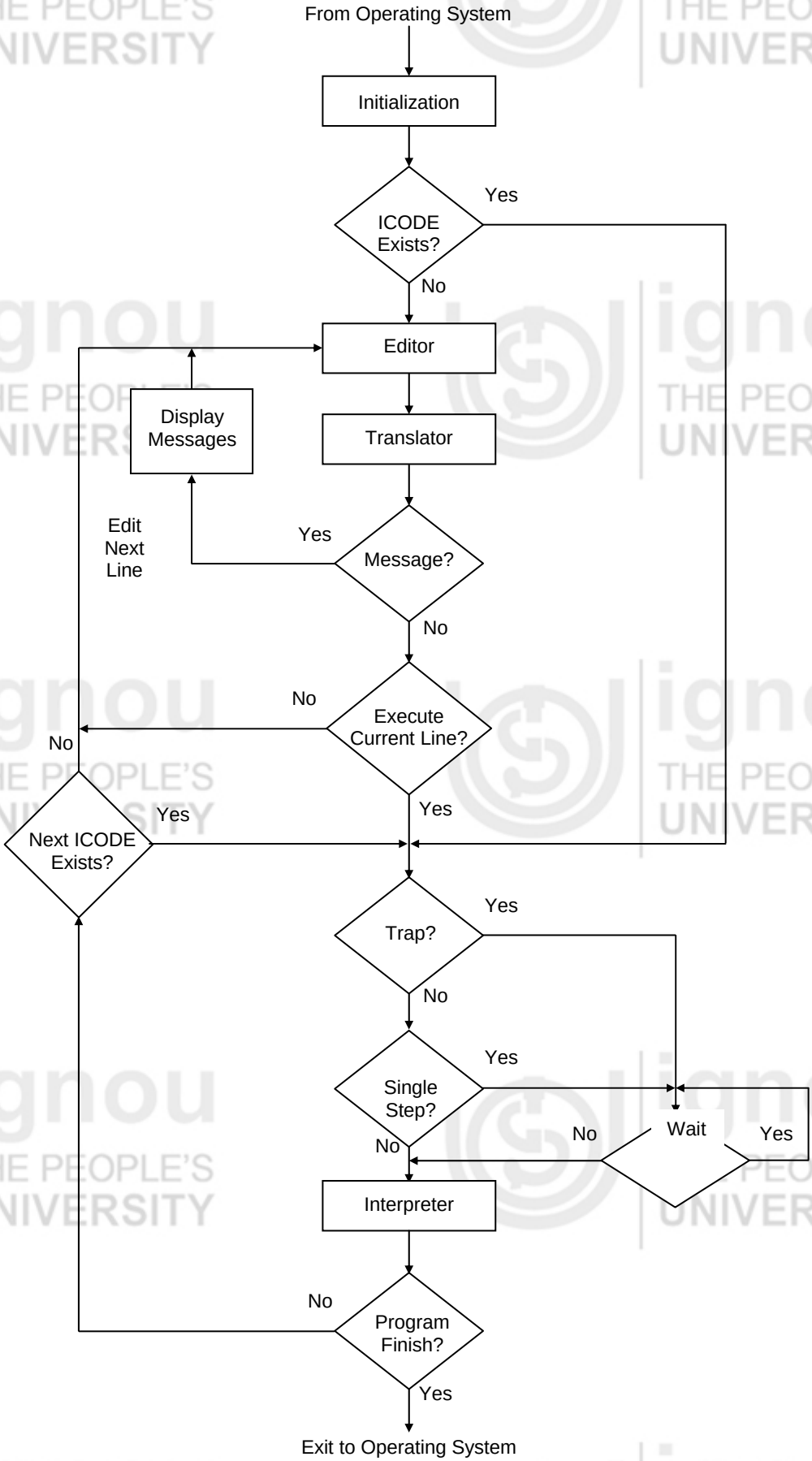


Figure 2.23 : Flow Chart

An **Organisational chart** (Figure 2.24) is a flow chart that shows the flow of authority and responsibility in a structured organisation.

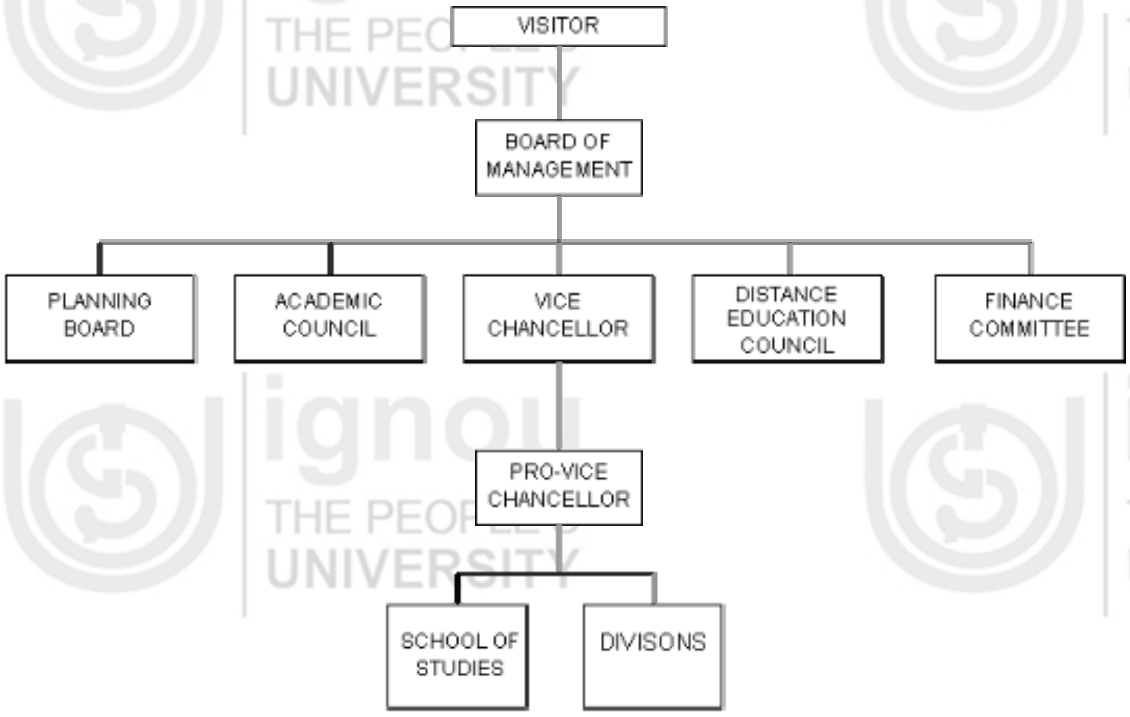


Figure 2.24 : Organisational Chart

Diagrams and Photographs

These are most effective to portray physical relationships, such as those in pieces of machinery or equipment. Diagrams drawn by hand are often used to portray perspectives that cannot be photographed. *Cutaways* for example let you "remove" a par of the surface to expose what is underneath (or inside) – they are sort of cross sections. *Exploded diagrams* (Figure 2.25) separate components from each other.

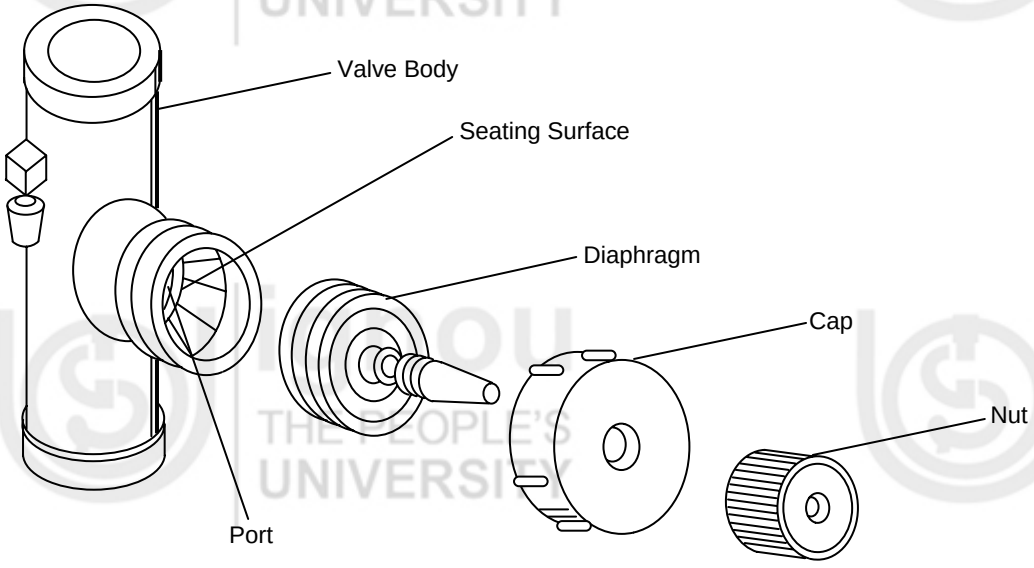


Figure 2.25 : Exploded Diagram

SAQ 4

What is the advantage of using Visual Aids?

Example 2.5

You are required to introduce the topic "A PROFILE OF INOVATIONS IN MICRO-HYDRO POWER SCHEMES IN HILLY AREAS", in your talk before a lay gathering.

Give an outline of your slides that you will prepare for your presentation touching upon the main construction features of the devices/structures.

Solution

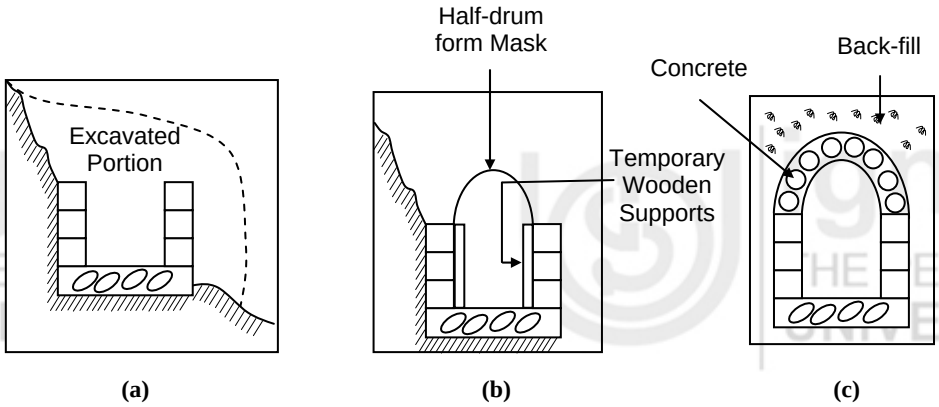


Figure 2.26 : Steps in the Construction of a Covered Stretch of a Canal

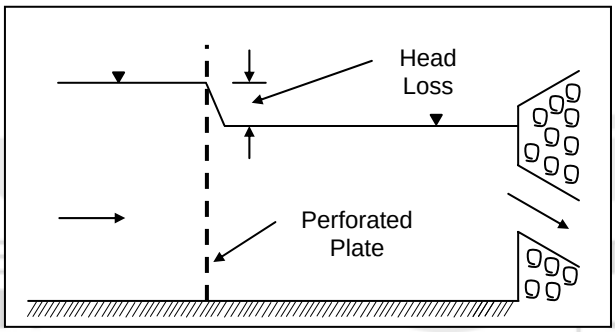


Figure 2.27 : A Perforated Plate Put in the Forebay Suppresses Vortex Formation

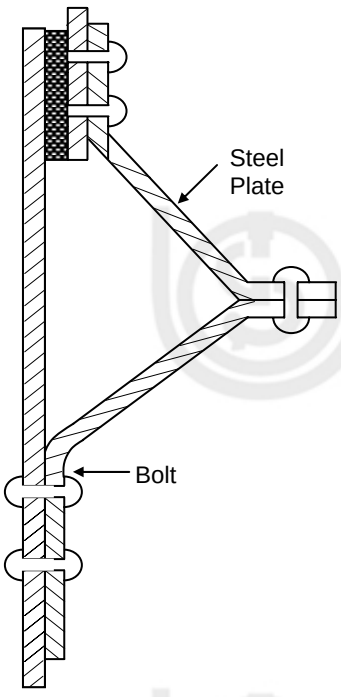


Figure 2.28 : A Bellows-type Expansion Joint (Penstock)

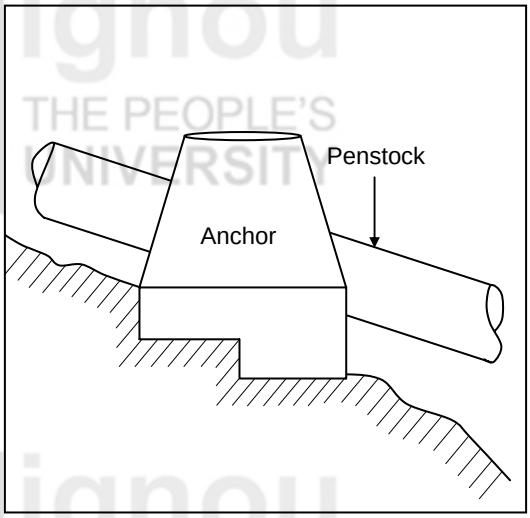


Figure 2.29 : A Serrated Surface Ensures Proper Key between Anchor and Foundation (Penstock)

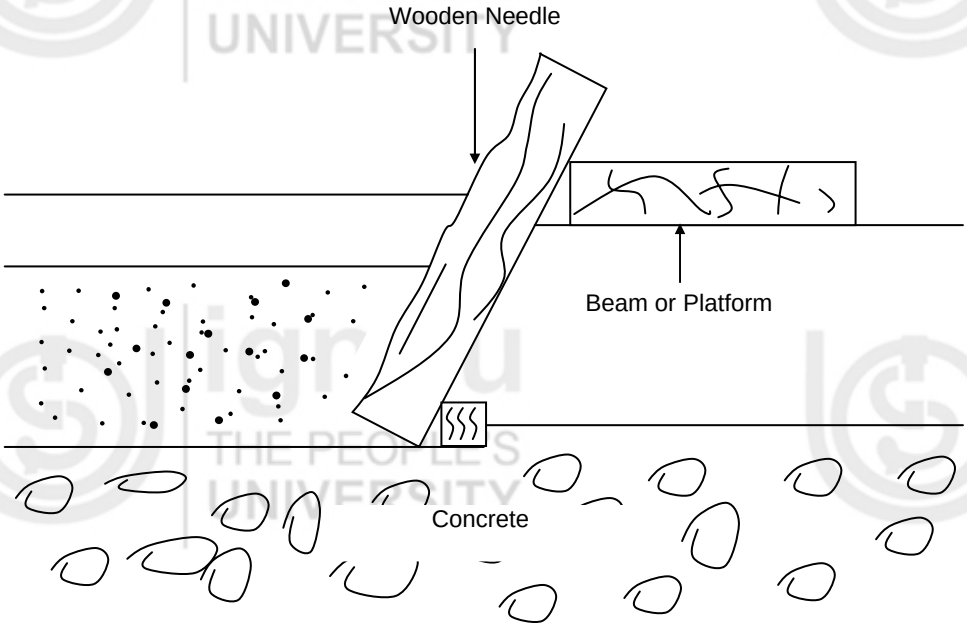


Figure 2.30 : Needles (Wooden) are Occasionally Used as a Gate

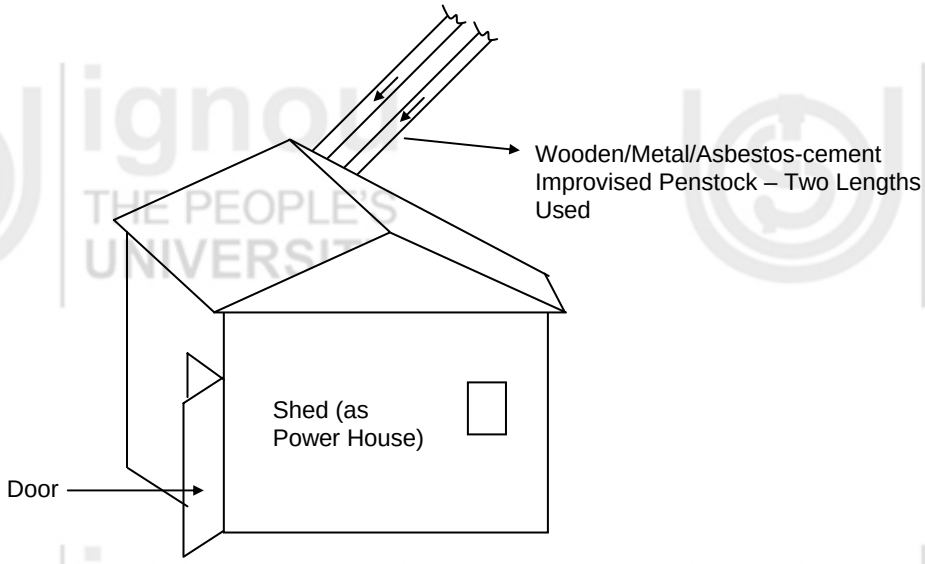


Figure 2.31 : An Improvised Shed (From Local Materials that are Available) – Working as a Power House

2.7.5 Formatting Conventions that Make Reading Easier

There are many features of technical writing that make it look different from most writings we see in newspapers, bookstands, etc. Here are some interesting formatting features that can usefully be followed.

(a) Single Spacing

(b) Short paragraphs

(c) Lists

(d) Heading (underlined titles)

(e) Numbers to mark the various paragraphs

(f) Liberal use of white space

All of these features occur frequently in scientific and technical writing because they are functional.

Single spacing saves space, and the other features make a text easier to read, especially for busy and inattentive readers.

Headings clearly announce the contents of a section so that busy readers can skip that section if they do not need its details.

Short paragraphs and white space make a report easy on the eye, even though it may be single-spaced.

The numbering, indentation, and lists provide clues to the organisation of the report. They help the reader see what sections provide proof for the generalisation and they allow a reader to skip freely from section to section without reading everything.

One thing that new technical writers have to learn is that the formatting conventions are widespread as well as functional. Short paragraphs, for instance, are common in much good technical writing. This may seem strange to those who were taught that a "good" paragraph should be at least 100 to 200 words long to be fully developed. Notice, however, that short paragraphs are not necessarily undeveloped paragraphs. You can spread out a 200 word proof over several short indented paragraphs and create a fully developed section. Such a section is much easier to read and probably more meaningful than a long paragraph version. Ultimately, however, practice makes a writer an expert one in his/her job.

Here is an example of an unformatted text followed by the formatted version. Do you find the formatted version more functional that is easier to understand and read?

UNFORMATTED VERSION OF THE DISCUSSION SECTION OF ABC RIVER BASIN, AS GIVEN IN A TECHNICAL REPORT

The ABC river basin is a small part of Western Himalayas. At its upper part the basin is narrow and elongated, while it broadens up along its lower part (Figure 2.32). The upper portion of the basin is a characterized by rugged mountainous topography, while the lower basin comprises low hills and aggradational plain.

The average height of the basin (catchment) is about 2200 m above MSL (Mean Sea Level) – the basin ground elevation varies from 4000 m to 400 m above MSL. The basin in the main slopes from West to East. The river in its upper reaches is fed by the melting of snow or ice of Kali Glacier at its origin, and by rain in the lower reaches.

The river basin is about 2000 km^2 area situated with J, and U districts, and a small portion of D district. Four prominent tributaries of river ABC have been identified : (i) Plar, (ii) Dhar, (iii) Kasli, and (iv) Simrose.

Comprehensive soil survey for ABC basin has not yet been undertaken. However, on the basis of the available literature (reports, articles, etc. see the appended Bibliography), the soils are mainly alluvial in nature: but near the outlet area there is some accumulation of rabble. Generally, soil that is brought down gets deposited at the foot hills – the texture varying from sandy loam to silty clay loam.

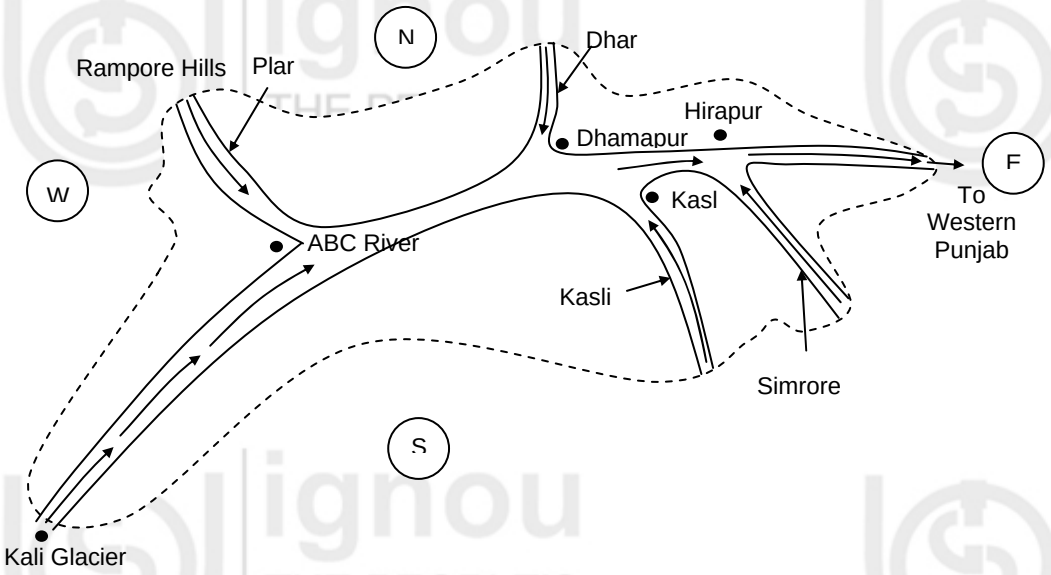


Figure 2.32 : Sketch Plan of ABC River Basin (Scale : 1 cm = 25 km)

An area of about 45,000 hectares is considered irrigable from ABC river. Table 2.2 outlines the present status of irrigation in the districts.

Table 2.2 : Extent of Area Irrigated in ABC Basin

Name of District	Area Sown		Area Irrigated	
	Gross	Net	Gross	Net
J	–	–	–	–
U	–	–	–	–
D	–	–	–	–

The basin is also endowed with power potential – some of the resources, have been tapped, while work, vis-à-vis, others is yet to be undertaken. The land use pattern is yet to be studied in depth – in general, maize and fruit are grown here and there; and in some tracts wheat is grown.

From origin to its outfall the L-section of the river shows a wide degree of variation, such as (indicated in detailed contour plan that is under preparation) :

RL 4000 m – 1600 m ⇒ Steep gradient of 1 : 10.5

RL 1600 m – 900 m ⇒ 1 : 150

Below 900 m ⇒ the Slope decreases to 1 : 2000

Formatted Version of This Report

1.0 *Description of River ABC Basin*

1.1 *Introduction*

The ABC River . . . . . (Figure 2.32).

1.2 *Area and Physical Features*

The upper portion . . . . . lower reaches.

The river basin is about 2000km^2 . . . . . of D district.

1.2.1 *Tributaries of ABC River*

Four prominent . . . . . (iv) Simrose.

1.3 *Soil*

Comprehensive soil survey . . . . . silty clay loam.

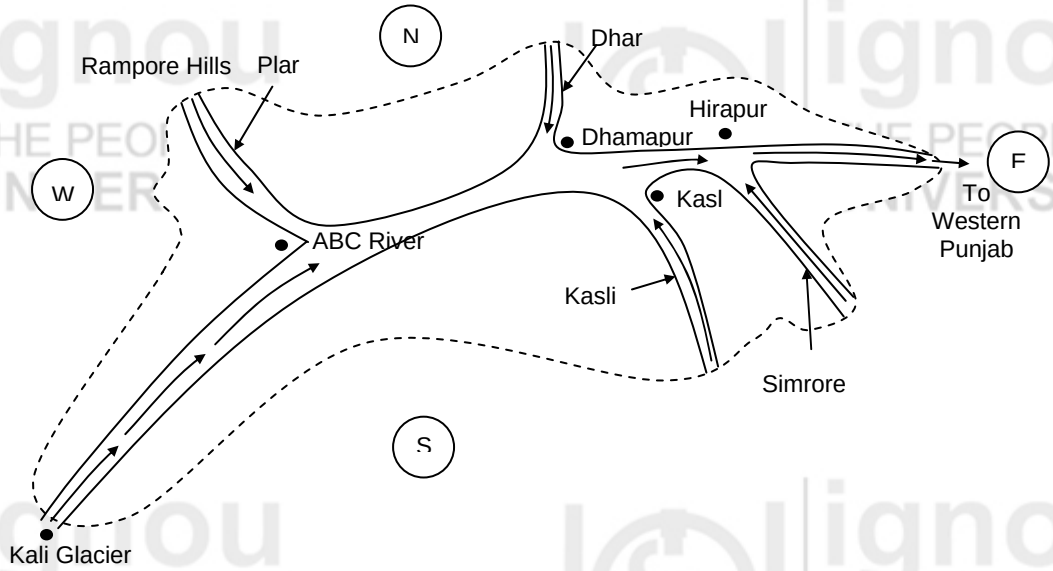


Figure 2.32 : Sketch Plan of ABC River Basin (Scale : 1 cm = 25 km)

1.4 *Irrigation Potential*

An area of about 45,000 hectares . . . . .

(**Note :** give Table 2.2 also in this section) . . . . . in the districts.

1.5 *Power Projects*

The basin is also endowed . . . . . yet to be undertaken.

1.6 *Land Use Pattern*

The land use pattern . . . . . wheat is grown.

1.7 *River Profile*

From origin to its fall . . . . . 1 : 2000.

Activity

Read as many technical reports as you can lay hands on. Every report should be read at least thrice. Try learn the methodology and absorb the ideas as well as develop your own. And, if you can, improve upon the report you go through.

2.8 SUMMARY

A professional in the technical field needs to develop skills to find and use massive amounts of information.

Technical writing often needs descriptions of objects, mechanisms and processes.

A *manual* is a document consisting primarily of a set of instructions. The readers should be able to understand them and perform the task without causing harm to themselves or the equipment.

An *abstract* is a brief technical statement of the contents of an article or a report that comes before it.

Visual elements improve the strength and memorability of a message.

2.9 ANSWERS TO SAQs

A careful reading of the Unit will help you to find the information.