

After 13 years, the earth conference on environment and development was held in Riodega-Neiro (Brazil), by 182 countries participants made serious deliberation as given below

- Decreasing the quantity of carbon dioxide in the atmosphere
- Management of forests
- Change of technology
- Bio diversity
- Sustained development
- Financial management to save the world from pollution
- The alternative bio-sources instead of petroleum products should be used.

Climate change is a change which can be related to the activities of man directly or indirectly, which changes the components of global environment and which can be seen in the natural period of time.

Mainly the climate changes can be seen by the total stock of available green house gases in the environment and not by the release of green house gases annually.

Melting of the polar ice

The depletion of ozone is increasing, the temperature of earth's surface is also increasing day by day. Due to the effect of increasing temperature the ice on the poles of the earth has started melting rapidly, then the water level of the sea is rising. By melting of the ice of the poles an imbalance in the eco-system is increasing which is very harmful.

It is essential to control the gases CFC, methane, Nitrous oxide etc. released by industries which harms the ozone layer, and 'melting' ice of the poles destroying animals and vegetation.

Rise in sea water

Due to increase in the temperature of the surface of the earth, the ice on the polar region is rapidly melting, as a result water level of the sea is upto 6cm and by the 21st century level of sea water will rise upto 65cm. So, rise in temperature should be stopped otherwise animals and plants will be affected greatly.

Kyoto conference 1977

In the atmosphere, the carbon-di-oxide is increasing and its temperature is also continuously increasing, causes dangers. So an international conference on climate was held in Dec. 1977 in the city of Kyoto in Japan. 160 countries delegates participated and made a historical agreement for prevention of change in climate due to increase in temperature of the environment of the earth.

The main goal of this conference on climate change was to control the main causes of climate change and trying quality improvement in the world environment from the angle of hygiene and health.

According to this agreement various countries agreed or reducing green house gases.

European organisation - 86%, America - 7%, Japan 6%.

A provision was made in the agreement that the defaulter would be fined and the amount of fine would be voluntarily deposited in the development fund.

Ozone gas

'Ozone' word is originated from Greek word '**Ozo**'. 'Ozo' means '**smell or odour**'. This gas was first discovered by a dutch scientist "**Van Marum**". It has a peculiar odour". Due to this odour only, it is called **ozone gas**. Sun light produces this gas. The oxygen in the atmosphere becomes active in sunlight and changes into ozone gas.

In the environment, this gas is present in a very small quantity. Ozone (O₃) contains 3 atoms of oxygen. This combination of 3 atom of oxygen present in the lower atmosphere is harmful for the human beings, but 'its' presence in the upper atmosphere is very beneficial and essential. This gas is produced itself. When the sun rays strike the upper layer of the atmosphere, then due to high energy radiation, some part of it is converted into ozone. The oxygen gas is converted into ozone by action of electricity clouds, lightening.

At a height of 20-30 km from the surface of the earth in the area of stratosphere of the atmosphere one layer is found. This layer or cover is called as '**ozone gas**'.

This gas acts as a protector of the environment. The part where the ozone gas is found is called as **ozone sphere**.

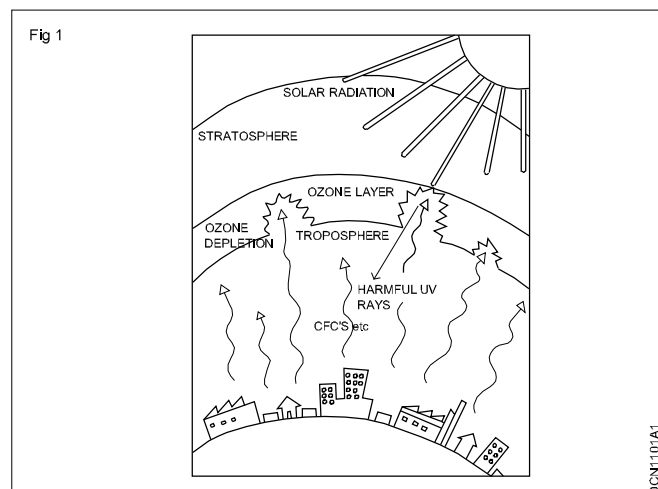
Ozone Layer Depletion

The reduction in the thickness of ozone layer in spring is called as **ozone hole**. This hole is declining in the northern hemisphere on an average rate of **4.1% annually since 1997**.

Causes of the depletion of ozone layer

The reasons for depletion of ozone layer are

- Due to the production of the compound '**Chloro Flouro Carbon**' (CFC) the ozone gas is depleting. When it reaches the stratosphere it attacks the ozone layer and reduces it. (Fig 1)



- The ozone gas layer is affected by polar cyclones.

- The chlorine gas produced by eruption of volcanoes also leaves a bad effect on ozone layer, and it is converted into carbon monoxide.
- Due to excessive amount of Nitrogen oxide in the atmosphere, it affects the ozone layer.
- Radioactive radiation from the nuclear centres has also badly affected the ozone layer.

Effects of ozone depletion

- It produces green house effect and the climate is also changed.
- Ozone depletion results in low production of crops.
- It causes damage to the organs of living things.
- Ultra violet rays harm the plants.
- It causes to spread the skin cancer diseases.
- It increases the smoke in the cities.
- It raises the possibilities of acid rains in the urban areas..
- It increases the temperature of the environment.
- It affects the mental health of man.
- It increases the temperature of atmosphere which has a bad effects on the vegetation.
- The UV rays reaching the earth are harmful to the pregnant women and the infants children also.

Preventive measures for ozone layer depletion

In 1989 limited nations environment and development conference, serious deliberation move alone to put a ban an Chloro Fluro Carbon in a fixed period of time.

- The main cause of formation of ozone hole was the use of Chloro Fluro Carbon (CFC) which is used in refrigerator industry. It harms the ozone layer therefore it should be banned all over the world
- Smoke emitted by the aeroplane should be controlled
- Nuclear explosive strictly banned.
- Use eco-friendly household cleaning products
- Efforts to be made for controlling the smoke emitted by transport vehicles, and in factories.

The ozone layer above India is fortunately completely protected. Because the thickness of ozone layer above the land area of India is 3 times as compared to other countries which are hinge holes in ozone layer.

Acid rain and its effects

When the quantity of acids in the raining water is more than the average, then such rain is called as 'Acid rain'.

or

When the PH of rain water or snow is less than 5.7, it is called as **acid rain**.

or

It is the precipitation of diluted acid from the atmosphere on the earth.

There are two types of depositions of acids in acid rain, they are

- Dry deposition
- Wet deposition

In dry deposition, particles of acid gases like 'NO₂, SO₂' and acid aerosols fall on the earth along with rain. It helps in making acid by dissolving in water in the soil.

In wet deposition, along with acid, water falls on the earth in the form of rain, fog or snow.

Composition of acid rain

Acid rain contains

- Sulphuric acid (H₂SO₄) ' 60% - 70%
- Nitric acid (HNO₃) ' 30% -40%

Nitric acid is formed by dissolving of nitrogen peroxide (NO₂) in water. It is produced in the factories, vehicles, nitrogenous fertilizers factories by the burning of fossil fuel. Sulphuric acid is formed by dissolving sulphur dioxide gas in water. It is produced in volcanoes (67%) and factories (23%).

Due to presence of acid in the rain water, PH values falls. The average PH of rainwater is between 5-6 and 6-5.

The acid rains are the result of the activities if man and the negligence of the industrial units.

The bad effects of acid rain

- By the use of water pollutant with acid rain, man and other living beings are badly affected and the man becomes victims to many types of diseases.
- This rain reduces the lustre of the metals too.
- It decreases the reproduction process of the fishes.
- Wide leaves of the vegetation are harmed by it.
- The nutrients in the soil are badly affected by this rain, especially the amount of iron is reduced.
- Water of the rivers, natural resources like wells and ponds gets polluted with acid rain waters. By drinking this water, both man and animals are badly affected.
- It may also causes corrosion in many buildings bridges, monuments, fencing etc.
- With the excessive acid rain, visibility is reduced.
- It decolorizes the leaf pigments.
- It causes irritation in the eyes and skin of human beings.
- Mosquitoes, flies and water insects multiply in this rain.

Familiarisation and information about the institute and trade

Objectives: At the end of this lesson you shall be able to

- state the general training system
 - state the information about the trade
 - state the rules and regulation of the institute and trade.
-

Training system**General**

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy labour market. The vocational training programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

Draughtsman Civil trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of two years (04 semester) duration. It mainly consists of Domain area and Core area. In the Domain area-trade theory and practical impart professional skills and knowledge; while core area imparts workshop calculation and science, Engineering Drawing, and Employability Skills impart requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Trade Certificate (NTC) by NCVT which are recognized worldwide.

Candidates broadly need to demonstrate that they are able to :

- Read & interpret technical parameters /documentation, plan and organize work processes, identify necessary materials and tools.
- Perform work with due consideration to safety rules, Govt. Bye laws and environmental protection stipulations.
- Apply professional knowledge, core skills & employability skills while performing the work
- Check the work as per sketches and rectify errors
- Document the technical parameters related to the work undertaken.

About the trade**What do draftsman do?**

Draftsmen, also called drafters, perform some of the same tasks as architects and often work with architects. Draftsmen, like architects, prepare CAD drawings. However, drafting can be applied to many other areas besides construction and architecture. Drafting can be used to create drawings of circuitry or mechanical designs. A draftsman's CAD drawings include technical details and

specifications such as materials, dimensions and procedures. In addition to using CAD, draftsmen also use calculators, tables and technical handbooks.

The type of work a draftsman does depends on his or her area of expertise. For example, drafters produce drawings for new construction projects. They may specialize in residential or commercial buildings or in the type of material used, such as steel, timber or reinforced concrete. Civil drafters prepare drawings for use in major civil engineering projects, such as highway and bridge construction, sewage systems and flood control projects.

Draftsmen are responsible for creating technical drawings that accurately represent design ideas. Draftsmen use hand drawing and computer - aided drafting methods to generate precise drawings that meet given specifications and are used by manufacturers, builders and engineers.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks with in the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Job duties and tasks for “civil drafter”

- 1 Produce drawings using computer assisted drafting systems (CAD) or drafting machines or by hand using compasses, dividers, protractors, triangles and other drafting devices.
- 2 Draft plans and detailed drawings for structures, installations, and construction projects such as highways, sewage disposal systems, and dikes, working from sketches or notes.
- 3 Draw maps, diagrams, and profiles, using cross-sections and surveys, to represent elevations, topographical contours, subsurface formations and structures.

This course is meant for the candidates who aspire to;

- 1 Use and maintain in good condition -drawing instruments, slide rule, survey instrument, autolevel, digital theodolite, total station, GPS, computer & drafting software, plotter & printer etc.
- 2 Plan and draw of residential buildings from given data.
- 3 Prepare working drawings of all types of buildings from line sketches in CAD.
- 4 Planning, drawing, estimating, and costing of civil work. Drawing plans by using CAD. Making of 3D models of

civil work. Giving setting out of site, supervision of civil work etc.

- 5 Prepare proposals for drainages and water supply for a given building including preparation of detailed drawings.
- 6 Plot the longitudinal section and cross - section for a proposed road and calculate the earth work and materials for road work.
- 7 Draw the parts of R.C.C structures and steel sections. Prepare working drawing of R.C.C structures from the given field data.
- 8 Draw from sketches or specifications various types and cross - section of roads culverts, bridges, Railways & irrigation structures in CAD.
- 9 Carry out the surveying by using latest equipments (Auto level, Digital theodolite, total station, GPS).

N.C.O Code No. 3118.20 Draughtsman, Civil

Prepare drawings of buildings, stores, highways, dams, culverts, etc. from sketches, notes or data for purposes of construction or alternations. Takes instructions from Civil Engineer studies sketches and calculates dimensions from notes or data. Draws to given scale different elevations, plan, sectional views etc. of desired construction using drawing instruments. Draws detailed drawings of specific portions as required. Indicates types of materials to be used, artistic and structural features, etc. in drawing as necessary. may do tracing and blue printing. May reduce or enlarge drawings. May prepare or check estimate schedules for cost of materials and labour. May prepare tender schedules and draft agreements. May work as draughtsman Architectural.

N.C.O. Code No.3118.50 Draughtsman, Structural : Prepares drawings of bridges, steel structures, roof tresses etc. from sketches, designs of data for purposes of construction, alteration or repairs. Studies sketches, data, notes etc. and receives instructions from Structural or Mechanical Engineers, regarding details and types of drawings to be made. Calculates dimensions as necessary from available notes, data etc and by application of standard formulae. Draws to scale detail, assembly and arrangement drawings showing sectional plan and other views as directed and prints (writes) necessary instructions regarding materials to be used, limits, assembly etc. to clearly indicate all aspects of structure to be manufactured. May prepare estimate and operation schedules for labour and material costs. May prepare tender schedule and draft agreements. May prepare tables showing requirements of bars, their numbers, sizes and shapes. May trace and make blue prints.

N.C.O Code No.3118.60 Draughtsman, topographical: Sketches topographical drawings to scale in different colours using blue print prepared from field plane tables. Carries out independently projection of small scale map to predetermined size, incorporating features covered in survey, producing total geographical effect by hill shading, giving contours, profile, cross sections, authorized symbols, etc. Uses grid tables, projection table compasses, pantograph, planimeter, etc.

Options for employment are

Employment opportunities for trainee from this trade as draftsman, surveyor and land surveyor shall be available in Central & State Government Departments.

Private sector opportunities shall be as Draftsman, Construction Supervisor with Architect, Civil Engineer, and Civil Contractor, Builders.

Options for Self- Employment are

The Trainee shall be able to independently undertake planning, drawing, estimation & costing and supervision of civil construction work. He can set up his own office for above work and also to supply Civil Construction materials.

Rules and regulation of the institute and trade

- The trainees who are all got admission in I.T.I has to follow same general rates stipulated by the institution, and those are given below
- The trainees who are all got admission in I.T.I has to follow same general rates stipulated by the institution, and those are given below
- He should try to earn good room from the institution
- The trainees should attend the institution to the correction in punctuality should be maintained.
- He should be very sincere and faithful not only to this instructor but also other instructors and staff the institute.
- He should attend were proper formal dress as specified by the institute.
- He should not wear loose clothes and this may be the cause for accident while crossing in shops floor.
- He should have good attitude and behave with good manner to all the staff members his fellow students and to this senior students.
- He should take part in the activities of the institute.
- He should maintain discipline of the class room and the institution.
- He should not spoil the environment of institute.

Note : The above rules and regulation are also compulsory for the Girl trainees to adhere

Overview of the subject to be taught in each semester

Objective: At the end of this lesson you shall be able to

- state the subject to be learned in each semester.
-

Overview of the subject to be taught for each semester

During the two years duration, a candidate is trained on subject viz. Professional Skill, Professional Knowledge, Workshop Science & Calculation and Employability Skills. In addition to this, a candidate is entrusted to undertake project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing tasks. The practical part starts with simple geometrical drawing and finally ends with preparing sanction plan of Residential / Public building; drawing of roads, bridges, railway tracts, dams and Estimation and costing of civil works at the end of the course.

The broad components covered under Professional Skill subject are as below.

Job area after completion of training

After completion of this training trainees maybe able to earn their livelihood. Environment of I.T.I is differs from the schools education. In I.T.I we concentrate more time in practical training i.e he has to obtain good skill in the trade in which he trained. Hence we can say I.T.I.s are institutions which lay the carpet for self job opportunity and differ job opportunity in public sector and private sector.

There are so many departments in public sector and private sector which provides the job opportunity for the trade of Draughtsman Civil .

The name of some public sectors are given below.

- Central public works department
- Central archetech department
- Military Engineering service
- National High ways department
- Central geological department
- Survey of India
- Railways
- State P.W.D.
- Nagar palkas
- Private building construction companies

Now Government of India passed an order in parliament those are all trained in particular group of trades such as D'man Civil, D'man Mechanic and Mechanic shop group of trades, they can join in 2nd year of diploma courses in the respective states.

Subject to be taught in the trade of D'man Civil for each semester

Ist Semester

- Occupational safety and health
- First Aid and introduction of PPF
- 5S concept
- Power failure, fire alarm
- Use of drawing instruments and equipment, their care and maintenance
- Layout of drawing sheets and following of different size of drawing sheets.
- Plane and solid geometrical figures
- Simple problems on projection of points, lines surfaces and solids.
- Drawing of sketches from modles (Plan, sections and elevation)
- Conventional signs and symbolism drawing
- Read and use of plains, diagonal, comparative, diagonal, vernier and scale of chords.
- Arrangement of bricks in different types of bonds in building and in foundation
- To have to knowledge to prevent the structure from the dampress
- Various types of arches and lintels

IInd Semester

- Chain surveying and preparation of site plan
- Observe the bearings of lines
- Traverse survey using compass
- Longitudinal and cross - sections for the given route using auto level.
- Calculation of reduced levels of various points.
- Preparation of contour map
- Traverse survey using theodolite
- Topographical map using theodolite and level
- Different type of doors and windows
- Different type of carpentry joints
- Electrical wiring system drawing
- Different ground floors
- Different types of roofs with all details
- Upper floors - General principles of construction
- Truss and stair cases.

IIIrd Semester

- Draw plan, section and elevation of a residential building (single story / and double story) with the help of sketches and line diagram.
- Practice an CAD- Explain method of giving commands -Explain drawing area setup - explain drawing and settings.
- Principles of planning local building by laws with ISI standards.
- Perspective them of building
- Inking - Lerroy set printing of letters- tracing- practice of blue prints.
- Create objects on 3D modeling and concept of CAD.
- Preparing detailed drawing of reinforced bars - *dincating shape of band, hook, details of cranks and development length.
- Draw details of R.C.C stair
- Preparation of bar bending schedule
- Draw reinforcement details of T-beam, inverted beam and cantilever
- Draw reinforcement details of R.C.C retaining wall
- Preparation of the reinforcement details of column with footing and contagious columns
- Draw the details of framed structures and portal frame.
- Draw the different types of steel sections.
- Draw the different types of rivets and bolts.
- Elevation and section of girders

- Draw roof trusses and standings
- Preparing the detailed drawing of various pipe joints
- Preparing the detailed drawing of the different types of sanitary fittings arrangements of man holes - details of septic tanks in plumbing system of new technology.
- Draw the details of R.C.c water tanks

4th Semester

- Draw the cross - sectional view of different types of roads showing component / parts.
- Draw the detailed longitudinal section of road showing its gradient.
- Typical plan showing curve.
- Details of different types of culverts and bridge.
- Draw the typical cross- section of rail sections, railway tracks in cutting and reimbursement
- Draw the detailed drawing of dam, barrages and weir.
- Draw the detailed sectional view of distributaries and head regulators.
- Preparing detailed drawing of different types of cross drainage works.
- Draw the schematic diagram of different structures of hydro electric project.
- Preparing the detailed estimate of a building - quantity of items required, rate analysis etc.
- Preparing the detailed estimate by using software.
- Transverse survey using total station.
- Use of GPS and application in survey work.

Engineering Drawing

Objectives: At the end of this lesson you shall be able to

- state the importance of engineering drawing
 - state the areas of civil engineering drawing.
-

Introduction

The communication of ideas through the graphical language is probably the oldest form of communication among human. Engineering graphics is the study that required special equipment to form the images.

Engineering Drawing

Drawing drawn by a person, having knowledge about engineering aspect for the engineering purpose is an engineering drawing. It is the universal graphic language of engineers, spoken, read and written in its own way. Every language has its own rules of grammar.

Engineering drawing also has its grammar in the theory of projections, its idioms in conventional practice, its punctuations in the types of lines, its abbreviations, symbols and its descriptions in the constructions. The shape of objects are established by different lines and size description are by symbols lettering and dimensioning.

In Civil Engineering, this is concerned with structural works. It is very broad with many subspecialties, including structural, geotechnical, water resource and transportation engineering. Structural engineers are concerned with the safe design and construction of structures.

These can range from small warehouses to skyscrapers and from highway overpasses to large bridges and can include dams of all sizes. Geotechnical and soil mechanics engineers evaluate the capacity of rocks and soils to bear heavy structures.

Water resource engineers handle water collection, distribution, and purification, including the building of dams, flood control, and irrigation. Transportation engineers design highway and public transportation systems.

List of drawing instruments, equipments and materials to be used during training

Objectives: At the end of this lesson you shall be able to

- state instruments, equipments and materials
 - list out instrument, equipments and materials
 - state the standard as per 962-1987
 - to use different drawing instruments, equipments and materials
 - follow Precautions in the use of instruments, equipments and materials.
-

Introduction

Engineering Drawing is the language of engineers, the accuracy and neatness of the engineering Drawing depends on the quality of the instruments, equipments and material used. Hence, preference should be given to standard instruments and equipments and draughtsman

Geometrical Drawing

It is the foundation of all engineering drawing. It is the art of representation of geometrical objects on a drawing sheet, which is difficult to learn or teach without the good aids. Accuracy, neatness and legibility are of great importance in engineering drawing.

Plane geometrical Drawing

It is the art of representation of objects having two dimensions, i.e. length and breadth such as, square, rectangle, etc. on a drawing sheet.

Solid Geometrical Drawing

It is the art of representation of objects having three dimensions, i.e. length and breadth and height such as, cube, cylinder, etc. on a drawing sheet.

Can computer graphics replace the drafting board? If the necessary hardware and software are available, much time can be saved, by using the computer to construct geometrical figures, drawing etc. however, the computer cannot replace the drafting board and equipments as a learning tool.

The learning process is accomplished through traditional construction methods, may then only easily accomplished by the use of computer.

The skill of manual drafting is still in great demand and will continue to be, however, because computer drafting is not suitable for all phases of design.

For example, for designing certain types of custom-made architecture and in remodeling one-of-a-kind developments manual draughtsman are still in demand for their abilities and extensive experience.

should be able to use different drawing instruments.

List of instruments

- Drawing board
- Tee-square or Mini Drafter
- Set-square

- Scale
- Protractor
- French curves
- Stencil
- Drawing instruments box

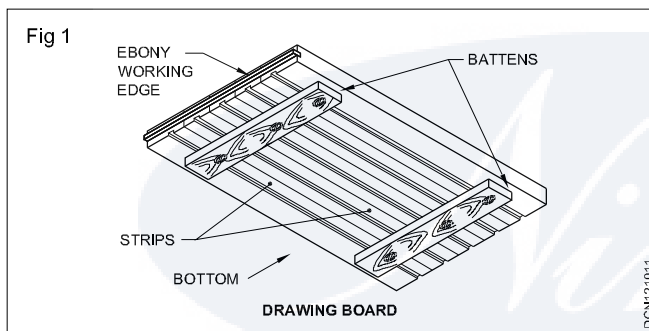
List of equipments

- Drafting machine
- Computer for Auto CAD. (Monitor UPS, CPU, key board, mouse, etc.)
- Plotter/Printer

List of materials

- Drawing papers
- Drawing pencils
- Rubber/ Eraser
- Drawing papers fasteners (Drawing pins, Cello tape)
- Tracing paper or tracing film

Drawing board (Fig 1)



The standard size should be as per IS: 1444-1963/1977 of Bureau of Indian Standards.

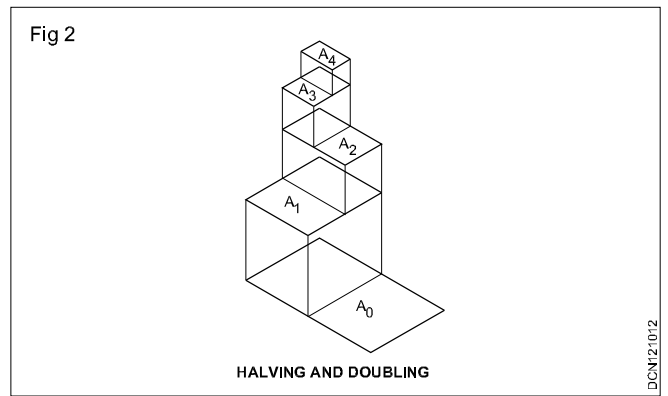
Sl. No.	Designation	Drawing Boards Sizes in mm (L x W x T)	Drawing sheets to be used with designation
1	B0	1500 x 1000 x 25	A0
2	B1	1000 x 700 x 25	A1
3	B2	700 x 500 x 15	A2
4	B3	500 x 350 x 15	A3

The following precaution may be taken in handling the drawing boards:

- Always keep an extra sheet on the top surface of the drawing board.
- Do not keep anything on the top flat surface of the drawing board.
- Take sufficient care in up keeping the straightness of the ebony edge.

Drawing papers: (Fig 2)

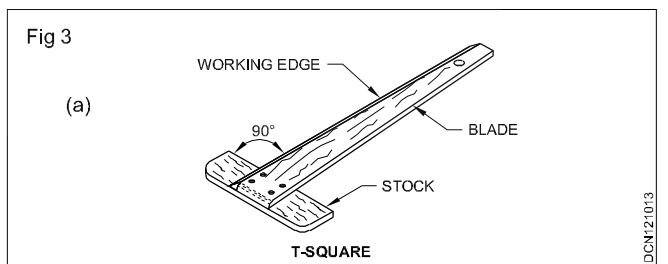
The standard size as per Bureau of Indian standard (B.I.S)



Designation	Trimmed size (mm)	Untrimmed size (mm)
A0	841 x 1189	880 x 1230
A1	594 x 841	625 x 880
A2	420 x 594	450 x 625
A3	297 x 420	330 x 450
A4	210 x 297	240 x 330
A5	148 x 210	165 x 240

- 1 The size of the drawing sheets to be used depends on the size of the object to be drawn and the scale to be used.
- 2 The length of the drawing sheet can be horizontal or vertical while drawing.
- 3 A2 size of drawing sheet is most convenient for drawing purposes in the class room.
- 4 The width to length ratio of drawing sheet is $1 : \sqrt{2}$
- 5 Area of A0 drawing sheet is 1.00 square metre.

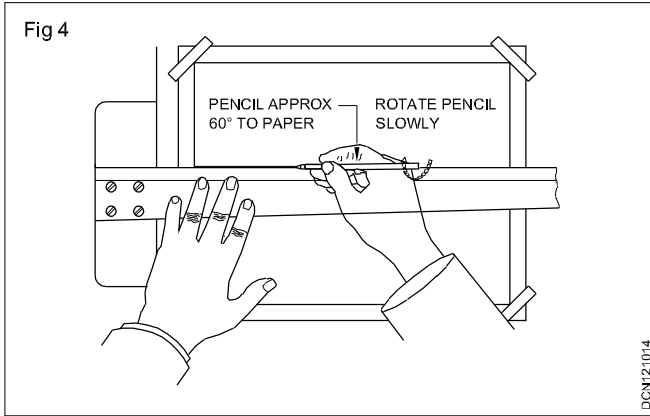
T-square (Fig 3)



It consists of two parts, a long strip called blade and a short strip called head or stock. The blade is fitted with an ebony or plastic piece on its upper edge to form a working edge.

The following precautions may be taken in handling the T-square: (Fig 4)

- 1 When not in use, T-square should be left flat on the drawing board or suspended from the hole at the end of the blade.
- 2 Clean the blade with moist cloth to remove lead particles.
- 3 Do not use T-square as a hammer to drive in the drawing pins etc.



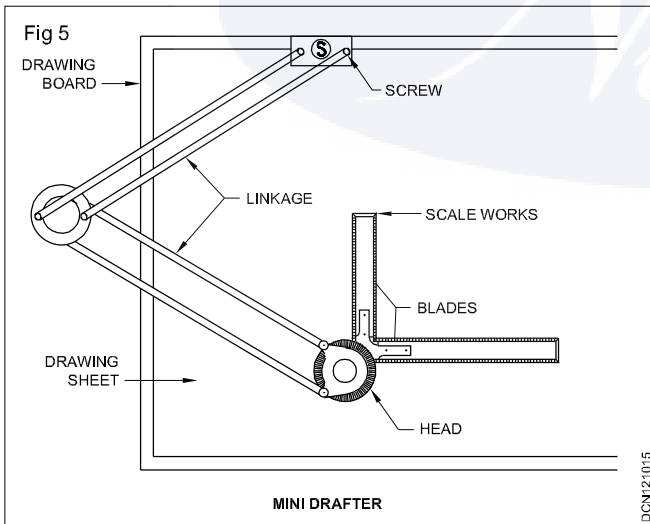
4 Do not use the ebony edge as a straight edge for cutting paper with knife.

5 Ensure that the screw heads are tight.

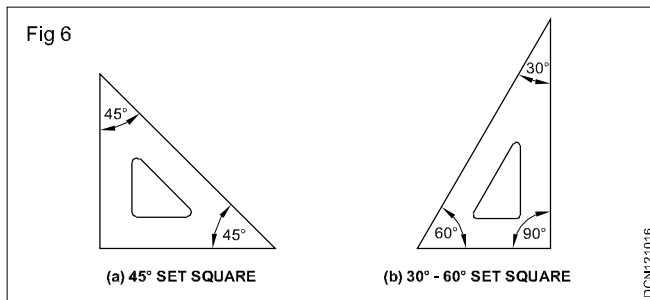
T-square is used to draw only horizontal lines. Do not use lower edge of the T-square to draw horizontal lines. While drawing horizontal lines, the pencil should be slightly inclined towards the right. Vertical and inclined lines are drawn with the help of set squares.

Mini drafter(Fig 5)

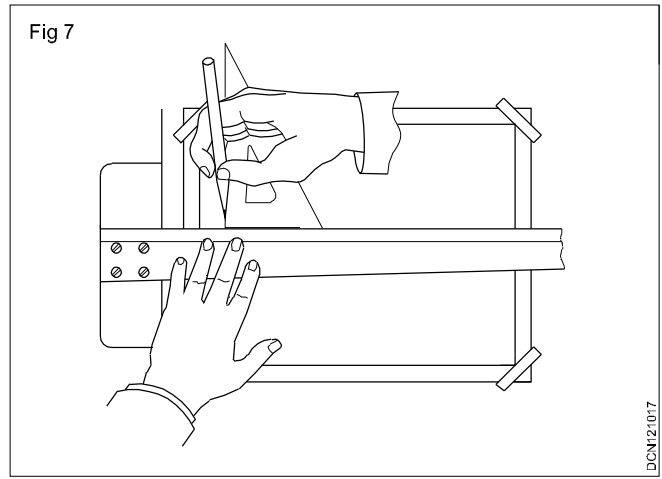
It is a simple and small shaped instrument of the drafting machine. Now-a-days these are mostly used by the engineering students. All the working functions of T-Square, Set-Square, Protractor, Scales and their merits are co-ordinated in a Mini-Drafter.



Set-square (Fig 6 and Fig 7)



It is made of transparent celluloid plastic in triangular shape. They are available in two types, 30°-60° and 45°-45°.



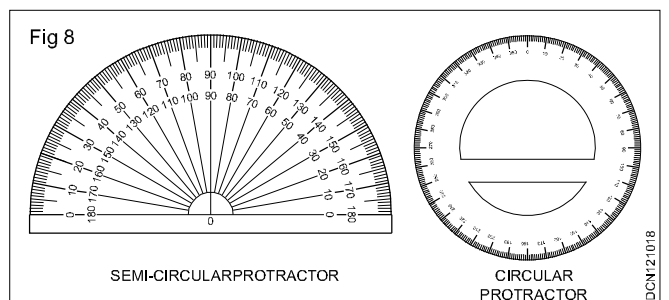
Engineer's scales (Table)

It is used to make full size, reduced size or enlarged size drawings conveniently, depending upon the size of the object and that of the drawing sheet. They are made of cardboard, plastic and as recommended by Bureau of Indian Standards, are available in set of eight scales. They are designated from M1 to M8.

Table

Designation	Description	Scales
M1	Full size	1:1
	50 cm to a metre	1:2
M2	40 cm to a metre	1:2.5
	20 cm to a metre	1:5
M3	10 cm to a metre	1:10
	05 cm to a metre	1:20
M4	02 cm to a metre	1:50
	01 cm to a metre	1:100
M5	5 mm to a metre	1:200
	2 mm to a metre	1:500
M6	3.3 mm to a metre	1:300
	1.66 mm to a metre	1:600
M7	2.5 mm to a metre	1:400
	1.25 mm to a metre	1:800
M8	1 mm to a metre	1:1000
	1.5 mm to a metre	1:2000

Protractor: (Fig 8)



It is made of transparent celluloid plastic, available in semi circle or circle.

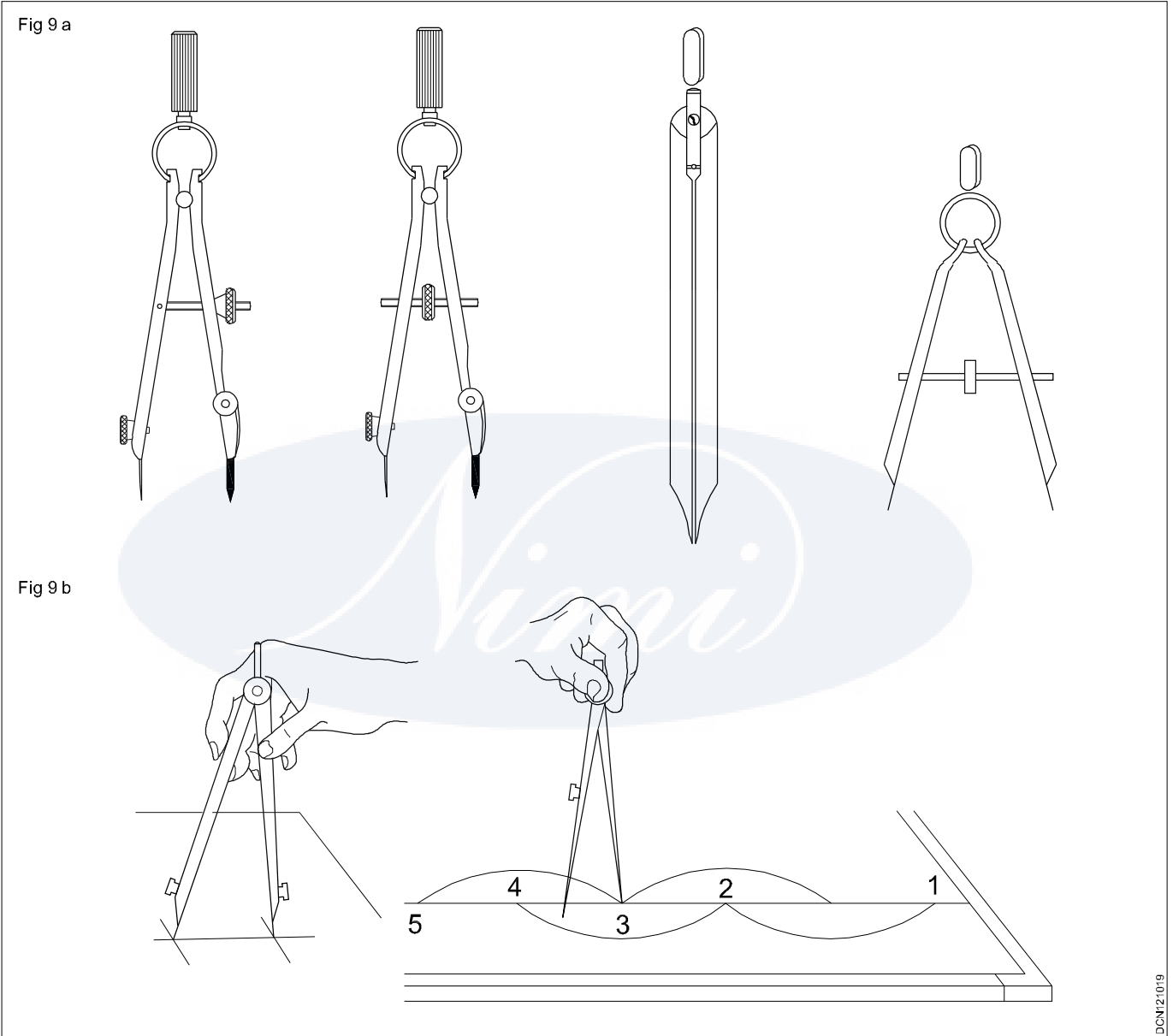
Compass (Fig 9)

It is used for drawing circles both in pencil and in ink. It consists of two legs hinged at one end. One leg is attached with a steel needle by means of a screw while the other leg is provided with a socket to accommodate interchangeable attachments.

Dividers (Fig 10)

Dividers are similar to the compass and are made in square, flat and round forms. They are used for:

- 1 Dividing curved or straight lines into any number of equal parts.
- 2 Transferring dimensions from one part of the drawing to another part.
- 3 Setting dimensions from the scale to the drawings.



Drawing pencils (Fig 11)

These are in many grades. The grade HB denotes medium soft. The grade H denotes the degree of hardness in an increasing order. Similarly, grade B indicates the degree of softness in an increasing order.

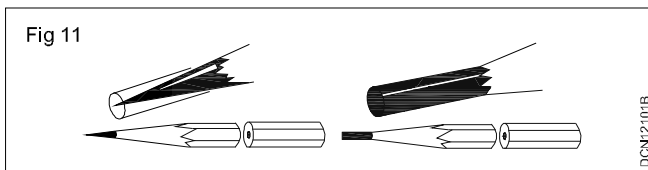
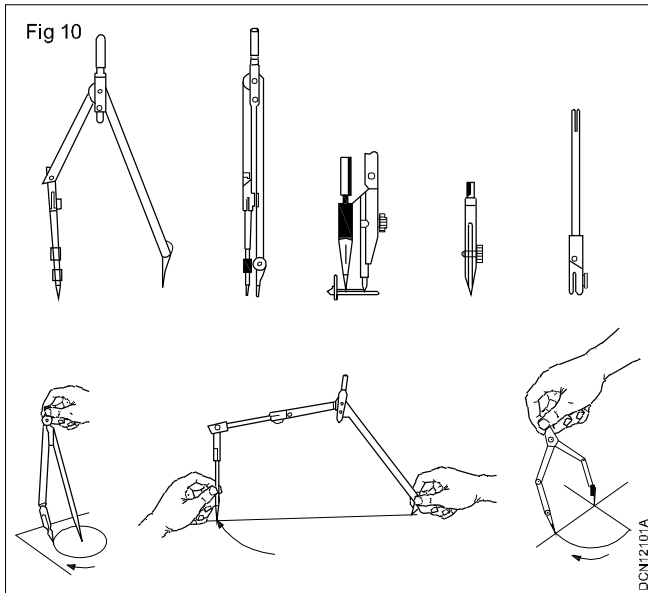
The lead of the wood pencil may be sharpened in the following ways

- 1 Cylindrical
- 2 Conical
- 3 Wedge (Chisel edge)

4 Bevel

Mechanical clutch pencil is very common in use. This is very simple, easy to use, requires no sharpening time and even cheaper in long run. Hence, this type of pencil is preferred by professional draughtsman. Students using these types of pencils will save a lot of time.

- 1 Only a sharp pencil can make quality drawing and hence, sharpen the pencil as and when it is necessary.
- 2 Sharpen the pencil only where there is no grade mark.
- 3 In a compass H pencil sharpened to bevel point, having its wedge shaped side slopping outside, is used.



4 As a general guide, use:

- I HB pencil for sketching
- II H for outlines, visible lines, finishing, dimensioning, lettering, arrows etc.
- III 2H for construction lines, dimension lines, centre lines, section lines etc.

Eraser

Soft pencil erasers are ideal for erasing pencil marks. This eraser will not destroy the surface of the paper and hence drawing can be re-penciled.

Fastener: (Fig 12)

Following materials are used to fix the drawing sheet on the drawing board.

- Thumb pins
- Cello tapes
- Fold back gap spring clips.

Template

Templates are available for drawing circles, arcs, ellipses, triangles, squares and other polygons. Also, symbols used by various engineering faculties, such as architectural, mechanical, electrical, chemical etc. are now available in the form of templates.

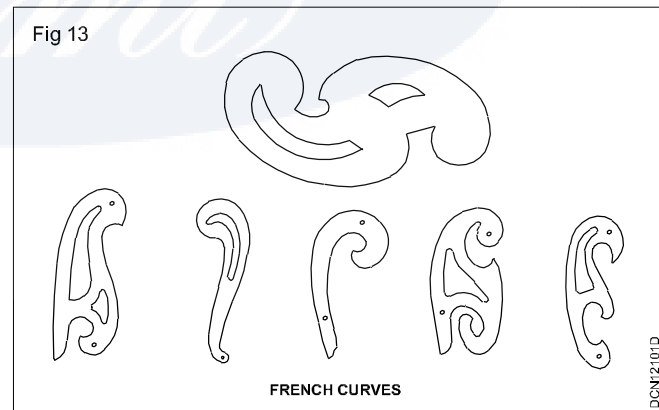
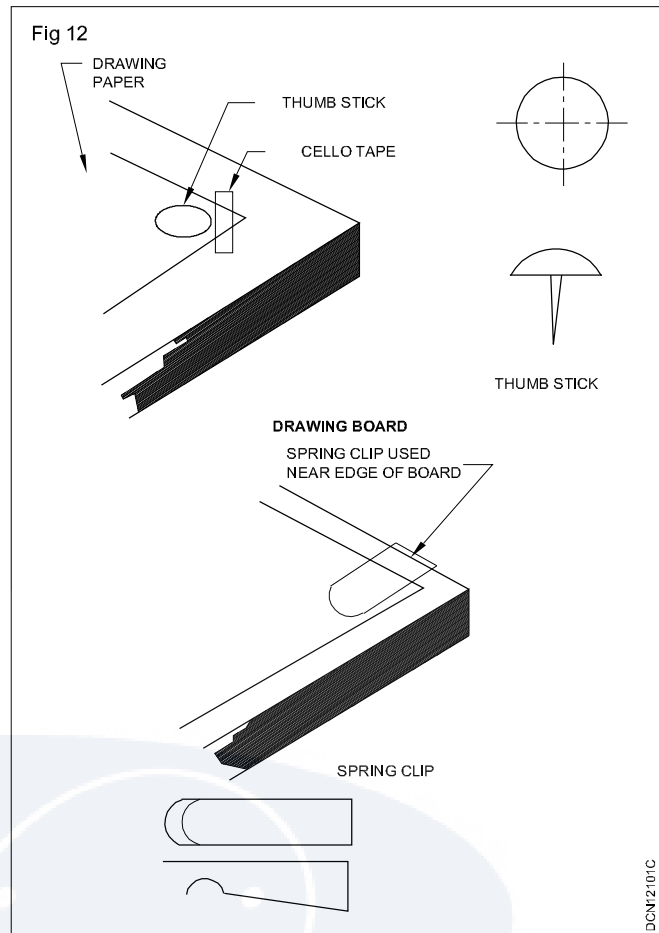
Stencils

Stencil is a thin flat piece of celluloid used to write letters and numerals. This helps the draftsmen to write neatly and uniformly and at a faster rate.

French curves (Fig 13)

A French curve is a curved ruler used for drawing irregular curves that are neither circles nor circular arcs. It is made

of wood, plastic or transparent celluloid. There are different forms and sizes of French curves.



Flexible curve

Flexible curve is made out of materials having flexibility. It is made of lead bar enclosed in rubber and can be bent into any shape to form a curve. It helps to draw smooth curve passing through any given points. Flexible curves of various sizes are now available in the market.

Selection

- HB- For free hand works
- H- For making drawing and lettering
- 2H- for drawing construction lines, dimensions lines, section lines and centre lines.
- 3H, 4H- For drawing minute details