DRAUGHTSMAN CIVIL

NSQF LEVEL - 5

1st Year (Volume II of II)

TRADE PRACTICAL

SECTOR: CONSTRUCTION

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENT OF INDIA

NATIONAL INSTRUCTIONAL
MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

Sector : **Construction**

Duration : **2 Years**

Trade : **Draughtsman Civil - 1st Year (Volume II of II) - Trade practical - NSQF (Level - 5)**

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Mentor Councils comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai has now come up with instructional material to suit the revised curriculum for **Draughtsman Civil 1st Year (Volume II of II) Trade Practical NSQF Level - 5 in Construction Sector.** The NSQF Level - 5 Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 5 trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 5 the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

Director General / Addl. Secretary,
Ministry of Skill Development & Entrepreneurship,
Government of India.

New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of the Federal Republic of Germany. The prime objective of this institute is to develop and provide instructional materials for various trades as per the prescribed syllabi (NSQF LEVEL - 5) under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

In order to perform the skills in a productive manner instructional videos are embedded in QR code of the exercise in this instructional material so as to integrate the skill learning with the procedural practical steps given in the exercise. The instructional videos will improve the quality of standard on practical training and will motivate the trainees to focus and perform the skill seamlessly.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

R. P. DHINGRA
EXECUTIVE DIRECTOR

Chennai - 600 032

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisations to bring out this Instructional Material **(Trade Practical)** for the trade of **Draughtsman Civil** (NSQF LEVEL - 5) under **Construction** Sector for ITIs.

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NIMI records its appreciation for the Data Entry, CAD, DTP operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks the invaluable efforts rendered by all other NIMI staff who have contributed towards the development of this Instructional Material.

NIMI is also grateful to everyone who has directly or indirectly helped in developing this Instructional Material.

INTRODUCTION

The trade practical manual is intended to be used in practical workshop /Hall. It consists of a series of practical exercises to be completed by the trainees during the first semester course of **Draughtsman Civil** under **NSQF Level - 5** Syllabus, which is supplemented and supported by instructions / informatics to assist in performing the exercises. These exercises are designed to ensure that all the skills in prescribed syllabus are covered.

Module 1 - Chain surveying

Module 2 - Compass surveying

Module 3 - Plane table surveying

Module 4 - Levelling

Module 5 - Theodolite survey

Module 6 - Carpentry

Module 7 - Electrical wiring

Module 8 - Floors

Module 9 - Vertical movements

Module 10 - Pitched roof

The skill training in the shop floor is planned through a series of practical exercise centered around some practical object. However, there are few instances where the individual exercise does not from a part of project.

Contents of Trade Theory

The manual of trade theory consists of theoretical information for the first semester course of the Draughtsman Civil under NSQF - Level 5. The contents are sequenced according to the practical exercise contained in the manual on trade practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

The trade theory has to be taught and learnt along with the corresponding exercise contained in the manual of the trade practical. The indications about the corresponding practical exercises are given sheet of this manual.

It will be preferable to teach/learn trade theory connected to each exercise at least one class before performing the related skill in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not the purpose of self-learning and should be considered as supplementary to class room instruction.

CONTENTS

SYLLABUS FOR DRAUGHTSMAN CIVIL

1st Year Volume II of II **Duration: Six Month**

Week No.	Ref. Learning Outcome	Professional Knowledge (Trade Theory) with Indicative hours	Professional Skills (Trade Practical)
27-30	Performsitesurvey with chain / tape and prepare site plan. Perfom site survey using prismatic compass. Perform site survey with plane table and prepare a map.	**Surveying:-** Chain Survey :- (55 hrs.) 41. Equipment and instrument used to perform surveying. 42. Distance measuring with chain and tape. 43. Entering Field book and plotting. 44. Calculating the area of site. 45. Prepare site planwith the help of Mouza map. Compass survey:- (40 hrs) 46. Field work of prismatic compass survey. 47. Plotting of prismatic compass survey. 48. Testing and adjusting the compass. 49. Observation of bearings. 50. Bearing a line. 51. F.B.,B.B., R.B.,W.C.B. of a Line,Traverse and also check the close traversing. Plane Table Survey :- (17 hrs) 52. Surveying of a Building site with Plane Table.	**Surveying:-** • Introduction, History and principles of chain survey. • Instrument employed. • Use, care, maintenance and common terms. • Classification, accuracy, types. • Main divisions (plane & geodetic). • Chaining. • Speed in field and office work. • Knowledge of Mouza Map. Compass survey:- • Instrument and its setting up • Bearing and each included angle of close traverse. • Local attraction. • Magnetic declination and its true bearing. • Precaution in using prismatic compass. Plane table survey:- • Instrument used in plane table survey • Care and maintenance of plane table
31-34	Make tropography map by contours with leveling instruments.	Levelling:- (112 hrs.) 53. Handling of levelling instruments & their settings 54. Temporary adjustment of alevel. 55. Simple levelling. 56. Differential levelling (Fly levelling). 57. Carry out Levelling field book. 58. Equate Reduction of levels – Height of collimation and Rise and Fall method – Comparison of methods. 59. Solve problems on reduction of levels. 60. Calculate Missing data and how to fill it up–	Levelling:- • Auto level , dumpy Level, Tilting Level - introduction, definition • Principle of levelling. • Levelling staffs, its graduation & types. • Minimum equipment required • Types,component / part and function. • Temporary and permanent adjust ment, procedure in setting up. • Level& horizontal surface. Datum Benchmark, Focussing & parallax • Deduction of levels / Reduced Level.

		calculations & Arithmatical checkin various problems and its solution. 61. Practice leveling with different instruments. 62. Check levelling. 63. Profile levelling or Longitudinal, plotting the profile. 64. Surveying of a building site with chain and Levelling Instrument with a view to computing earth work. 65. Contour - Direct and Indirect methods. 66. Make Topography map, contours map. 67. Solve trigonometric problems. 68. Prepare a road project in a certain alignment.	• Types of leveling, Application to chain and Levelling Instrument to Building construction. • Contouring ;-Definition, Characteristics, Methods. • Direct and Indirect methods • Interpolation of Contour, Contour gradient , Uses of Contour plan and Map. • Knowledge on road project.
35-37	Perform a site survey with Theodolite and prepare site plan.	Theodolite survey:- 69. Field work of theodolite. 70. Horizontal angle. 71. Vertical angle. 72. Magnetic bearing of a line. 73. Levelling with a theodolite. 74. Calculation of area from traverse. 75. Determination of Heights. 76. Calculation of departure, latitude, northing and easting - (Total 56 hrs) 77. Setting out work-Building, culvert, centre line of Dams, Bridges and Slope of Earth work, etc. (28 hrs)	Theodolite survey:- • Introduction. • Types of theodolite. • Uses, Methods of Plotting. • Transit vernier theodolite. • Terms of transit theodolite. • Fundamental line of theodolite. • Adjustment of theodolite. • Checks, Adjustment of errors. • Open and closed traverse and their application to Engineering Problems. • Vernier scale- types. • Measurement of horizontal angle. • Measurement of vertical angle. • Adjustment of a close traverse. • Problems in transit theodolite-departure, latitude, northing and easting.
38-39	Drawing of different types of carpentry joints. Draw different types of doors and windows according to Manner of construction, Arrangement of component, and working operation	Making detailed drawing of :- 78.Carpentry joints: lengthening, bearing, housing, framing, panelling & moulding. (22 hrs) 79. Different Types doors including panelled, glazed and flush door. (22 hrs) 80. Different types windows and ventilators. (12 hrs) Electrical Wiring:- Prepare drawing of	• Carpentry joints :-terms, classification of joints, Uses, types of fixtures , fastenings. • Doors ¡VParts, Location, standard sizes, types. • Windows-types. • Ventilators-purpose-types.

		81. Wiring in different system. (08 hrs) 82. Electrical wiring plan with all fittings showing in drawing. (20 hrs)	
40	Prepare the detailed drawing of electrical wiring system.	Electrical Wiring:- Prepare drawing of 81. Wiring in different system. (08 hrs) 82. Electrical wiring plan with all fittings showing in drawing. (20 hrs)	Electrical Wiring:- • Safety precaution and elementary first aid. • Artificial respiration and treatment of electrical shock • Elementary electricity. • General ideas of supply system. • Wireman¡¦s tools kit. Wiring materials. Electrical fittings. • System of wirings. Wiring installation for domestic lightings.
41-42	Draw types of ground and upper floors.	Drawing details of:- 83. Types of ground & upper floors. (28 hrs) 84. Various floor finishing, sequence of construction. (28 hrs)	• Floors - Ground floor & upper floor - Types. • Flooring - materials used types.
43-44	Draw types of vertical movement according to shape, location, materials by using stair, lift, ramp and escalator.	Drawing different forms ofvertical movements:- 85. As per shape - Drawing of straight, open newel, doglegged, geometrical and bifurcated stairs & spiral stairs. (18 hrs) 86. As per material - brick, stone, wooden, steel & RCC stairs. (20 hrs) 87. Drawing of Lift and Escalator. (18 hrs)	• Stairs:- Terms. Requirements, Planning and designing of stair and details of construction. • Basic concept of lift and Escalator
45-47	Draw different types of roofs truss according to shape, construction, purpose and span	Drawing details of:- 88. Slopped/Pitched Roof Truss - King Post and Queen Postroof trusses showing detailed connections. (32 hrs) 89. Steel roof trusses showing detailed connections. (30 hrs) 90. Wooden roof truss, showing detailed connections. (22 hrs)	Roofs & Roof coverings: - • purposes,Elements, Types, Fla, pitched. • Truss-king post, queen post, mansard, bel-fast, steel, composite. • Shell-types-north-light & double curved. • Dome. Components parts. • Roof & coverings - objectives, types & uses.

48-49	Project work / on the job training Broad area :- (a) Prepare site map using chain/prismatic compass/plane table / leveling instrument/ theodolite. (b) Prepare innovative drawing/model of doors/ windows. (c) Prepare innovative drawing/model of vertical movement/roofs.
50-51	Revision
52	Examination

Note: -

1. Some of the sample project works (indicative only) are given against each semester.
2. Instructor may design their own project and also inputs from local industry may be taken for designing such new project.
3. The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill.
4. If the instructor feels that for execution of specific project more time is required than he may plan accordingly to produce part/ sub-drawings in appropriate time i.e., may be in the previous semester or during execution of normal trade practical.
5. Drawings at weeks 1 to 54 are in traditional and from 55 to 99 weeks are in computer drafting.

ASSESSABLE / LEARNING OUTCOME

On completion of this book you shall be able to

. Perform site survey with chain / tape and prepare site plan.
. Perfom site survey with prismatic compass and prepare site plan.
. Perform site survey with plane table and prepare site plan.
. Make topography map / contour map with leveling instrument.
. Perform site survey with Theodolite and prepare site plan.
. Drawing of different types of carpentry joints.
. Draw different types of doors and windows according to manner of construction, Arrangement of component, and working operation.
. Prepare the detailed drawing of electrical wiring system.
. Draw types of ground and upper floors.
. Draw different types of vertical movement according to shape, location, materials in stair, lift, ramp and escalator
. Draw different types of roofs according to shape, construction, purpose and span.

Equipment and instrument used to perform surveying

Objectives : At the end of this exercise you shall be able to
- **identify the names of the surveying instrument**
- **identify the surveying equipments.**

Task 1 **: Write the names of the surveying instruments in Table 1.**

Table 1

S.No	Name of the instrument
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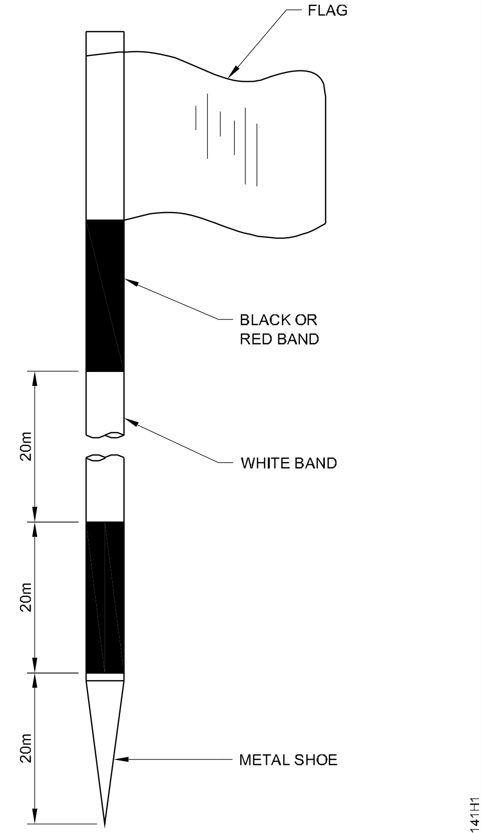
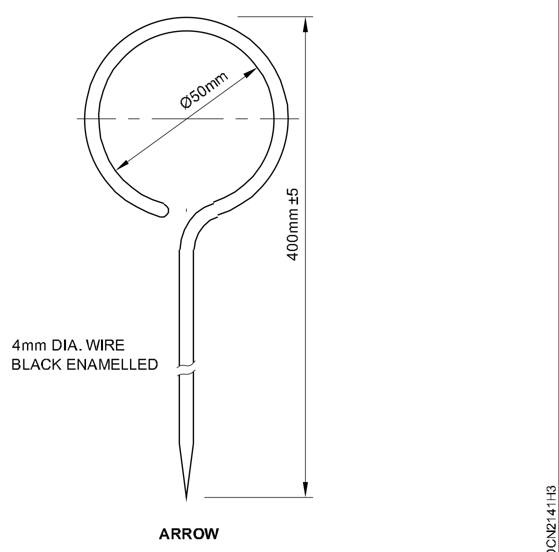
Fig 1



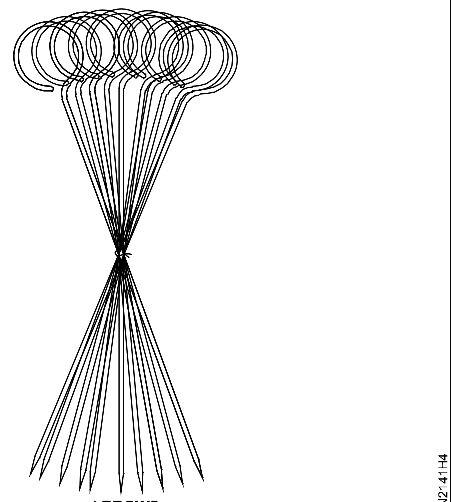
RANGING ROD

Fig 3



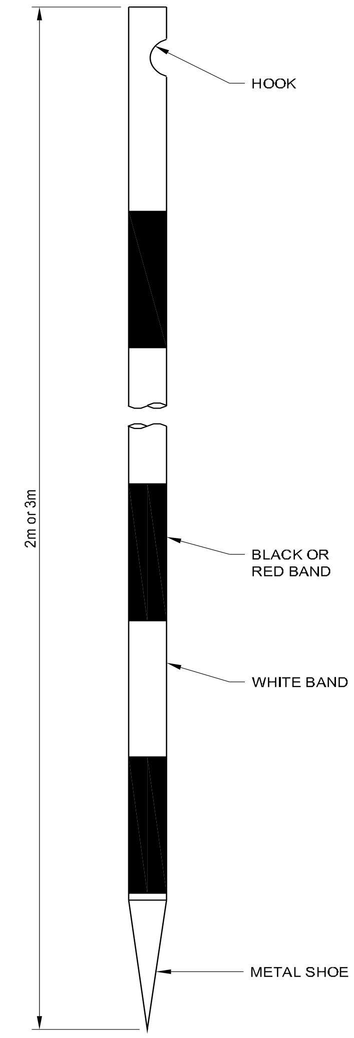
ARROW

Fig 4



ARROWS

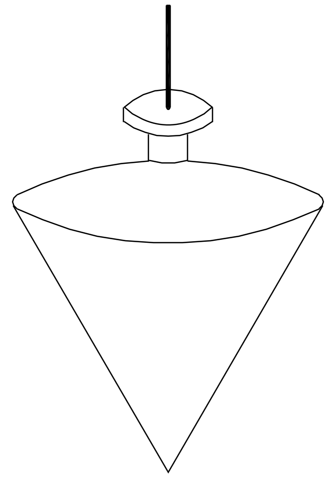
Fig 2



OFFSET ROD

DCN2141H2

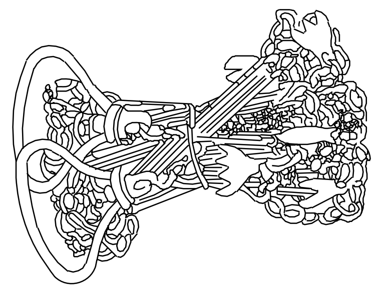
Fig 7



PLUMB BOB

DCN2141H7

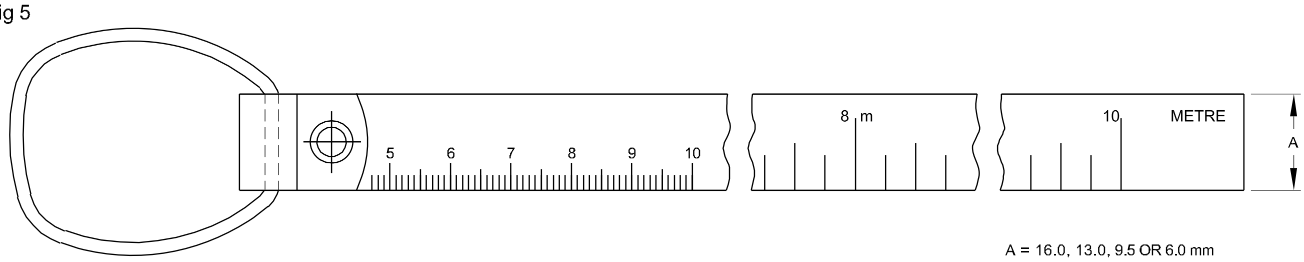
Fig 8



FOLDING OF CHAIN

DCN2141H8

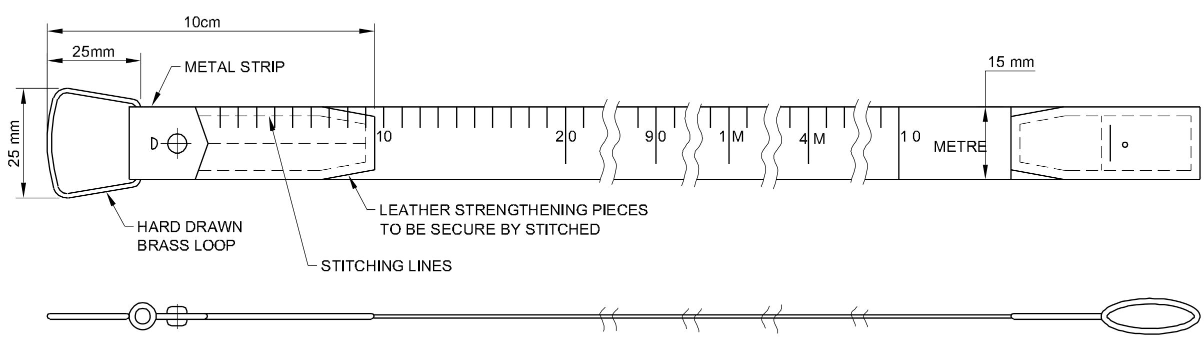
Fig 5



STEEL TAPE

DCN2141H5

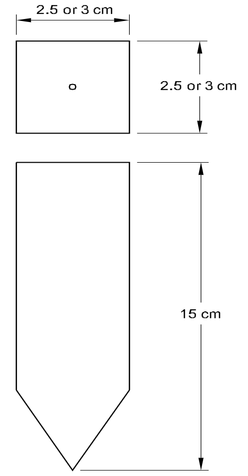
Fig 6



METALLIC TAPE

DCN2141H6

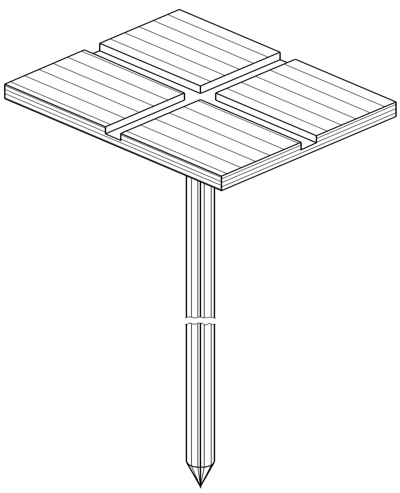
Fig 9



WOODEN PEG

DCN2141H9

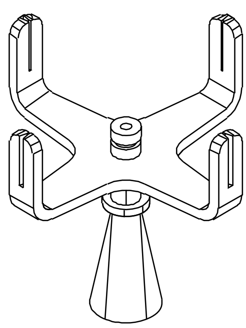
Fig 10



WOODEN CROSS STAFF

DCN2141HA

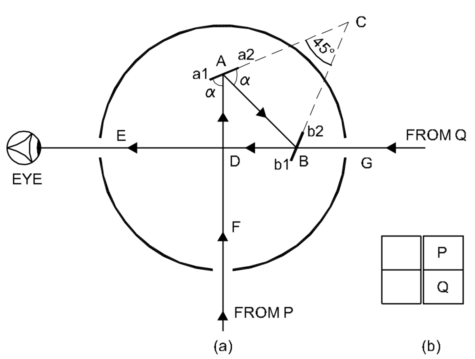
Fig 11



METAL ARM CROSS-STAFF

DCN2141HB

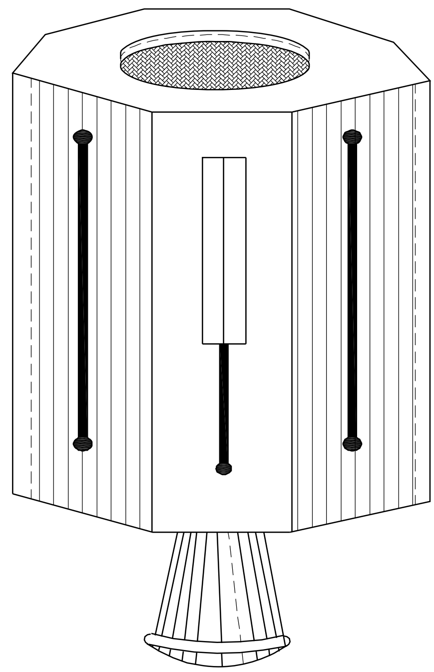
Fig 12



OPTICAL SQUARE

DCN2141HC

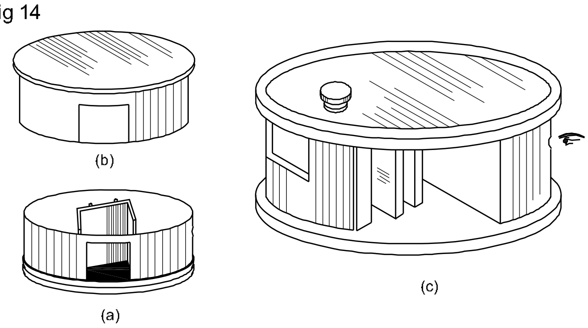
Fig 13



FRENCH CROSS-STAFF

DCN2141HD

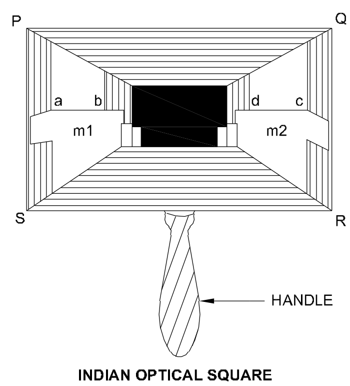
Fig 14



ROUND OR CYLINDERICAL OPTICAL SQUARE

DCN2141HE

Fig 15



INDIAN OPTICAL SQUARE

DCN2141HF

TASK 2: **Write the name of the equipments used in surveying in Table 2**

Table 2

S.No	Name of the instrument
1	
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Fig 2

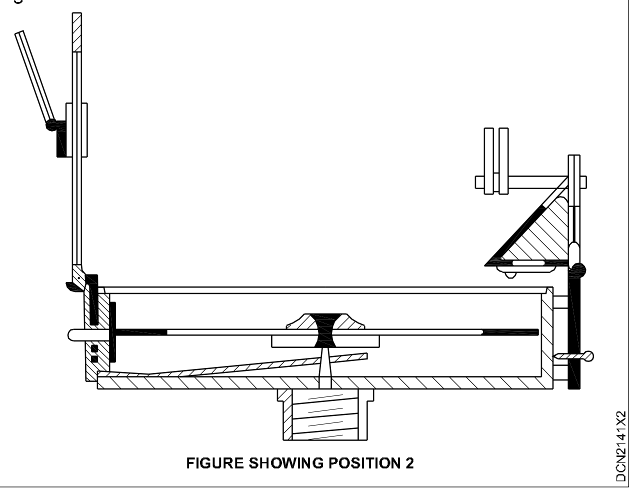


FIGURE SHOWING POSITION 2

Fig 3

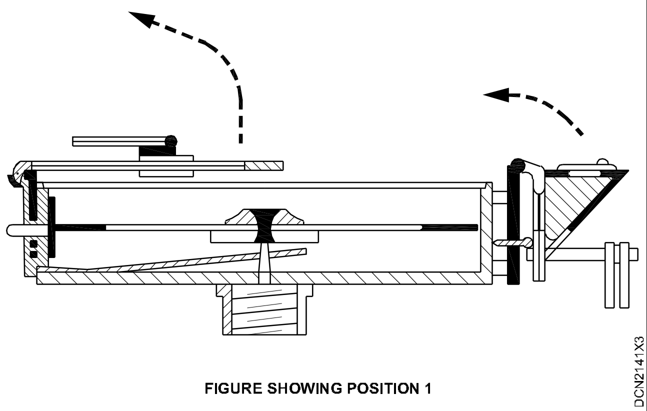


FIGURE SHOWING POSITION 1

Fig 1

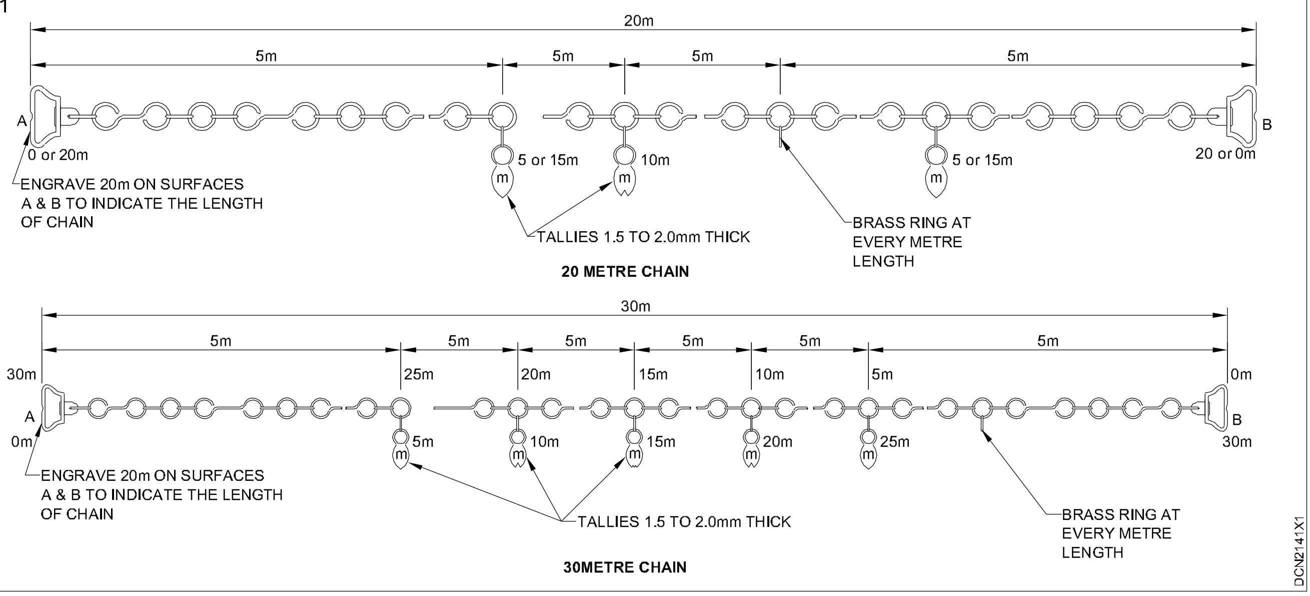
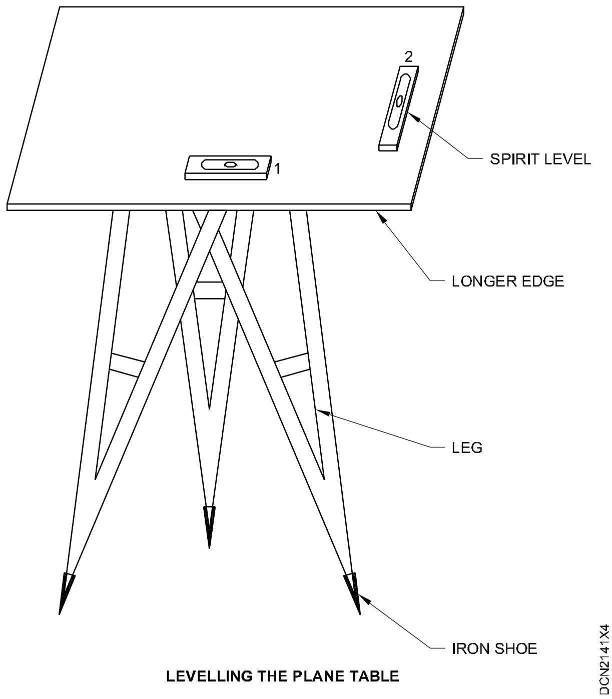
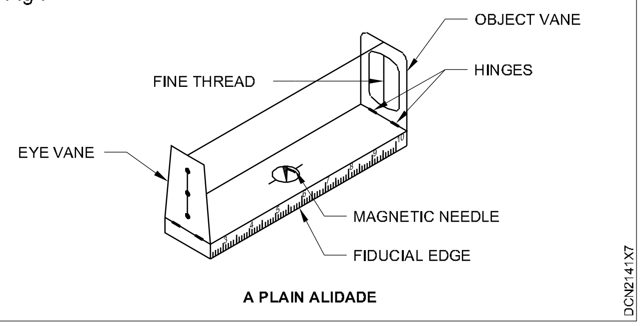


Fig 4



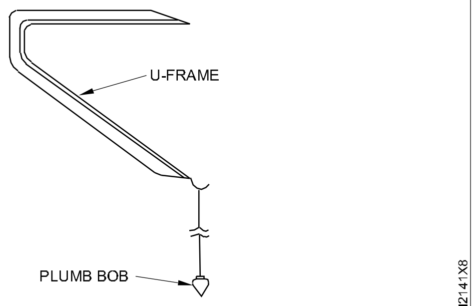
LEVELLING THE PLANE TABLE

Fig 7



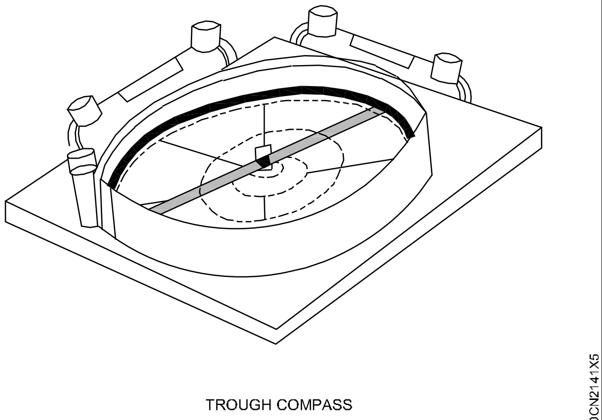
A PLAIN ALIDADE

Fig 8



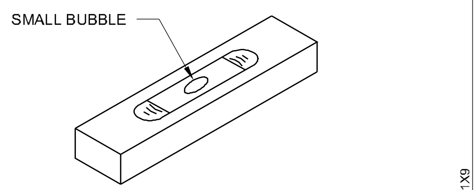
FORK WITH PLUMB BOB

Fig 5



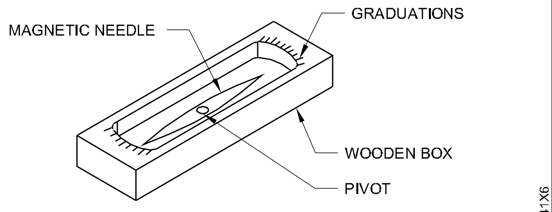
TROUGH COMPASS

Fig 9



SPIRIT LEVEL

Fig 6



TROUGH COMPASS

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Fig 10

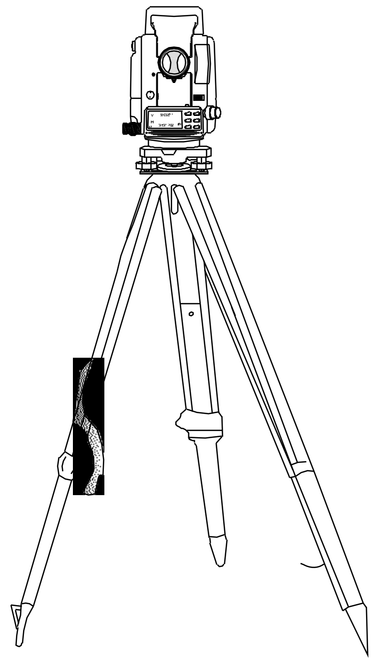
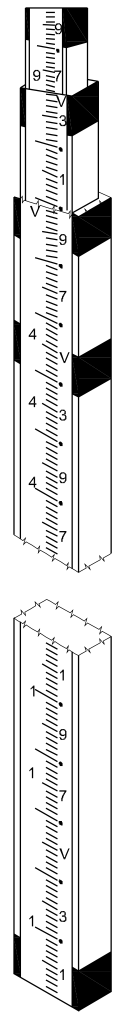
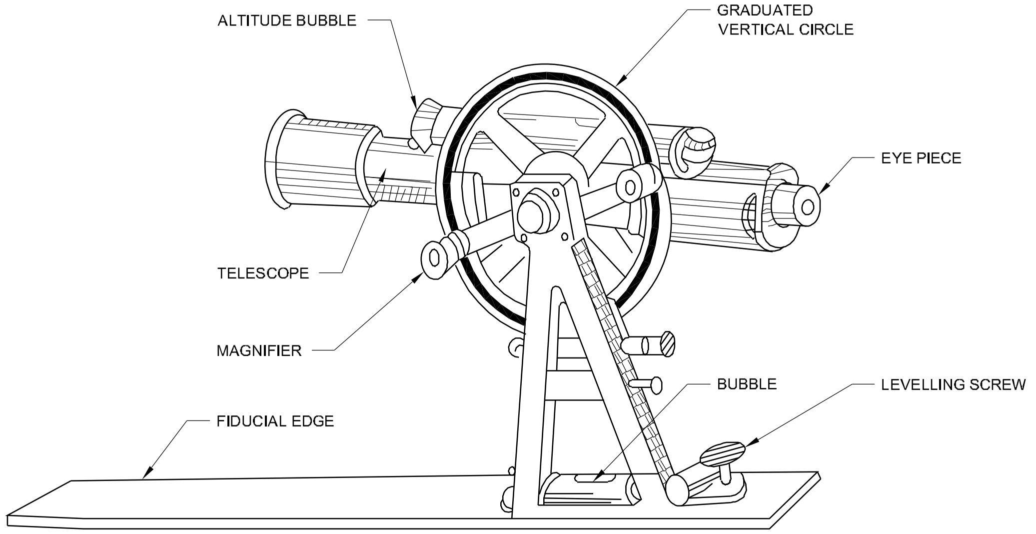


Fig 12



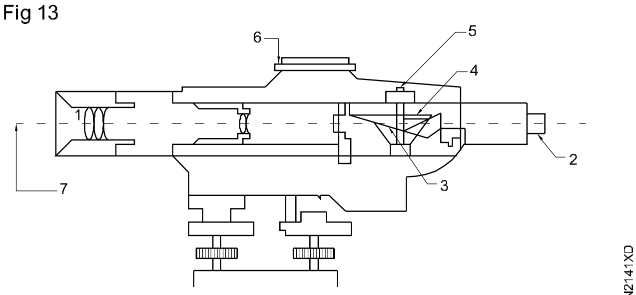
TELESCOPIC STAFF

Fig 11



A TELESCOPIC ALIDADE

Fig 13



AUTO LEVEL

Fig 14

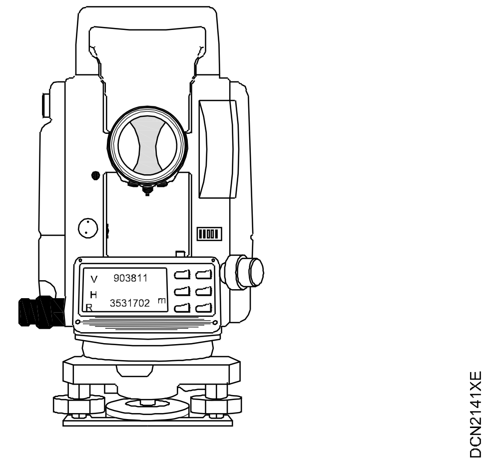
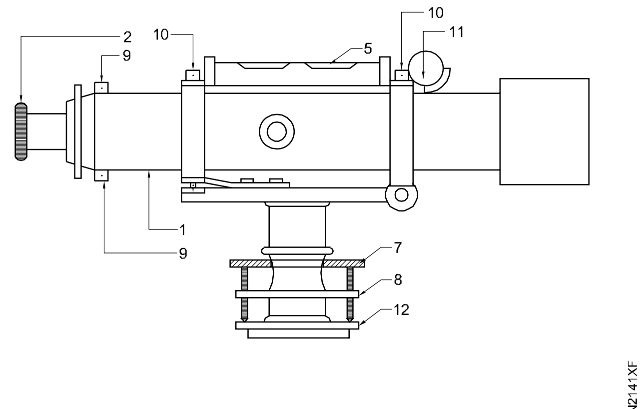


Fig 15



DUMPY LEVEL

Distance measuring with chain and tape

Objectives : At the end of this exercise you shall be able to
- **measure the distance between two given points within 30m/20m**
- **measure the distance if it exceeds by one chain length**
- **measure the distance between two given points by using 15m/30m steel tape.**

Requirement

Tools/Instruments

- Chain 20m/30m - 1 No.
- Steel tape 15m/30m - 1 No.
- Metallic tape 15m/30m - 1 No.
- Ranging rod 2/3m-3cmf - 3 Nos.
- Arrows 40cm long - 10 Nos.

PROCEDURE

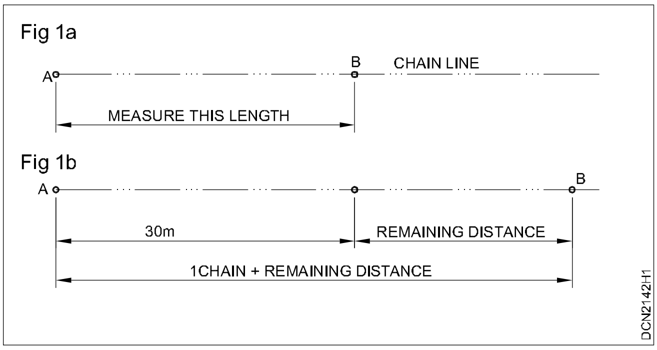
TASK 1: **Measure the distance between two given points within 30m/20m by using 30m/20m chain.**

1 Select a point A on ground and fix an arrow at that point.

2 Unfold and stretch the 20m/30m chain from A to B inline with AB.

3 Count the tallies and links from A to B.

4 This is the distance between A and B (Fig 1a).



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TASK 2: **Measure the distance if it exceeds by one chain length.**

1 Fix an arrow at the end of the chain length.

2 Drag the chain forward to B.

3 Count as previously done.

4 Distance AB = No of full chain+ Remaining distance measured. (Fig 1b).

— — — — — — — —

Task 3: **Measure the distance between two given points by using 15m/30m steel tape.**

Case (a)

If the distance is within 15m/30m length

– Select two points A,B.

– Unwind the tape, hold the zero point (Ring) at A.

– Pull the tape until to reach B.

– Read the measurements on tape.

Case (b)

If the distance exceeds one tape length 15m/30m

– Mark the 15m/30m on the line.

– Measure the remaining length from this point and add.

Booking in the field book

Entering all the readings with respect to figure in the field book.

— — — — — — — —

Entering field book and plotting

Objectives: At the end of this exercise you shall be able to
- **entering single line field book**
- **entering double line field book**
- **survey and plot your ITI with chain.**

Requirement

Tools / Instruments

• Metric chain	- 30m
• Arrows	- 40cm
• Ranging rods	- 23m
• Cross staff	- 1 No.
• Junior Drafter	- 1 No.
• Pegs	- 24 Nos.
• Metallaic tape 30 m length	- 1 No.
• Nails	- as reqd.

Materials

• Rect Note book 20cm x 12cm length wise open	- 1 No.
• Drawing sheet A3	- 1 No.
• Single line field book	- 1 No.
• Double line field book	- 1 No.
• Pencil HP	- 1 No.
• Eraser	- 1 No.
• Set of scale	- 1 set.
• Cello tape	- 1 roll.

PROCEDURE

TASK 1: **Entering single line & double line field book**

1 Date of commencement and completion of survey and names of the survey.

2 Mark the symbols denoting the station point.

3 Note the detatils of survey lines.

4 Locate sketches of survey stations.

5 Mark the lines an AB & BC.

6 Start the booking from bottom of page and moved upwards.

7 Record each chain line or tie line in a seperate page.

8 The record should move inforward direction of chaining.

9 All measurements should be recorded immediately.

10 If the entire page is dis regarded it should be crossed and marked as CANCELLED.

11 Indicate the offset objects with conventional signs (Fig 1 & 2).

12 Write the dimensions between the arrow heads.

13 Write the offset close to the offset points. line with chainages.

14 For main station denote by the symbol Δ.

15 Write the zero change of the commercement inside the Δ.

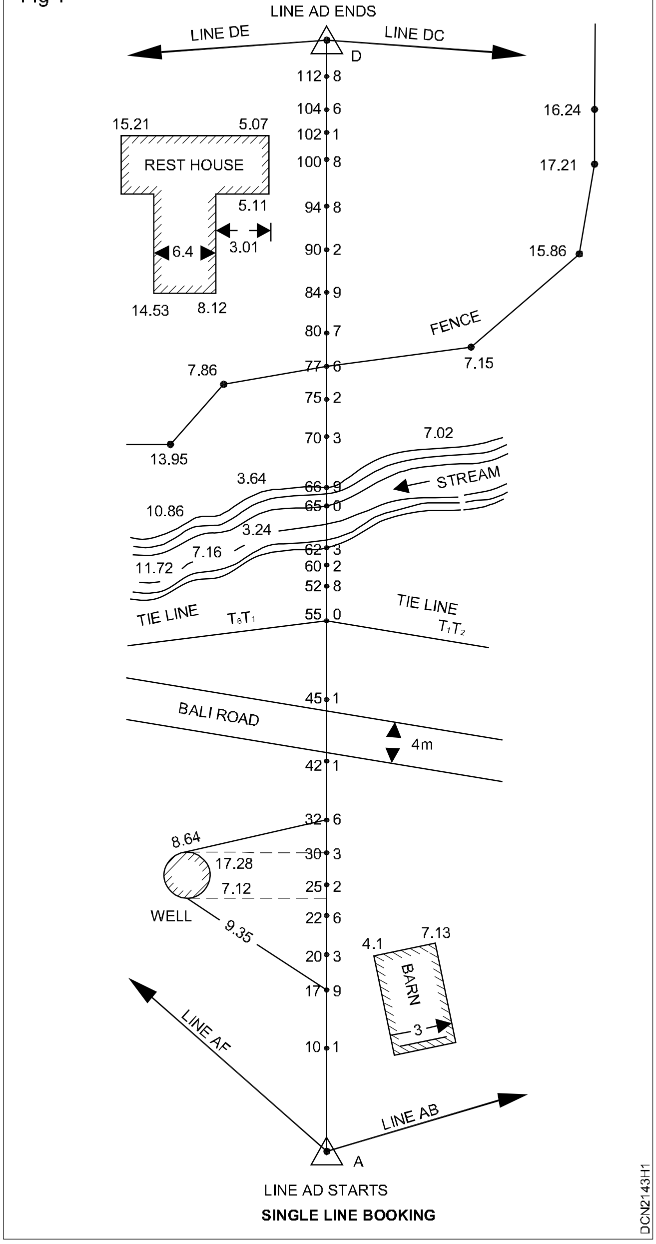
16 Close inside the Δ.

17 Mark the subsidery stations by means of circle or 0 as oval.

Plotting of a chain survey

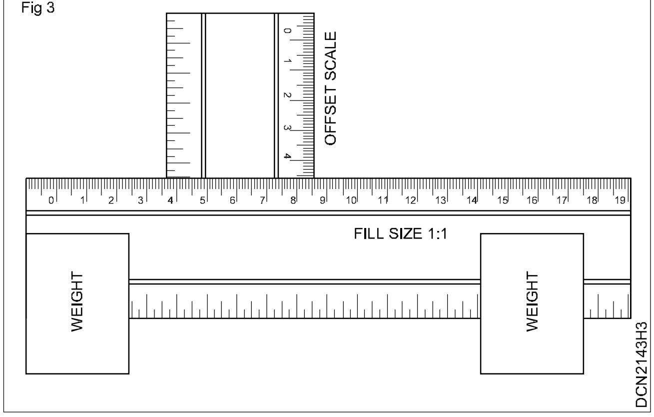
- Plotting work is started after the field work is over.
- The survey is plotted on the drawing sheet with a suitable scale.
- It should be plotted always north direction, so then the top of the drawing sheet represents north.
- The plotting should be always drown on the centre of the sheet taking sufficient spaces for margin, title and scale.
- The base line is firstly drawn in its proper position.
- Intermediate stations are marked on the base line and complete the frame work of the triangles.
- The triangles are checked by check lines.
- For plotting offsets, mark the chainages of the points along the chain and from which the perpendicular offsets are marked by using an offset scale.
- The plotting of offsets should be continued according to the field book is maintained in the field book.
- The main stations and substations, objects, chain line are shown in accordance with the conventional signs.
- The heading should be written on the top of the drawing sheet.
- The map should not have any dimensions.

Fig 1



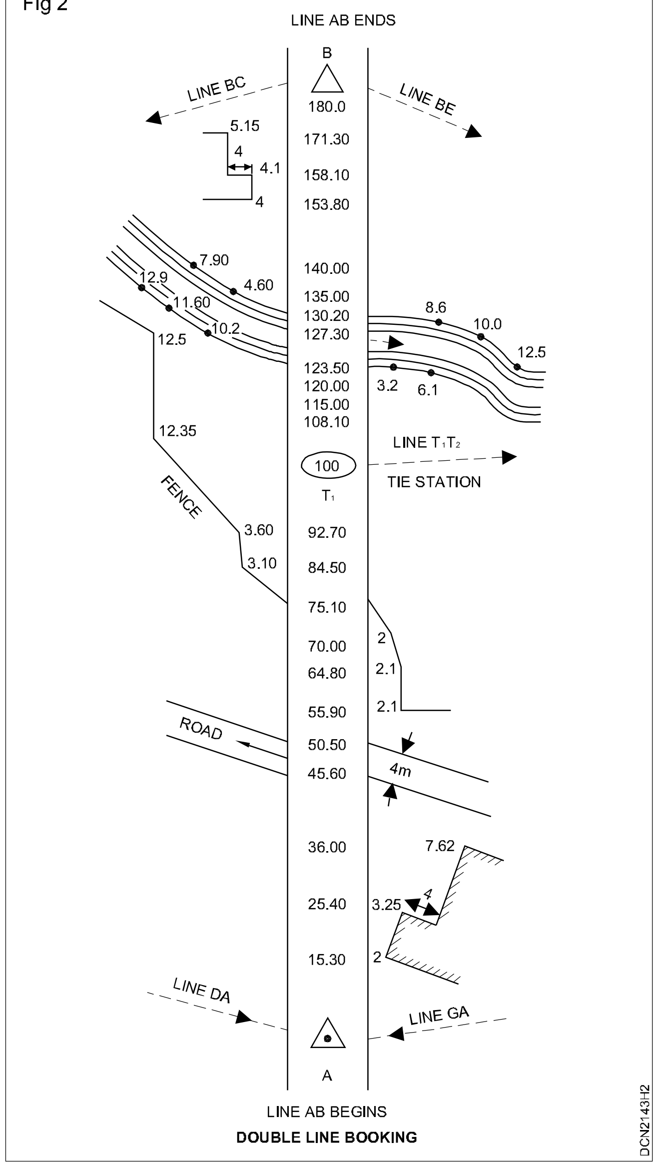
Offset scale (Fig. 3): Using of offset scale for plotting perpendicular offset

Fig 3



- Put the long scale along the chain line, with its zero mark is exactly at the starting point of the line.

Fig 2



- The offset scale is placed at right angles to the long scale and moved to the required chainages. Then the offset lengths are marked with the help of the pricker.

North point

The north point must be shown on a plan in any convenient blank space on the paper preferably at the top pointing upwards

Scale

Scale should be drawn under the title or just inside the border at the bottom of the drawing.

Conventional signs & Symbols

The earth surface contains varities of natural and artifical features. If it is to be shown graphically, it will not be possible without its description. To overcome this difficulty standard symbols have been adopted for each type of details.

The symbols which are drawn to natural or artifical details on a map is known as convetional signs.

Various signs used in Surveying are as follows.(Table 1)

SL. NO.	OBJECT	CONVENTIONAL SIGN	COLOUR
1.	CHAIN LINE		CRIMSON LAKE
2.	TRIANGULATION STATION	A	CRIMSON LAKE
3.	TRAVERSE STATION	A	CRIMSON LAKE
4.	BENCH MARK	10.000 OR B.M. 10.000	CRIMSON LAKE
5.	BUILDING (PUCCA)		CRIMSON LAKE
6.	BUILDING (KATCHA)		BURNT UMBER
7.	TEMPLE, CHURCH, MOSQUE		CRIMSON LAKE
8.	WALL & GATE		CRIMSON LAKE
9.	BOUNDARY WITH PILLARS		CRIMSON LAKE
10.	DAM		CRIMSON LAKE
11.	CITY OR TOWN		BUILDINGS - CRIMSON LAKE ROADS - BURNT SIENNA
12.	CEMETRY		BLACK
13.	RIVER		PRUSSIAN BLUE
14.	CANAL OR STREAM (PERENNIAL)		PRUSSIAN BLUE
15.	CANAL OR STREAM (NON-PERENNIAL)		EDGES - BLACK
16.	CANAL WITH LOCK		PRUSSIAN BLUE
17.	LAKE OR POND		PRUSSIAN BLUE
18.	WELL		PRUSSIAN BLUE
19.	DRAIN (KATCHA)		PRUSSIAN BLUE
20.	DRAIN (PUCCA)		DRAIN - PRUSSIAN BLUE DIRECTION - CRIMSON LAKE
21.	WIRE FENCING		BLACK
22.	WOOD FENCING		YELLOW
23.	PIPE RAILING		BLACK
24.	BOUNDARIES		BLACK
25.	HEDGE		HEDGE GREEN
26.	TREE	OR	HEDGE GREEN
27.	JUNGLE		HEDGE GREEN
28.	ORCHARD		HEDGE GREEN
29.	CULTIVATED LAND		DRAINS - PRUSSIAN BLUE CULTIVATION - GREEN
30.	BARREN LAND		BLACK
31.	ROUGH PASTURE		BLACK
32.	MARSH OR SWAMP		BLACK
33.	SAND HILL		BLACK
34.	EMBANKMENT		BLACK
35.	CUTTING		BLACK
36.	FOOTH-PATH		BURNT UMBER
37.	VILLAGE CART-TRACK		BURNT UMBER
38.	UNMETALLED ROAD		BURNT SIENNA
39.	METALLED ROAD		BURNT SIENNA
40.	RAILWAY SINGLE LINE	OR	BLACK
41.	RAILWAY DOUBLE LINE		BLACK
42.	ROAD BRIDGE		BURNT SIENNA
43.	RAILWAY BRIDGE		BLACK
44.	ROAD & RAIL LEVEL CROSSING		RAIL - BLACK ROAD - BURNT SIENNA
45.	TELEPHONE OR TELEGRAPH LINE		BLACK
46.	ELECTRIC LINE		BLACK
47.	NORTH DIRECTION	N	BLACK
48.	DEMARCATED PROPERTY BOUNDARY		
49.	UNDEMARCATED PROPERTY BOUNDARY		
50.	CULVERT		
51.	ELECTRIC LINE		

TASK 3: **Survey and plot your ITI with chain**

Fig 4 shows the model site of the exercise.

Field work

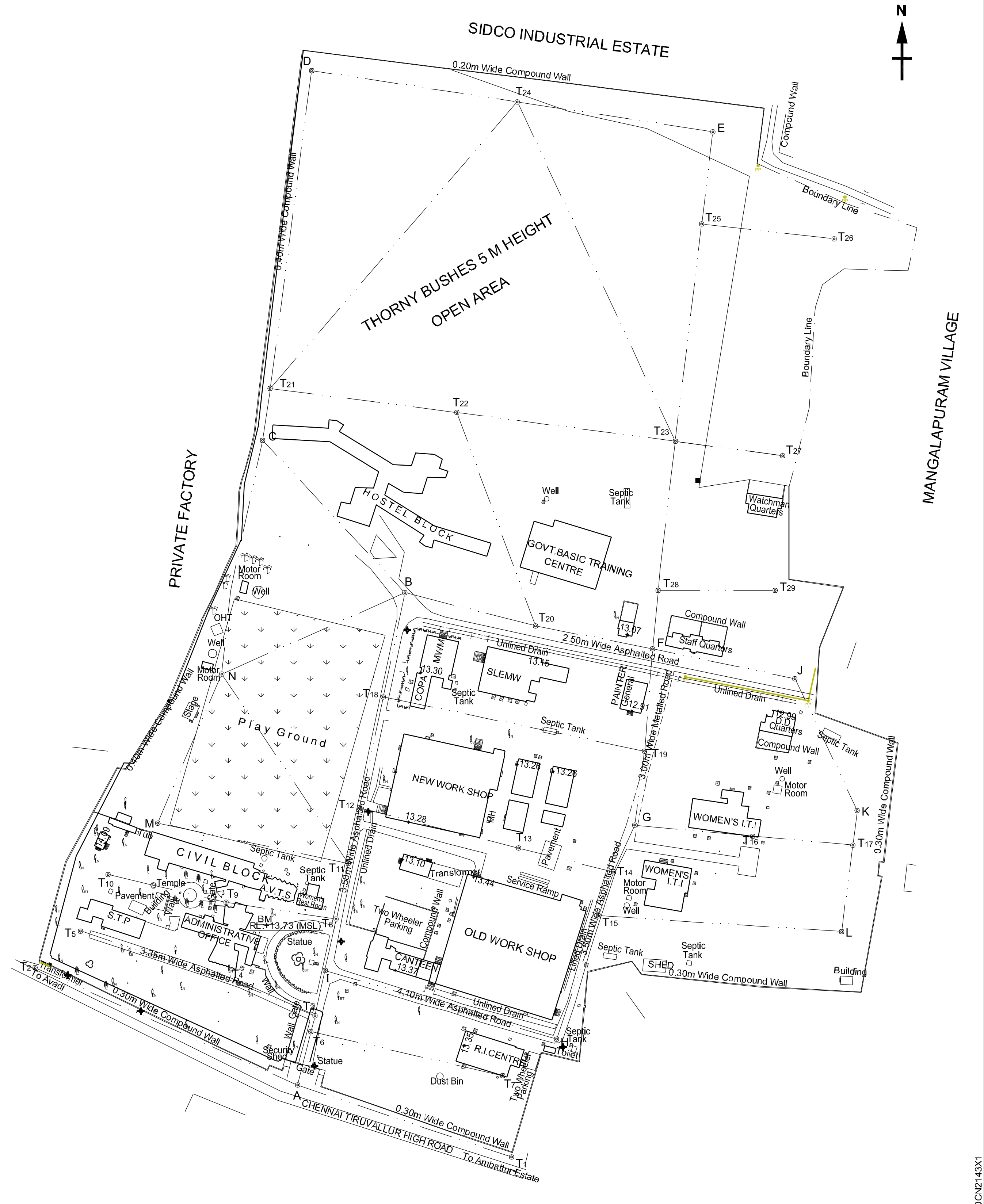
1 Make reconnaisance survey prepare rough sketch of the given site in the field book.

2 Select and mark the control stations for the main line/ base line A to N covering the whole area to be surveyed.

3 Select the Base line AB and main lines BC, CD, DE, EF, FG, GH, FJ, JK & KL etc. (Fig 5)

4 Select the check line BC, BN,NT etc.

Fig 4



5 Select the tie stations T_1,T_2 etc as required for taking internal details.

6 Take reference sketches for the main stations.

7 Run the chain and measure the baseline AB, main lines check lines, and Tie lines and enter in the field book.

8 From the above measurements plot the frame work joining all points to a suitable scale and check the accuracy.

If the error is within maximum permissible value, then adjust the lengths of the sides of the wrong triangles, after that continue the survey.

If the error exceeds the permissible value then resurvey the wrong lines after that continue the same.

If there is no error, continuing the survey work measuring the chainages, and offsets on both sides of the chainlines and enter in the field book.

Office Work

9 Plot the details with conventional signs as per field book entries.

10 Print the title of the survey in right hand corner at the bottom or at the top of the drawing. Then note the scale of the drawing below it .

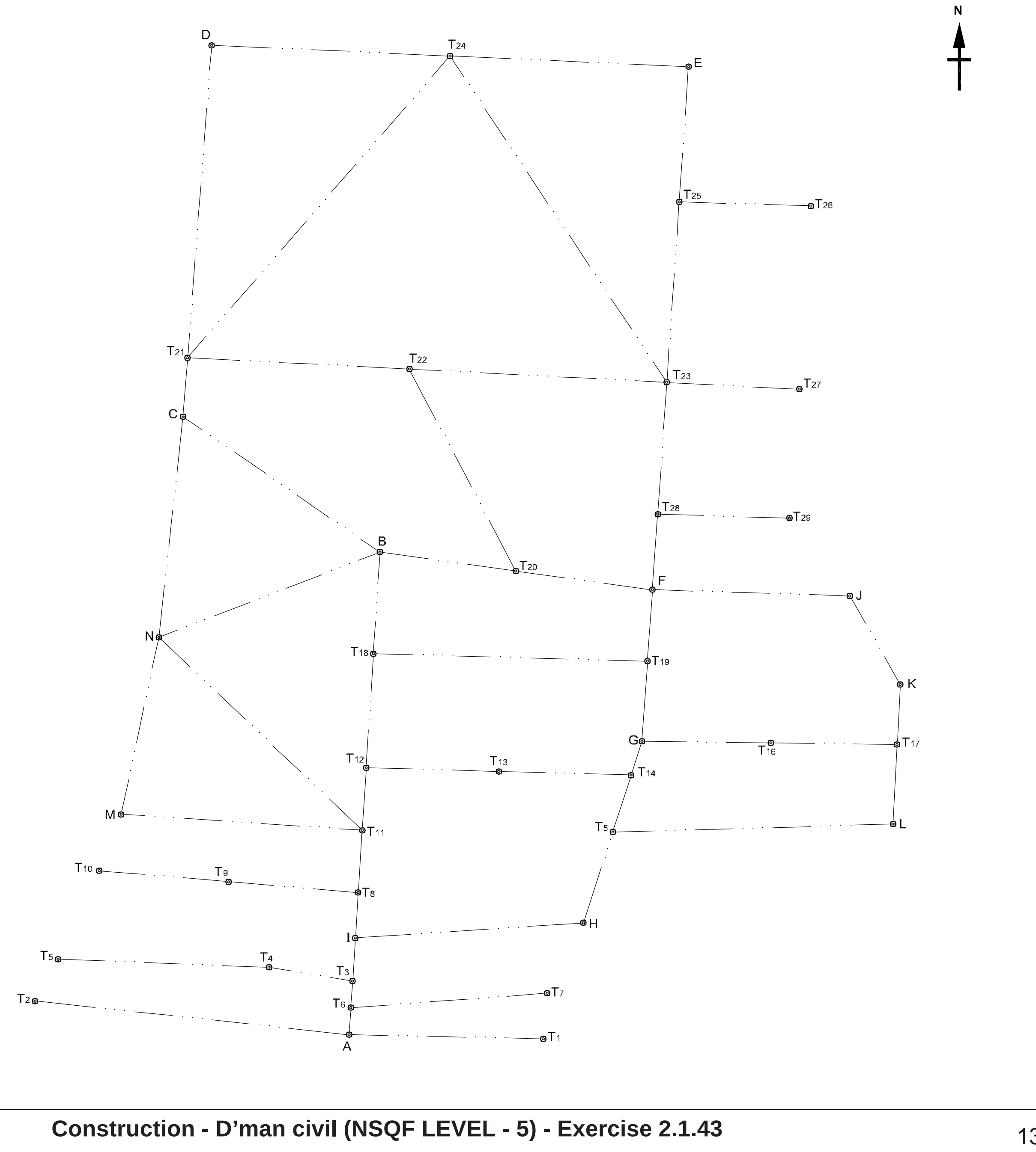
11 Mark the north direction its right top corner of the drawing sheet.

Use the conventional signs for the various types of objects

12 Draw all the boundary lines with Indian ink.

13 Give colouring according to the symbol.

Fig 5



Calculating the area of the site

Objectives: At the end of this exercise you shall be able to
- **calculate the area of the polygonal shaped land**
- **calculate the same by planimeter**
- **calculate the areas of an irregular field**
- **apply geometrical formulae for calculating the area**
- **describe the construction and use of planimeter.**

Requirement

Tools/Instruments

- Metric chain 30mm - 1 No.
- Arrows 40cm long - 10 Nos.
- Ranging rods 2/3m - 6 Nos.
- Cross staff - 1 Nos.
- Junior drafter - 1 Nos.

Materials

- Drawing sheet A3 - 1 No.
- Field note book - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Set of scale - One set.
- Cello tape - 1 roll.

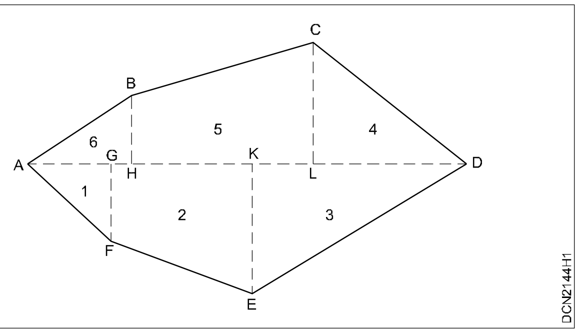
PROCEDURE

TASK 1: **Calculate the area of the polygonal shaped land**

Field work

1 Mark the given points ABCDE & F on the ground. (Given by the Instructor) (Fig 1)

Fig 1



2 Select the longest distance between any two points say AD as the base line.

3 Run the chainline along AD.

4 Locate the perpendicular offset FG.

5 Note the chainage at G and measure off set FG and enter in the field book.

6 Repeat the above process for locating the perpendicular offsets BH,EK and CL.

7 Note the chainages at H,K and L and measure offset BH, EK and CL and enter in the field book.

Office work

8 Draw the baseline AD to a suitable scale on the drawing sheet.

9 Mark the chainages G,H,K and L on AD.

10 Draw perpendicular offsets say FG,BH,EK and CL as per the field book.

11 Divide the polygonal shaped area into number of triangles and trapezium by joining the polygonal points A,B,C,D,E,F & A.

12 Calculate the area of the divided triangles and trapezium.

13 Calculate the total area by adding the area of above segments. (1 to 6)

— — — — — — — —

TASK 2: **Calculate the area of the polygonal shaped land by planimeter**

1 Set the vernier of the index mark to the corresponding to the scale. (i.e) If the scale is 1:100, the index mark should be set to 33:33 as per the manufacturer's guide and so on.

2 Fix anchor point outside the figure. If the area is large, it should be divided into sections.

3 Fix the anchor point is firmly in the paper inside (or) outside of the figure.

4 Reach the tracing point is easily every point on the boundary line.

5 Select a point on the boundary of the map and the tracing point is placed on it.

6 Observe the disc, wheel and the vernier, the initial reading is recorded i.e. (I.R).

7 Move the tracing point is gently in a clockwise direction along the boundary of the area.

8 Observe the number of times (N) the zero mark of the dial passes the index mark in clockwise (or) anticlock-wise direction.

9 Observe the disc, wheel and the vernier, the final reading (F.R) is recorded, after reaching the starting point.

10 Calculate area of the figure by applying the formula. (i.e) Area = M (F.R - I.R ± 10N + C)

where

M = Multiplying constant given in the table

N = Number of times the zero mark of the dial passes the index mark.

C = The constant given in the table

F.R = Final reading

I.R = Initial reading

'N' is considered to be positive when the zero of the dial passes the index mark in clockwise direction.

'N' is considered to be negative when the zero of the dial passes the index mark in anticlockwise direction.

The value of C is added only when the anchor point is inside the figure.

While using the planimeter, the following points to be remembered.

1 The map must be placed over a horizontal plane.

2 The anchor point should preferably be kept outside the figure to avoid additive constant.

11 Measure the area of the figure twice from different starting points.

12 If the area is large, divide into a number of sections, the area of each section may be calculated separately and then added to obtain the total area.

13 Set the initital reading to zero for the sack of simplicity.

14 Move the tracing point gently and exactly along the boundary line.

15 The map should not be folded.

16 The surface of the map should be smooth.

— — — — — — — —

TASK 3: **Calculation of the area of an irregular field**

In this survey the area of plot may be determined by the direct use of field notes.

In this method of survey a chain line known as base line to be laid through the centre of the area of the field.

The offset are taken to the boundary points in the order of their chinages on both the sides of the base line.

The chainages and offsets are entered in the field book.

With reference to the field book the boundary points are plotted and the area to be divided into number of triangles and trapezium according to the shape.

— — — — — — — —

TASK 4: **Application of geometrical formulae for calculating the area**

Now apply the geometrical formulae for calculating the according to the shape of the figures. (Fig. 1)

1 Area of triangle

½ x base x height

2 Area of trapezium

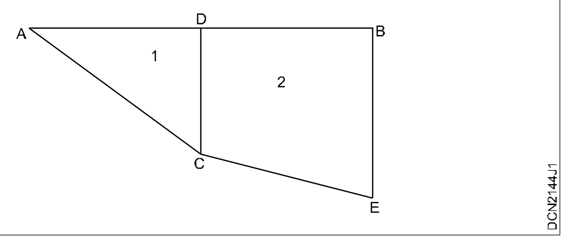
base (a+b)/2 x height

Plot the following details of a field and calculate its area all measurements are in metres. (Fig 2)

Serial No. 1 In DABG

Chainage in metres 0 and 20m.

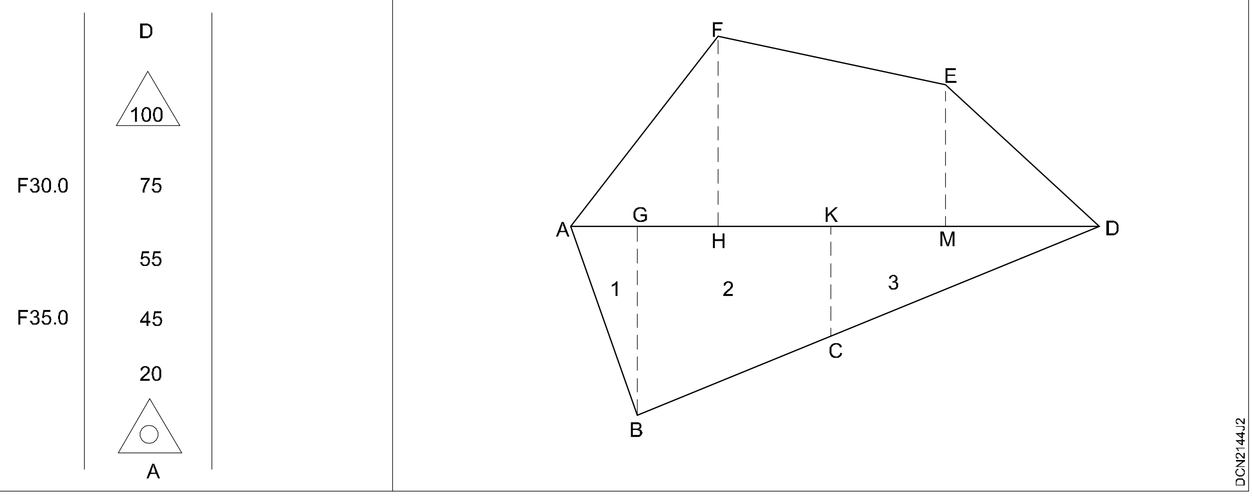
Fig 1



Offsets in metres 0 and 36m.

In Δ ABG

Fig 2



Area = ½ x base x height

=1/2 x 20 x 36

=360 sq.m.

Area of trapezium GBCK

Chainage in metres = 2m and 55m = 35m.

Offsets in metres 36m and 20m = 28m.

=35 x 28 = 980 sq.m.

Sl. No. 3

Area of triangle KCD

=45m x 10m = 450 Sq.m.

Sl. No. 4

Area of triangle DME = 25 x 15 = 375 sq.m.

Sl. No. 5

Area of Trapezium = 30 x 32.50m= 975.00 sq.m.

Sl. No. 6

Area of triangle AHF = 45 x 17.50 = 787.50 sq.m.

S. No.	Figure	Change in metres	Base in Metres	Offsets in metres	Mean offsets in metres	Area in square Metres		Remarks
						+ve	-ve	
1	2	3	4	5	6	7	8	9
1	ΔABG	0 and 20	20	0 and 36	18	360.00	-	
2	Trapezium GBCK	20 and 55	35	36 and 20	28	980.00	-	
3	ΔKCD	55 and 100	45	0 and 20	10	450.00	-	
4	ΔDME	100 and 75	25	0 and 30	15	375.00	-	
5	Trapezium	75 and 45	30	30 and 35	32.50	975.00	-	
6	ΔAHF	45 and 0	45	35 and 0	17.50	787.50	-	
					Total	3927.50		

Exercise (Fig 3)

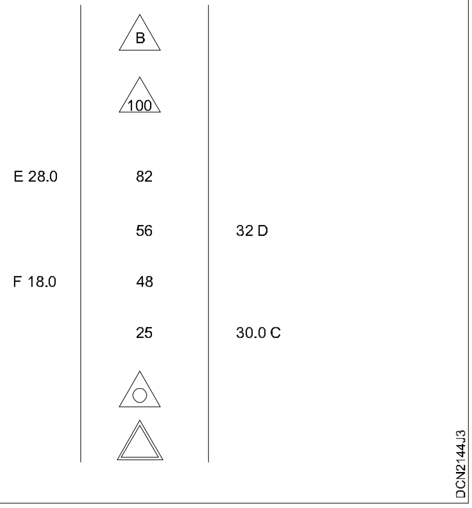
The same exercise may be used by planimeter and find the area.

Exercise 1, (2)

Calculation of the area of an irregular field

In this survey the area of plot may be determined by the direct use of field notes.

Fig 3



TASK 5: **Instrumental method**

Planimeter

It is a mechanical device which is used for measuring of the area of any irregular shape of the figure. It gives best results more than that can be achieved by any other method except by direct calculation from the field notes.

Angler polar planimeter

Constructional details of a planimeter (Fig 4)

– It consists of two arms. The arm 'A' is called as Tracing arm. Its length can be adjusted and graduated.

– It carries a tracing point 'D' which can be moved along the boundary of the line of the area.

– An adjustable support 'E' which keeps the tracing point just clear of the surface.

– The other arm 'F' is called as the pole arm (or) anchor arm.

– It is having a needle point with a weight 'K' at one end.

– The weight forms the centre of rotation.

– The other end of the pole arm can be pivoted at a point 'P' by a ball and socket arrangement.

– A carriage point 'B' which can be set at various points of the tracing arm with respect to the vernier of the index mark I.

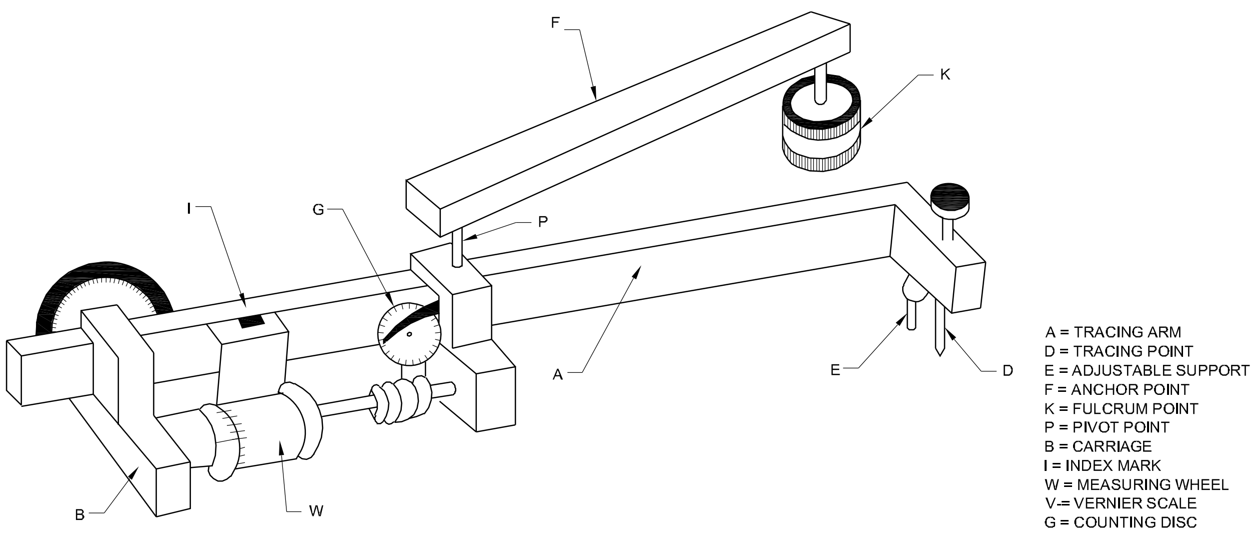
– The carriage point having a measuring wheel 'W' and a vernier 'V'.

– The wheel is divided into 100 divisions and the vernier is divided into 10 divisions.

– The wheel and the vernier measure readings upto three places (i.e) 0.145, 0.194 etc.

– The wheel is geared to a counting disc which is divided into 10 divisions. For ten complete revolutions of the wheel, the disc shows a reading of one divisions. Therefore the planimeter shows a reading of four digits (i.e. 1.145, 1.194).

Fig 4



PLANIMETER

The wheel shows - tenth and hundreth

Vernier shows - Thousandth

The planimeter rests on the tracing point, anchor point and the measuring wheel.

Example 1

The following readings were recorded by a planimeter with the anchor point inside the figure. I.R = 9.377, F.R = 3.336, M = 100 cm^2 and C = 23.521.

Calculate the area of the figure when it is observed that the zero mark of the dial passed the index mark once in the clockwise direction.

Given data

I.R = 9.377

F.R = 3.336

N = -1 (For anticlose wise direction)

M = 100 cm^2

C = 23.521

Area = M (F.R - I.R ± 10N + C)

A = 100 (3.336 - 9.377 - 10 x 1 + 23.521)

= -6.041 - 10 + 23.521

= -16.041 + 23.521

= 7.480 x 100

= 748 cm^2

Example 2

The following particulars were noted while measuring the area of a figure with a planimeter.

a I.R and F.R were 8.652 and 6.798 respectively.

b The tracing arm was set to the natural scale.

c The zero of the dial passed the index mark once in the anticlockwise direction.

d Constant C = 20.

e Scale of the map is 1cm = 10m.

f The anchor point was inside the figure.

Calculate the area of the figure.

Given data

I.R = 8.652

F.R = 6.798

Natural scale means M = 100 cm^2

C = 20

N = -1

Scale 1cm = 10m

Area of the figure A = M (F.R - I.R - 10 x N + C)

= 100 (6.798 - 8.652 - 10 x 1 + 20)

= 814.6 cm^2

Since the scale is 1 cm = 10m

1 cm^2 = 10m^2

Required Area = 814.6 x 100 = 81460m^2.

Example 3

The area of an irregular figure was measured with a planimeter having the anchor point outside the figure. The initial and final readings were 4.855 and 8.754 respectively. The tracing arm was set to the natural scale. The scale of the map was 1cm = 5m. Find the area of the figure.

Given data

I.R = 4.855

F.R = 8.754

M = 100 cm^2 (Natural scale)

N = 0 (There is no comment about the crossing of the index mark)

C = 0 (anchor point outside)

Scale = 1cm = 5m

Area = M (F.R - I.R)

= 100 (8.754 - 4.855)

= 389.9 cm^2

Scale of the figure 1 cm = 5m

1 cm^2 = 25m^2

Required Area = 389.9 x 25 = 9747.5m^2.

Exercise

Calculate the area of the figrue corresponding to the following data recorded by planimeter.

a I.R = 2.436

b F.R = 7.745

c M = 100 cm^2

d C = 20.00

e The figure traversed clockwise with the anchor point inside and the zero of the dial passed the index mark once in the reverse direction.

(Ans. 1530.9 cm^2)

Prepare site plan with the help of mouza map

Objectives: At the end of this exercise you shall be able to
- **identify the different set backs in a plot**
- **create a site plan showing details.**

Requirements

Tools/Equipments/Instruments

- Metric Chain 30mm - 1 No.
- Arrow 40cm long - 10 Nos.
- Ranging Rods 2/3m - 6 Nos.
- Cross staff - 1 No.
- Junior drafter - 1 No.

Materials

- Drawing sheet A3 - 1 No.
- Field note book - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Set of scale - One set.
- Cello tape - 1 roll.

PROCEDURE

TASK 1: **Prepare the site plan as per given sketch (Fig 1)**

1 Select a scale of 1:400 and draw the plan of the plot as per given dimensions.

2 Draw a horizontal line from the front boundary at a convenient distance : say 4:10 m (minimum 3.00m from boundary)

3 Create the outer line of building by providing given set backs.

4 Create dimensions and other required notes as shown.

5 Identify and mark the front, rear and side yards.

6 Draw symbols for north direction.

7 Complete the required drawing.

— — — — — — — —

TASK 2: **Prepare the given sketch using templates (Fig 2)**

1 Draw the plan to a scale of 1:50

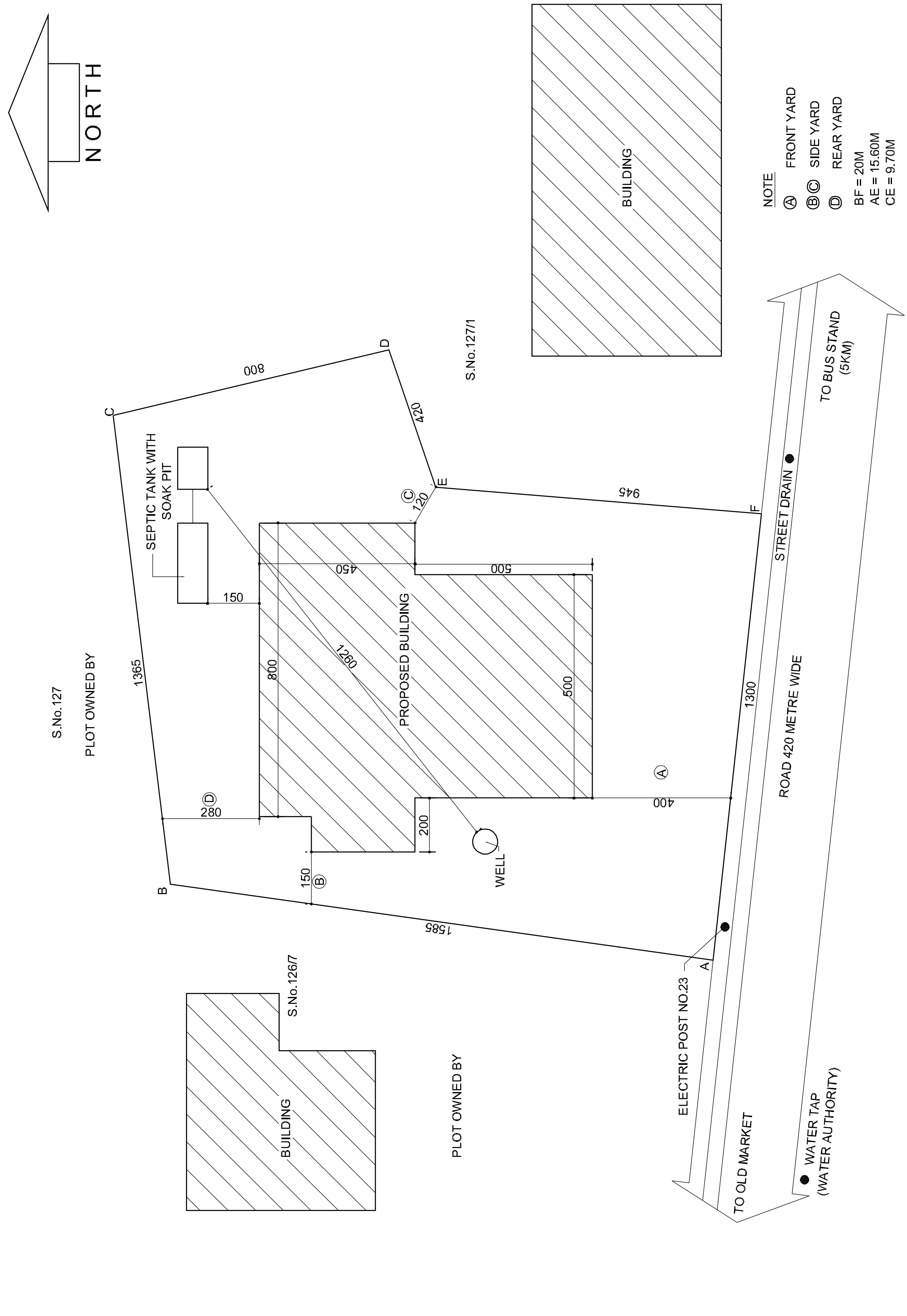
2 Select the temple and create the furniture.

3 Furnish the surrounding details as shown, for lawn, swimming pool, garden etc.

4 Complete the drawing.

— — — — — — — —

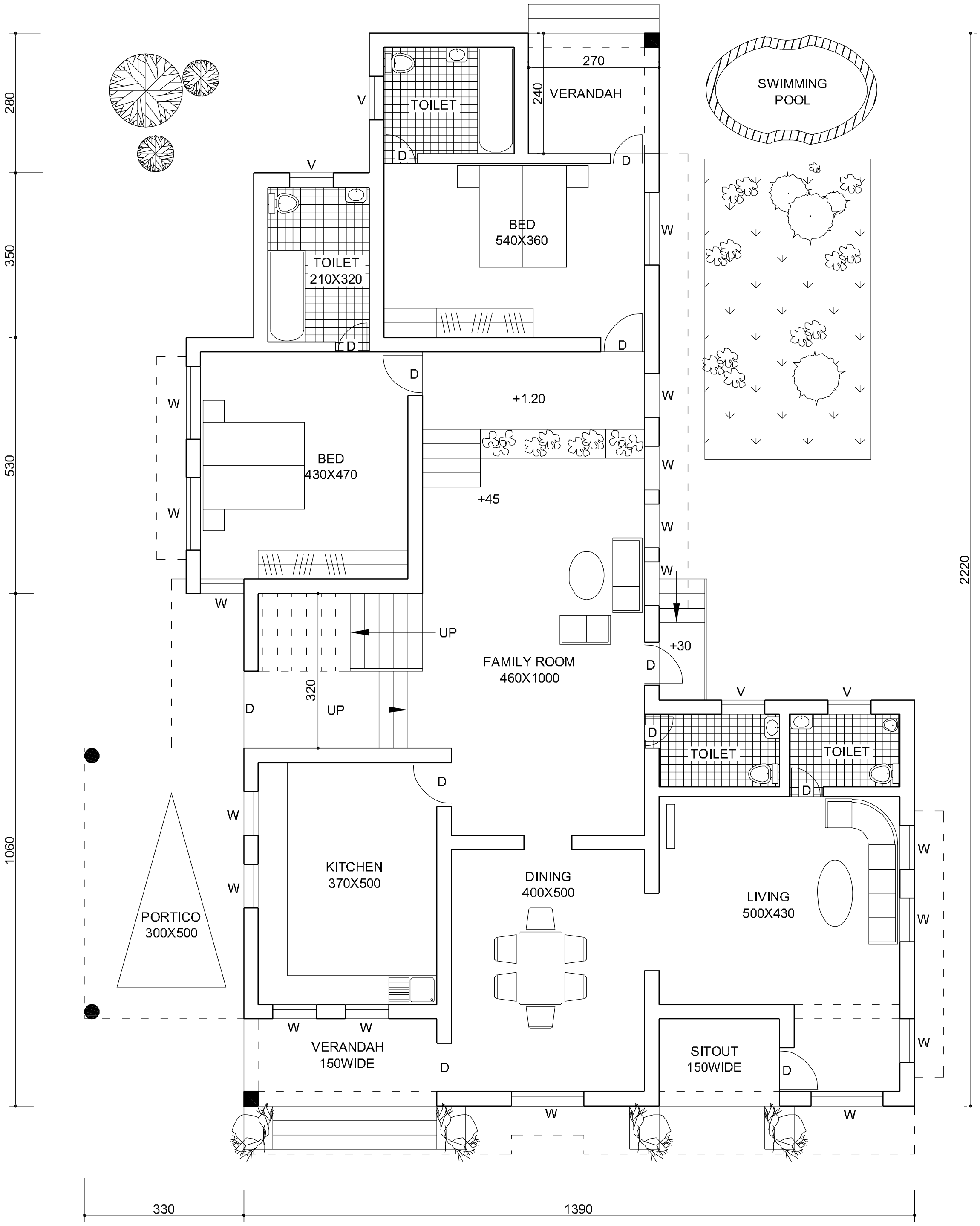
Fig 1



SITE PLAN

DCN2145H1

Fig 2



LAYOUT AND DETAILING A RESIDENCE

DCN2145H2

Field work of prismatic compass survey (Triangular plot & Hexagonal Plot)

Objectives: At the end of this exercise you shall be able to
- **observe the bearings of a given triangular plot & hexagonal plot**
- **calculate and check the included angles**
- **plot the area.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Ranging rods - 2 Nos.
- Wooden peg - 3 Nos.
- Chain or tape 30m - 1 No.
- Arrows - 10 Nos.

Materials

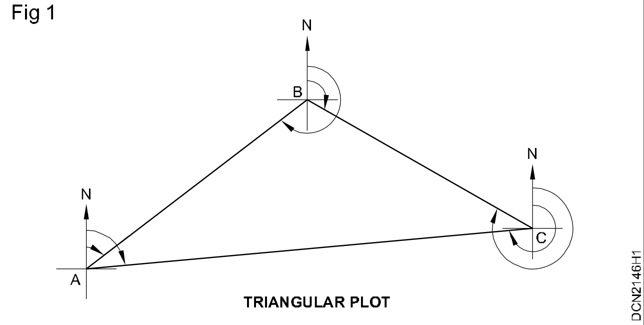
- Drawing sheet A3 - 1 No.
- Field book - 1 No.
- Pencil HB - 1 No.
- Eraser - 1 No.
- Cello tape - 1 roll.
- Set of scale - 1 set

PROCEDURE

TASK 1: **Observe the bearings of a given triangular plot**

1 Select and drive pegs at A,B and C stations which are intervisible to each other. (Fig 1)

Fig 1



2 Measure the horizontal distance of AB,BC and CA and note the readings at (1),(2) and (3) in the table respectively.

3 Fix ranging rods at stations 'B' and 'C'.

4 Set up and level the compass over the station 'A'.

5 Observe the reading by sighting 'B' and note it on (4) in the table.

6 Similarly observe the reading by sighting 'C' and note it on (5) in the table.

7 Shift the compass to station 'B'.

8 Fix the ranging rod at 'A'.

9 Setup the compass over the station 'B'.

10 Observe the readings by sighting 'C' and 'A' and note them on (6) and (7) in the table respectively.

11 Shift and setup the compass to station 'C'.

12 Fix the ranging rods at 'B'.

13 Observe the readings by sighting 'A' and 'B' and note them on (8) and (9) in the table.

Table

Line	Length in (m)	Fore bearing	Back bearing
AB	(1)	(4)	(7)
BC	(2)	(6)	(9)
CA	(3)	(8)	(5)

— — — — — — — —

TASK 2: **Calculate and check the included angles**

1 Calculate the included angles using fore bearing and back bearing.

2 Check the calculated the included angels of the triangles with the theoretical sum of angels is equal to 180^o.

— — — — — — — —

TASK 3: **Plot the area**

1 Calculate the included angles using fore bearing and back bearing.

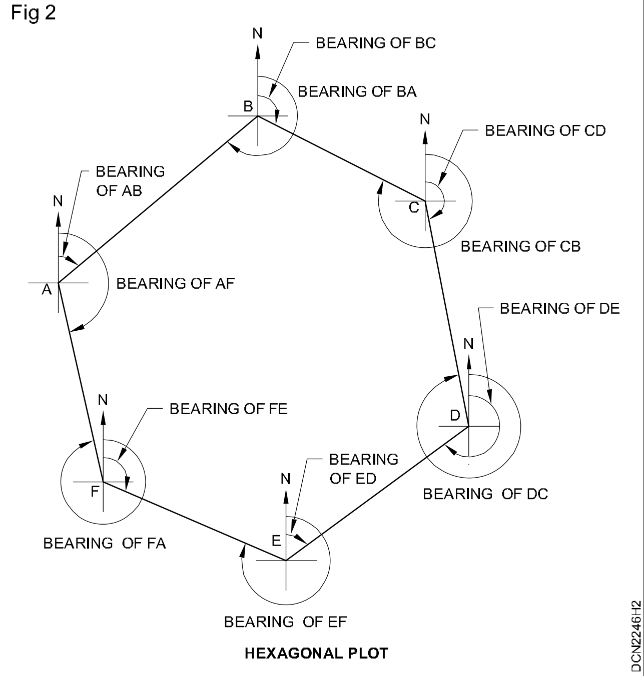
2 Check the calculated the included angels of the triangles with the theoretical sum of angels is equal to 180^o.

— — — — — — — —

TASK 4 : **Observe the bearings of a given hexagonal plot**

1 Select and drive pegs at all the stations A, B, C, D, E and F which are intervisible to each other. (Fig 2)

Fig 2



2 Measure the horizontal distance of AB, BC, CD etc. and note them as mentioned in the previous method against each line.

3 Set up the compass on first station 'A' and level it.

4 Fix ranging rods at station 'B' and 'F' where the bearing is to be located and observe the bearings.

5 Note down the bearings in the field book.

6 Repeat the procedure as explained in the previous exercise and note the bearings.

— — — — — — — —

TASK 5: **Calculate and check the included angles**

1 Calculate the included angles using fore bearings and back bearings.

2 Check the included angles by using the theortical formula (2 N - 4) Right angles.

Where N is the number of sides.

— — — — — — — —

TASK 6: **Plot the area**

1 Plot the polygonal figure and check it with the calculated included angles.

— — — — — — — —

Ploting of prismatic compass survey

Objectives: At the end of this exercise you shall be able to
- **locate the details and prepare a map.**

Requirements

Tools/Equipments/Instruments		Materials	
• Prismatic compass	- as reqd.	• Drawing sheet A2	- 1 No.
• Ranging rods	- as reqd.	• Field book	- 1 No.
• Wooden peg	- as reqd.	• Pencil HB	- 1 No.
• Pencil	- 1 No.	• Eraser	- 1 No.
• Eraser	- 1 No.	• Cello tape	- 1 roll.
• Chain and tape 30m	- each one	• Set of scale	- 1 set
• Arrows	- 10 Nos.		

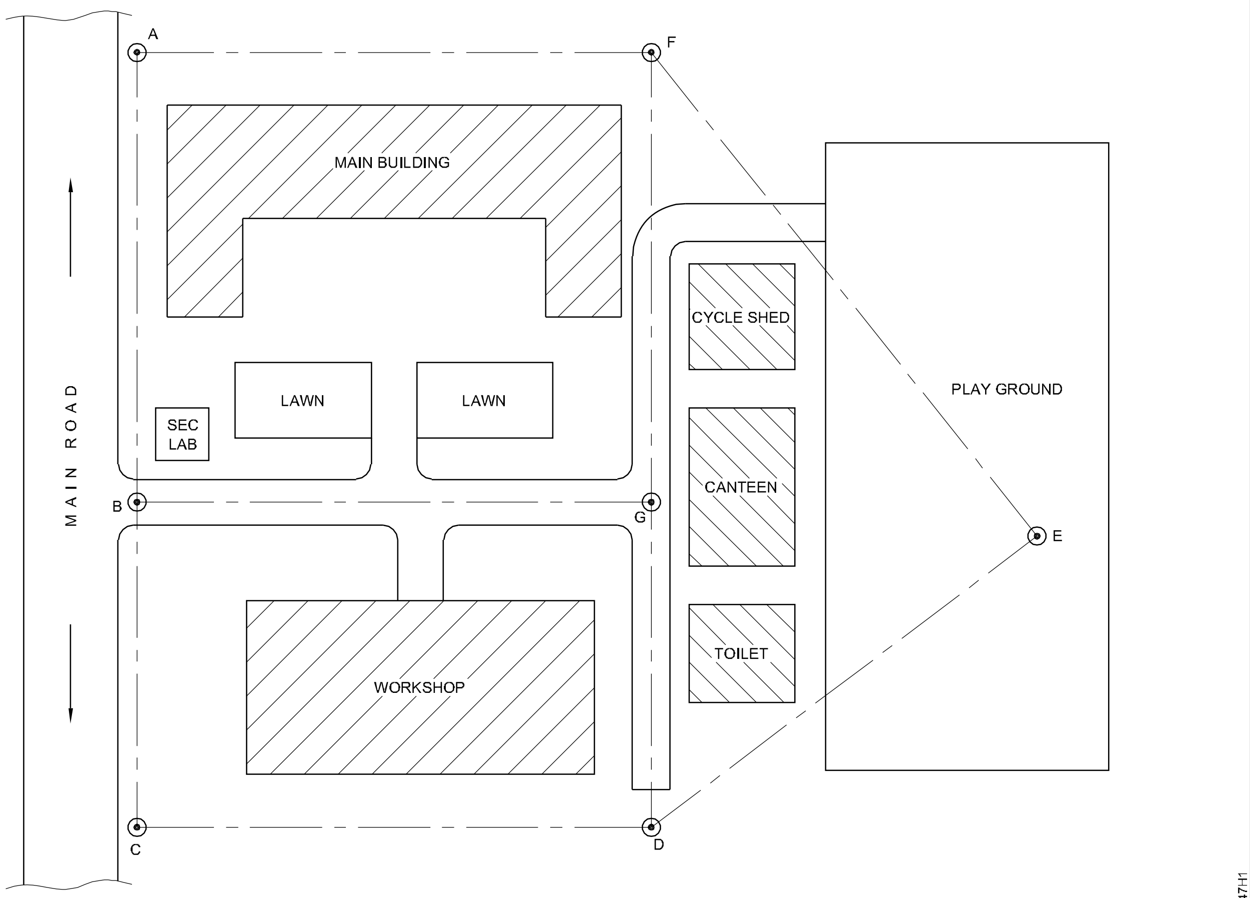
PROCEDURE

TASK 1: **Locate the details and prepare a map**

1 Make a visit to the existing site for the purpose of identifying the instrument stations, objects and special features located on the area to be surveyed (Fig 1).

2 Select an instrument stations A,B,C,D,E,F and G which gives maximum details for mapping.

Fig 1



MODEL LAYOUT OF AN INSTITUTE

3 Setup the instrument over the selected station 'A'.

4 Fix ranging rod at stations 'B' & 'F'.

5 Sight stations 'B' & 'F' and take the bearings of 'AB' & 'AF'.

6 Run the chain along 'AB' and take offsets for objects on both sides of the chain.

7 Observation should be recorded in field book.

8 Shift the Instrument station 'B'.

9 Check the bearing by back sighting 'A'.

10 Fix a ranging rods at stations 'C' & 'G'.

11 Sight stations 'C' & 'G' and take the bearing of 'BC' & 'BG'.

12 Run the chain along BC and take offsets of objects on both sides of chain line.

13 Observations should be recorded in the field book, as per the table given below.

14 Repeat the same process to complete the whole survey.

15 Plot the map based on the bearings and distances taken.

Line	Length in (m)	Fore bearing	Back bearing
AB			
BC			
BG			
CD			
DE			
DG			
EF			
FG			
FA			

— — — — — — — —

Testing and adjusting the prismatic compass

Objectives: At the end of this exercise you shall be able to
- **center the compass exactly over the station**
- **level the instrument**
- **focus the prism**
- **observe the bearings**
- **plot the observed bearings of the traverse.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Measuring tape 30m - 1 No.
- Ranging rod 2/3m long - 2 Nos.
- Arrows 40cm long - 2 Nos.

Materials

- Field book - 1 No.
- Ink pen - 1 No.

PROCEDURE

TASK 1: **Centering of compass**

1 Drive an iron or wooden peg on the station.

2 Spread the tripod legs by loosening the leather strap.

3 Place the tripod legs firmly on the ground approximately over the station.

4 Take out the compass from leather/plastic cover.

5 Remove the metal cover of the compass.

6 Fix the compass on the top of the tripod.

7 Bring the object vane to vertical position as shown in Fig 1(a) and Fig 1(b).

8 Bring the prism arrangement from position I to position II as shown in Fig 1(a) and Fig 1(b).

9 Drop a small pebble from centre of the tripod.

If the pebble falls on the centre of the peg, the compass is exactly centered over the station.

If the pebble does not fall on the peg, adjust the legs of the tripod.

Again drop a small pebble from centre of the tripod.

10 Repeat the above procedure till the pebble falls exactly over the peg.

Fig 1(a)

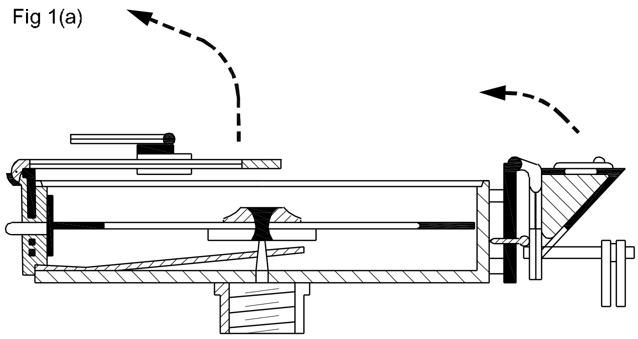


FIGURE SHOWING POSITION 1

Fig 1(b)

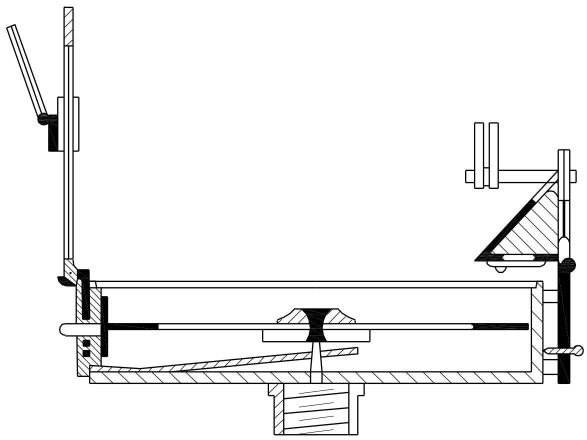


FIGURE SHOWING POSITION 2

DCN2248H1

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TASK 2: **Levelling**

1 Adjust the compas by using the ball and socket arrangement till the graduated ring swings freely after centering.

2 Level it by eye judgement.

> **Check:**
>
> **Place a spirit level on glass cover of the compass**

> **If the bubble of the spirit level is at its centre, the compass is in levelled position.**

3 If the bubble is not at its centre, repeat the above procedure to bring it at its centre.

— — — — — — — —

TASK 3: **Focusing the prism**

1 Move the prism attachment slightly upward or downward till the readings can be seen sharp and clear after levelling.

— — — — — — — —

Observe the bearings and plotting

Objectives: At the end of this exercise you shall be able to
- **observe the bearings**
- **plot the observed bearings of the traverse.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Measuring tape 30m - 1 No.
- Ranging rod 2/3m long - 2 Nos.
- Arrows 40cm long - 2 Nos.

Materials

- Field book - 1 No.
- Ink pen - 1 No.

PROCEDURE

TASK 1: **Observing the bearings**

1 Fix a ranging rod where the bearing is to be found.

2 After centering levelling and focussing the prism, turn the compass box until the ranging rod is bisected by the hair when looked through the slit in the prism.

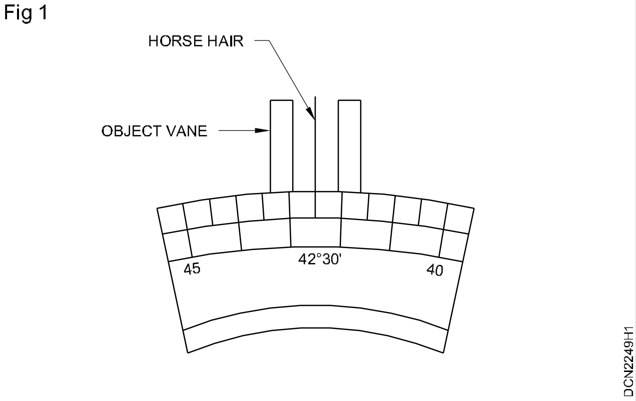
3 Allow the magnetic needle comes to rest.

4 Observe through the prism.

5 Note the reading at which the hair line cuts the image of the graduated ring as shown in Fig 1.

Sighting of the object and reading of the graduated ring should be done simultaneously.

Fig 1



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TASK 2: **Plotting**

1 Before starting the plotting work calculate the included angles of the closed transverse.

2 Sum all the included angles.

3 Check the included angles with (2n - 4) x right angles (where 'n' is the number of sides).

4 Select a suitable size of drawing sheet according to the size of the site to be plotted.

5 Fix the drawing sheet on the board.

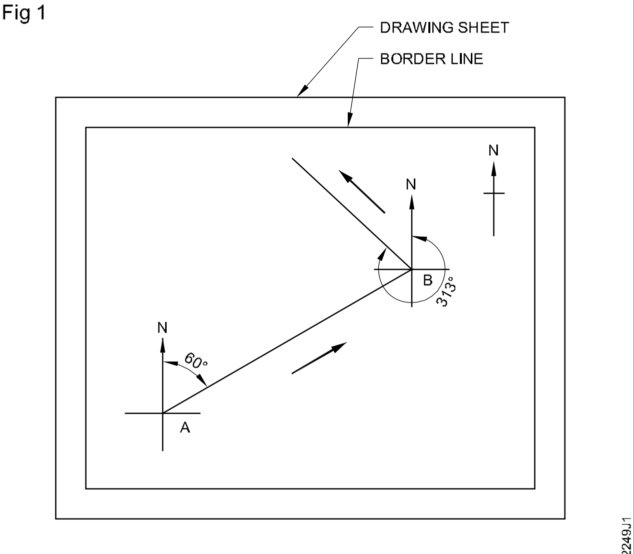
6 Draw border line and indicate the North direction on the right hand top corner of the sheet.

Method I - Parallel meridian method (Fig 1)

7 Select a suitable position to plot the first station 'A' such that all the stations can be plotted with in the drawing sheet.

8 Set the drafter parallel to the North direction and draw a vertical line on the first station 'A'.

Fig 1



PARALLEL MERIDIAN METHOD

9 Coincide the zero mark of the circular protractor with North direction already drawn on 'A'.

10 Mark a point corresponding to the bearing of the first line 'AB'.

11 Join the station 'A' and the point noted for the bearing.

12 Extend it to a convenient length.

13 Choose a suitable scale and mark the distance of the line 'AB'.

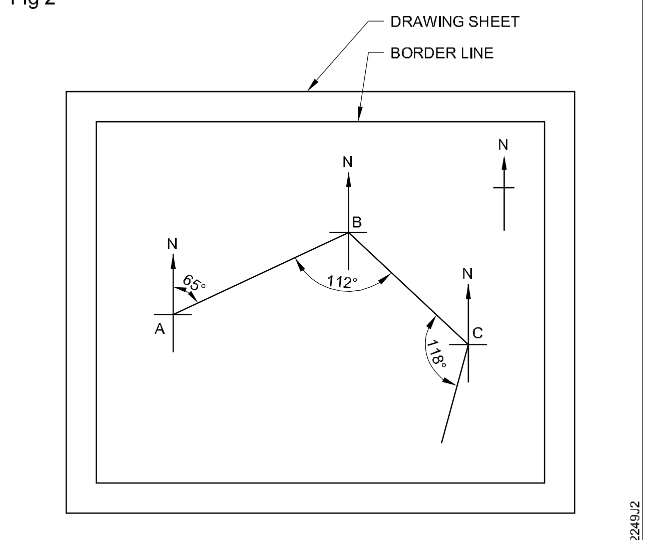
14 Denote the station as 'B'

15 Set the drafter again parallel to the North direction at 'B'

16 Continue the plotting work as mentioned above till all the stations are plotted.

Method II - Included Angle Method (Fig 2)

Fig 2



INCLUDED ANGLE METHOD

1 Mark the station 'A' and draw the first chain line AB to a suitable scale as mentioned in the method I.

2 Mark the station 'B' to a convienent scale.

3 Place the zero end of the circular protractor along BA.

4 Mark a point such that ∠ABC should be the same as calculated earlier.

5 Prolong the line through the point from B.

6 Mark the 'C' on the line to the same scale.

7 Continue the above process till all stations are plotted.

Method III - Central Meridian (or) Paper Protractor method (Fig 3)

1 Select a point 'O' in the centre of the drawing sheet.

2 Mark the North direction (meridian) on the point.

3 Keep the 0^0 and 180^0 graduations of the circular protractor coinciding with the north & south direction line with centre point 'O'.

4 Plot the bearing of all the lines with reference to the north direction as shown in Fig 3.

5 Select a suitable location to plot the first station 'A' such that all the stations can be plotted within the drawing sheet.

6 Select a suitable scale for marking field distances on the drawing sheet.

7 Set the drafter parallel to the line AB in the paper protractor which is already drawn.

8 Keep the drafter on A and draw a line parallel to the line AB which is in the paper protractor to a convenient length.

9 Mark the station B on the line, with the selected scale.

10 Set the drafter parallel to the line BC in the paper protractor which is already drawn.

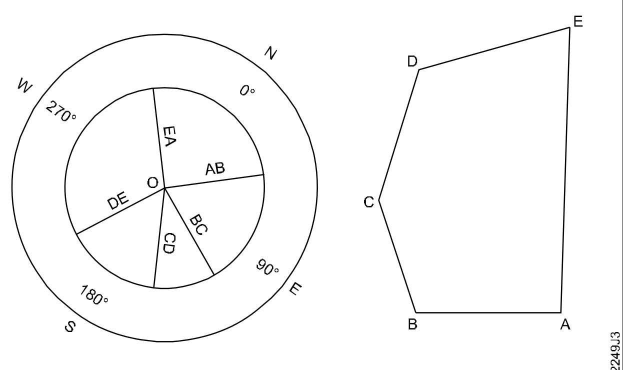
11 Keep the drafter on B and draw a line parallel to the line BC which is in the paper protractor to a convienent length.

12 Mark the station 'C' on the line to the same scale.

13 Continue the above procedure till all the stations are plotted.

14 Erase the excess lines.

Fig 3



CENTRAL MERIDIAN METHOD

— — — — — — — —

Bearing the line AB

Objectives: At the end of this exercise you shall be able to
- **observe the bearings**
- **check the accuracy of the instrument.**

Requirements

Tools/Equipments/Instruments

- Prismatic compass with tripod - 1 No.
- Measuring tape 30m - 1 No.
- Ranging rod 2/3m long - 2 Nos.
- Arrows 40cm long - 2 Nos.

Materials

- Field book - 1 No.
- Ink pen - 1 No.

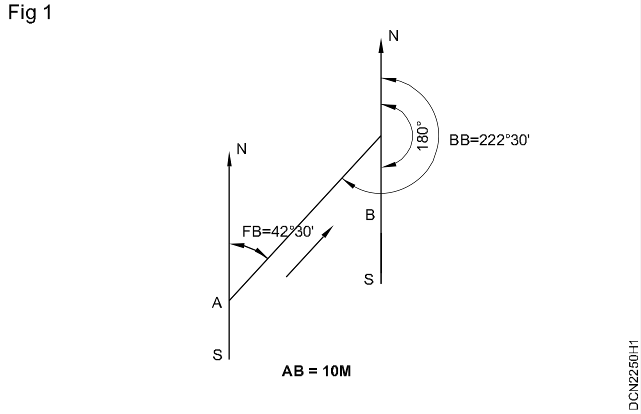
PROCEDURE

TASK 1: **Observe and record the bearings and personal error**

1 Select a line AB on a firm ground to a given length of 10m. (Fig 1)

The stations A and B should be selected free from local attraction.

Fig 1



2 Fix arrows at stations 'A' and 'B'.

3 Setup the prismatic compass over the station 'A'.

4 Centre the compass over the station 'A' and level it.

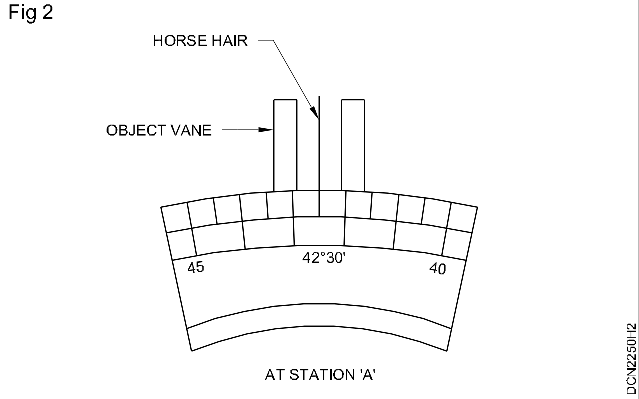
5 Fix a ranging rod at the station 'B'.

6 Turn the compass box until the ranging rod at station 'B' is bisected by the vertical hair of the object vane through the slit of the eye vane.

7 When the graduated ring comes to rest look through the prism and note the reading (42^0 30') at which the hair line produced appears to cut the image of the graduated ring (Fig 2).

8 Thus the required fore bearing of line AB is $42^0$30' and record it in the Field Book.

Fig 2



The sighting of the object and reading of the graduated ring are done simultaneously

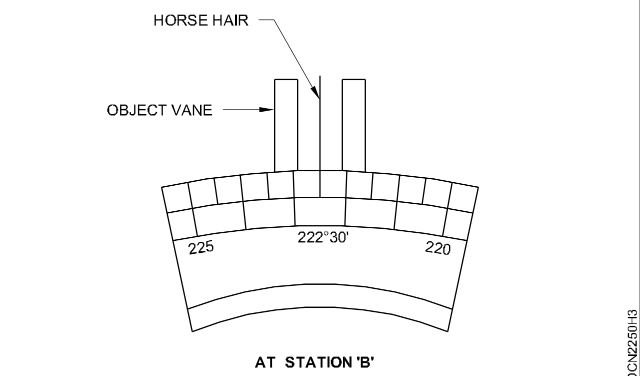
9 Shift the instrument, and setup at station 'B'.

10 Fix the Ranging rod at station 'A'.

11 Turn the compass Box, to sight the station 'A'.

12 Observe the bearing i.e. Back Bearing of the line 'AB' (222^0 30') Fig 3) and record it in the Field book.

Fig 3



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TASK 2: **Check the accuracy of the instrument and personal error**

(i) Back bearing of the given line AB is equal to fore bearing of the given line AB ± 180^0.

If the above condition is not satisfied with the observed back bearing of AB, then the instrument is having some error due to local attraction or wrong observation or wrong entry in the field book.

— — — — — — — —

Traverse survey and check the close surveying

Objectives: At the end of this exercise you shall be able to
- **set out the rectilinear field as a per the given readings**
- **survey and locate the group of building by plane tabling.**

Requirements

Tools/Equipments/Instruments

• Plane table with Tripod	- 1 No.
• Alidade	- 1 No.
• Spirit level	- 1 No.
• Trough compass	- 1 No.
• Plumbing fork with plumb bob	- 1 No.
• Prismatic compass	- 1 No.
• Measuring (30m) steel tape,	- 1 No.
• Chain 30m	- 1 No.
• Arrows	- 10 Nos.
• Pegs	- 10 Nos.
• Ranging Rod	- 2 Nos.

Materials

• Set of scale	- one set
• Pencil, Eraser etc.	- each one
• Drawing sheet A2	- 1 No.
• Drawing sheet A3	- 1 No.
• Field book with given data	- 1 No.
• Cello tape	- 1 roll.
• Set of scale	- 1 set

PROCEDURE

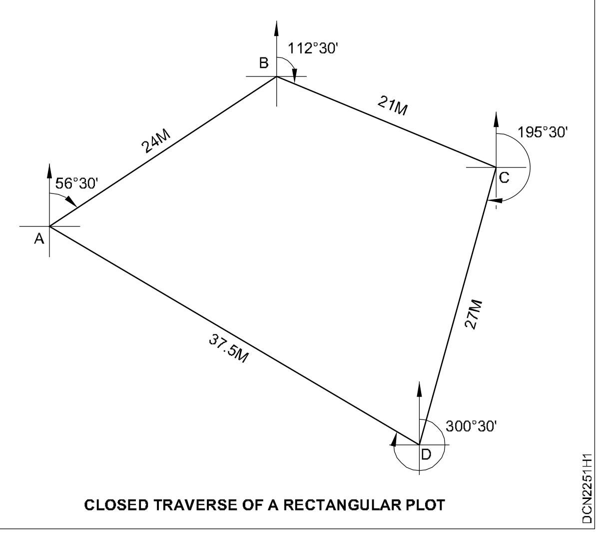
TASK 1: **Set out the rectilinear field as a per the given readings**

1 Before setting out the traverse in the field, calculate the interior angles for the station A,B,C and D and check it with the sum of included angles. $(2n - 4)90^0$.

2 Plot the traverse ABCDA with the given bearings and lengths.

3 Select a field without local attraction as far as possible for settingout a rectangular plot. (Fig 1)

Fig 1



CLOSED TRAVERSE OF A RECTANGULAR PLOT

4 Select a station 'A' in the field.

5 Set up the compass over the station 'A'.

6 Set the given bearing of AB $56^0 30'$ in the compass.

7 Sight through eye vane and object vane and fix a ranging rod approximately equal to the given distance in the line of sight.

8 Mark the distance AB of 24m along the above line and fix a peg at 'B'.

9 Shift the compass and setup over the station 'B'.

10 Observe the back bearing of AB and check it with the given bearing of $236^0 30'$.

If the observed back bearing of AB is not same as the given bearing the occured error may be,

Instrumental error (or)
Personal error (or)
Natural error

To rectify the above error, repeat the whole process from the beginning.

11 Set the given bearing of BC of $112^0 30'$ in the compass and sight through the line of sight.

12 Mark the given distance of BC of 21m and drive a peg at C.

13 Repeat the above procedure to complete the traverse ABCDA.

Line	Length in (m)	Fore bearing	Back bearing
AB	24.00	56^0 30’	236^0 30’
BC	21.00	112^0 30’	292^0 30’
CD	27.00	195^0 30’	15^0 30’
DA	37.50	300^0 30’	120^0 30’

— — — — — — — —

TASK 2: **Survey and locate the group of building by plane tabling**

Assume plane table survey to be conducted for the area shown in the area. (Fig 2)

1 Select the stations A,B,C,D,E,F,G,H,I,J around the buildings.

2 Set up the table at station A with drawing sheet, level it and orient it.

3 With the help of a trough compass mark the magnetic north on the sheet.

4 Select a suitable scale to locate the details and draw the map.

5 From station A, locate the stations B and H and details of the building corner.

6 Shift the table to station B and locate stations C and I and other details.

7 Similarly shift the table to C, D, E, F, G, H and also at I and J to take the details.

The corners of the building, road etc are taken by radiation or intersection method.

8 Follow the procedure already explained in 1.4.05.

9 Check the closing error after finishing at the starting point A.

10 Note the name of the building, features, important notes side by side while plotting.

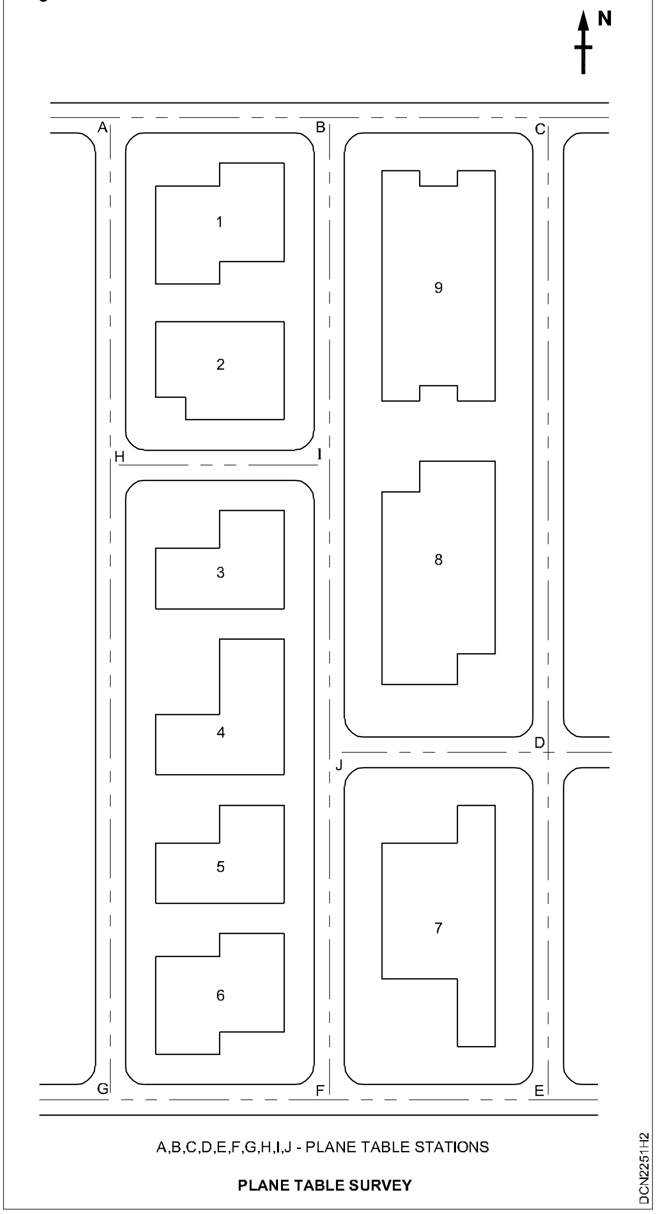
11 After locating all details, remove the sheet.

Necessary inking and colouring should be done.

Due to long distance GH the details of 4 and 5 cannot be visible Hence this may be omitted in this exercise.

The details 4 and 5 should be taken by using Two point in following exercise 2.3.52.

Fig 2



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Practice on plane tabling by radiation method orientation of plane table

Objectives: At the end of this exercise you shall be able to
- **set out the rectilinear field as a per the given readings**
- **survey and locate the group of building by plane tabling**
- **locate and reproduce the ground boundary points on the sheet**
- **survey and locate the boundaries and details of land by Radiation method**
- **survey and locate teh boundaries by intersection method.**

Requirements

Tools/Equipments/Instruments

- Plane table with Tripod - 1 No.
- Alidade - 1 No.
- Spirit level - 1 No.
- Trough compass - 1 No.
- Plumbing fork with plumb bob - 1 No.
- Measuring (30m) steel tape - 1 No.
- Pegs - 6 Nos.
- Arrows - 10 Nos.
- Ranging rod - 3 Nos.

Materials

- Existing layout plan - 1 No.
- Set of scale - 1 set.
- Pencil, Eraser etc. - each one
- Cello tape - 1 roll.

PROCEDURE

TASK 1: **Orient the table to find a new station point and locate the new building**

1 Select ‘A’ and ‘B’ be the two known points of the corners of building No.3 which is the plotted positions as ‘ab’ on the map in Ex. No. 1.4.06 (Fig 1a and 1b).

2 Fix the map of Ex.1.4.06 on the plane table board.

3 Use the two point problem to find the details of building No.4 and 5 which is to be omitted in Ex.1.4.06.

4 Select a temporary point ‘P’ and an approximate point ‘C’ on the ground in front of building corners A and B such that the angles $\angle PAC$ and $\angle PBC$ are not less than 30^0 for good intersection.

5 Set up the table over ‘P’

6 Orient the table in such a way that the plotted position ‘ab’ is approximately parallel to ‘AB’

7 Place the alidade on ‘a’.

8 Sight A and draw a back ray.

9 Place the alidade on ‘b’.

10 Sight B and draw a back ray.

11 Denote as ‘p_1’ where the two back rays intersect each other.

12 Transfer the point ‘p_1’ to Ground as p_1.

13 Fix a ranging rod at the approximate station at ‘C’.

14 Place the alidade on ‘p_1’ and draw a ray towards ‘C’.

15 Choose any point ‘c_1’ on the line ‘PC’ by estimation.

16 Shift the table to ‘C’ and set up it with ‘c_1’.

17 Orient the table with ‘c_1p_1’ by sighting ‘P’.

18 Place the alidade on ‘a’ and sight A , draw a back ray.

19 Denote ‘c_2’ where the backray from ‘a’ cuts the line ‘p_1c_1’.

20 Place the alidade on ‘c_2’ and sight ‘B’.

21 Draw a ray towards ‘B’.

22 Denote the point ‘b1’ where the ray ‘c2B’ meets the ray already drawn p1b produced.

If the table is exactly oriented to AB, then ray drawn c2B which will pass through the already plotted point ‘b’.

23 Now the line ‘ab_1’ is exactly parallel to the building points A & B.

24 Place the alidade ‘ab_1’.

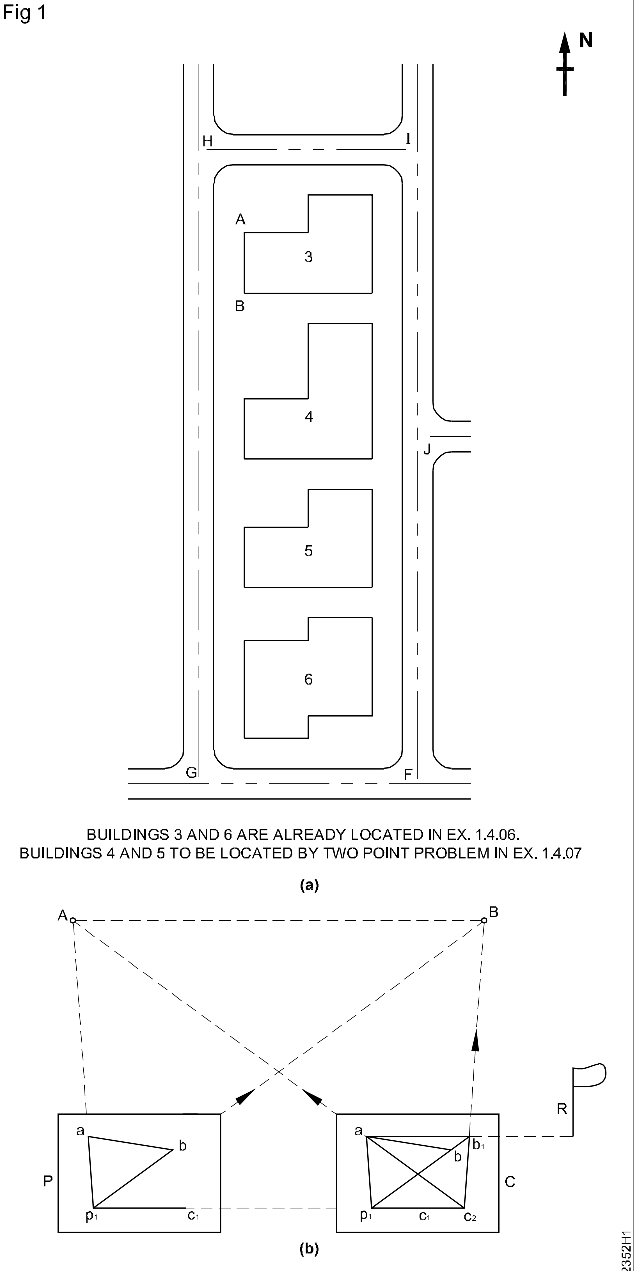
25 Fix a ranging rod at ‘R’ in the line of sight ‘ab1’ at a distance not less than 8m.

26 Place the alidade along ‘ab’ and unclamp the table.

27 Rotate the table until the Ranging Rod ‘R’ is again sighted.

28 Tighten the clamp. Now the table is exactly oriented to the building position AB.

Fig 1



TWO POINT PROBLEM

29 Place the alidade on 'a' sight A and draw a back ray.

30 Similarly place the alidade on 'b' sight B and draw a back ray.

31 Denote the point 'c' where the above two rays intersect each other.

32 Transfer the plotted point 'c' in the map into ground as 'C'

33 Start the survey to locate the new objects in the old map with reference to this instrument station.

Measure the ground distance CA,CB, and check it with plotted distance ca,cb.

— — — — — — — —

TASK 2: **Locate and reproduce the ground boundary points on the sheet**

1 Select the given boundary points A,B,C,D,E and F on the ground and drive pegs.

2 Select the point T so that all points A,B,C,D,E and F are visible from station T.

3 Set up the plane table over the station T.

4 Clamp the board after centering and levelling the plane table.

5 Fix the given drawing sheet over the plane table.

6 Select a point 't' on the drawing sheet exactly over the ground station T with the help of plumbing fork and plumb bob.

7 Mark the magnetic north on the right hand top corner with the help of trough compass.

8 Fix a pin on drawing sheet at 't'.

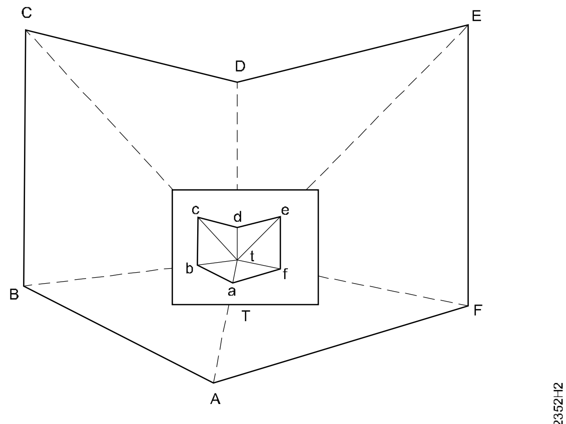
9 Pivot the alidade on 't' sight the points A,B,C,D,E and F and draw rays along the fiducial edge of the alidade, and denote a,b,c,d,e and f to their respective rays with a pencil.

10 Measure the ground distances TA,TB,TC,TD,TE and TF by tape.

11 Plot the distances to a convenient scale along the respective rays, thus getting a, b, c, d, e and f.

12 Join the points a,b,c,d,e and f on the sheet to give the out line of the Boundary. (Fig 2)

Fig 2



RADIATION

Care must be taken to see that the alidade is touching the point 't' while the sights are being taken

Check:

The field work can be checked by measuring the distances AB,BC,CD etc and comparing them with their plotted lengths of ab,bc,cd,dc,ef and fa.

— — — — — — — —

Skill sequence

Levelling the plane table

Objective: This shall help you to

- **level the plane table.**

1 Spread the legs of the tripod in firm position approximately over the station.

2 Place the plane table over the tripod and tighten the clamp.

3 Adjust the legs of the tripod to bring the table to a convenient height of the surveyor.

4 Bring the longer edge of the table parallel to any two legs by rotating it about its vertical axis.

5 Place the spirit level on the table parallel to the longer edge of the table as in position 1 of Fig 1.

6 Bring the bubble of the spirit level to its centre by moving the third leg to its left or right.

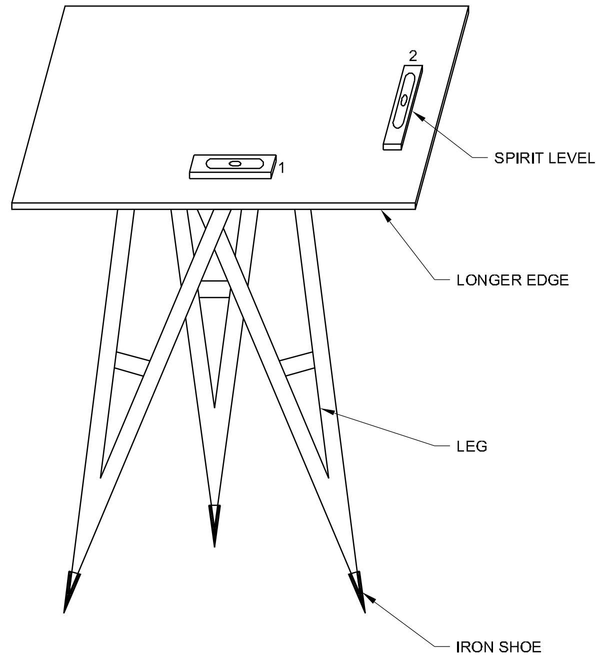
7 Place the spirit level on the table perpendicular to its previous position as in position 2 of Fig 1.

8 Bring the bubble of the spirit level to its centre by moving the third leg to forward or backward.

9 Check the bubble of the spirit level remains central in all positions.

10 Repeat the above process until the bubble of the spirit level remains central in all positions.

Fig 1



LEVELLING THE PLANE TABLE

— — — — — — — —

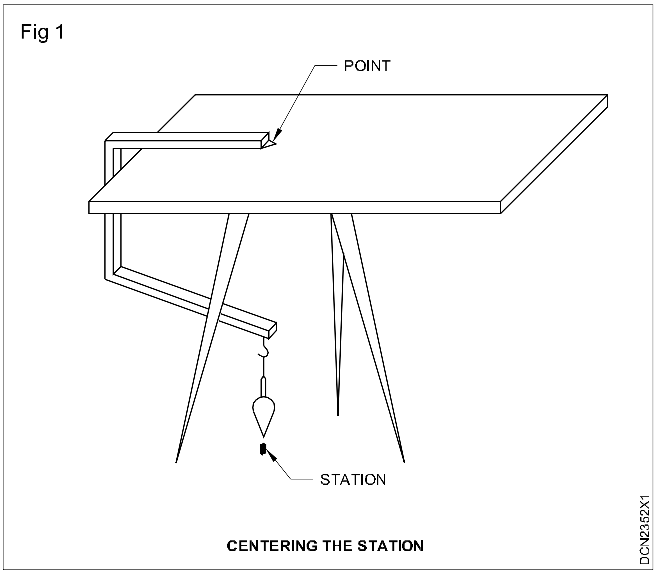
Centering

Objective: This shall help you to

- **center the plane table over a station.**

1 Clamp the board, after completing the levelling, centering should be done.

2 Select a point on the drawing sheet for the station occupied by the plane table by observing such that all the objects should be covered within the drawing sheet. (Fig. 1)



3 Fix a pin on the point.

4 Place the pointed end of the plumbing fork (or) 'U' frame touching the pin on the paper.

5 Shift the table bodily until the plumb - bob hangs exactly over the centre of the station peg.

— — — — — — — —

Orientation of plane table

Objective: This shall help you to

- **set the table in parallel with the existing points.**

Two methods of orientation are,

– Orientation of the plane table with a magnetic compass.

– Orientation of the plane table by Back sighting (alidadle).

Orienting the plane table with a magnetic compass

1 Select a station A and setup the table over the station and mark it as 'a' in the drawing sheet.

2 Place the trough compass on the right hand top corner of drawing sheet at the first station.

3 Draw a line along the longer edge of the Trough compass when the needle shows north direction exactly.

4 Select and fix a ranging rod at the next station 'B'.

5 Keep the alidade touching the first station point on the drawing sheet.

6 Sight the next station through the alidade and draw a ray.

7 Measure the distance 'AB' on the ground and mark it on the sheet as 'ab' to a convenient scale. Fig. 1a.

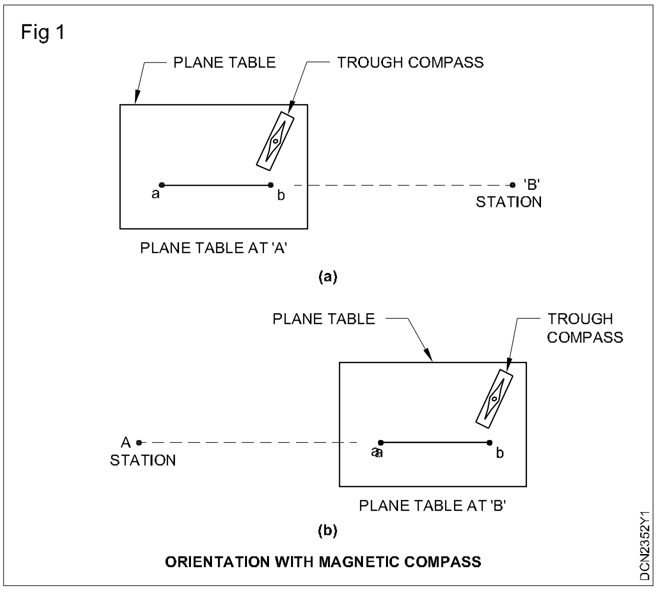
8 Shift the plane table to the station 'B' after taking all the details from the first station.

9 Level and centre the plane table at the station 'B' with plumbing fork with plumb bob.

10 Place the compass along the north line already marked on the sheet.

11 Unclamp and turn the table until the needle show exactly in north direction. (Fig. 1b)

12 Clamp the board in this oriented position of the table.



This method of orientation is not an accurate if any of the stations are affected by local attraction.

Orienting the plane table by Back sighting

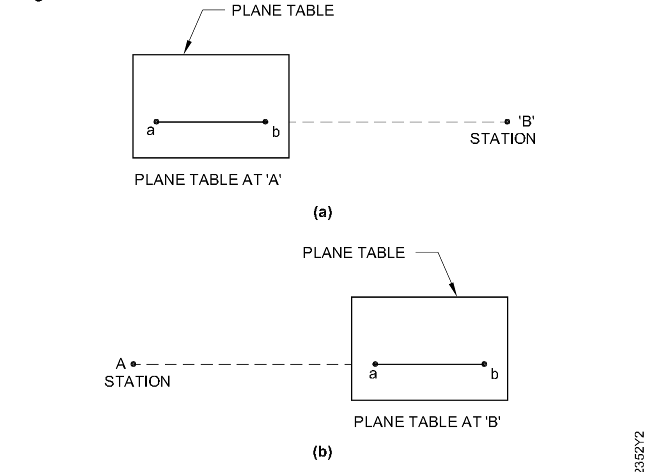
1 Follow the first eight steps as in the previous skill (Orientating the plane table with a magnetic compass).

2 Level and centre the plane table at the station 'B', with plumbing fork with plumb bob. (Fig. 2a)

3 Place the alidade along the ray 'ba' already drawn from the previous station to sight 'A'.

Rotate the table until the line of sight bisects the ranging rod at the previous station 'A'.

Fig 2



ORIENTATION WITH BACK SIGHTING

This method of orientation will be accurate even all stations, are affected by local attraction.

1 Now check the centering of the plane table over station ‘B’ with plotted position ‘b’ and correct it by bodily shifting the table.

2 Again keep the alidade along ‘ba’ and sight ‘A’ and rotate the table until it bisects ‘A’.

3 Repeat the above two process simultaneously until to get the exact orientation. Fig. 2b.

— — — — — — — —

TASK 3: **Survey and locate the boundries and details of land by radiation method.**

1 Select 1,2,3,4,5,6,7 & 8 be the boundary points to be surveyed with some objects of an area as shown in Fig.3.

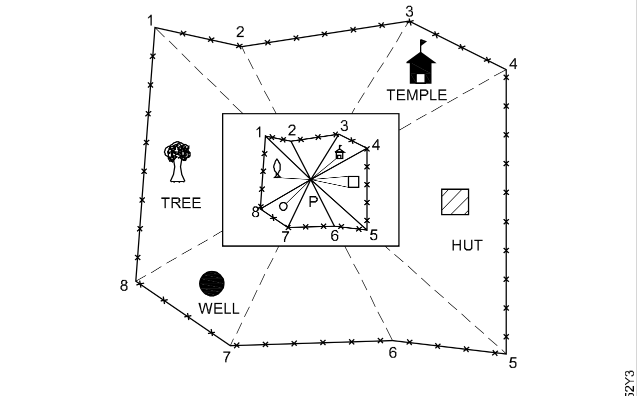
2 Let tree, temple, Hut & well be the some objects situated within the boundary as shown in Fig 3.

3 Select a station point ‘P’ which is visible from all the boundary points and the objects with in the boundary.

4 Setup the table over ‘P’ and mark ‘p’ on the drawing sheet and centre it.

5 Locate all the boundary points with suitable scale by the Radiation method on the drawing sheet with alidade.

Fig 3



RADIATION METHOD

With the same instrument position locate the objects such as tree, temple, hut, wall etc. with the use of alidade.

With the same scale mark and draw the conventional symbols for the different details.

— — — — — — — —

TASK 4: **Survey and locate the boundaries by intersection method**

1 Select 5 boundary points C,D,E,F &G on the ground and drive pegs. (Fig.4)

2 Select two base stations A,B on the ground so that all boundary points are visible from the stations.

3 Set up the table at A and level it.

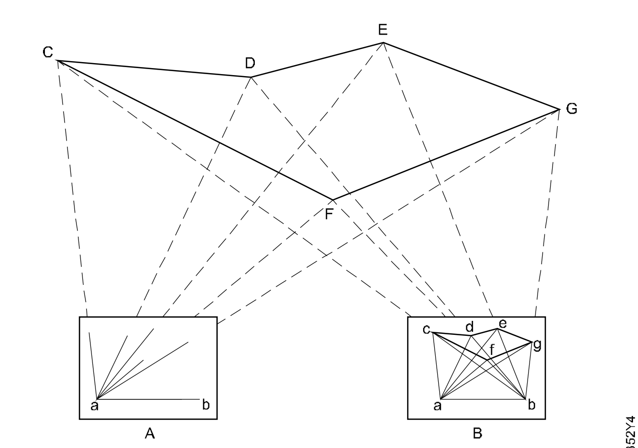
4 Clamp the board after centering and levelling the plane table over station A.

5 Transfer the ground station ‘A’ as ‘a’ in the drawing sheet.

6 Keep the alidade touching ‘a’ sight ranging rod at the point c and draw a ray with pencil.

7 Similarly sight and draw the other rays from ‘a’ to other points D,E,F and G.

Fig 4



INTERSECTION

8 Sight the station B draw a ray and measure the distance scale it and mark as ‘b’.

The line joining the base stations ‘A’ and ‘B’ known as base line should be visible to all points and be a round figure say 5 or 10m.

9 Shift the plane table over station B and level, centre and orient it.

10 Keep the alidade touching ‘b’ sight the previous point ‘C’ and draw the ray to intersect corresponding ray at ‘c’.

11 Similarly sight and intersect all other points D,E,F and G to corresponding rays at d,e,f and g.

12 Join the intersection of all these points c,d,e,f and g are the required boundary line.

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Handling and practice of levelling instruments and their settings

Objectives: At the end of this exercise you shall be able to
- **identify the type of level**
- **identify the parts of dumpy level and auto level**
- **identify the construction of telescopic leveling staff.**

Requirements

Tools/Instruments

- Dumpy level with tripod - 1 No.
- Auto level with tripod - 1 No.
- Telescopic leveling staff - 1 No.
- Nil

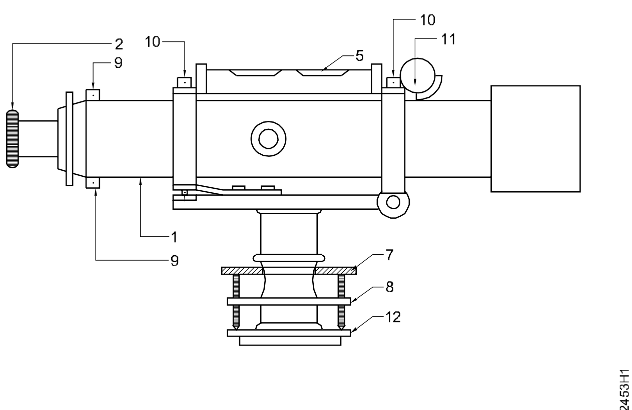
PROCEDURE

1 Remove the dumpy level from the wooden box.Note the position of object glass and eye piece before the removal. (Fig 1)

2 Spread the legs of the tripod at a convenient height.

3 Fix the level over the tripod and explain its parts.

Fig 1



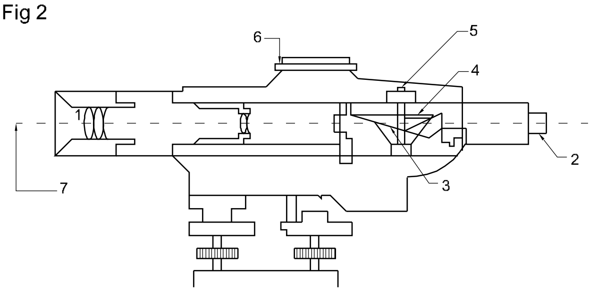
DUMPY LEVEL

DCN2453H1

1 Telescope, 2. Eye - piece, 3. Ray shade, 4. Objective end, 5, Longitudinal bubble, 6. Focusing screws, 7. Foot scres, 8. Upper parallel plate (Tribrach), 9. Diapharam adjusting screws, 10. Bubble tube adjusting screws, 11. Transverse bubble tube, 12. Foot plate (Trivet stage)

2 Similarly explain the parts of auto level. (Fig 2)

Fig 2



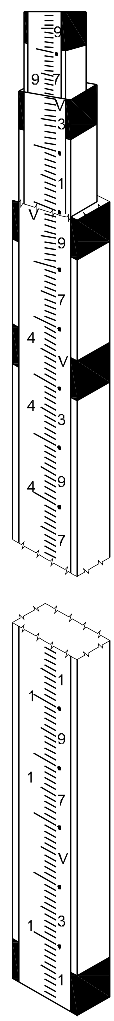
AUTO LEVEL

DCN2453H2

1. Objective lens, 2. Eyepiece, 3. Compensator object, 4. Compensator suspension, 5. Magnetic dampering system, 6. Line of sight

5 Explain the construction of telescopic leveling staff. (Fig 3)

Fig 3



TELESCOPIC STAFF

DCN2453H3

Skill Sequence

Holding of staff

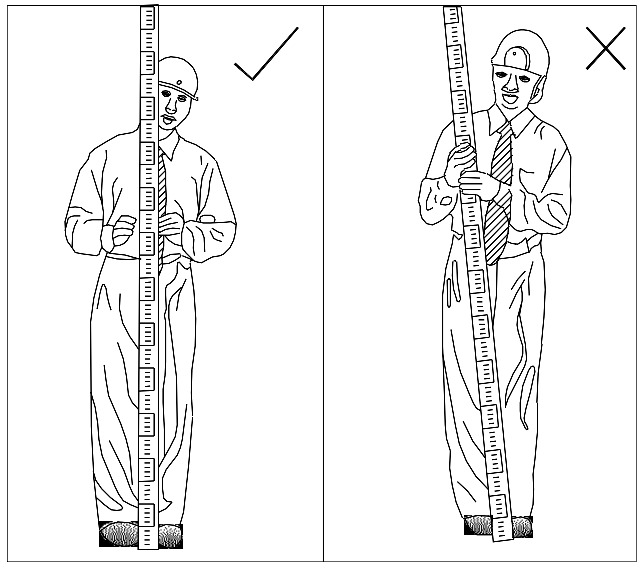
Objective: This shall help you to
- **level the plane table.**

1 Strech the staff to its full length.

2 Place the bottom fo the staff between the toes.

3 Hold the staff between the palms of the hands at the height of the face. (Fig 1)

Fig 1



HOLDING OF STAFF

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TASK 2: **Reading the leveling staff**

1 Set up and level the dumpy level at a suitable position.

2 Hold the staff vertically at staff station.

3 Direct the telescope towards the leveling staff and focus the telescope.

4 Check the verticality of the staff with the vertical hair and adjust it with the use of hand signals.

Signal (Fig 2)	Message
Movement of the left arm over 90°.	Move to my left. (fig 2a)
Movement of the right arm over 90°.	Move to my right. (fig 2b)
Movement of the left arm over 30°.	Move top of staff to my left. (fig 2c)
Movement of the right arm over 30°.	Move top of staff to my right. (fig 2d)
Extension of arm horizontally and moving hand upwards.	Raise height of peg or staff. (fig 2e)
Extension of arm horizontally and moving hand downwards.	Lower height of peg or staff. (fig 2f)
Extension of both arms and slightly thrusting downwards.	Establish the position. (fig 2g)
Extension of arms and placement of hand on top of head.	Return to me. (fig 2h)

5 Check the position of the bubble. If it is not at the centre, bring it to the centre of its run using the foot screw beneath or nearer to telescope.

6 Note the reading against the horizontal hair appears to cut the staff.

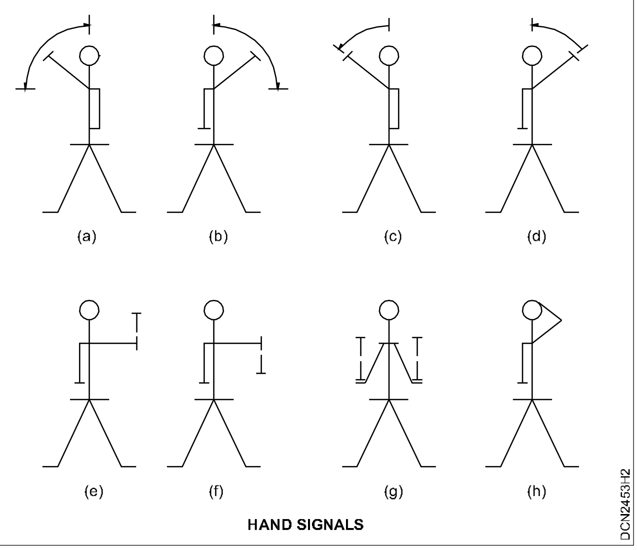
7 First note the red figure denoting the metre numeral on the left of the staff.

8 Secondly note the black figure denoting the minimum decimeter reading.

9 Finally count the number of black and white strips graduated to read the centimeters and millimeters, where the horizontal cross hair cuts the staff.

The graduations are marked erect in the staff, and therefore, while looking through the telescope the staff is seen as inverted. Hence the staff should be read from top to bottom.

Fig 2



HAND SIGNALS

Temporary adjustments of level

Objectives: At the end of this exercise you shall be able to
- **set up the tripod on the ground**
- **fix the instrument on the tripod**
- **level the instrument**
- **perform elimination of parallax.**

Requirements

Tools/Instruments

• Dumpy level with tripod	- 1 No each.
• Telescopic leveling staff	- 1 No.
• Level field book	- 1 No.

PROCEDURE

TASK 1: **Setting up the tripod on the ground (Fig 1)**

- Loosen the strap of the tripod.
- Spread the legs of the tripod to a convenient height.
- Keep the two legs firmly on one side of a non-slippery ground and the third on the other side.
- Adjust the third leg so that the top of the tripod is approximately horizontal by eye judgement.

Fig 1

LEG ADJUSTMENT

— — — — — — — —

TASK 2 : **Fix the instrument on the tripod (Fig 1)**

- After noting the position of the level in the box, remove it from the box.
- Release the clamp screw of the instrument and hold it with right hand.
- Turn round the lower part of the level with the left hand and screw the instrument firmly on the tripod.

— — — — — — — —

TASK 3: **Levelling of the instrument (Fig 2)**

1 Place the telescope parallel to the line joining the two foot screws.

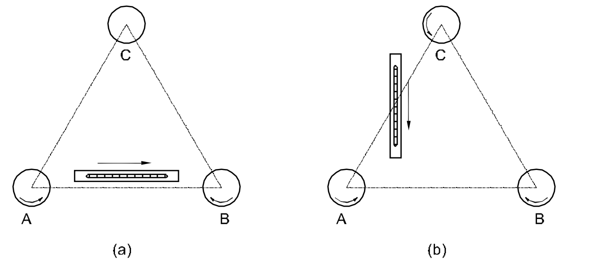
2 Bring the bubble of the spirit level on the telescope to the centre of its run by turning the foot screws beneath the telescope either inward or outward.

3 Turn the telescope through 90° to its previous position.

4 Turn the third foot screw inward or outward and bring the bubble of the spirit level on the telescope to the centre of its run.

5 Repeat the step 2 and step 4 several times so that the bubble remains in the centre in all positions of the telescope.

Fig 2



LEVELLING UP WITH THREE FOOTSCREWS

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TASK 4: **Elimination of parallax (Fig 3)**

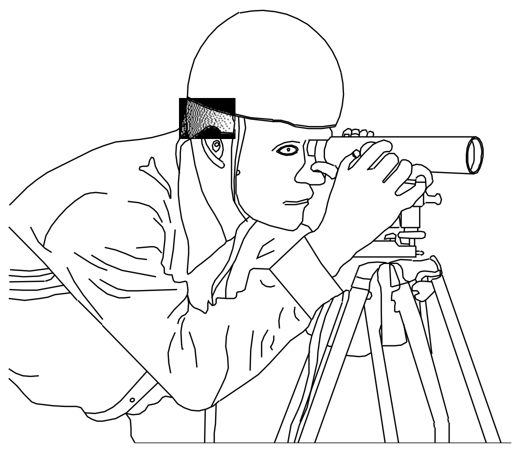
i) Focussing of the eye-piece.

- Remove the lid of the telescope.
- Direct the telescope towards the sky or towards a white paper.
- Looking through the telescope, turn the eye-piece inward or outward till clear image of cross wires is obtained.

ii) Focussing of the object glass.

- Direct the telescope towards the leveling staff.
- Turn the focussing screw inward or outward till clear image of the leveling staff is seen.
- Check for the parallax by moving the eye up or down.

Fig 3



FOCUSSING THE OBJECT

— — — — — — — —

Simple levelling

Objectives: At the end of this exercise you shall be able to
- **measure the level difference between the points A and B and determine the reduced level of one point with reference to the other**
- **determine the RL of a given 5 points from a single instrument position (simple levelling) and observe and enter readings in field book**
- **reduce the levels in two methods.**

Requirements

Tools / Equipments / Instruments
- Dumpy level with tripod - 1 No.
- Levelling staff - 1 No.

Materials
- Levelling field book - 1 No.

PROCEDURE

TASK 1: **Measure the level difference between the points A and B and determine the reduced level of one point with reference to the other (Fig 1)**

1 Select two station points A and B on a firm ground.

2 Set up and level the instrument approximately at mid point O.

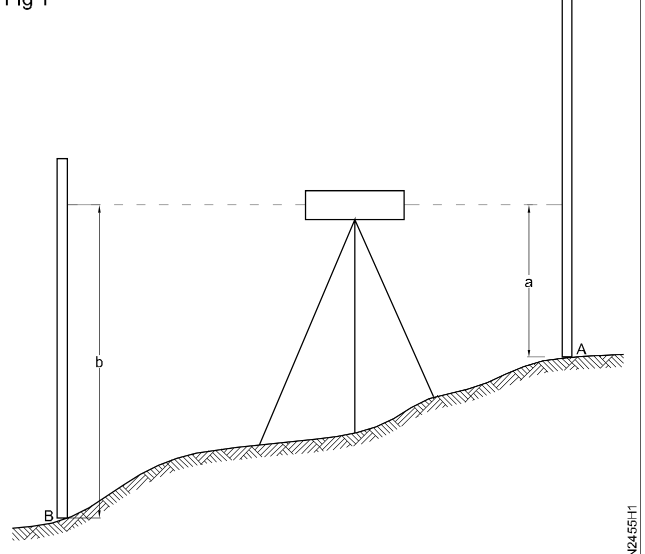
3 Take staff readings on A and B, let the readings be a and b respectively.

4 The level difference between A and B is equal to the difference of the staff readings observed at station A and station B.

ie: level difference = b - a (if b > a).

5 If the reduced level of A is known, the reduced level of B = reduced level of A - level difference.

Fig 1



SIMPLE LEVELLING

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TASK 2: **Determine the RL of a given 5 points from a single instrument position (simple levelling) and observe and enter readings in field book**

1 (Fig 1) Setup and level the instrument position at 'O' which is visible and approximately equal distance to all station.

2 Direct the telescope towards the staff held vertically on BM and focus it carefully to obtain clear graduations.

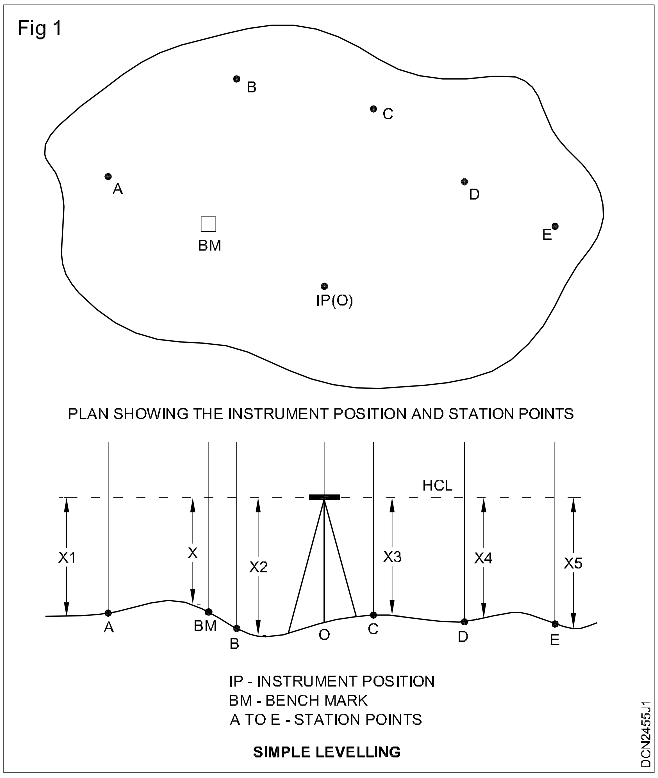
3 Take the reading (X) and enter Back sight in a field book.

4 Send the staff man to the station A.

5 Direct the telescope towards the station A, focuss it with again take the inter sight reading (say X1) and enter in a field book.

6 Send the staff man to all stations B,C,D direct the telescope towards the above stations take all the inter sight reading and enter the in a field book (say X2,X3 and X4).

7 Send the staff man to the station E and take the fore sight reading (say X5) and enter in a field book.



TASK 3: **Reduce the levels in two methods**

1 Reduce the levels to all the stations by either

(i) Height of collimation method (or)

(ii) Rise and Fall method.

2 Apply usual arithmetical check.

a) The specimen page of a level book illustrating the method of booking staff readings and calculating RL of stations by Height of collimation method is shown under.

Back sight	Inter sight	Fore sight	HC	Reduced Levels	Remarks
X	X1				Reading taken on BM
	X2				- do - at A
	X3				- do - at B
	X4				- do- at C
		X5			-do- at D
					- do - at E

Height of collimation = R.L of BM + Backsight Reading (X)

Reduced level at A = HCL - Reading at A (X1)

Reduced level at B = HCL - Reading at A (X2)

Reduced level at C = HCL - Reading at A (X3)

Reduced level at D = HCL - Reading at A (X4)

Reduced level at E = HCL - Reading at A (X5)

Arithematical check :

$\sum$ Back sight - $\sum$ Fore sight = Last RL - First RL.

b) The specimen page of a level book illustrating method of booking staff readings and calculating R.Ls of stations by the rise and fall method is shown under.

Back sight	Inter sight	Foresight	Rise	Fall	Reduced Levels	Remarks
X	X1					Reading taken on BM
	X2					- do - at A
	X3					- do - at B
	X4					- do- at C
		X5				-do- at D
						- do - at E

If X-X1 is +ve, enter the difference in Rise column. If it is -ve, enter the difference in Fall column.

Similarly X1-X2, X2-X3, X3-X4, X4-X5 is +ve enter the difference in Rise column. If it is -ve, enter the diff. in Fall column.

If the R.L of the BM is known, then R.L of the stations A, B, C,D and E may be obtained by adding its respective rise or subtracting its respective fall from the R.L of proceeding point.

Arithematicl check

$\sum$ B.S - $\sum$ F.S = $\sum$ Rise - $\sum$ Fall = Last RL - First RL.

— — — — — — — —

Differential levelling

Objective: At the end of this exercise you shall be able to
- **determine the level difference between two points A and B, when it is not possible to see both stations from a single set up.**

Requirements

Tools / Instruments
- Dumpy level with tripod - 1 No each.
- Telescopic leveling staff - 1 No.
- Peg, hammer - 1 No each.

Materials
- Level field book - 1 No.
- Pencil - 1 No.
- Eraser - 1 No.

PROCEDURE

Let A and B be the two points whose level difference is to be determined, which are far away from each other.

a Set up and level the instrument at O_1. (Fig 1)

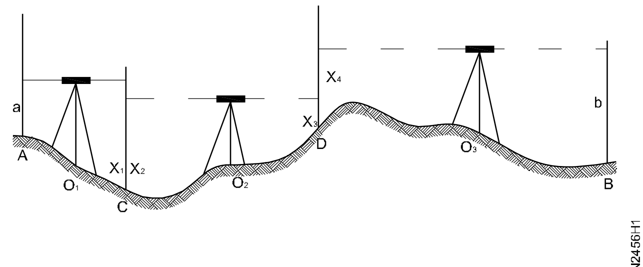
b Take staff readings on stations A and C. Enter the readings on field book as 'a' and 'X_1' respectively.

c Shift and place the instrument on O_2. Carry out temporary adjustments. Then take staff readings on C and D. Note it on the field book as X_2 and X_3.

d Repeat the process until a foresight reading (b) is taken on station B.

BS	IS	FS	HI	RL	Remarks
a					Station A
X_2		X_1			Station C
X_4		X_3			Station D
		b			Station B

Fig 1



DIFFERENTIAL LEVELLING

e Level difference between A and B = $\sum$ BS- $\sum$ FS

$= (a+X_2+X_4) - (X_1+X_3+b)$

f Reduced level of B = reduced level of A $\pm [(a+X_2+X_4) - (X_1+X_3+b)]$

Carryout levelling in field book

Objective: At the end of this exercise you shall be able to
- **enter the field book by Height of collimation method and Rise and fall method.**

Requirements

Tools / Instruments

- Dumpy level with tripod - 1 No.
- Telescopic leveling staff - 1 No each
- Peg, hammer - 1 No each

Materials

- Level field book - 1 No.
- Pencil - 1 No.
- Eraser - 1 No.

PROCEDURE

TASK 1: **Enter the field book by Height of collimation method and Rise and fall method.**

1 The observations X_1, X_2, X_3 X_4, and X_5 are taken from a single set up of level.

2 The readings for the both method may be recorded as given below.

3 Each row represents station points.

4 For the both method the first staff reading is taken to a point of known elevation.

5 This is known as back sight. (X_1)

6 Enter this in the BS column of the both method in the first row.

7 The last staff reading of the both is taken on a point of unknown elevation. (X_5)

8 Enter this is the FS coloumn of both method.

9 The sights in between BS & FS is intermediate sights.(X_2,X_3,X_4)

10 The above are entered in the is column of both methods.

Table 1: Height of collimation method

BS	IS	FS	HI	RL	Remarks
X_1			HI = R_1+X_1	R1	BM
	X_2			HI_1-X_2	Station A
	X_3			HI_1-X_3	Station B
	X_4			HI_1-X_4	Station C
		X_5		HI_1-X_5	Station D

Check : BS - FS = Last RL - First RL.

Table 2: Rise and Fall Method

BS1	IS	FS	Rise	Fall	RL	Remarks
X_1					R_1	BM
	X_2					Station A
	X_3					Station B
	X_4					Station C
		X_5				Station D

Check: (BS - FS) = (RISE - FAIL) = (Last RL - First RL)

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Problems in levelling

Objectives: At the end of this exercise you shall be able to
- **determine the reduced levels of the station points by height of collimation method**
- **determine the reduced levels of the station points by rise and fall method.**

Requirements

Tools / Instruments
- Dumpy level with tripod - 1 No.
- Telescopic leveling staff - 1 No each.
- Peg, hammer - 1 No each.

Materials
- Level field book - 1 No.
- Pencil - 1 No.
- Eraser - 1 No.

TASK 1: Problem in levelling

Following consecutive readings were taken on points 1 to 7 along a line.

0785, 1.326, 2.538, 3.435, 1.367, 2.328, 1.234, 1.657

The instrument was shifted after the fourth reading and the first reading was taken on BM with RL = 100.00. rule out a page of level book and work out the RL of all points by **Height of Collimation Method and Rise and Fall Method**.

Solution

Station	Readings			Height of line of collimation	RL	Remark
	B.S.	I.S.	F.S			
1	0.785			100.785	100.00	BM
2		1.326			99.459	RL = 100
3		2.538			98.247	
4	1.367		3.435	98.717	97.350	
5		1.238			96.389	
6		1.234			97.483	
7			1.657	97.060		
Total	2.152		5.092			

H.I. = R.L. + B.S. = 100.00 + 0.785 = 100.785

R.L. = H.I. – I.S / F.S. = 100.785 – 1.367 = 99.459

Arithmetical check

Σ B.S. – Σ F.S. = 02.152 – 5.092 = -2.940

Last R.L. – First R.L. = 97.060 – 100.00 = 2.940 Ans.

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TASK 2 :

The readings are entered in the page of level field book as shown below. Reduce the levels by both the **Height of collimation method and Rise and Fall method**, given the R.L. of a B.M. 1 as 200.000 m. Apply the check.

Solution for the above problem in rise and fall method

Station	Readings			Rise	Fall	RL	Remark
	B.S.	I.S.	F.S				
1	0.785					100.00	BM
2		1.326			0.541	99.459	RL = 100
3		2.538			1.212	98.247	
4	1.367		3.435		0.897	97.350	CP
5		2.328			0.961	96.389	
6		1.234		1.094		97.483	
7			1.657		0.423	97.060	
Σ B	2.152	Σ F.S	5.092	1.094	4.034		

Arithmetical checks

Σ B.S. – Σ F.S. = 2.152 – 5.092 = -2.940

Σ Rise – Σ Fall = 1.094 – 4.034 = -2.940

Last R.L. – First R.L. = 97.060 – 100.00 = 2.940 Ans.

Station	B.S.	I.S.	F.S.	R.L.	Remarks
1	1.430			200.000	B.M. 1
2		2.015			
3		1.005			
4	3.370		0.400		C.P.
5		2.975			
6		1.415			
7			0.695		B.M. 2

Solution: By Height of collimation method

Station	B.S.	I.S.	F.S.	Height of collimation	R.Ls.	Remarks
1	1.430			201.430	200.00	B.M. 1
2		2.015			199.415	
3		1.005			200.425	
4	3.370		0.400	204.400	201.030	C.P.
5		2.975			201.425	
6		1.415			202.985	
7			0.695		203.705	B.M. 2

General rule in height of collimation method is

Height of collimation = R.L. of B.M. + B.S. on that B.M.

R.L. of any point = Height of collimation - I.S. / F.S. of that point.

∴ Height of Collimation for the 1st set up

= 200.00 + 1.430 = 201.430

R.L. of a point 2 = 201.430 - 2.015 = 199.415

3 = 201.430 - 1.005 = 200.425

R.L. of C.P. (4) = 201.430 - 0.400 = 201.030

Height of collimation for the 2nd set up

= 201.030 + 3.370 = 204.400

R.L. of a point 5 = 204.400 - 2.975 = 201.425

6 = 204.400 - 1.415 = 202.985

R.L. of B.M.2 (7) = 204.400 - 0.695 = 203.705

Arithmetical check

Σ B.S. = 1.430 + 3.370 = 4.800

Σ F.S. = 0.400 + 0.695 = 1.095

Σ B.S. - F.S. = 4.800 = 1.095 = 3.705

Last R.L. - First R.L. = 203.705 - 200.000 = 3.705

Σ B.S. - Σ F.S. = last R.L. - First R.L.

Hence OK

By rise and fall method

Station	B.S.	I.S.	F.S.	Rise	Fall	R.Ls.	Remarks
1	1.430					200.00	B.M. 1
2		2.015			0.585	199.415	
3		1.005		1.010		200.425	
4	3.370		0.400	0.605		201.030	C.P.
5		2.975		0.395		201.425	
6		1.415		1.560		202.985	
7			0.695	0.720		203.705	B.M. 2

General rule

Difference in level between the successive points

1st reading - 2nd reading = $\pm$ Rise / Fall.

R.L. of any point = R.L. of the previous point $\pm$ Rise/Fall

Difference in levels for station 2

= 1.30 - 2.015 = - 0.585 (Fall)

For Station 3 = 2.015 - 1.005 = + 1.010 (Rise)

4 = 1.005 - 0.440 = + 0.605 (Rise)

5 = 3.370 - 2.975 = + 0.395 (rise)

6 = 2.975 - 1.415 = + 1.560 (Rise)

7 = 1.415 - 0.695 = + 0.720 (Rise)

R.L. of a station point 2 = 200.00 - 0.585 = 199.415

3 = 199.415 + 1.010 = 200.425

4 = 200.425 + 0.605 = 201.030

5 = 201.030 + 0.395 = 201.425

6 = 201.425 + 1.560 = 202.985

7 = 202.985 + 0.720 = 203.705

Arithmetical check

Σ B.S. = 1.430 + 3.370 = 4.800

Σ F.S. = 0.400 + 0.695 = 1.095

Σ B.S. - Σ F.S. = 4.800 - 1.095 = 3.705

Σ Rise = 1.010 + 0.605 + 0.395 + 1.560 + 0.720 + 4.290

Σ Fall = 0.585

Σ Rise - Σ Fall = 4.290 - 0.585 = 3.705

Last R.L. - First R.L. = 203.705 + 200.00 = 3.705

Σ B.S. - Σ F.S. = Σ Rise - Σ Fall = Last R.L. - First R.L.

Hence OK.

— — — — — — — —

Calculate missing data in levelling survey

Objectives: At the end of this exercise you shall be able to
- **calculate the entries marked (x) from the level book**
- **complete arithemetic check**
- **solve various problems.**

Requirements

Tools / Instruments

- Dumpy level with tripod - 1 No.
- Telescopic leveling staff - 1 No each.
- Peg, hammer - 1 No each

Materials

- Level field book - 1 No.
- Pencil - 1 No.
- Eraser - 1 No.

PROCEDURE

TASK 1: **Compute the entries marked (x) from the level book given below.**

Station	Back Sight	Inter Sight	Fore Sight	Rise	Fall	Reduced Level (RL)
1	1.816	-	-	-	-	33.500
2	-	x	-	-	-	34.105
3	-	x	-	-	-	34.372
4	x	-	x	-	-	35.024
5	-	0.917	-	-	-	35.668
6	-	1.312	-	-	-	x
7	-	-	1.184	-	-	x

Solution :

(i) R.L of Station 1 = 33.500

R.L of Station 2 = 34.105

Rise from station 1 to station 2 = 34.105 - 33.500 = 0.605m.

B.S on station 1 = 1.816

I.S on station 2 = 1.816 - 0.605 = 1.211

(ii) R.L of station 2 = 34.105

R.L of station 3 = 34.372

Rise from station 2 to station 3 = 34.372 - 34.105 = 0.267m.

I.S on station 2 = 1.211

I.S on station 3 = 1.211 - 0.267 = 0.944

(iii) Rise from station 3 to station 4 = 35.024 - 34.372 = 0.652m.

F.S on station 4 = 0.944 - 0.652 = 0.292

Rise from station 4 to station 5 = 35.668 - 35.024 = 0.644m.

B.Sc on station 4 = 0.917 + 0.644 = 1.561

(iv) Comparing I.S on station 5 and I.S and I.S on station 6 Fall from station 5 to station 6.

= 1.312 - 0.917 = 0.395

R.L of station 6 = 35.668 - 0.395 = 35.273.

(v) Compare I.S on station 6 and F.S on station 7, Rise from Station 6 to 7 = 1.312 - 1.184 = 0.128m.

R.L of station 7 = 35.273 + 0.128 = 35.401

(vi) Tabulate the Result.

Station	Readings			Rise	Fall	R.L	Remarks
	B.S	I.S	F.S				
1	1.816					33.500	Starting point
2		1.211		0.605		34.105	
3		0.944		0.267		34.372	
4	1.561		0.292	0.652		35.024	C.O
5		0.917		0.644		35668	
6		1.312			0.395	35.273	
7				0.128		35.401	End point
Total	3.377		1.476	2.296	0.395		

— — — — — — — —

TASK 2 : **Arithmetic check**

Σ B.S - Σ F.S	= Σ Rise - Σ Fall	= Σ Last RL - 1 sr RL
= 3.377 - 1.476	= 2.296 - 0.395	= 35.401 - 33.500
= 1.901	= 1.901	= 1.901

— — — — — — — —

TASK 3: **Solve the excercise and check**

Complete the entries marked (x) from the level book given below.

Station	Readings			Rise	Fall	R.L	Remarks
	B.S	I.S	F.S				
1	3.202						B.M No 1
2	1.883		x		0.550		
3	2.204		2.853				
4	x		1.153				
5		0.420		1.606		653.908	B.M No.2
6	1.245		x		1.092		
7	1.793		0.719				
8	1.557		0.690				
9				x	1.065		B.M No 3

— — — — — — — —

Practice levelling with different instruments

Objectives: At the end of this exercise you shall be able to
- **practice of levelling with Dumpy level instrument**
- **practice of levelling with auto level instrument**
- **practice of levelling with Wye (y) level instrument**
- **practice of levelling with Cookes revevible instrument**
- **practice of levelling with Tilting level instrument.**

Requirements

Tools / Instruments

- Dumpy level - 1 No.
- Autolevel - 1 No.
- Wye level - 1 No.
- Cooke's level - 1 No.
- Tilting level - 1 No.
- Tripod - 1 No.

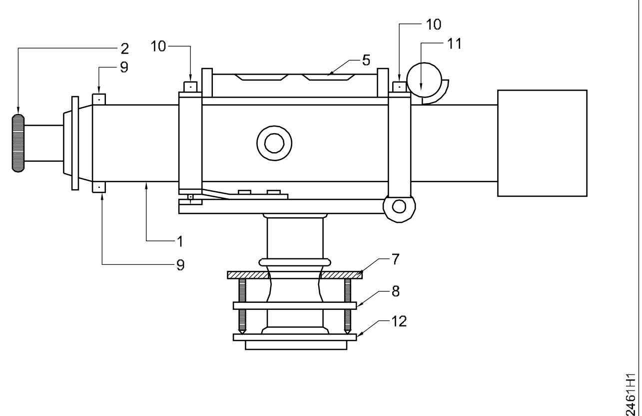
Materials

- Level field book - 1 No.
- Paper - 1 No.
- Pencil - 1 No.
- Eraser - 1 No.

PROCEDURE

TASK 1: **Practice on Dumpy level (Fig 1)**

Fig 1



DUMPY LEVEL

Use of this instrument has been defined in earlier exercise. Any how to have a second thought, view and parts of the object are shown.

Trainee can recall this exercise and practice the same.

1. Telescope, 2. Eyepiece, 3. Ray shade, 4. Objectve end, 5. Longitudinal bubble, 6. Focusing screws, 7. Foot screws, 8. Upper parallel plate (Tribrach), 9. Diapharam adjusting screws, 10. Bubble tube adjusting screws, 11. Transverse bubble tube, 12. Foot plate. (Trivet stage)

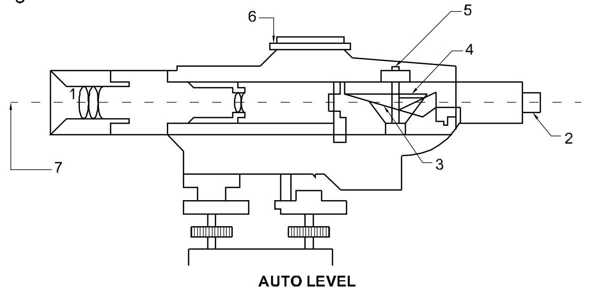
— — — — — — — —

TASK 2: **Practice on Auto level (Fig 2)**

This is also done in earlier exercise. Even though it is practiced in earlier, again trainee can do the same and for his guidence. The view of parts of level is given below.

1. Objective, 2. Eyepiece, 3. Compensator object, 4.Compensator suspension, 5.Magnetic dampering system, 6. Line of sight.

Fig 2



AUTO LEVEL

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TASK 3: **Practice on Wye (y) level (Fig 3)**

The same procedure should be adopted as in dumpy level handling and practice.

The figure shows the parts of wye (y) level.

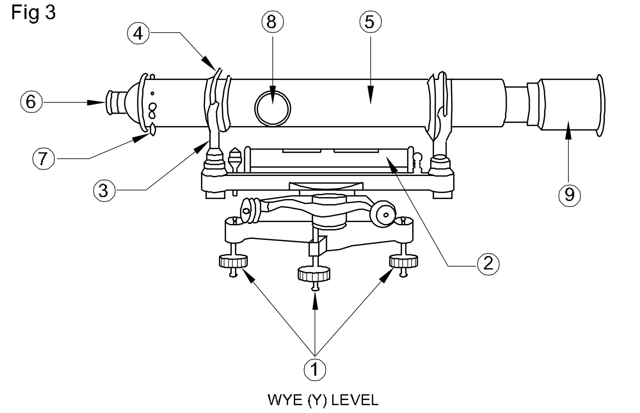
Level can be revolved about its longitudiral axis in the Y"s.

It is very delecate and non-compact in structure.

It has got many loose and open parts - subjected for frictional week.

Wye (Y) Level.

Fig 3



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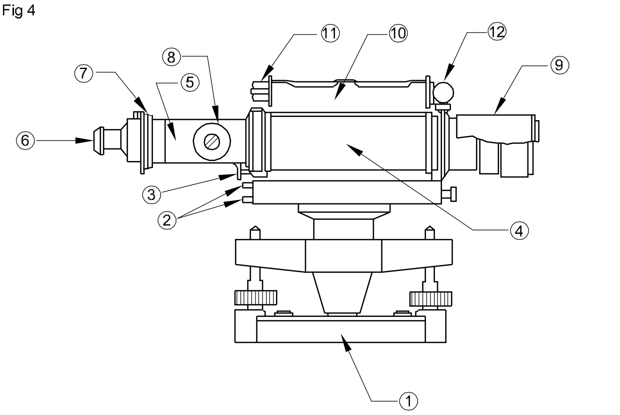
TASK 4: **Practice an Cooke's Reversible level**

Fig 4 Shows the level and parts.

1. Levelling head.	2. Limb nuts.
3. Stop - screw.	4. Socket.
5. Telescope.	6. Eye-Piece.
7. Diaphragm Screws	8. Focussing screw.
9. Ray-shade.	10 level tube.
11. Level tube nuts.	12 Cross-bubble tube.

- It is the combination of dumpy level and wye levels.
- By providing a flange screw it acts for reversibility of the telescope.
- Hence it is named as cookes reversible level.
- By loosening the stop screws the telescope can be rotated about the largitudinal axis.

Fig 4



- Trainees should practice an this level- with guidence of the instructor - following the procedure on done in earlier cases.

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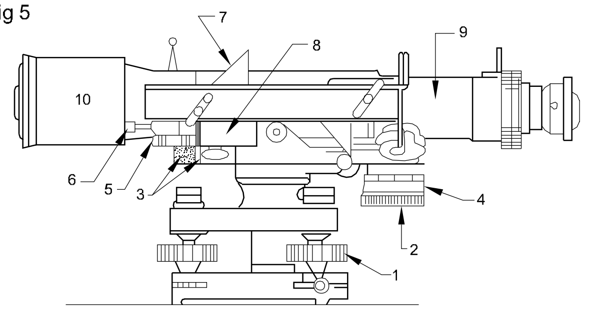
TASK 5: **Practice on tilting level**

Fig 5 shows the instruments and its parts.

1. Levelling screws.	2. Micrometer screw.
3. Cross levels.	4. Scale.
5. Milled head.	6. Clamp screw.
7. Prism.	8. Reflector.
9. Telescope.	10.Ray - shade.

- Telescope of this level has a small motion about horizotal axis just below it.
- In this level the line of collimation x at right angles to the vertical axis of the instrument.

Fig 5



- Trainees should study the parts and its function. Practice leveling as done previously.
- Instructor should guide the trainees for closing practice.

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Fly levelling & check levelling

Objectives : At the end of this exercise you shall be able to
- **explain fly levelling**
- **explain check levelling**
- **explain indirect levelling.**

Requirements

Tools / Instruments

• Dumpy level	- 1 No.
• Tripod	- 1 No.
• Levelling staff	- 1 No.
• Ranging rod	- 1 No.
• Pegs hammer	- 1 No.

Materials

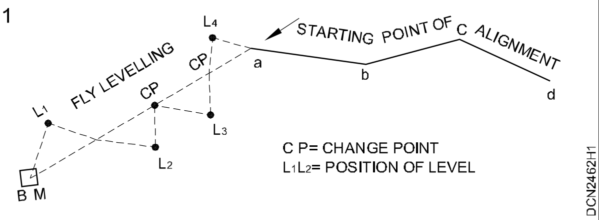
• Level field book	- 1 No.
• Paper	- 1 No.
• Pencil	- 1 No.
• Eraser	- 1 No.

Fly levelling (Fig 1)

When different leveling is done in order to connect a bench mark to the starting point of the alignment of any project, it is called fly levelling is also done to connect the BM to any intermediate point of the aligment for checking the accuracy of the work.

In such leveling, only the back sight and fore-sight readings are taken at every set up of the level and no distances are measured along the direction of levelling. the level should be set up just midway between the BS and the FS.

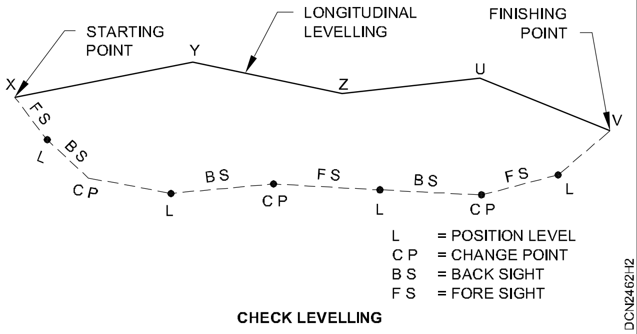
Fig 1



Check levelling (Fig 2)

The fly levelling done at the end of day's work to connect the finished point with the starting point on that particular day is known as check levelling. It is undertaken in order to check the accuracy of the day's work.

Fig 2



Indirect levelling

The method of levelling in which the relative elevations of the points are found out by some indirect observation is known as indirect leveling. It may be carried out in this following three forms:

a Barometric levelling.

b Hypsometry.

c Trigonometrical levelling.

Barometric levelling

The indirect leveling which is conducted to fix the relative elevations of points by the measurement of pressure at these points using barometer is known as barometric levelling.

Barometric levelling is based on the priniciple that the atmospheic pressure varies inversely with the height. This method gives approximate result and so it is adopted in the reconnaissance or in the preliminary survey.

Hypsometry

The method of indirect leveling adopted to find the relatives elevations of points by the measurement boiling points at these points using hypsometer is known as hypsometry. It works based on the principle that boiling points of water decreased at higher altitudes.

Trigonometric levelling

The method of indirect levelling in which the relative elevations of different points are obtained by measuring the vertical angles and horizontal distance is known as trigonometric levelling.

Problem on reduction of levels

Objective: At the end of this exercise you shall be able to
- **compute the reduced levels of points and gradiants of lines on sloping ground.**

Problem in differential levelling

Example

Following consecutive readings were taken on points 1 to 7 along a line
0785, 1.326, 2.538, 3.435, 1.367, 2.328, 1.234, 1.657

The instrument was shifted after the fourth reading and the first reading was taken on BM with RL = 100.00. rule out a page of level book and work out the RL of all points by collimation method and rise and fall method.

Solution

Station		Readings		Height of line of collimation	RL	Remark
	B.S	I.S	F.S			
1	0.785			100.785	100.00	BM
2		1.326			99.459	RL = 100
3		2.538			98.247	
4	1.367		3.435	98.717	97.350	
5		1.238			96.389	
6		1.234			97.483	
7			1.657		97.463	
Total	2.152		5.092			

H.I = R.L + B.S = 100.00 + 0.785 = 100.785

R.L = H.I - I.S / F.S = 100.785 - 1.367 = 99.459

Arithmetical check

B.S - F.S = 02.152 - 5.092 = - 2.940

Last R.L - First R.L = 97.060 - 100.00 = 2.940 Ans.

Solution for the above problem is rise and fall method

Station	Readings			Rise	Fall	RL	Remarks
	B.S	I.S	F.S				
1	0.785					100.00	BM
2		1.326			0.541	99.459	RL=100
3		2.538			1.212	98.247	
4	1.367		3.435		0.897	97.350	CP
5		2.328			0.961	96.389	
6		1.234		1.094		97483	
7			1.657		0.423	97.060	
B	2.152	F.S	5.092	1.094	4.034		

Arithmetical Check

B.S- F.S = 2.152 - 5.092 = - 2940

Rise - Fall = 1.094 - 4.034 = 2.940

Last R.L - First R.L = 97.060 - 100.00 = 2.940 Ans.

Exercise 1

Following staff readings were taken with a level. The instrument having been shifted after the fourth, seventh and tenth readings, R.L of the starting Bm is 150.00 m.

Enter the readings in the level book page and reduce the level by the collimate method and apply the usual checks.

1.420, 0.650, 3.740, 3.830, 0.380, 2.270, 4.640, 0.960, 1.640, 2.840, 4.680 and 4.980.

Longitudinal levelling or profile levelling

Objective: At the end of this exercise you shall be able to
- **determine the reduced levels of points at known distance along the given route.**

Requirements

Tools/Equipments/Instruments

- Auto level with tripod - 1 No.
- Telescope levelling staff - 1 No.
- Angle measuring instrument - 1 No.
- Pegs, Hammer - 1 No.
- T - Square - 1 No.
- Scale set - 1 No.
- Set Squares - 1 No.

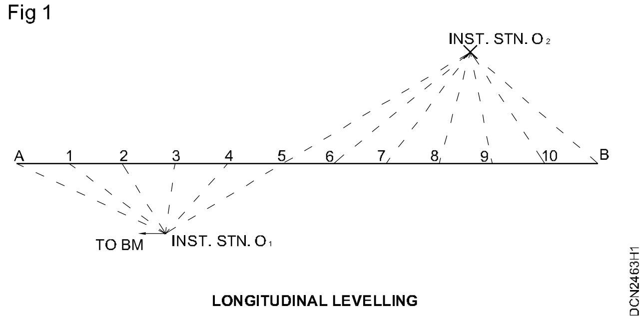
Materials

- Levelling field book, pencil, eraser - 1 No.

PROCEDURE

1 Mark the end points of the centre line AB with ranging rods (Fig 1)

Fig 1



2 Measure the direction of the line using any angular measuring instrument.

3 Measure the length o the line AB using tape and erect pegs at an interval of 200 m along the line AB. Also erect pegs at the points where the ground level changes abruptly.

4 Set up and levels the instrument at a suitable point '01' from where maximum number of observations is possible.

5 Take a BS reading on the bench mark and intermediate sights on the longitudinal section points.

6 Also take a foresight reading on a suitable change point on account of the length of sight being beyond the power of the telescope.

7 Shift the instruments to a suitable position and carry out the temporary adjustments.

8 Take a Bs reading on the change point and continue the process until the last point is reached.

9 Record the readings in the respective colums as soon as they are taken, in the following tabular form.

10 Calculate the reduced levels of the points by height of instrument method.

Work should always commence from a bench mark and should end on a bench mark.

Station	Chainage	Bearing		BS	IS	FS	HI	RL	Remarks
		FB	BB						

Plotting of longitudinal section

Objective: At the end of this exercise you shall be able to
- **prepare the logitudinal section of the route.**

1 Read and interpret the chainages and levels of the route. (Fig 1)

Chainage	Ground level
0	680.245
1	680.335
20	680.395
30	680.525
40	680.665
50	680.775
60	680.965
70	681.210
80	681.370
90	681.645
100	681.840
110	681.930
120	682.015
130	682.115
140	682.240
150	682.345
160	682.400
170	682.520
180	682.640
190	682.730
200	682.825

2 Select a suitable horizontal scale (1.1000) and a veritical scale. (1.100)

3 Draw a horizontal line of length 20cm, equal to the length of the section line.

4 Mark the longitudinal section points on this line and also note the chainages of these points.

5 Note the reduced levels of the ground points against the respective chainages points.

6 Draw another horizontal line parallel and equal to the first, keeping a vertical distance of 2cm, representing the datum line.

7 Choose a suitable datum level 676.000.

(Datum level should be selected in such a way that the length of the ordinate should be between 4cm to 15cm)

8 Mark the longitudinal section points on the datum line.

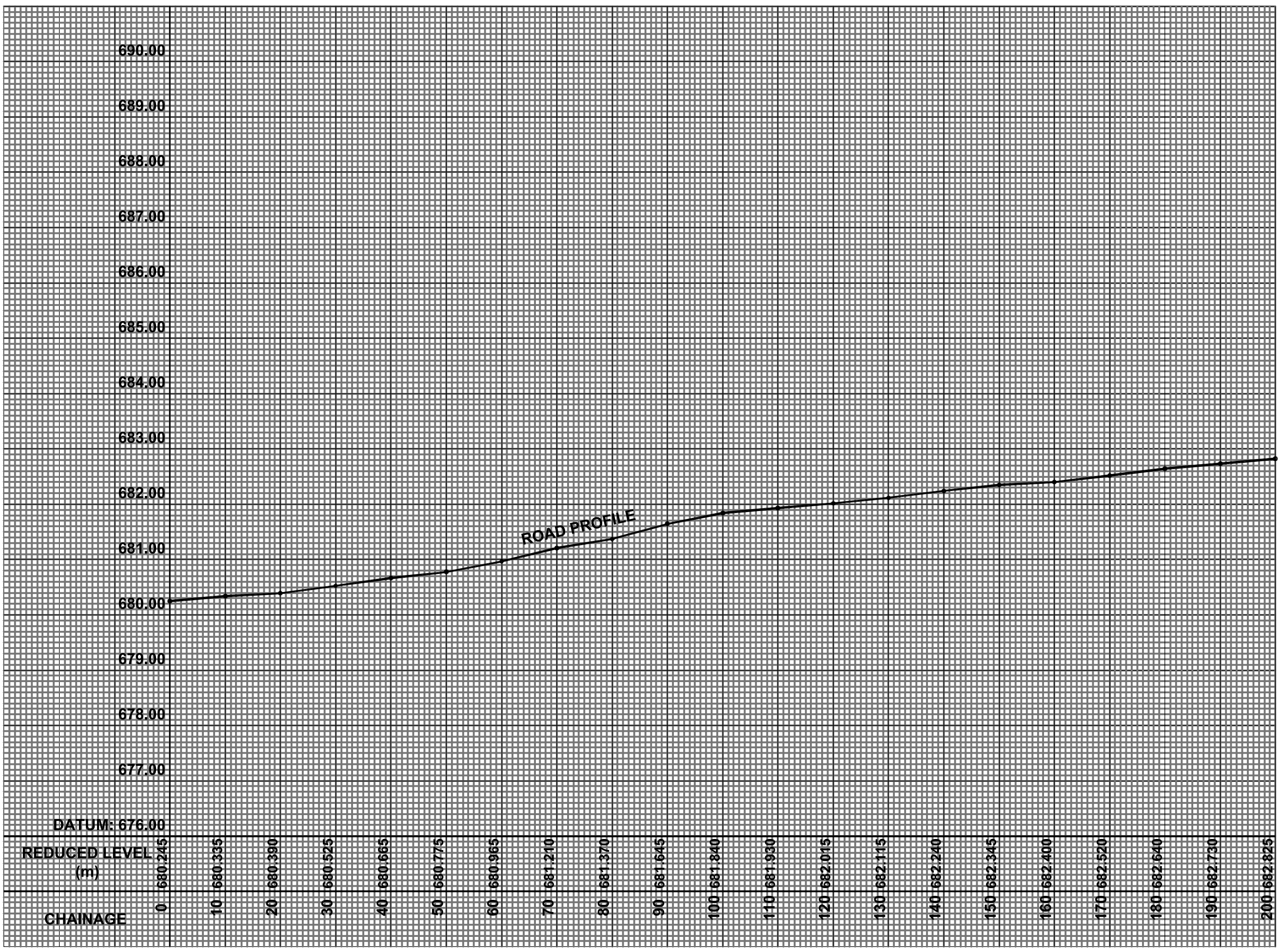
9 Draw vertical lines through these points.

10 Scale off the ground level and mark the ground levels on the respective lines.

11 Join these points by straight lines of get the ouline of the ground surface.

The datum line and ground line are drawn in black and the perpendicular lines in thin blue lines.

Fig 1



SCALE: VERTICAL 1:100
HORIZONTAL 1:1000

CHAINAGE FROM 0Km to 0.20Km

LONGITUDINAL SECTION OF PROPOSED ROUTE

DCN2463X1

Chain survey around a small building by triangulation, and traversing

Objectives: At the end of this exercise you shall be able to
- **chain survey around a given small building by triangulation**
- **chain survey around a given small building by traversing**
- **chain survey around a given small building by traversing using chain angle method.**

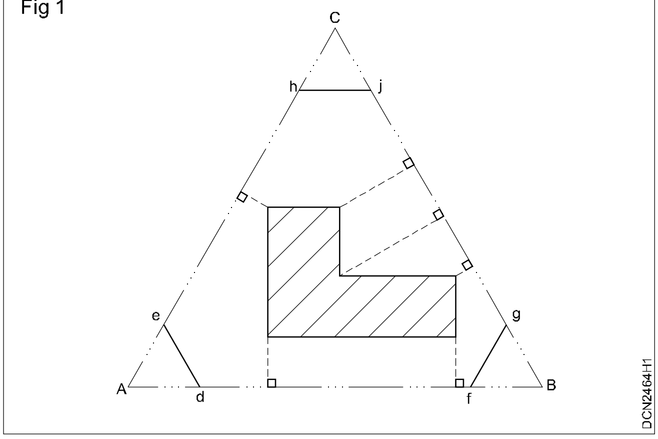
Requirements

Tools/Equipments/Instruments		Materials	
• 30m chain	- 1 No.	• Drawing sheet A3	- 1 No.
• Arrows 40cm long	- 10 No.	• Field note book	- 1 No.
• Ranging rod 2/3m long	- 4 Nos	• Pencil HB	- 1 No.
• 30m steel tape	- 1 No.	• Eraser	- 1 No.
• Cross staff	- 1 No.	• Set of scale	- 1 No.
• Peg 15cm long	- 5 Nos.	• Cello tape	- as reqd.

PROCEDURE

TASK 1: **Chain survey around a given small building by Triangulation. (Fig 1)**

Fig 1



Field work

1 Prepare a rough sketch of the given small building in the field book.

2 Fix the Triangulation station points A,B and C around the building which are intervisible.

3 Prepare reference sketches to station A,B and C.

4 Run the chain line from A to B.

5 Take chainages and offsets of the corners of the building and enter in the field book.

6 Mark a point 'd' & 'f' on the chainline AB to check chain angle.

7 Similarly follow the same procedure for chain lines 'BC' and 'CA'.

8 Also mark a points 'g' and 'j' on the chainline 'BC' and 'e' and 'h' on the chainline 'CA' and fix arrows.

9 Measure checklines distance 'de', 'fg' and 'hj' and enter in the field book.

Office work

10 Draw the chianline 'AB' to a suitable scale on the drawing sheet.

11 Draw an arc of radius equal to AC with centre 'A'.

12 Draw an arc of radius equal to BC with centre 'B'.

13 Denote the point 'c' where the above arcs meet each other.

14 Join AC and BC.

15 Mark the checkline points 'd' and 'f' on the chainline 'AB'.

16 Similarly mark the checkline points g,j and 'h' 'e' on the checkline BC and CA respectively.

17 Measure the checkline distance 'de' , 'hj' and 'gf' in the drawing.

18 Check the measured distance with field measurements for accurancy of the frame work.

19 Plot the chaniages and offsets to all chainlines according to the field book.

20 Join all the offsets point to get the actual shape of the building.

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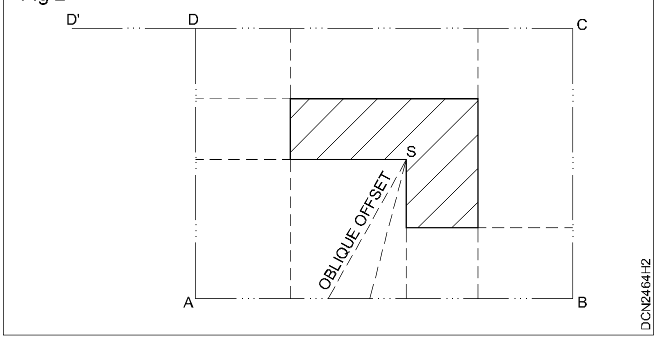
TASK 2: **Chain survey around a given small building by traversing** (Fig 2)

Fig 2



Field work

1 Prepare a rough sketch of the given small building in the field book.

2 Select and fix survey stations ‘A’ and ‘B’ which are intervisible to each other.

3 Prepare reference sketches to station ‘A’ and ‘B’.

4 Run the chain line from A to B for a known length.

5 Note the chainages and measure the offsets.

6 Enter the chainages and offsets in the field book.

7 Locate the interior corner (s) of the building by taking oblique offsets from any two fixed round chainages.

8 Locate the station ‘c’ by sighting station ‘A’ using the cross staff at B.

9 Run the chainline from B to C and locate the details along BC.

10 From station ‘c’ erect perpendicular line ‘CD’ to ‘BC’ which is approximately equal in length ‘AB’.

11 Fix a ranging rod on ‘D’.

12 Fix a cross staff at ‘A’ and sight ‘B’.

13 Move the ranging rod along CD to locate D by sighting through the another Groove in the cross staff at A.

14 Run the chainlines from C to D and locate the details along CD.

15 Simillarly, Run the chianline from D to A, and locate the details along DA.

Office work

16 Draw a chainline ‘AB’ to a suitable scale.

17 Draw a perpendicular line to AB from B for a distance BC to locate ‘C’.

18 Similarly locate the station D and check it from station A.

19 Mark the chainages on the correspond chain lines.

20 Draw the offsets from the correspond chainlines.

21 Connect all the offset points to get the actual outlines of the buildings.

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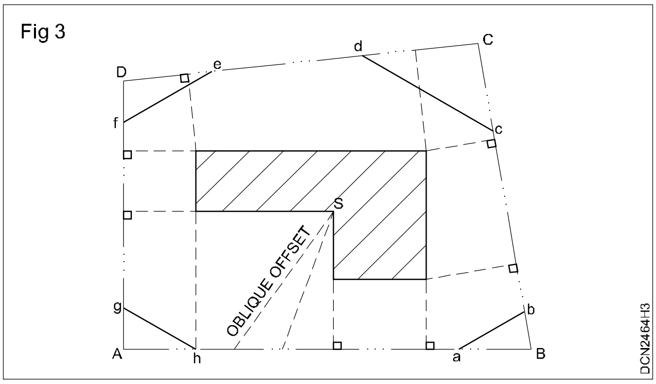
TASK 3: **Chain survey around a given small building by travering using chain angle method** (Fig 3)

Fig 3



Field Work

1 Prepare a rough sketch of the given small building in the field book.

2 Fix survey stations A and B which are intervisible to each other.

3 Prepare reference sketches to the station A and B.

4 Run a chain line from A to B to a known length and note the chainages.

5 Measure the offsets and enter in the field book.

6 Fix a check line point ‘a’ on the chainline ‘AB’ where more than 3m from station B and fix an arrow.

7 According to the ground conditions run the chainline from B to C at any angle using chain angle method.

8 Take chainages and offsets on the chainline BC.

9 Fix a chainline point ‘b’ in the chain line BC.

10 Measure the distance ‘ab’ and enter in the field book.

Use chain angle method when the chain line is not possible to run at right angle to each other.

11 Similarly follow the above procedure for the chain lines CD and Da.

Office work

12 Draw the chain line AB to a suitable scale.

13 Mark the chain lines and offsets on the chainline AB as per field book measurements.

14 Mark the check line point ‘a’ on the chainline AB.

15 Draw an arc with centre as ‘a’ and radii as ‘ab’.

16 Draw another arc with centre as B and radii as ‘Bb’.

17 Denote the checkline point ‘b’ where the above two are intersect each other.

18 Join Bb and prolong it up to station C.

19 Mark the chainages and offsets on the chain line BC.

20 Follow the above procedure for remaining chain lines CD and DA.

— — — — — — — —

Skill Sequence

Preparing reference sketch to stations

Objective: This shall help you to
- **prepare reference sketch to the stations.**

1 Mark the station on the field book as shown in Fig 1.

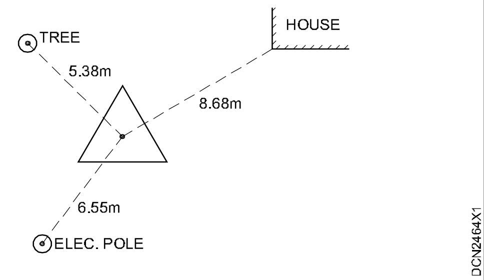
2 Observe the permanent objects which are located around the station.

3 Mark the permenant objects in the field book by drawing rough sketch.

4 Measure the distances.

5 Note the distances in the field book.

Fig 1



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Plotting a chain survey

Objective: This shall help you to
- **plot a chain survey.**

Choose a suitable scale according to the importance of the work.

1 Allocate a margin of 2cm around the paper.

2 Select a suitable position of the baseline.

3 Draw the base line by pencil.

The accuracy of entire framework is mainly depends upon the accuracy of base line.

4 Mark the intermeidate stations on the base line.

5 Similarly complete the frame work.

6 Check the accuracy of the plotted frame work by means of check and tie lines.

7 Mark the chainage of the points along the chain line from where offsets were measured.

8 Draw the perpendicular lines with set square and scale of length of the offsets.

9 Keep the field book side by side in the same direction when plotting.

10 Ink the lines and objects after completing and checking.

11 Write the title of the survey in right hand corner at the bottom of the drawing.

12 Write the scale of the plan below the title.

13 Mark the north direction at the Right hand corner above the drawing.

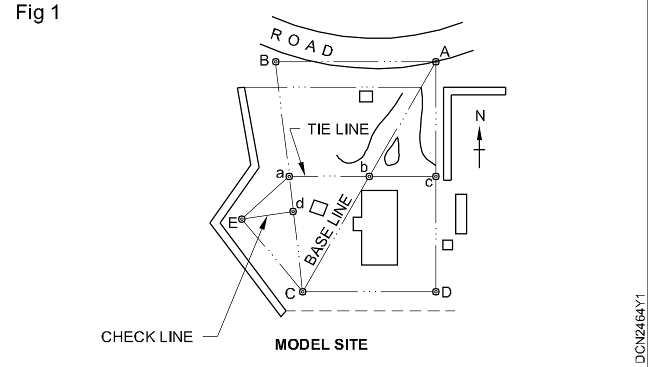
— — — — — — — —

Chain survey around a group of buildings by triangulation and plotting the same

Objectives: At the end of this exercise you shall be able to
- **prepare key plan of the site**
- **select and fix stations, base lines, check lines, tie lines**
- **take reference sketches for stations**
- **run the chain line and locate the details.**

TASK 1: **Prepare key plan of the site (Fig 1)**

Fig 1



Field work

1 Make reconnaissance survey, prepare a rough sketches of the given site in the field book.

— — — — — — — —

TASK 2: **Select and fix stations, base lines, check lines and tie lines (Fig 2)**

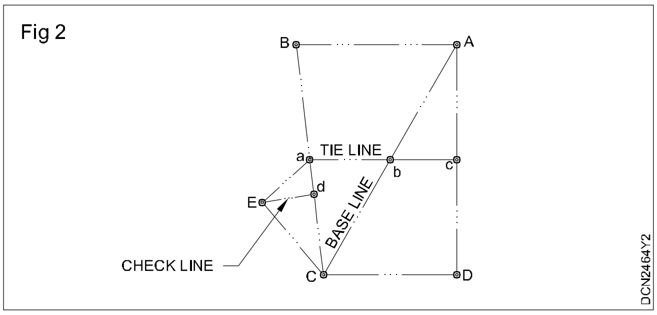
1 Select and mark the main line control stations ABCD and E on the site, to cover the whole area to be surveyed.

2 Select the base line AC.

3 Select and mark the check line Ea, Ed.

4 Select and mark the tie lines ab and bc.

Fig 2



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TASK 3: **Take reference sketches for stations**

1 Take reference sketches for the main stations A,B,C,D and E.

Fig 2 Shows about the selection of main stations, base line, tie line and check line.

— — — — — — — —

TASK 4: **Run the chain line and locate the details**

1 Run the chain and measure the baseline AC and main lines AB, BC, CD, DA and CE enter in the field book.

2 Measure check line Ea and Ed and enter in the field book.

3 Measure Tie lines ab and bc and enter in the field book.

4 From the above measurements draw the frame work joining all the control points to a suitable scale on the drawing sheet.

5 To check the accuary of the frame work, measure check lines Ed and Ea tie lines ab and bc in the plotting and verify with the field measurements.

Limit of permissble error.

6 The maximum permissible error is 1 in 1000 (for example + 1m for every 1000m).

If the error is within the maximum permissible value then adjust the lengths of the sides of the wrong triangles after that continue to locate the interior offset details.

If the error exceeds the permissible value then resurvey the wrong lines to continue the survey.

If there is no error, continuing the survey work, measuring the chainages offsets on both sides of the chain lines and enter in the field book.

7 Plot the details as per field book entries.

8 Print the title of the survey in right hand corner at the bottom or at the top of the drawing thus note the scale of the drawing below it.

9 Mark the north direction in right top corner of the drawing sheet.

10 Determination of area of a plot from plan using planimeter and from field notes.

— — — — — — — —

Indirect contouring by square method

Objectves: At the end of this exercies you shall be able to
- **determine the reduced levels of points**
- **draw the contour lines.**

Requirements

Tools/Equipments/Instruments

- Dumpy level with tripod - 1 No each.
- Ranging rods, leveling staff tape, pegs, hammer - as reqd.
- Scale set, T-square, set squares - 1 No each.
- Plane tabel with tripod trought compass, alidade - 1 No each.
- Hammer, scale set - 1 No each.
- Ranging rods, telescopic levelingstaff - as reqd.
- Prismatic compass with tripod - 1 No each.

Materials

- Drawing sheet, field book, pencil, eraser - 1 No.
- Drawing sheet A2 size - 1 No each.
- Level field book - 1 No.
- Pencil eraser - 1 No.

PROCEDURE

1 Divide the whole area into a number of squares of side 10m. (Fig 1)

2 Erect pegs at corners of these squares.

3 Establish a bench mark near the centre of the area.

4 Set up and level the dumpy level at convenient position.

5 Take a BS reading on the bench mark. Also take staff readings on various points on the corner of the squares.

6 Record the staff readings and corresponding distance in a systematic way.

7 Determine the reduced levels of these points by height of collimation method.

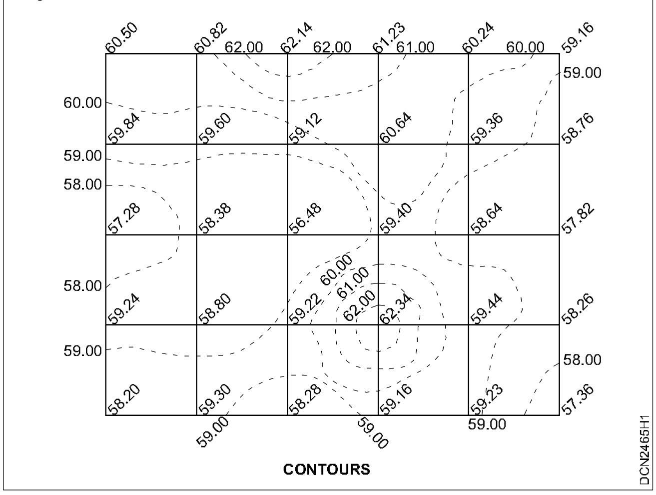
8 Select a suitable scale.

9 Plot the sqaures and write the corresponding reduced levels of corner points.

10 Read and interpret the reduced levels.

11 Decide the contour lines that are to be plotted on the plan from the spot levels.

Fig 1



12 Locate the contour points by arithmethic method interpolation.

13 Join the points of some reduced levels with free line to get the contour lines.

— — — — — — — —

Indirect contouring by plane table and level

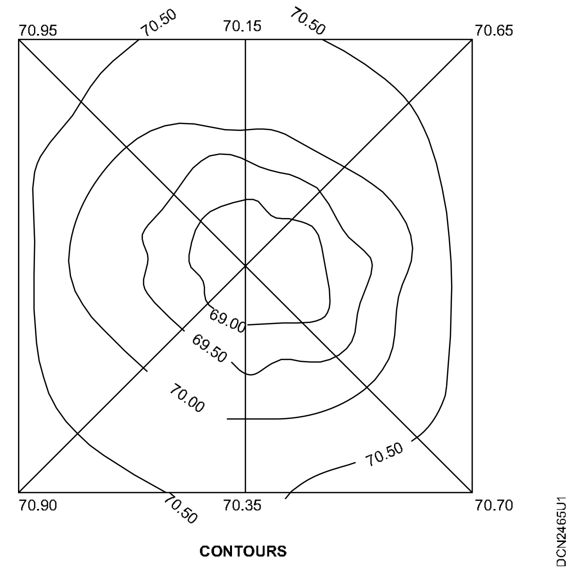
Objectives: At the end of this exercise you shall be able to
- **establish various directions using plane table**
- **determine the reduced level using dumpy level**
- **locate the contour points by interpolation**
- **draw the contour lines**.

1 Follow the steps 1 to 10 of exercise no 2.2.01.

2 Decide the reduced levels of contour points on the radial lines and locate them by interpolation.

3 Join the points of same elevation with free hand line to get the contour lines. (Fig 1)

Fig 1



CONTOURS

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Indirect contouring by cross section

Objectives: At the end of this exercise you shall be able to
- **determine the reduced levels of points**
- **interpolate the contour points**
- **draw the contour lines.**

1 Mark the centre line of the road with ranging rod. (Fig 1)

2 Divide the centre line into different segment according to direction.

3 Measure the direction of these segments using compass.

4 Measuring the length of the line using tape and also mark pegs at an intervel of 20m along the centre line.

5 Erect cross section lines at the longitudinal section points.

6 Mark points at an interval of 5m along these cross section lines.

7 Establish a bench mark near the starting point.

8 Set up and level the dumpy level at a convenient position.

9 Take a BS readings on the bench mark. Also take staff readings at various cross section points.

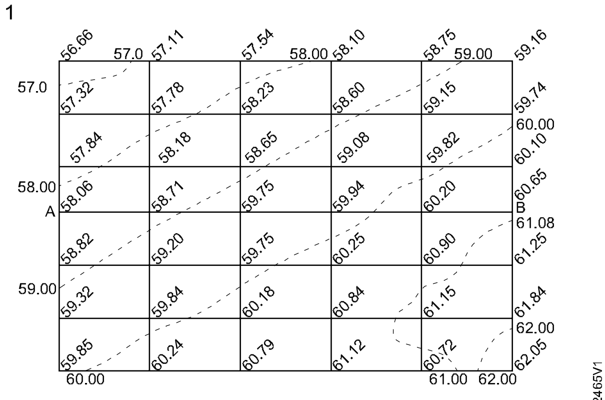
10 Record the staff readings and distance in the respective columns as soon as they are taken.

11 Take FS reading on change point when visibility is being obstructed due to long sight.

12 Continue the work up to the last point and end the work on a bench mark.

13 Compute the reduced levels of the points by height of collimation method.

Fig 1



INDIRECT CONTOURING BY CROSS-SECTION

14 Select a suitable scale.

15 Plot the section and write the corresponding reduced levels of longitudinal as well as cross section points.

16 Read and interpret the reduced levels and decided the contour lines that are to be plotted on the plan from the spot levels.

17 Locate the contour points by arithmetic method of interpolation.

18 Join the points of same elevations by wavy lines to get the contour lines.

— — — — — — — —

Indirect contouring by radial line using plane table

Objectives: At the end of this exercise you shall be able to
- **determine the reduced level using telescope alidade**
- **interpolate the contour points**
- **draw the contour lines.**

1 Select a suitable point ‘0’ at the centre of the area.

2 Centre and level the plane table over the point ‘0’.

3 Draw the direction of north on the drawing using trough compass.

4 With telescope alidade pivoting the point ‘0’ draw a line and with line of sight horizontal, take staff readings at the end point of this line i.e top hair reading, central hair reading and bottom hair reading.

5 Similarly draw a number of radial lines and take respective staff readings.

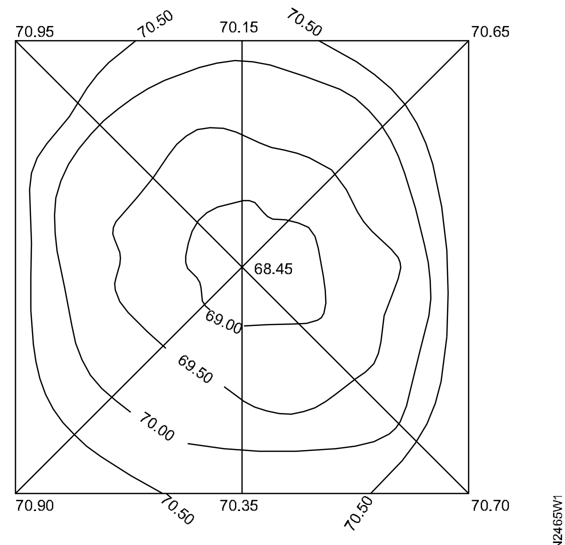
6 Take a BS readings on the bench mark.

7 Also take staff reading on the point ‘0’.

8 Calculate the distance using the formula D=100S, where D is the horizontal distance between the centre point ‘0’ and the staff station and S is the difference of the top and bottom hair staff reading.

9 Calculate the HI and find the reduced levels of centre point and end points of the radial lines. Reduced level of point = HI center hair reading.

Fig 1



INDIRECT CONTOURING BY RADIAL LINE

10 Decide the reduced levels of contour points on the radial lines and locate them by interpolation.

11 Join the points of same elevation with free hand line to set the contour lines. (Fig 1)

— — — — — — — —

Direct contouring by radial line using compass

Objectives: At the end of this exercise you shall be able to
- **establish various direction using compass**
- **locate the contour points**
- **draw the contour lines.**

1 Select a point at the centre of the area. (Fig 1)

2 Set up the compass over this point and carry out the temporary adjustments.

3 Establish a number of radial lines at an angular interval of 60.

4 Measure the length of these radial lines using tape.

5 Set up and level the dumpy level near the centre point.

6 Establish a temporary bench mark near the centre point.

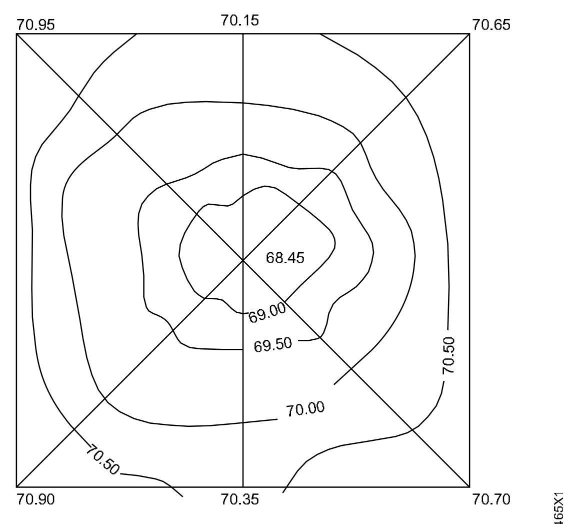
7 Take a BS readings on the beach mark.

8 Also take staff readings t centre point and at the ends of each radial line.

9 Calculate the reduced levels of these points.

10 Fix the reduced levels of points that are to be located on each radial line.

Fig 1



DIRECT CONTOURING BY RADIAL LINE

11 Calculate the staff reading required to locate a particular contour point i.e staff reading = Height of instrument - reduced level of contour.

12 Hold staff on an estimated position on the radial line and take the staff reading. Move the staff forward or backward till the required staff reading is obtained.

13 Mark the point with a peg and measure the distance of the point from the centre.

14 Similarly mark various contour points on each radial line.

15 Repeat this process on all times.

16 The points are then plotted on the plan to a suitable scale.

17 The contour lines are dran by joining the corresponding points by dotted curved lines.

— — — — — — — —

Indirect contouring by compass and level

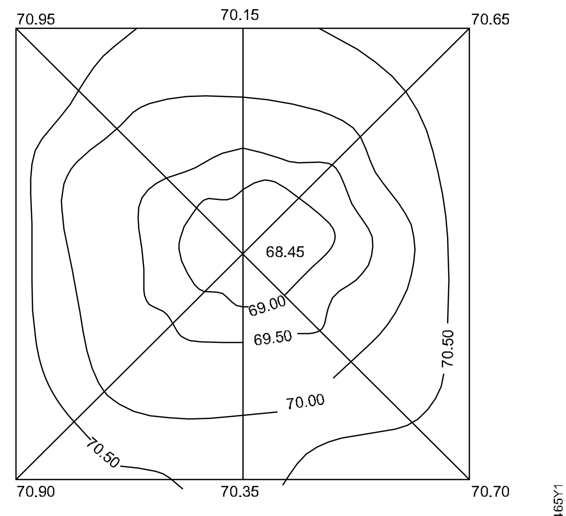
Objectives: At the end of this exercise you shall be able to
- **establish the directions using compass**
- **draw the contour lines.**

1 Follow the steps 1 to 10 of exercise no 2.2.06.

2 Locate the contour points on the radial line by interpolation.

3 Join the points of same reduced levels to get the contour lines. (Fig 1)

Fig 1



DIRECT CONTOURING BY RADIAL LINE

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Map reading of Contours and tripography map

Objectve: At the end of this exercies you shall be able to
- **reading a map.**

Requirements

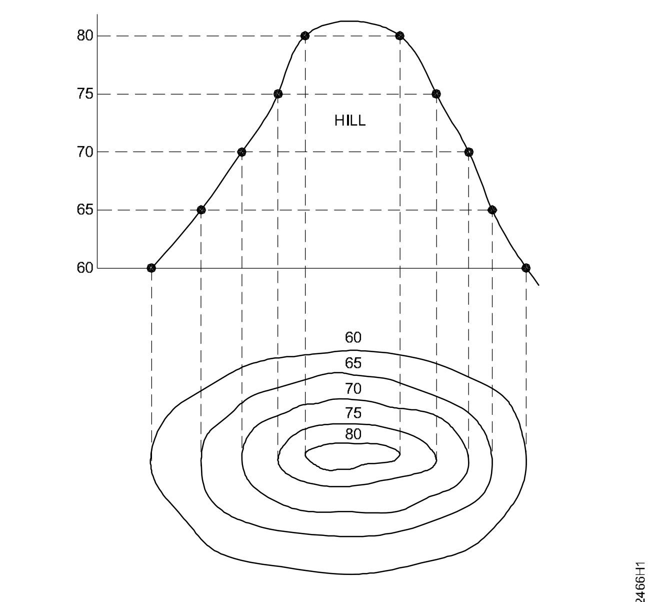
Tools/Equipments/Instruments	Materials	
• Nil	• Map	- 1 No.

Reading a map of contour

In a map,

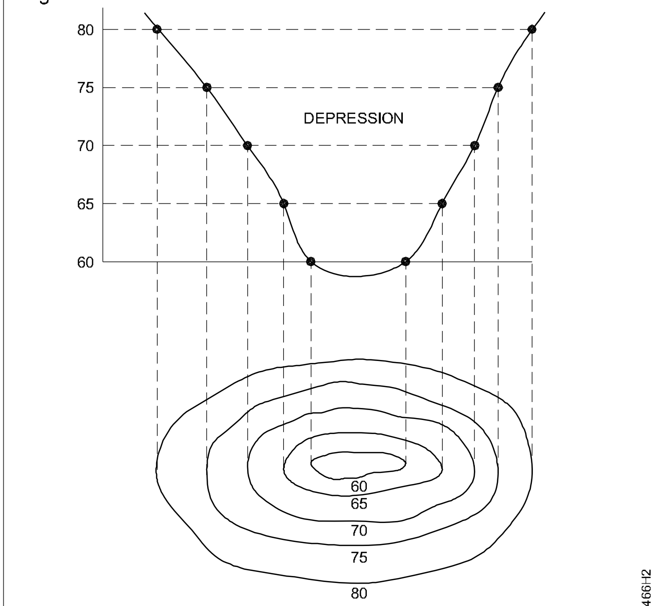
- In a series of closed contour lines, if the higher values are inside (as in Fig 1), It represents a Hill.

Fig 1



HILL

Fig 2



VALLEY

- In a series of closed contour lines, if the higher valure are outsides (as in Fig 2) it indicates a Depression.
- In a series of contour lines, if the higher values are inside the a bend or loop, it represents a Ridge line. (Fig .3)
- In a series of contour lines if the higher values are out side the bend it indicates a valley. (Fig 4)
- In a series of contour lines, if the lines are not merging or crossing one another represents a over hanging cliff. (Fig 5)
- In a series of contour lines if the contour lines are not run into one another, except in the case of a vertical cliff. (Fig 6)

Fig 3

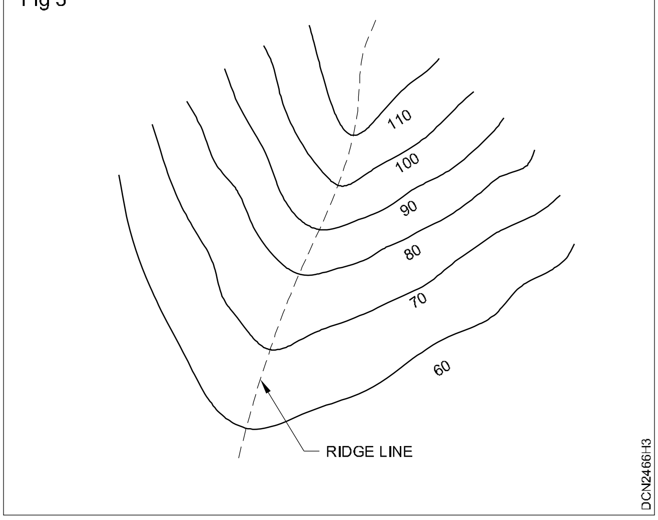


Fig 4

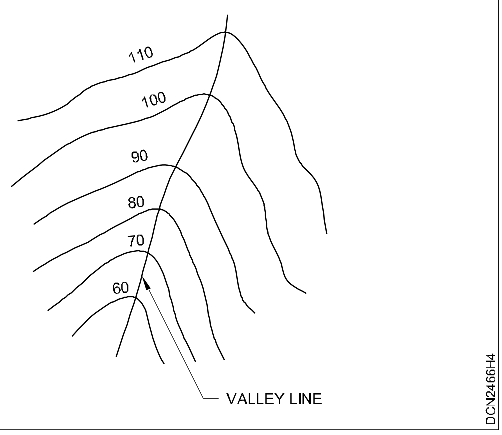


Fig 6

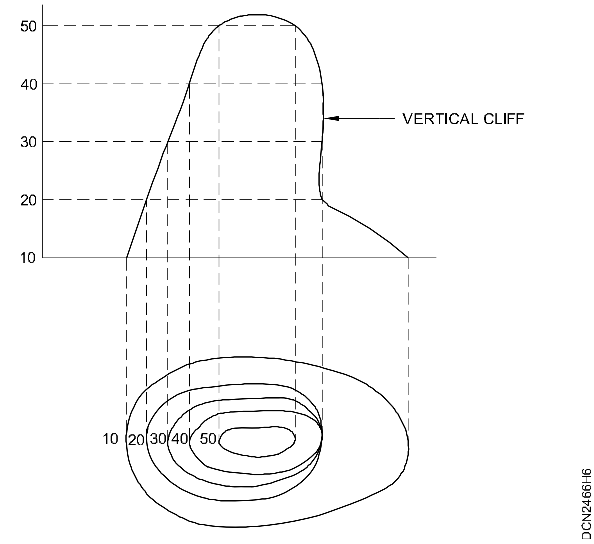
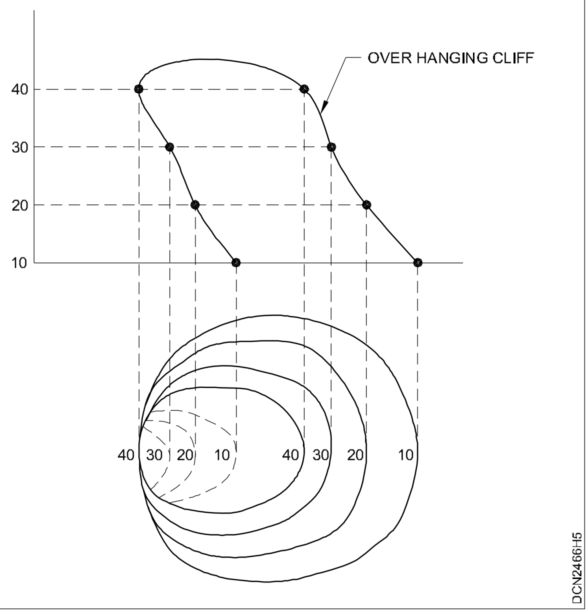
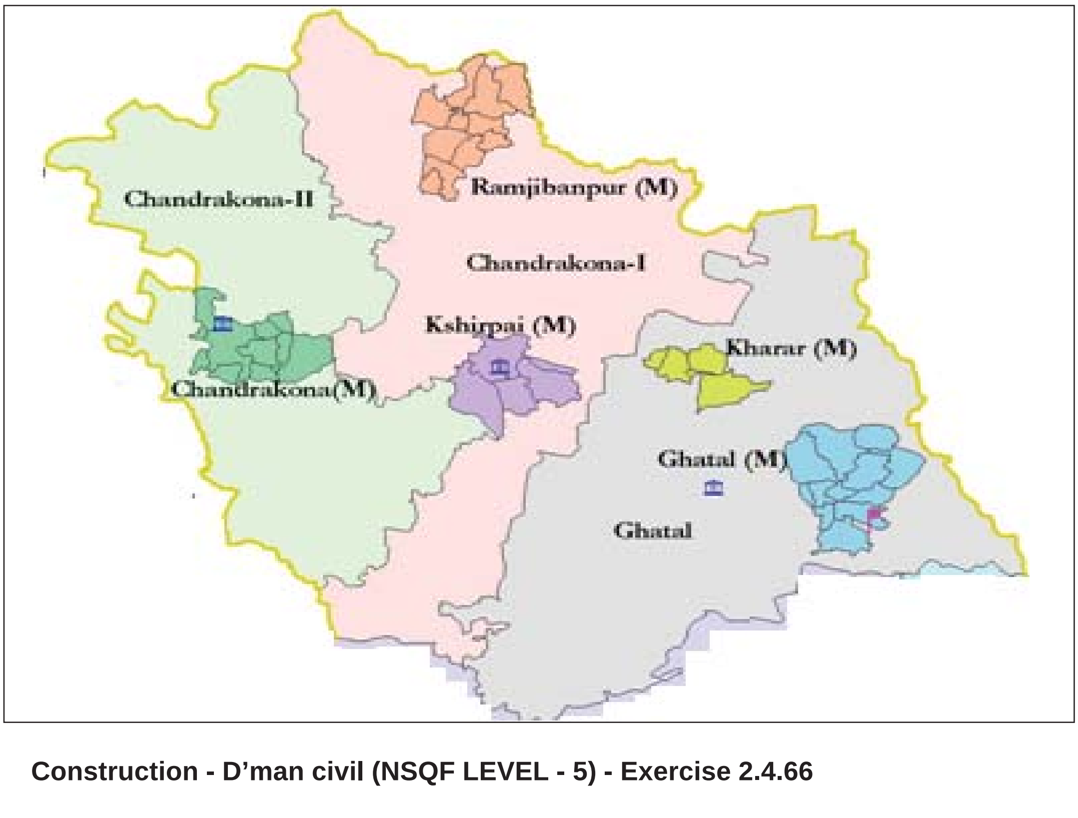


Fig 5





Trignometric levelling - base of the object accessible (object vertical)

Objectves: At the end of this exercies you shall be able to
- **operate the instrument**
- **measure the distance between base of the vertical object and the instrument station**
- **find the reduced level of the point Y at the top of the building.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No.
- Plumb bob - 1 No.
- Levelling staff - 1 No.
- Hammer - 1 No.

Materials

- White paper - 1 No.
- Measuring tape - 1 No.
- Peg - 1 No.

PROCEDURE

1 Select an instrument station 'O' on a fairly open ground at a reasonable distance from the base of 'Y'. (Fig 1)

2 Set up the instrument at 'O'.

3 Perform all the temporary adjustments.

4 Set the vertical verneir 0-0.

5 Direct the telescope to the staff vertically hold at the given BM (check altitude bubble).

6 Clamp both plats. Exactly bisect the staff.

7 Observe the staff reading (S) and enter it in the table.

8 Loosen the lower clamp turn the telescope towards 'Y'.

9 Lock lower clamp , tighten the vertical circle clamping screw.

10 Bisect 'Y' exactly using tangent of vertical circle clamping screw and lower screw.

11 Observe vertical angle (q) in both scales and enter it in the respective columns. (check altitude bubble).

12 Change face of the instrument and observe the vertical angle to 'Y'.

13 Average of the angles in C and D scale is the vertical angle. (q).

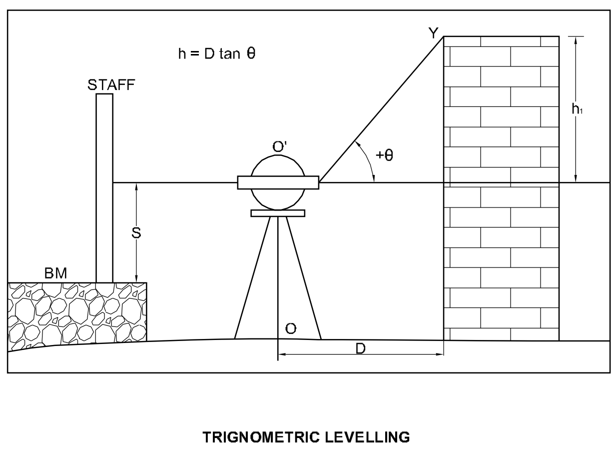
14 Measure the horizontal distance (D) between the instrument station 'O' and base of the point 'Y' using tape.

15 Find reduced level of the point 'Y'.

RL of Y = RL of BM + S + h1

If staff reading observed is different, take average of the staff readings as 'S'.

Fig 1



TRIGNOMETRIC LEVELLING

Tabular column for trignometric levelling

Instru-ment	Sight to	Length (m)	Face Left											Face Right											Average vertical angle			Rough sketch
			C			D		Mean			Vertical angle			C			D		Mean			Vertical angle						
			°	'	"	'	"	°	'	"	°	'	"	°	'	"	'	"	°	'	"	°	'	"	°	'	"	

Prepare a road map (open traverse)

Objective : At the end of thsi exercise you shall be able to
- **prepare a road map with details along the road.**

Requirements

Tools/Equipments/Instruments

- Prismatice compass - 1 No,
- Ranging rods - as reqd.
- Wooden pegs - as reqd
- Chain and tape - 30m - 1 No.
- Eraser - 1 No.
- Set of scale - 1 Set.

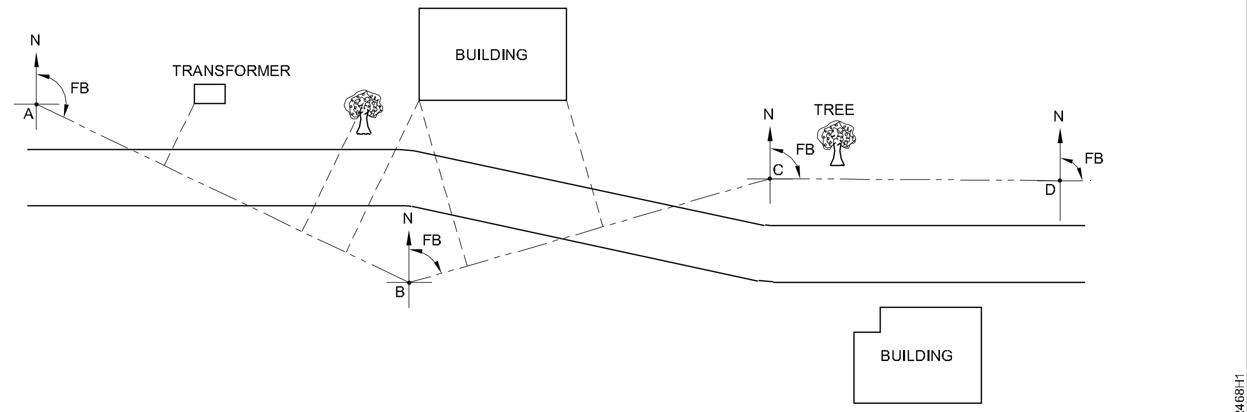
Materials

- Drawing sheet A3 - 1 No.
- Field book - 1 No.
- Pencil HB - 1 No.
- Arrows - 10 Nos.
- Cello tape - 1 roll.

PROCEDURE

TASK 1: **Prepare a road map with details along the road**

Fig 1



PLAN SHOWING THE ROAD PROFILE

1 Make a visit to the existing road for the purpose of identifying the objects and special features located on the sides of road to be surveyed. (Fig 1)

2 Select an instrument station 'A' at the beginning of road which gives maximum details for mapping.

3 Select the other stations B,C,D etc.

4 Setup the instrument over the selected station 'A'.

5 Fix a ranging rod at station 'B'.

6 Sight station 'B' and take the bearing and note it in the field book.

7 Run the chain along 'AB' and take offsets of the objects on both sides of the road.

8 Observations should be recorded in the field book.

9 Shift the instruments to station 'B'.

10 Take the bearing by back sighting 'A'.

11 Check it with the fore bearings of 'AB'.

12 Fix a ranging rod at 'C'.

13 Sight station 'C' and take the bearing of 'BC' and enter it.

14 Run the chain along BC and take offsets of objects on both sides of the road.

15 All the bearings should be entered in the field book as per the table given below.

16 The offsets taken for different objects are entered as a chain survey field book.

17 Plot the road map based on the bearings and offsets.

Run the survey line along the sides of the road only, to avoid traffic problems.

Model tabulation

Instrument at	Sight to	Distance in metre	Bearing	Remarks
A	B			AB
B	A			BA
	C			BC
C	B			CB
	D			CD

— — — — — — — —

Road project

Objectives : At the end of this exercise you shall be able to
- **conduct map study**
- **conduct reconnaissance survey**
- **conduct preliminary survey**
- **conduct location survey.**

TASK 1: **Map study**

1 Mark the various possible routes on the map connecting the terminal points observing the criteria of route selection.

2 Study well various routes by conducting reconnaisance survey.

— — — — — — — —

TASK 2: **Reconnaissance survey**

1 Measure the magnetic bearing of the lines of the aligment by a prismatic compass and note in the field book.

2 Measure the distance along the alignment approximately by pacing.

3 Note the objects and nature of the ground on both sides of the alignment upto 50m on the field book.

4 Avoid obstacles like religious places or valuable structure if any while fixing aligment.

5 Avoid crossing the alignment obliquely over the river by diverting the alignment suitably.

6 Note all other important points like the railway crossing, cancel crossing, etc.

7 Collect the HFL (High Flood Level) ever attained and the discharge records for the last few year from the appropriate authorities to design the culverts and bridges.

8 Prepare preliminary records of properties eligible for compensation.

— — — — — — — —

TASK 3: **Preliminary survey**

1 After fixing suitable alignment construct a pillar at the starting point of the alignment of the road which is already fixed by reconnaissance survey.

2 Conduct by fly level to connect the near by GTS bench mark with the starting point of the road project.

3 Conduct a prismatic compass survey or plane table survey to prepare route survey map covering about 50M on both sides of the alignment.

4 Conduct a longitudinal map levelling along the aligment at regular interval (say 20 or 40m).

5 Take cross sections at regular intervals. (say 100m)

6 Establish permanent bench marks at suitable places along the alignment for future reference.

7 Take cross sections of the rivers, etc accurately.

8 Prepare the following drawings:

   a Route survey map.

   b Longitudinal map section with formation levels.

   c Cross sections with formation width and sole slope.

   d Contour map of the strip of land along alignment.

   e Design of curves with setting out tables.

   f Mass diagram for the earthwork.

— — — — — — — —

TASK 4 : **Location survey**

1 Fix the centre line of the road after selecting the most economical alignment by stout pegs or pillars at intervals of 30m.

2 Mark the total land width required by pillars at regulars intervals. (say 30m)

3 Mark tangent points and intersection points of the curves by pillars.

— — — — — — — —

TASK 5 : **Construction survey**

1 After location survey retrace the centre line shown on the plan and referencing centering points on the curve.

2 Check bench marks, running centerline levels over the retraced lines.

3 Take elevations at all stations, at all breaks on the ground and at other points where it is necessary to take cross section for volume granitites.

4 Set slope stakes and grade stakes.

5 Set stakes for complete layout of culverts and bridges.

6 Set out curves.

7 Report and make advantageous changes, if any in line grade or minor adjustment of the drainage structure.

8 Reset the stakes that have been destroyed as the progresses.

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Familiarization and field work of theodolite

Objectives: At the end of this exercise you shall be able to
- **unplace and place theodolite from and to the theodolite box respectively**
- **fix and unfix theodolite to and from the tripod respectively**
- **identify parts of the theodolite.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No each.
- Plumb bob - 1 No.
- Peg - 1 No.
- Hammer - 1 No.

Materials

- White paper - 1 No.

PROCEDURE

- Tripod is placed on a firm ground at a convenient height with the tripod legs set well apart.
- Set two legs of the tripod firmly into the ground.
- Adjust the third leg in circumferential directions so that the top of the tripod becomes approximately horizontal.
- Open the instrument box.
- Note how the instrument is placed in the box.
- Take out the instrument from the box. Hold it with right hand.
- Turning the trivet in clockwise direction, screw the instrument firmly on the tripod.
- Study parts of the theodolite.
- Remove the theodolite from the tripod by turning the trivet in anticlockwise direction.
- Loosen all screws.
- Place the theodolite in the box safely.

— — — — — — — —

Temporary adjustments of theodolite

Objectives: At the end of this exercise you shall be able to
- **setup the theodolite**
- **level the theodolite**
- **eliminate parallax.**

Setting up

Approximate levelling

1 Fix an instrument station on the ground.

2 Tripod is placed over the station at a convenient height with the tripod legs set well apart.

3 Set two legs firmly into the ground.

4 Adjust the third leg so that the top of the tripod becomes approximately level (level can be checked by eye judgement).

Fixing the instrument

1 Fix the theodolite over the tripod head.

2 Suspend a plumb bob from the hook attached to the vertical axis of the theodolite.

Centering

One of the legs of the tripod moved radially to bring the plumb bob exactly over the station.

The leg is pushed into the ground.

Levelling up

1 Bring the plate level tube parallel to the line joining any two foot screws.

2 Bring the bubbles to the centre of its run by moving these two foot screws either inwards of outwards.

3 Turn the telescope through 90^0 so that the bubble tube lies over the third foot screw.

4 Turn this screw inward or outward and bring the bubble of the plate level tube to the centre of its run.

5 Turn the telescope to its original position by rotating through 90° and check the bubble. Repeat the steps 2 to 4 till bubble is central in both the positions of the bubble tube.

Elimination of parallax

Focussing the eyepiece

1 Remove the lid of the telescope.

2 Hold a white paper in front of the telescope (or direct the telescope to the sky) and move eye piece inwards or outwards till the cross hairs are seen distinct and sharp.

Focussing the object glass

1 Direct the telescope towards the object.

2 The focusing screw is turned until the object appear clear and sharp.

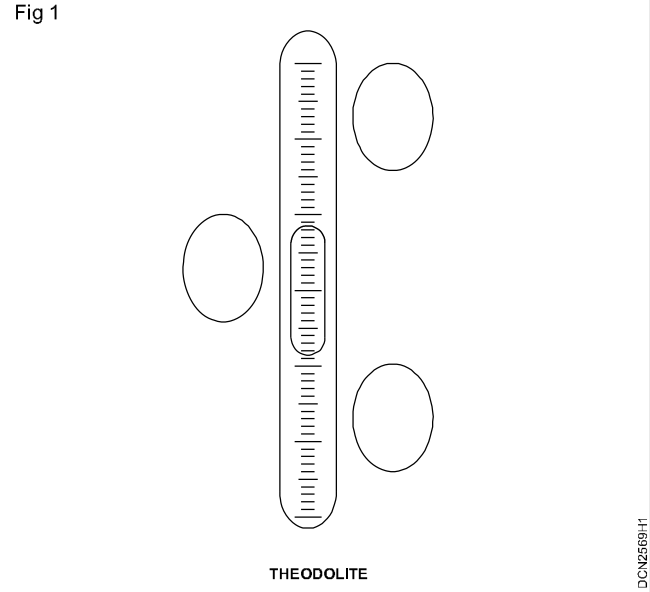
— — — — — — — —

Permanent adjustment 1 (plate level test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axis**
- **perform the plate level test**
- **adjust the instrument.**

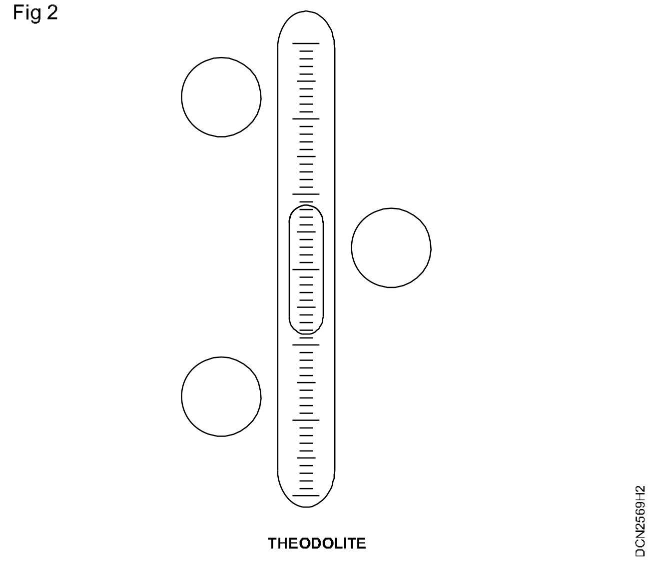
- Fix an instrument station O.
- Set up the instrument over the station O with telescope in normal condition (vertical circle left of the observer and bubble is up).
- Perform all the temporary adjustments.
- Bring the plate bubble parallel to any two foot screws and make the bubbles to its centre of the run (Fig 1.)

Fig 1



- Revolve the bubble in the horizontal plane so that the end is reversed. (Fig 2)

Fig 2



- If the bubble is out of the centre, count the number of graduations on the bubble tube.

Adjustment

- Correct half the error by means of pair of leveling screw and the remaining correction is made by means of capstan headed screw provided at the end of the level tube.

Check

- Follow steps 4 to 6 and check whether bubble remains central in two positions and do adjustment if necessary till bubble remains central in any position.

— — — — — — — —

Permanent adjustment 2 (cross hair ring test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the cross hair ring test**
- **adjust the instrument**.

1 Fix an instrument station O.

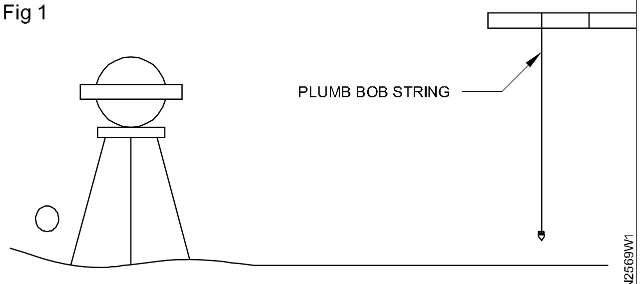
2 Set up the instrument over the station O with telescope in normal condition. (vertical circle left of the observer and bubbles is up)

3 Perform all the temporary adjustments.

4 Hang a plumb bob at a reasonable distance from the instrument.

5 Direct the telescope and the string of the plumb bob is bisected. (Fig 1)

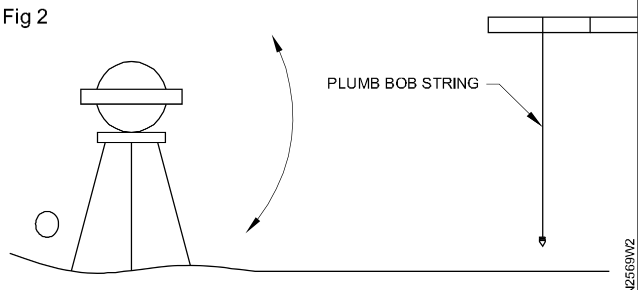
Fig 1



CROSS HAIR RING TEST

6 Rotate the telescope in the vertical plane. (Fig 2)

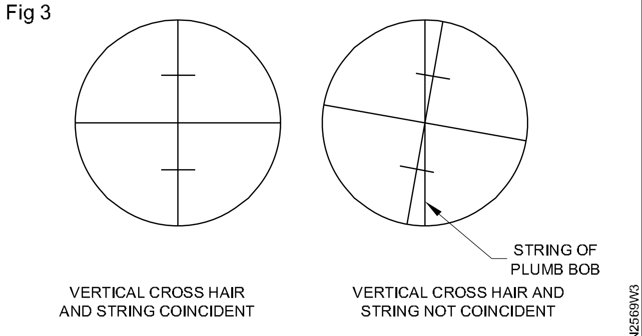
Fig 2



CROSS HAIR RING TEST

7 If the relative motion of the string is not along the vertical cross hair the instrument needs adjustment. (Fig 3)

Fig 3



CROSS HAIR RING TEST

Adjustment

- Loosen all four capstan screws on the cross - hair ring, Rotate the ring carefully so that the image of the string and the vertical cross hair coincide.
- The screws are then tightened.

Check

- Follow step 5 to 7 and if necessary adjustment steps till both vertical cross hair and string of plumb bob remains coincident.

Permanent adjustment 3 (collimation in azimuth test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the collimation in azimuth test**
- **adjust the instrument.**

- Fix an instrument station O.
- Set up the instrument over the station O with telescope in normal condition in midway of an open field (should have an unobstructed view of 200m).
- Perform all the temporary adjustments.
- Sight a point, A. (Fig 1)
- Transit the telescope and fix another point, B_1. (Fig 2)
- Change face of the instrument and again bisect the first point, A. (Fig 3)
- Transit the telescope. If the line of sight passes through the already fixed point, then the line of sight is perpendicular to the horizontal axis.
- If not fix the new point, B_2. (Fig 4)
- Measure the distance between points.
- Measure a quarter of the distance from the last point. (Fig 5)

Fig 1

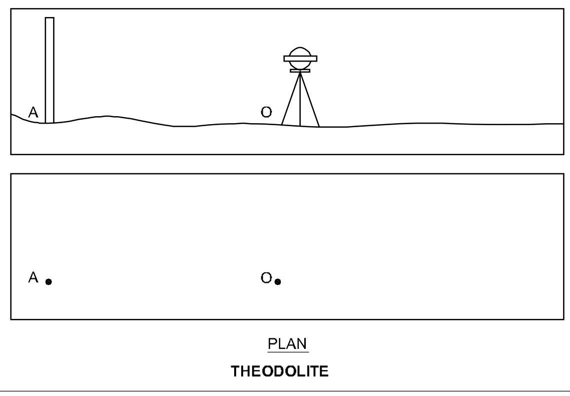


Fig 2

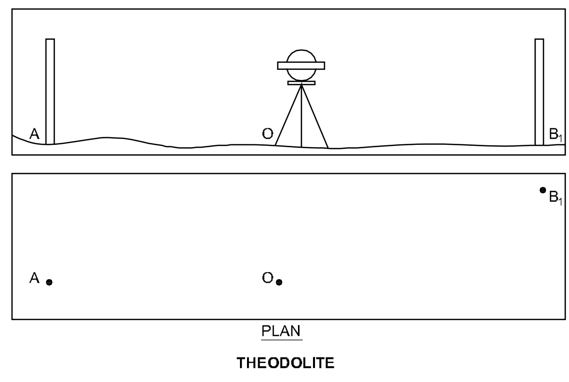


Fig 3

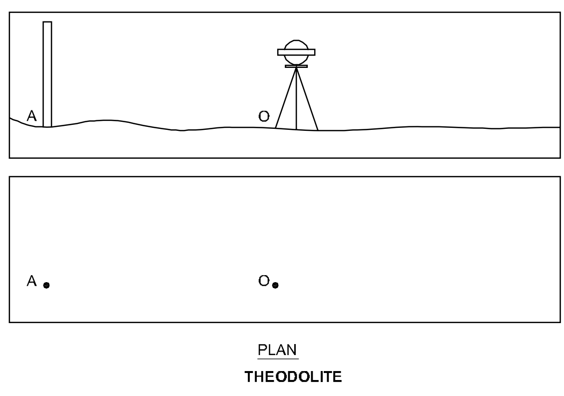


Fig 4

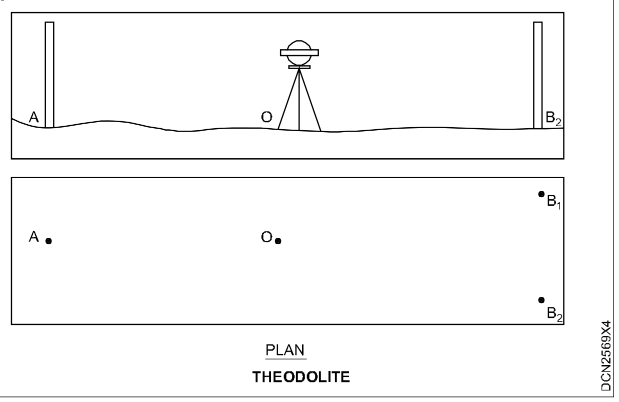
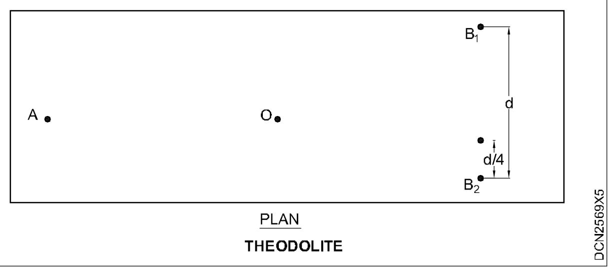


Fig 5



Adjustment

- Adjust the vertical hair by means of two opposite capstan headed screws so that the line of sight passes through the quarter distance.

Check

- Repeat the test till line of sight pass through the same point in both face observations.

— — — — — — — —

Permanent adjustment 4 (spire test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the spire test**
- **adjust the instrument.**

- Fix up the instrument near to any tall object, at an instrument station O.
- Set up the instrument over the station O with telescoope in normal condition.
- Perform all the temporary adjustments.
- Sight a well defined point, S. (Fig 1)
- Lower the telescope and find a point on the ground, S'
- Change face of the instrument and again sight S.
- Lower the telescope. (Fig 2)
- If 'S' is sighted then the telescope is in adjustment. If not, instrument needs adjustment.

Fig 1

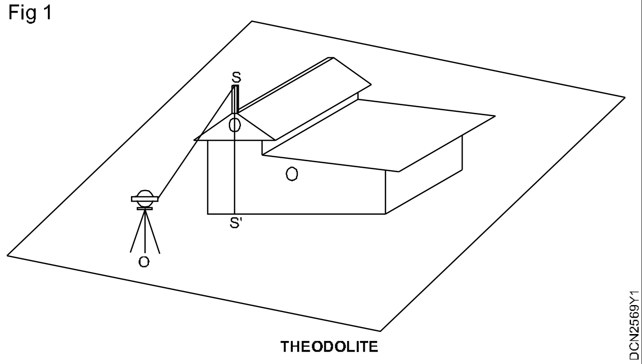


Fig 3

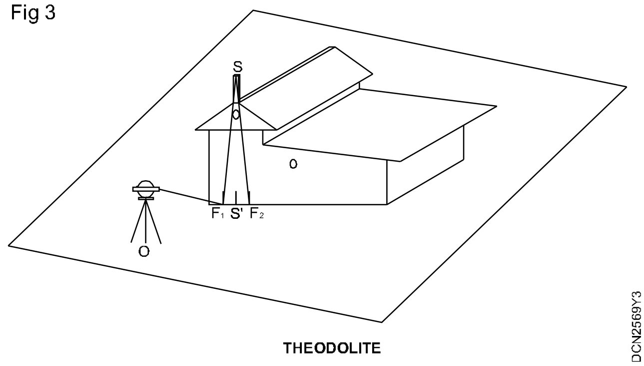


Fig 2

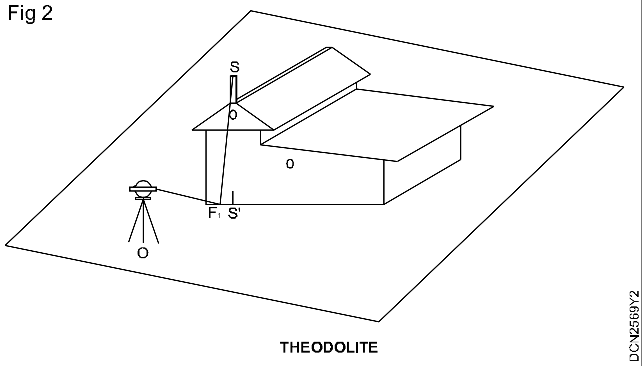
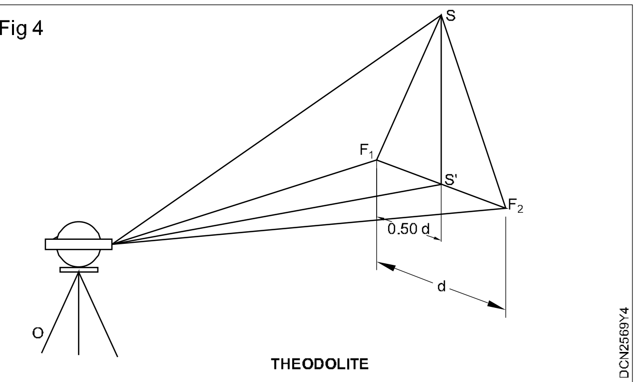


Fig 4



Adjustment

- Distance between foot distance is measured and mark half the midway between the distance, 'S' (F1 & F2 are the erroneous points sighted in face left and face right observations respectively). (Fig 3)
- Centre point is bisected and raise the telescope to sight the point, S.
- One end of the horizontal axis is moved with the adjusting screw until the line of sight bisects the point, S. (Fig 4)

Check

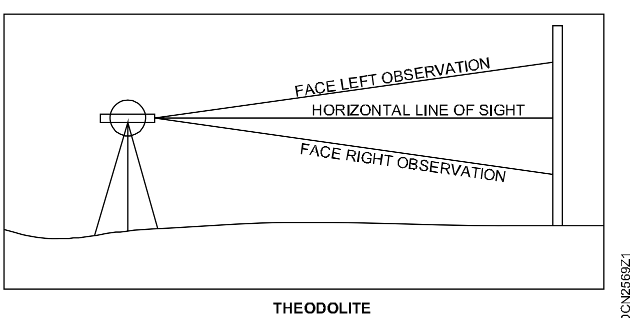
- Repeat the test and check the adjustment.

Permanent adjustment 5 (vertical circle index test)

Objectives : At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **adjust the instrument.**

- Fix up the instrument near to any tall object, at an instrument station O. (Fig 1)
- Set up the instrument over the station O with telescope in normal condition.
- Perform all the temporary adjustments.
- Set the vertical vernier to zero.
- A staff is held vertical at about 60m from the instrument and the readings is taken by face left observation.
- Then the face is chaged and the staff is read again. If there is an error, the face readings will be different.

Fig 1



Adjustment

- The telescope is set to read the mean of the two staff readings.
- Then the vertical circle should be brought back to read zero using the clip screws.

Check

- Repeat the test and perform the adjustment till both face readings remain same while observing.

Permanent adjustment 6 (vertical arc test)

Objectives: At the end of this exercise you shall be able to
- **establish relation between fundamental axes**
- **perform the vertical arc test**
- **adjust the instrument.**

- Fix up the instrument near to any tall object, at an instrument station O.
- Set up the instrument over the station O with telescope in normal condition.
- Perform all the temporary adjustments.
- Centre the altitude bubble on the telescope.
- The zero of the vernier of the vertical circle should coincide with the zero on the main scale of the vertical circle. If is doesn’t coincide, it means is needed adjustment.

Adjustment

- The capstan head screws are loosened and the vernier is moved til the zero coincides with that of the main scale.

— — — — — — — —

Measuring a horizontal angle (ordinary method)

Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate readings**
- **determine horizontal angle POQ.**

Requirements

Tools/Instruments

- Theodolite with tripod - 1 No each.
- Plumb bob - 1 No.
- Peg - 1 No.
- Hammer - 1 No.
- Ranging rods - 1 No.
- Measuring tape - 1 No.

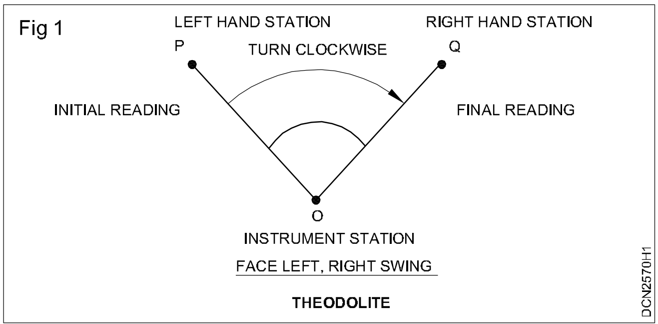
Materials

- White paper - 1 No.

PROCEDURE

1 Erect two stations P and Q by driving pegs on the field and erect ranging rods vertically behind the pegs. (Fig 1)

Fig 1



2 Fix an instrument station O.

3 Set up the instrument over the station O with telescope in normal condition. (vertical circle left of the observer and bubble is up)

4 Perform all the temporary adjustments.

5 Release both upper and lower clamps.

6 Turn the upper plate until the index of vernier of ‘A’ nearly coincides with the zero of the main scale. Lock the upper clamp.

7 Turn the upper tangent (slow motion) screw to make the two zeros exactly coincident.

- (After setting 00°00’00” on ‘A’ scale, check the reading on the ‘B’ of main scale, which should read 180°00’00” if there is no instrumental error)

8 Unclamp the lower clamping screws.

9 Direct the telescope to sight the ranging rod at the left hand station (P) and bisect the station.

- (Approximate bisection of the station is done by sighting over the telescope through a pin- and - hole arrangement provided over the top of the telescope.

10 Lock the lower clamp.

11 Bisect the station P exactly by using the tangent screw.

- (For exact bisection - bringing the station mark exactly at the intersection of horizontal and vertical hairs - of the station, vertical circle clamp and its tangent have to use.

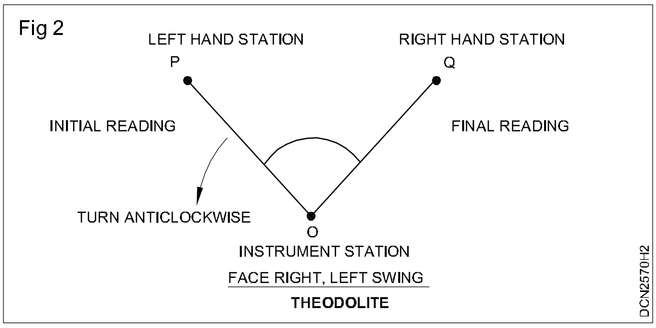
12 Once more check both the verniers A and B and ensure readings remain unchanged.

13 Enter readings in the respective colums of table in theodolite field book. Say 0°00’00”

- (A’ scale reading is entered fully. i.e in degree, minutes & seconds while only minutes and seconds of ‘B’ scale are entered)

14 Release the upper clamp and swing the telescope to bisect the station ‘Q’. (Fig 2)

Fig 2



15 Lock the upper clamp and get exact bisection using upper tangent screw.

16 Read and enter readings in the respective columns of the Table - 1.

17 Change face of the instrument by transiting and swinging.

18 Follow steps 5 to 15.

19 Angle POQ is the average of angles obtained from both face observations.

INSTRUMENT	SIGHT TO	FACE LEFT											FACE RIGHT											Averager horizontal ANGLE			Rough sketch
		A			B		MEAN			HORIZONTAL ANGLE			A			B		MEAN			HORIZONTAL ANGLE						
		0	‘	“	‘	“	0	‘	“	0	‘	“	0	‘	“	‘	“	0	‘	“	0	‘	“				

20 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

— — — — — — — —

Reading a horizontal angle

Objectives: At the end of this exercise you shall be able to
- **prepare a table for booking the readings**
- **read the Main Scale Reading (M.S.R) and Vernier Scale Reading (V.S.R)**
- **book the readings.**

- Erect an instrument station by driving peg on the ground.
- Loosen strap of the tripod.
- Place the tripod over the station at a convenient height with tripod legs well apart.
- Fix the theodolite over the tripod head. Remove cover of the theodolite.
- Do the temporary adjustments.
- Clamp the plates using lower clamp screw.
- Swing the telescope in clockwise direction to sight the station.
- Tighten the upper clamp. Bisect the station accurately using upper tangent screw.
- Determine value of main scale reading.
- Vernier reading is obtained by locating the reading at which the vernier line coincides with the main scale division.
- Book the readings in column A of the theodolite field book.
- Similarly observed the reading on the scale B and book the readings in respective columns of the field book.
- Find the average of A and B scale readings which is the desired reading.
- Loosen all the clamps and cover the objective. Unscrew theodolite from tripod.
- Gently place theodolite inside the box so that it fits properly.

— — — — — — — —

Measuring a horizontal angle (Repetition method)

Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate readings**
- **determine horizontal angle POQ by repetition method.**

1 Follow the steps 1 to 16 of the exercise - measurement of horizontal angle (ordinary method). (Fig 1)

2 Unlock the lower clamp and swing the telescope in clockwise direction to bisect the station ‘P’.

3 Lock the lower clamp. Exact bisection of ‘P’ is done using lower tangent screw.

4 Once more read the scales and check whether the readings remain unchaged.

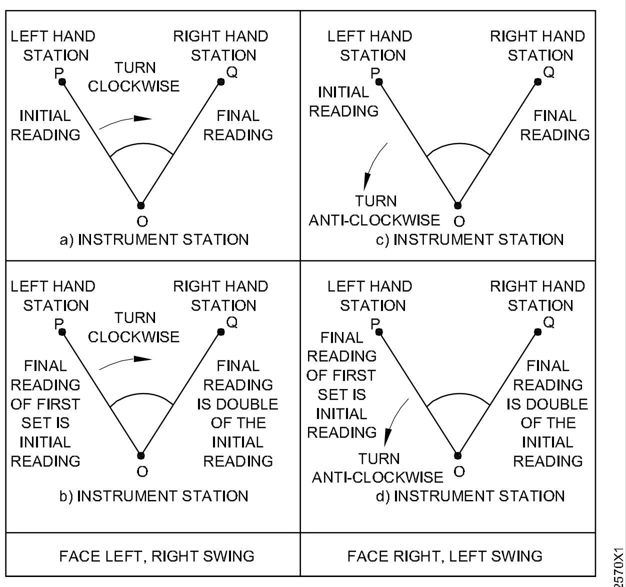
5 Release the upper clamp and swing the telescope to bisect the station ‘Q’.

6 Lock the upper clamp. Exact bisection of ‘Q’ is done using upper tangent screw.

7 Follow the steps for required number of times, say three times and find out the value of angle POQ.

(The average observed reading sighting ‘Q’ after last repetition divided by the number of repetitions is the angle POQ for the respective face observation)

Fig 1



THEODOLITE

			Face left Right Swing												Face Right Left Swing															
Instru ment	Sight to	Length (m)	A			B		Mean			No of repti tions	Horizontal angle			A			B		Mean			No.of repti tions	Horizontal angle			Average Horizontal Angle			Rough Sketch
			0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“	

8 Change face of the instrument.

9 Release both upper and lower clamps.

10 Set zero of the vernier coincides with zero of the main scale A.

11 Direct the telescope to sight the left hand station, say ‘P’ and bisect it.

12 Once more check both the verniers ‘A’ and ‘B’ and ensure readings remain unchanged.

13 Enter readings in the respective columns of table.

14 Release the upper clamp and swing the telescope in anticlockwise direction to bisect the right hand station ‘Q’.

15 Read and enter readings in the respective columns of the table.

16 Follow steps 5 to 7.

17 Angle POQ is the average of angles obtained from both face observations.

18 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

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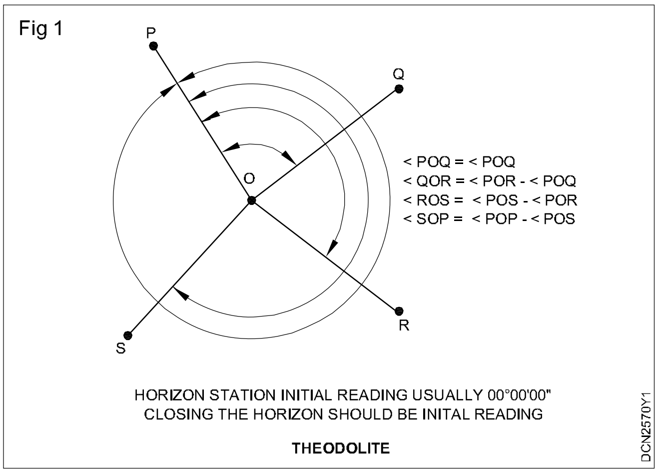
Measuring a horizontal angle (reiteration method)

Objectives: At the end of this exercise you shall be able to
- **adopt reiteration method**
- **observed and tabulate readings**
- **applying corrections for included angles**
- **determine horizontal angle POQ, QOR, ROS and SOT.**

1 Erect four stations P,Q,R and S by driving pegs on the field and erect ranging rods vertically behind the pegs. (Fig 1)

Fig 1



2 Fix an instrument station ‘O’ so as to get complete sight of the stations.

3 Follow steps 3 to 16 of exercise - measurement of horizontal angle (ordinary method).

4 Relese the upper clamp and swing the telescope to bisect the station ‘Q’.

5 Lock the upper clamp and get exact bisection using upper tangent screw.

6 Read and enter readings in the respective columns of the table.

7 Release the upper clamp and swing the telescope to bisect the station ‘R’.

8 Lock the upper clamp and get exact bisection using upper tangent screw.

9 Read and enter readings in the respective columns of the table.

10 Similarly bisect stations ‘S’ using upper clamp screws and its tangent and enter readings in the respective columns.

11 Finally close the horizon (sight the station P) and observed the reading.

12 Change face of the instrument and follow steps 5 to 16 of exercise - measurement of horizontal angle. (ordinary method)

13 Follow above steps 4 to 11.

14 Determine average horizontal angles POQ,QOR, ROS and SOP.

15 (Apply corrections, if closing error exists)

If the value of angle measured at p (after closing horizontal if more than 360°, divide the descrepancy equally and subtract from the each of the included angle calculated if it is less than 360°, divide the difference equally and add it.

16 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

			Face left Right Swing												Face Right Left Swing															
Instru ment	Sight to	Length (m)	A			B		Mean			No of repti tions	Horizontal angle			A			B		Mean			No.of repti tions	Horizontal angle			Average Horizontal Angle			Rough Sketch
			0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“	

Measuring a vertical angle (Angle of Elevation)

Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate readings**
- **measure the vertical angle (a).**

Requirements

Tools/Instruments

- Theodolite with tripod - 1 No each
- Plumb bob - 1 No.
- Peg - 1 No.
- Hammer - 1 No.
- Ranging rods - 1 No.
- Measuring tape - 1 No.

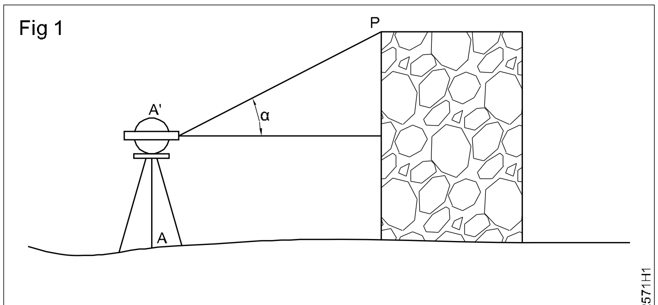
Materials

- White paper - 1 No.

PROCEDURE

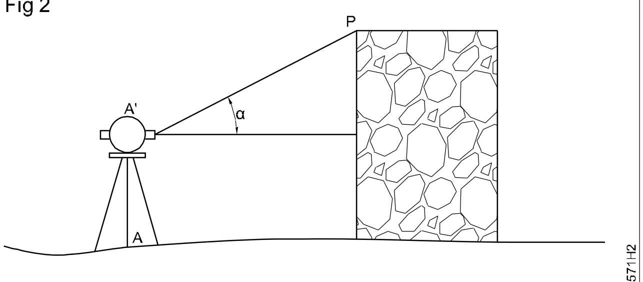
- Erect a station a by driving peg on an open and fair ground.
- Set up the instrument at A. (Fig 1)
- Perform all the temporary adjustments.
- Level the instrument with respect to altitude bubble level. (steps for keeping the plate bubble parallel is followed. but Instead of bringing plate level parallel and perpendicular, bring altitude bubble)
- Direct the telescope upwards to sight ‘P’ (Fig 2)
- Lock horizontal movement of plates.
- Tighten vertical clamp screw.
- Bisect ‘P’ exactly using tangent screws.
- Measure vertical angle, +a from C scale and D scale.
- Record the readings with sign.
- Mean reading is the vertical angle.
- Change face of the instrument and measure vertical angle following appropriate above steps.
- Average of both face readings is the angle of elevation (+a) to ‘P’ from ‘A’.

Fig 1



MEASURING VERTICAL ANGLE (FACE RIGHT)

Fig 2



MEASURING VERTICAL ANGLE (FACE RIGHT)

— — — — — — — —

INSTRUMENT	SIGHT TO	FACE LEFT											FACE RIGHT											Averager vertical			Rough sketch
		A			B		MEAN			HORIZONTAL ANGLE			A			B		MEAN			HORIZONTAL ANGLE						
		0	‘	“	‘	“	0	‘	“	0	‘	“	0	‘	“	‘	“	0	‘	“	0	‘	“				

Measuring direct angles

Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate readings**
- **determine direct angles PQR,QRS and RST.**

Instrument	Sight to	Length (m)	Face left Right Swing												Face Right Left Swing												Average Horizontal Angle			Remarks	Rough
			A			B		Mean			No of repti tions	Horizontal angle			A			B		Mean			No.of repti tions	Horizontal angle							
			0	'	"	'	"	0	'	"		0	'	"	0	'	"	'	"	0	'	"		0	'	"	0	'	"		
P	Q																													BEARING OF PQ=	

1 Erect five stations P,Q,R,S and T by driving pegs on the field and erect ranging rods vertically behind the pegs P and R. (Fig 1 & 2)

2 Follow steps 2 and 3 of the exercise - measurement of deflection angle.

3 Follow the steps 4 to 12 of exercise - measurement of horizontal angle (ordinary method).

4 Release the upper clamp and swing the telescope in the clockwise direction and bisect the station ‘R’

5 Lock the upper clamp and get exact bisection using upper tangent screw.

6 Read and enter readings in the respective columns of the table.

7 Transit the telescope, unclamp the lower clamp and bisect P.

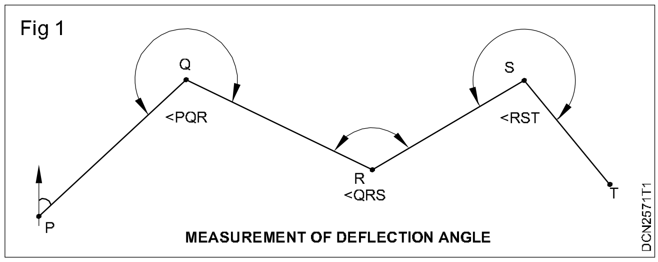
8 Lock the lower clamp and using tangent screw bisect P accurately. Ensure readings remain unchanged.

9 Unclamp the upper plate. Swing the telescope and bisect the station R.

10 Clamp upper plate. Bisect R accurately using upper tangent screw. Observe the readings.

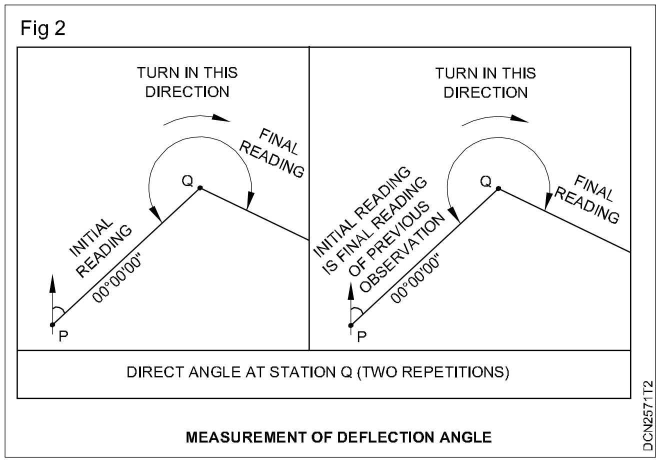
11 Average of this value is the value of the required angle PQR.

Fig 1



MEASUREMENT OF DEFLECTION ANGLE

Fig 2



MEASUREMENT OF DEFLECTION ANGLE

12 Similarly measure angles QRS and RST from stations R and S respectively.

13 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

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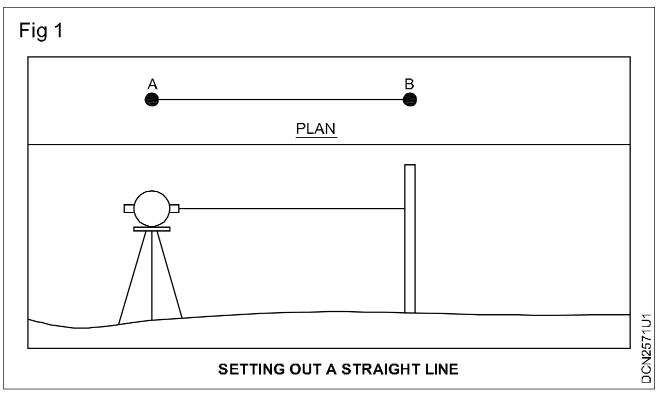
Setting out a straight line

Objectives: At the end of this exercise you shall be able to
- **set up the theodolite**
- **set up a line AB of length 20m.**

- Set a line AB of reasonable length on the ground and erect pegs at the ends of this line. (Fig 1 & 2)

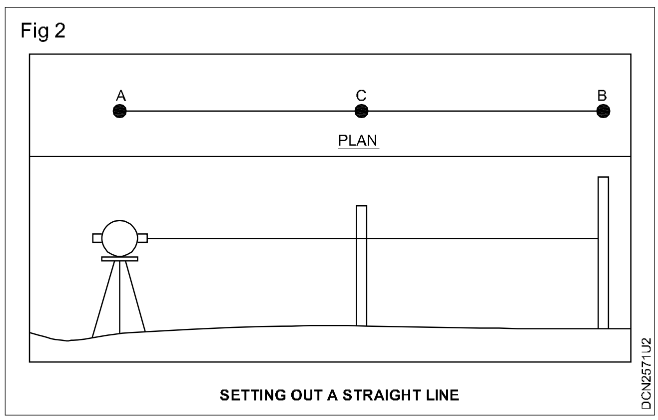
Fig 1



SETTING OUT A STRAIGHT LINE

- Drive a peg on the ground at A and set up the instrument over the station A.
- Perform all the temporary adjustments.
- After fixing horizontal motion direct the telescope towards the required direction of the line to be set out.
- Hold zero end of the tape at A.

Fig 2



SETTING OUT A STRAIGHT LINE

- Direct a survey man with ranging rod and 20m end of the tape, along the line of sight and fix the required end point, B, of the line.
- Exactly bisect the ranging rod and fix the point, B, by driving peg.
- Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

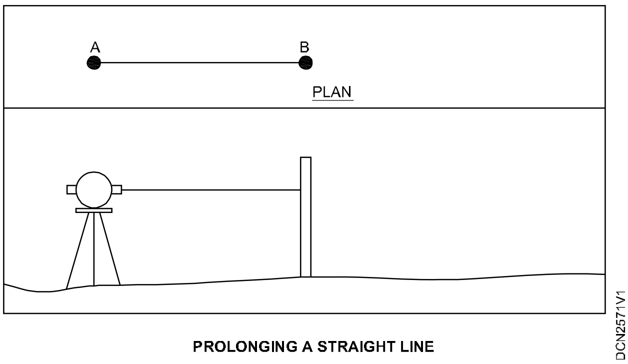
— — — — — — — —

Prolonging a straight line

Objectives: At the end of this exercise you shall be able to
- **set out a line AB**
- **prolong the line AB**
- **erect two points C and D on prolonged line by double sighting.**

1 Set a line AB and erect pegs at the ends of this line. (Fig 1)

Fig 1



PROLONGING A STRAIGHT LINE

2 Set up the instrument over the station A.

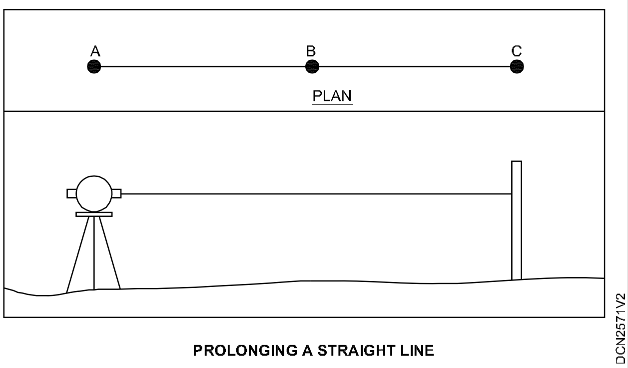
3 Perform all the temporary adjustments.

4 Bisect station B accurately with tangent screws after fixing horizontal motion (clamp plates).

5 Move the telescope in vertical plane and looking through the pin and hole arrangement direct the surveryor, with ranging rod, in line.

6 Set up the theodolite over B. (Fig 2)

Fig 2



PROLONGING A STRAIGHT LINE

7 With both screws clamped backsight A.

8 Transit the telescope.

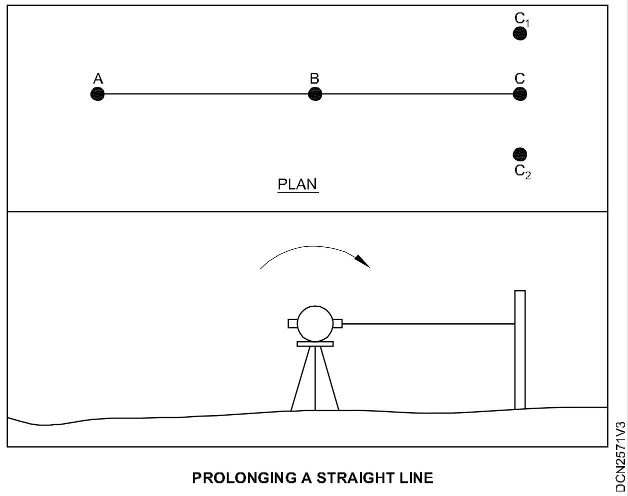
9 Exactly bisect the ranging rod and fix the point, C, by driving peg. (Fig 3)

10 Change face of the instrument. Follow steps 4 to 9.

11 If instrument is in perfect adjustment C will be sighted. Other wise locate new point, say C_2 and previous sighted point C_1.

12 Measure C_1 C_2 Find middle of C_1 C_2 which is the required point C, in line with AB.

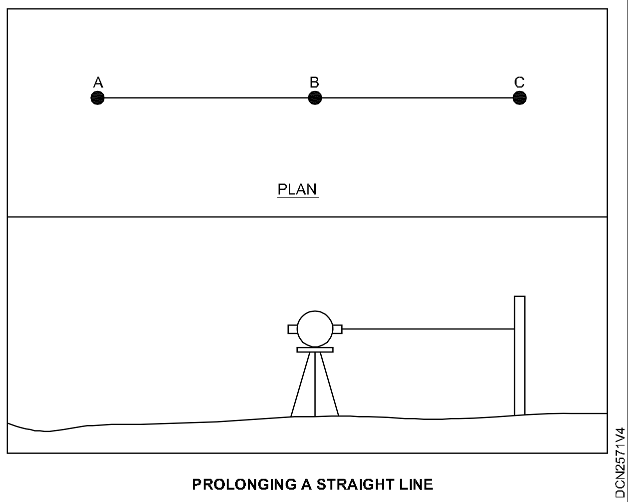
Fig 3



PROLONGING A STRAIGHT LINE

13 Move the instrument to C. (Fig 4)

Fig 4

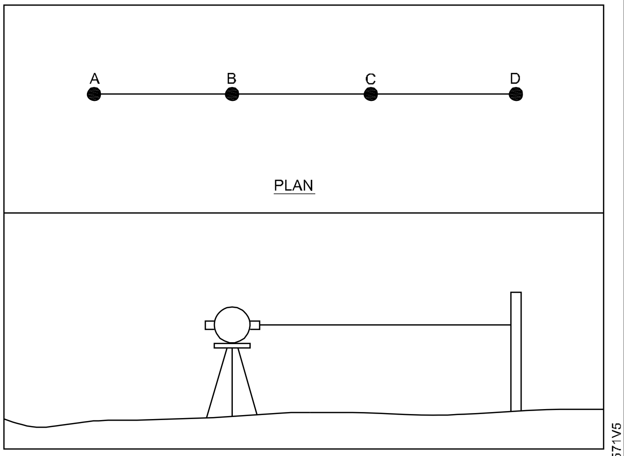


PROLONGING A STRAIGHT LINE

14 Similarly following above steps fix another point D. (Fig 5)

15 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

Fig 5



PROLONGING A STRAIGHT LINE

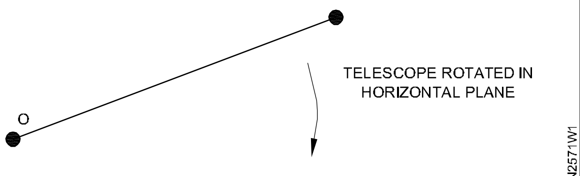
— — — — — — — —

Establishing a line at given angle

Objectives: At the end of this exercise you shall be able to
- **set given angle in theodolite**
- **set out the given angle POQ on the field**
- **establish line along the set out angle.**

1 Erect a station, P, by driving pegs on the field and erect ranging rods vertically behind the pegs. (Fig 1)

Fig 1



ESTABLISHING A LINE AT GIVEN ANGLE

2 Fix an instrument station O.

3 Set up the instrument over the station O with telescope in normal condition.

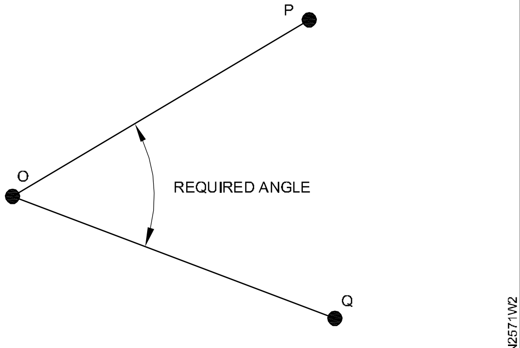
4 Perform all the temporary adjustments.

5 Releases both upper and lower clamps.

6 Turn the upper plate until the index of vernier of ‘A’ exactly coincides with the zero of the main scale.

7 Direct the telescope to sight the ranging rod at the left hand station (P) and bisect the station. (Fig 2)

Fig 2



ESTABLISHING A LINE AT GIVEN ANGLE

8 Lock the lower clamp.

9 Bisect the station P exactly by using the tangent screw.

10 Once more check both the vernier A and B and ensure readings remain unchanged.

11 Loosen the upper clamp.

12 Turn the telescope in the clockwise direction to set the horizontal angle as per given value. Lock the upper clamp. (or turn the telescope in anti clockwise direction)

13 Exact setting of the angluar value is done using upper tangent screw.

14 Direct the surveyor man with ranging rod (required length can set out following steps described in previous exercise) along the line of sight and fix the point, Q on the groung along the line of sight.

15 Check the angular value and the point, Q sighted.

16 Drive a peg on the ground.

17 For more accurate position, continue the opeartion, after changing the face and rotating in anti clock wise swing. if both are same position the instrument is in good condition or not, take the average if the two value.

18 Loosen all clamps. Remove the theodolite from the tripod and gently place it in the box.

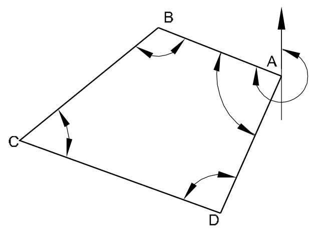
Closed traverse

Objectives: At the end of this exercise you shall be able to
- **measure the included angles**
- **balance the closed traverse ABCDA**
- **plot the traverse using coordinates.**

1 Reconnaissance the area to be surveyed. (Fig 1)

2 Select station as per field conditions.

Fig 1



CLOSED TRAVERSE

3 Mark the stations.

4 Take at least three permanent reference points of the stations.

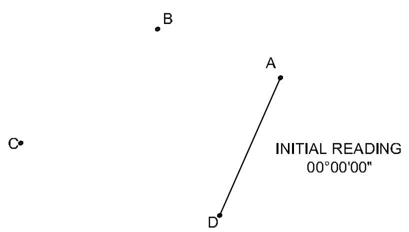
5 Set up the instrument at the starting station, say ‘A’.

6 Set the vernier scale A, 0-0.

7 Perform all the temporary adjustments.

8 Measure the magnetic meridian of the line AB using theodolite if it is fitted with magnetic compass (other wise use prismatic compass). (Fig 2)

Fig 2



CLOSED TRAVERSE

9 Loosen the lower clamp; direct the telescope towards the last back sight station D.

10 Tighten lower clamp and bisect the station exactly using the lower tangent screw.

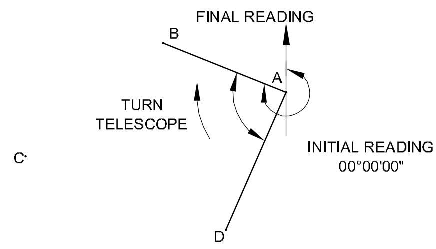
11 Loosen upper clamp; telescope is turned to sight the forward station ‘B’.

12 Tighten upper clamp; Bisect ‘B’ exactly and observe the horizontal angle.

13 Following appropriate above steps observe a face right reading (accuary can be improved by adopting repetition method).

14 Measured horizontal angles by both face observations at each station. (Fig 3)

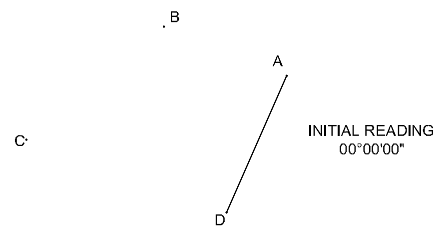
Fig 3



FACE LEFT OBSERVATION CLOSED TRAVERSE

15 Measure the length of the side. (Fig 4)

Fig 4



CLOSED TRAVERSE

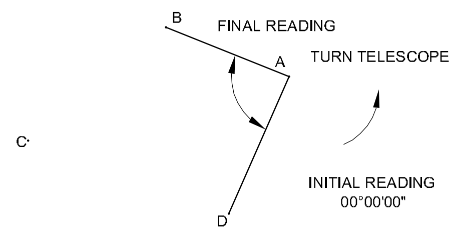
16 Proceed thus to finish off the traverse.

17 Calculate the coordinates.

18 Arithmetically balance the traverse if error exists

19 Plot the traverse using coordinates. (Fig 5)

Fig 5



FACE RIGHT OBSERVATION CLOSED TRAVERSE

20 Balance the traverse graphically if traverse failed to close while plotting.

			Face left Right Swing												Face Right Left Swing																
Instru ment	Sight to	Length (m)	A			B		Mean			No of repti tions	Horizontal angle			A			B		Mean			No.of repti tions	Horizontal angle			Average Horizontal Angle			Remarks	Rough
			0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“		
P	Q																													BEARING OF PQ=	

— — — — — — — —

Open traverse

Objectives: At the end of this exercise you shall be able to
- **measure the angles between the traverse lines.**
- **check the traverse**
- **plot the open traverse.**

Instrument	Sight to	Length (m)	Face left Right Swing													Face Right Left Swing													Average Horizontal Angle			Remarks	Rough Sketch
			A			B		Mean			No of repti tions	Horizontal angle			A			B		Mean			No.of repti tions	Horizontal angle							
			0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“	‘	“	0	‘	“		0	‘	“	0	‘	“		
P	Q																													BEARING OF PQ=	

PROCEDURE

1 Reconnaissance the area to be surveyed. (Fig 1)

2 Select stations as per field conditions.

3 Mark the stations.

4 Take at least three permanent reference points of the stations.

5 Set up the instrument at he starting station, say ‘A’.

6 Perform all the temporary adjustments.

7 Measure the magnetic meridian of the line AB using theodolite if it is fitted with magnetic compass (other wise use prismatic compass).

8 Shift and set up the instrument at station ‘B’.

9 Set the vernier scale A, 0 - 0.

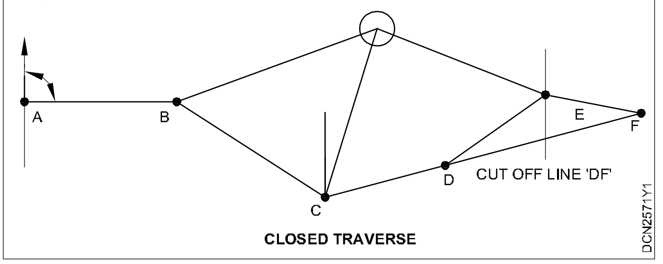
10 Perform all the temporary adjustments.

11 Loosen the lower clamp; direct the telescope towards station A.

12 Tighten lower clamp and bisect the station exactly using the lower tangent screw.

13 Exactly bisect forward station C and observe the horizontal angle (direct angle or deflection angle as describe earlier) and record the angle.

Fig 1



14 Thus following appropriate steps observe a face right reading at B. observe a face left reading as per the traversing method (accuracy can be improved by adopting repetition method).

15 Set up the instrument at forward station ‘C’.

16 Similarly procced further and finish off the traverse. (measure and record directions and distances)

17 Cut off lines and bearings of a prominent object from several stations are also note down for checking the traverse. Details can also locate by any method.

18 Plot the traverse to a suitabel scale.

— — — — — — — —

Magnetic bearing of a line

Objective : At the end of this exercise you shall be able to
- **setting up the theodolite for magnetic bearing of line.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No each.

Materials

- White paper - 1 No.
- Pencils - 1 No.
- Paper - 1 No.

PROCEDURE

TASK: **Reading magnetic bearing of a line.**

1 Set up the instrument over ‘A’ and level it accurately.

2 Set the vernier A to the zero of the horizontal circle.

3 Release the magnetic needle and loosen the lower clamps.

4 Rotate the instrument in the horizontal plane until the magnetic needle takes the normal position.

The zeros of the scales in the trought compass or the N and S graduation in the triangle box compass or the under mark in the tabular compass are opposite to the ends of the needle.

5 Tight the lower clamp and use its tangent screw for act concidence.

6 The line of sight is now parallel to the magnetic meridian and the vernier A reads zero.

7 Loosen the uper clam. Turn the telescope and sight the object B.

8 Bisect B exactly by using upper tangent screws.

9 Road both verniers are the horizontal circle.

10 The mean of the two vernier readings Gives the bearings of the line AB.

11 If greater accuracy is needed, change the face take a second reading and record the mean of the two.

— — — — — — — —

Levelling with a theodolite (simple levelling)

Objectives: At the end of this exercise you shall be able to
- **operate theodolite**
- **observe and tabulate staff readings**
- **find the reduced levels of the given points.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No each.
- Levelling Staff - 1 No.
- Plumb Bob - 1 No.
- Measuring tape - 1 No.
- Peg - 1 No.
- Hammer - 1 No.

Materials

- White paper - 1 No.

PROCEDURE

1 Find suitable ground point so that the points to be sighted can be well commanded. (Fig 1)

2 Perform all the temporary adjustments.

3 Make zero of the vertical circle coincide with zero of the vertical circle.

4 Clamp the vertical clamping screw and using its tangent make the reading 0-0.

5 Check whether the altitude bubble is in central position. (If bubble is out of the centre, bring the bubble to central position using the foot screw near to the telescope).

6 Hold the staff vertically over the given BM. (RL is +15.050m)

7 Direct the telescope towards the staff.

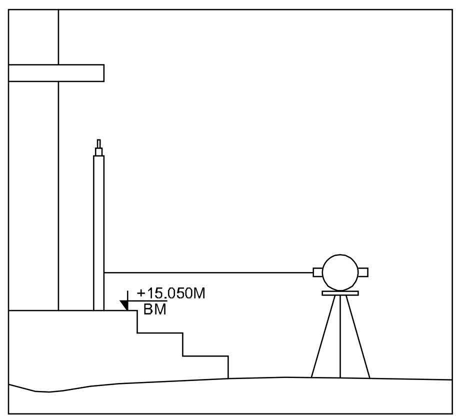
8 Arrest the horizontal motion. Exact bisection is done using the lower tangent screw.

9 The reading on the staff corresponding to the exact bisection of the middle horizontal hair and vertical cross wire is recorded (BS).

10 Hold the staff on the given point, of which RL has to be found.

11 Loosen the lower screw direct the telescope towards the staff.

Fig 1



SIMPLE LEVELLING

12 Lock the lower clamp. Exact bisection is done using the lower tangent screw.

13 Check whether the altitude bubble is in central position.

14 Record the reading (IS).

15 Similarly take staff reading (s) of the given points and record it. (IS and roading taken just before changing the HI of instrument , FS)

16 Find the reduced levels of the points by any of the methods.

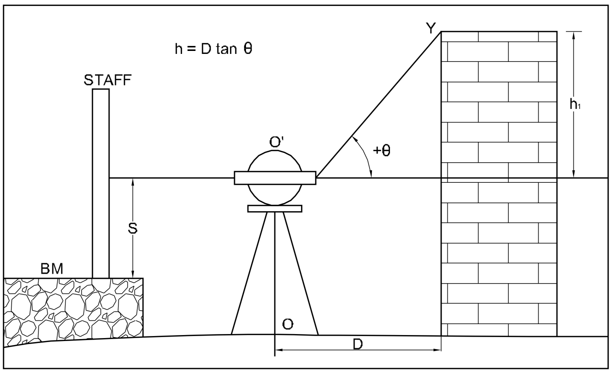
— — — — — — — —

Trignometric levelling - Base of the object accessible (object vertical)

Objectives: At the end of this exercise you shall be able to
- **operate the instrument**
- **measure the distance between base of the vertical object and the instrument station**
- **find the reduced level of the point Y at the top of the building.**

1 Select an instrument station ‘O’ on a fairly open ground at a reasonable distance from the base of ‘Y’. (Fig 1)

Fig 1



TRIGNOMETRIC LEVELLING

2 Set up the instrument at ‘O’.

3 Perform all the temporary adjustments.

4 Set the vertical vernier 0-0.

5 Direct the telescope to the staff vertically held at the given BM (check altitude bubble).

6 Clamp both plats. Exactly bisect the staff.

7 Observe the staff reading (S) and enter it in the table.

8 Loosen the lower clamp’ turn the telescope towards ‘Y’.

9 Lock lower clamp, tighten the vertical circle clamping screw.

10 Bisect ‘Y’ exactly using tangent of vertical circle clamping screw and lower screw.

11 Observe vertical angle (?) in both scales and enter it in the respective column. (check altitude bubble)

12 Change face of the instrument and observe the vertical angle to ‘Y’.

13 Average of the angles in C and D scale is the vertical angle (?).

14 Measure the horizontal distance (D) between the instrument station ‘O’ and base of the point ‘Y’ using tape.

15 Find reduced level of the point ’Y’.

RL of Y = RL of BM + S + h1

If staff reading observed is different, take average of the staff readings as ‘S’.

Tabular column for trignometric levelling

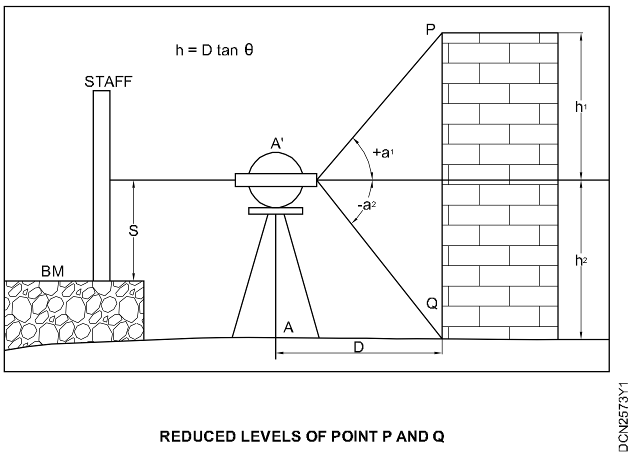
Instrument	Sight to	Length (m)	Face Left											Face Right											Average vertical			Rough sketch
			C			D		Mean			Vertical angle			C			D		Mean			Vertical angle						
			0	’	”	‘	”	0	’	”	0	’	”	0	’	”	‘	”	0	’	”	0	’	”	0	’	”	

Find reduced levels of the points

Objectives: At the end of this exercise you shall be able to
- **operate the instrument**
- **determine RLs**
- **determine vertical angle between two lines of sight.**

1 Erect a station a by driving peg on an open and fair ground. (Fig 1)

Fig 1



REDUCED LEVELS OF POINT P AND Q

2 Set up the instrument at A.

3 Perform all the temporary adjustments.

4 Set the vertical vernier 0-0.

5 Direct the telescope to the staff vertically held at the given BM (check altitude bubble).

6 Clamp both plates. Exactly bisect the staff.

7 Direct the telescope to sight 'p'.

8 Lock horizontal movement of plates.

9 Tighten vertical clamp screw.

10 Bisect 'p' exactly using tangent screws.

11 Measure vertical angle, +a1 from C scale and D scale.

12 Record the readings with sign.

13 Mean reading is the vertical angle.

14 Direct the telescope to sight 'Q'.

15 Follow above steps 6 and 7.

16 Bisect 'Q' exactly using tangent screws.

17 Measure vertical angle, -a2 from C scale and D scale

18 Record the readings with sign.

19 Mean reading is the vertical angle.

20 Change face of the instrument and follow appropiate above steps.

21 Average of both face readings is the required angles +a1 and -a2.

22 Algebraic difference of +a1 and -a2 is the required vertical angle.

23 Measure the horizontal distance between the instrument station and the points. (both in the same vertical plane)

24 Final RL of P and Q

RL of P = RL of BM + Staff reading on BM +h1

RL of Q = RL of BM + Staff reading on BM -h2

25 Find vertical angle between P and Q at 'A'.

Instrument	Sight to	Lenght (m)	Face Left				Face Right					Rough Sketch
			C	D	Mean	Vertical Angle	C	D	Mean	Vertical Angle	Average Vertical Angle	

— — — — — — — —

Calculation of area from traverse

Objectives: At the end of this exercise you shall be able to
- **calculate the independent Co-ordinates**
- **calculate the area of traverse ABCD.**

Requirements

Tools / Instruments	Materials	
• Nil	• White paper	- 1 No.

TASK 1: **Calculate the independent co-ordinates**

Given the altitude and departures of the sides of a closed traverse ABCD.

Side	Latitudes in Metres		Departre in Metres	
	N	S	E	W
AB	107.4		62.0	
BC		122.6	102.9	
CD		77.9		45.0
DA	93.1			119.9

Solution:

Take the co-ordinates of A (each multiple of 100 or 1000) the co-ordinates of other points are possitive.

Take the whole traverse lives in the first (NE) quadrant Take co-ordinates A as 200 and 100.

North co-ordination of A=200.00
(Assisment)

Add northing of B	= 107.40
North co-ordinate of B	= 307.40
Deduct southing of C	= 122.60
North Co-ordinate of C	= 184.80
Deduct southing of D	= 77.90
North co-ordinate of D	= 106.90
Add northing of A	= 93.10
Check Northing co-ordinate of A (same as answered)	= 200.00
East co-ordinate of A	= 100.00
Add easting of B	= 62.00
East co-ordinate of B	= 162.00
Add easting of C	= 102.90
Easting co-ordiante of C	= 264.90
Deduct westing of D	= 45.00
East co-ordinates of D	= 219.90
Deduct westing of A	= 119.90
Check east co-ordinate fo A (same as answered)	= 100.00

— — — — — — — —

TASK 2: **Calculate the area of traverse ABCD**

The independent co-ordinates of points are

Points	Northing	Easting
A	200.00	100.00
B	307.40	162.00
C	184.80	264.90
D	106.90	219.90
E	200.00	100.00

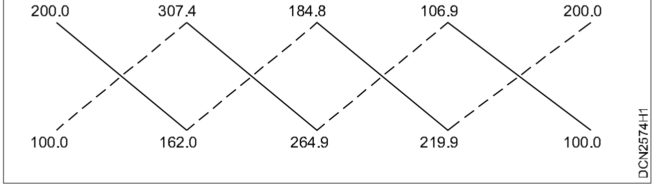
Arrange the co-ordiantes. in the determinate form. (Fig 1)

Area = 1/2 [{(200.0x162.0) - (307.4x100.0)} + {(307.4x264.9) - (184.8x162.0)} + {(184.8x219.9) - (106.9x264.9)
+ {(106.9x100) - (200.0x219.9)}]

= 1/2 [(32400 - 30740) + (81430 - 29938) + (40638 - 28318) + (10690 - 43980)

= 16091 sq.metres.

Fig 1



Determination of height

Objectives: At the end of this exercise you shall be able to
- **when the base of the object is accessible**
- **when the base of the object is in accessible.**

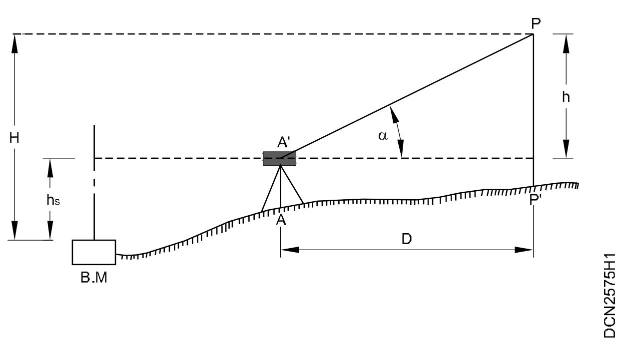
Requirements

Tools / Instruments		**Materials**	
• Theodolite with tripod	- 1 No each.	• White paper	- 1 No.
• Plumb bob	- 1 No.		
• Peg	- 1 No.		
• Hammer	- 1 No.		

TASK 1: **When the base of the object is accessible**

Keep the height of the object above the bench mark. (Fig 1)

Fig. 1



Let:

H = the height of the objects above B.M.

h = the height of the object above the instrument axis.

h_s = height of instrument axis above the B.M.

α = the vertical angle observe at the instrument - station.

D = the horizontal distance in metress measurement from the instrument station to the base to the object.

$h = D \tan \alpha$

$H = h + h_s = D \tan\alpha + h_s$

'D' distance is large.

The correction of currature

$$0.0673 \left(\frac{D}{1000}\right)^2$$

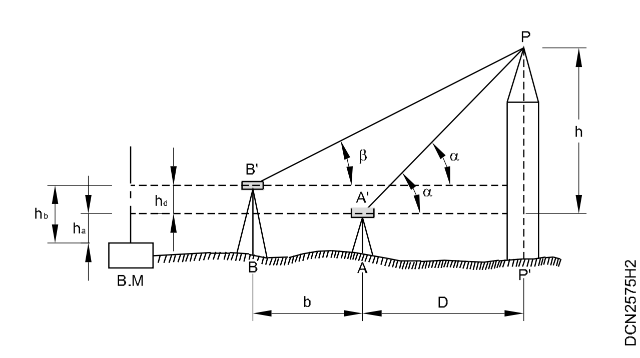
- Apply the above formula.
- Find the height of the object above the instrument station.
- Add the height of the instrument axis to the height of the object above the instrument axis.
- Obtained the height of the instrument axis in the wags.
- Measure the height of centre of the eye - piece above the station point by steel tape.
- Read the staff through the object - glars when held just near the eyes - piece end.

— — — — — — — —

TASK 2: **When the base of the object is inaccessible (Fig 2)**

- Find the height of the object above a Bench mark. (B.M)
- Choose two stations A and B suitable on level ground.
- Set up the instrument over the station A and level it accuralely.
- Set the altitude bubble centrel.
- Set the vertical vernier reading zero.
- Take a reading on the start held on B.M (or) reference point.
- Bisect the object P and read both vernier.
- Change the face again sight P and read both verniers.
- Take mean of the four readings, which is correct the value of the vertical angle.
- Shift the instrument to B and take similar observations as A.

Fig. 2



Let

α = the angle of elevation observed at A.

B = the angle of elevation observed at B.

b = the horizontal distance between the adjustment stations A and B.

D = the distance of the object from the near station.

h = height of the object P above instrument axis at ‘A’.

h_s = the staff reading at the B.M when the instrument is at A.

h_b = the staff reading at its B.M when the instrument is at B.

h_d = the level difference between the two position of the instrument axes.

= $h_a = h_s$.

When the instrument at further station B is higher them that at the near station A. (Fig 2)

$h = D \tan \alpha$ ----------------(i)

$h - h_d = (D+b) \tan B$----------------(ii)

putting the value of h from (i) in (ii)

$D \tan \alpha - h_d = (D+h) \tan B =$

$D \tan B + b \tan B$

(or) $D \tan \alpha - \tan B = b \tan B + h_d$

or $D = \dfrac{b \tan B + h_d}{\tan \propto - \tan B}$

put this value of D in (i)

$$h = \frac{b \tan B + h_d}{\tan \propto - \tan B} . \tan \propto$$

Height of the object above the B.M.

$H = h + h\alpha$

When the instrument at further station B is lower than that at near station A. (Fig 3)

Here,

$h = D \tan \alpha$ ----------------(i)

$h + h_d = (D+b) \tan B$ ----------------(ii)

The working as above

$$h = \frac{b \tan B - h_d}{\tan \propto - \tan B} \ \tan \propto$$

$H = h + h\alpha$

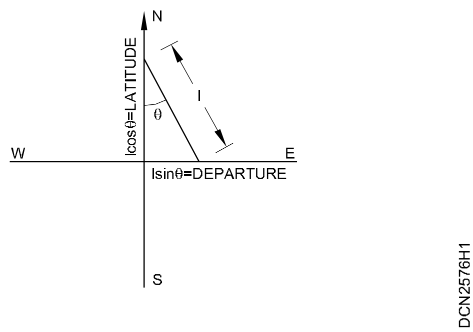
— — — — — — — —

Calculate of departure, altitude, northing and easting

Objective : At the end of this exercise you shall be able to
- **calculate of departure, altitude, northing and easting.**

TASK 1: **Calculate of departure altitude northing and easting (Fig 1).**

Fig. 1



Take l is the length of line, and 'O' is its reduced bearing.

Then,

(i) Latitude = l cosθ
Departure = l sin θ

(ii) $\tan\theta = \frac{\text{depature}}{\text{latitude}}$

θ

(or)

$$\theta = \tan^{-1}\frac{\text{depature}}{\text{latitude}}$$

(iii) (a) $l = \sqrt{\text{latitude}^2 + \text{depature}^2}$

(b) l =latitude x secθ

(c) l = departure × cosceθ

Example;

The co-ordinates of two points A and B are given

Point	co-ordinates	
	Northig	Easting
A	500.25	640.75
B	840.78	315.60

Find length and bearing of AB.

Solution

Let l = the length of AB

= the reduced bearing of AB.

Latitude of AB = the difference between the north co-ordinates of A and B = 840.78- 500.25=340.53

Depature of AB = the difference between, the east co-ordinates of A and B = 315.60-640.75=-325.15

$$\therefore \tan\theta = \frac{\text{depature}}{\text{latitude}} = \frac{325.15}{340.53} = 0.9548$$

∴ θ = 43° - 41'

Since the latitude is +ve and the daparture is -ve.

The line AB lines in the fourth

(N.W.) quadrant.

R.B of AB = N 43°41' W

W.C B of AB = 360° - 43° 41'

= 316° 19'

$$\text{Length of AB} = \sqrt{(\text{L})^2 + (\text{D})^2}$$

$$= \sqrt{(340.53)^2 + (325.15)^2}$$

= 470.83m.

Check length of AB = latitude of AB x secθ.

= 340.53 x sec 43° 41'

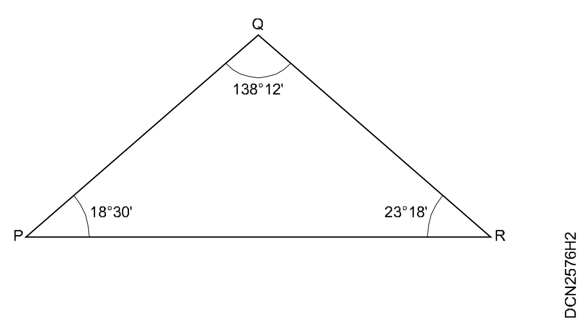
= 470.88m.

Example:

Included angle of the triangle PQR (Fig 2) $\angle QPR$ = bearing of PR - Bearing of PQ.

= 37° 6'-18' 36' = 18° 30'

Fig. 2



$\angle RQP$ = Bearing of QP = Bearing of QR = 198^0 36' - 60^0 24' = 138^0 12'

$\angle PRQ$ = Bearing of RQ - Bearing of RQ - Bearing of RP. = 240^0 24' - 217' 6' = 23^0 18'

Check: $\angle P + \angle Q + \angle R = 18^0 30' + 138^0 12'$ + 23^0 18' = 180^0 00'

<u>Length of PQ and QR.</u>

Apply line rule;

$$\frac{PR}{Sin\angle Q} = \frac{PQ}{Sin\angle R} = \frac{QR}{Sin\angle P}$$

$$PR = \frac{PR \text{ x Sin } \angle R}{\text{Sin } \angle Q} = \frac{1421 \text{ x Sin } 23^0 18'}{\text{Sin } 138^0 12'}$$

$$= \frac{1421 \text{ x } 0.3955}{0.6665} = 843.22 \text{ m}$$

$$QR = \frac{PR \text{ x Sin } \angle P}{\text{Sin } \angle Q} = \frac{1421 \text{ x Sin } 18^0 30'}{\text{Sin } 138^0 12'}$$

$$= \frac{1421 \text{ x } 0.3173}{0.6665} \text{ x } 676.49 \text{ m}$$

— — — — — — — —

Setting out work building culvert centerline of Dams Bridges and slope of earth work

Objectives: At the end of this exercise you shall be able to
- **setting out work for building**
- **setting our work for culvert**
- **setting out work for centre line of Dams**
- **setting out work for Bridges**
- **setting out have for slope of earth work.**

Requirements

Tools / Instruments

- Theodolite with tripod - 1 No each.
- Plumb bob - 1 No .
- Peg - 1 No.
- Ranging Rod - 1 No.

Materials

- White paper - 1 No.
- Pencil - 1 No.
- Eraser - 1 No.

TASK 1: **Setting out work for building**

- Set the theodolite at the site.
- Instructor should demostrate construction of proposed building survey.
- He should emphasize presafty precautions and operational safety precautions to be observed during survey.
- He should abo state post safety precautions to be observed.
- After his demo of the theodolite at site from the proposed construction of the building tranies should repeat the same.
- In the same manner by using the theodolite the other objectives of this exercise should be demanstrated by the instructor and the trainees should repeat the same.

— — — — — — — —

Carpentry joint

Objectives: At the end of this exercise you shall be able to
- **draw the views of lengthening joints**
- **draw the views of widening joints**
- **draw the views of bearing joints**
- **draw the views of angled or corner joints**
- **draw the views of oblique shouldered joints**
- **draw the views of through housing joint**
- **draw the views of housing joint (Single dovetail)**
- **draw the views of housing joint (stopped housing with shoulder)**
- **draw the different varities of panels**
- **draw the different forms of moulding.**

PROCEDURE

TASK 1: **Draw the plan and elevation of different types of lengthening joints (Fig 1)**

DATA: Width of the member - 300mm.

Thickness of the member - 200mm.

Length of the member - can be assumed.

- Draw the plan and elevation of lapped joints using member size 300x200mm.
- Draw the elevation of finished joints with single fish plates, double fish plates and intented fish plates.
- Draw the elevation of scarfed or spliced joints.
- Draw the elevation of table joints.

_ _ _ _ _ _ _ _

TASK 2: **Draw the sectional elevation of widening joints (Fig 2)**

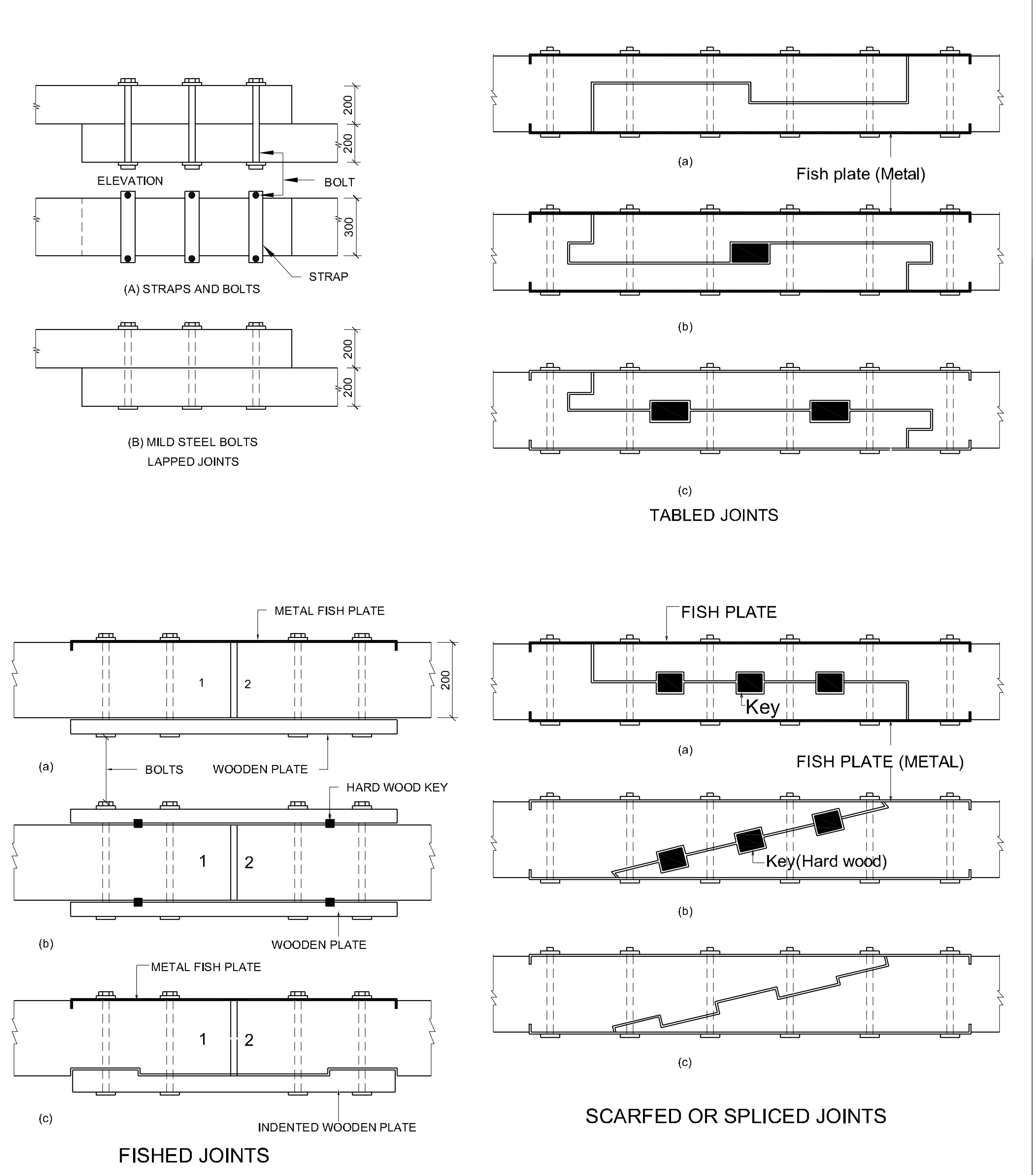
DATA: Thickness of member - 200 mm.

Draw the sectional elevation of

- Butt joint.
- Rebated joint.
- Rebated and filleted joint.
- Ploughed and tongued joint.
- Tougued and grooved joint.
- Rebated, tougued and grooved joint.
- Splayed, dowelled, matched and beaded, mathced nd V-joint and dovetailed joint.

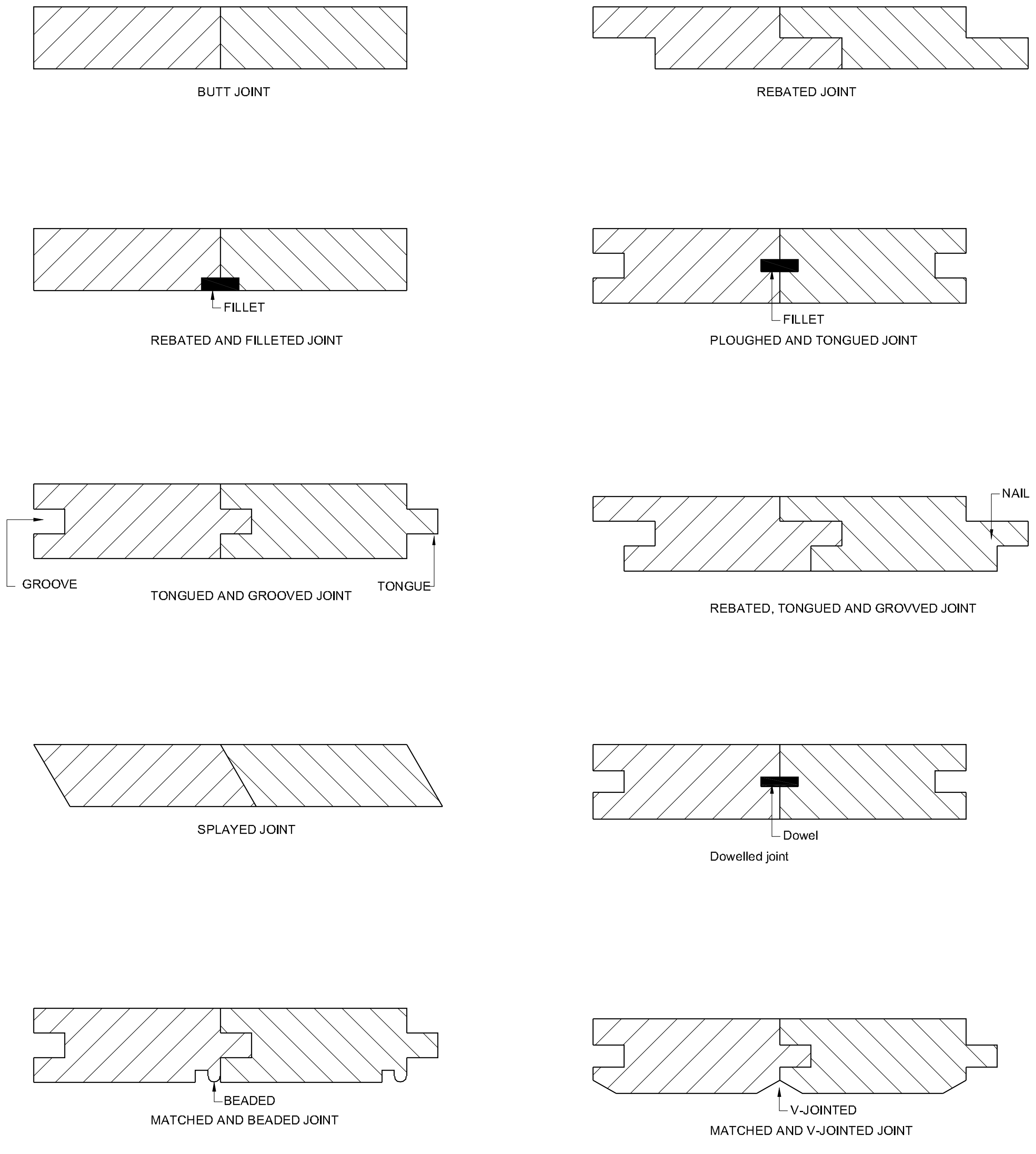
_ _ _ _ _ _ _ _

Fig 1



LENGTHENING JOINTS

Fig 2



WIDENING JOINTS

DCN2678E2

TASK 3 : **Draw the views of bearing joints, angle joints and oblique shouldered joints (Fig 3, Fig 4, Fig 5)**

Width of the member - 300 mm.

Thickness of the memeber - 200 mm.

1 Draw the three dimensional views of halved joint, notched joint cogged joint, housed joint, chase - mortise joint,dovetailed joint mortise and tenon joint, joggled joint, bridled joint, tusk and tenon joints.

2 Draw the sketches of Angled or corner joint and oblique shouldered joint.

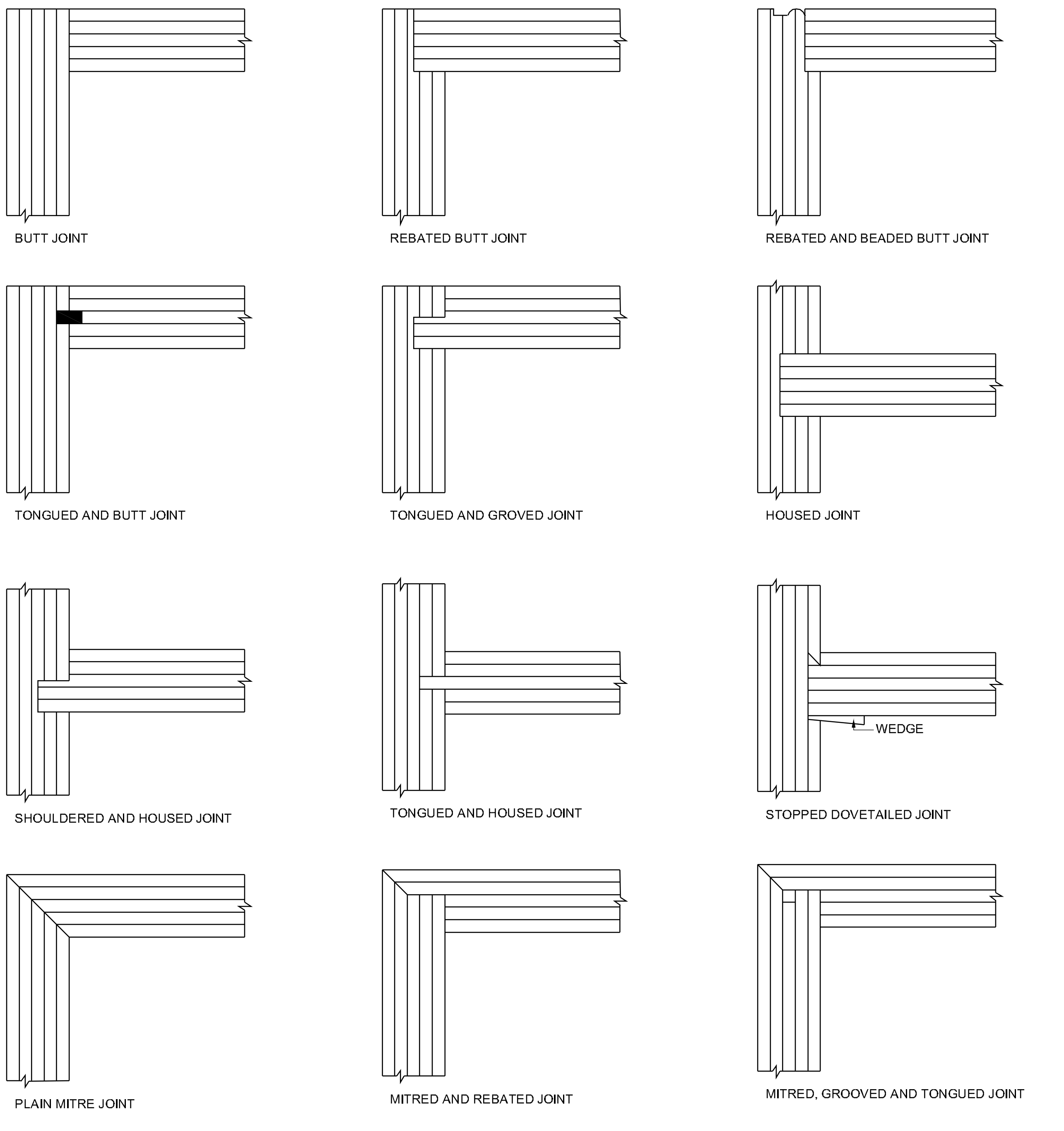
DATA

Size of the members can be assumed suitably.

Draw the all types of bearing joints.

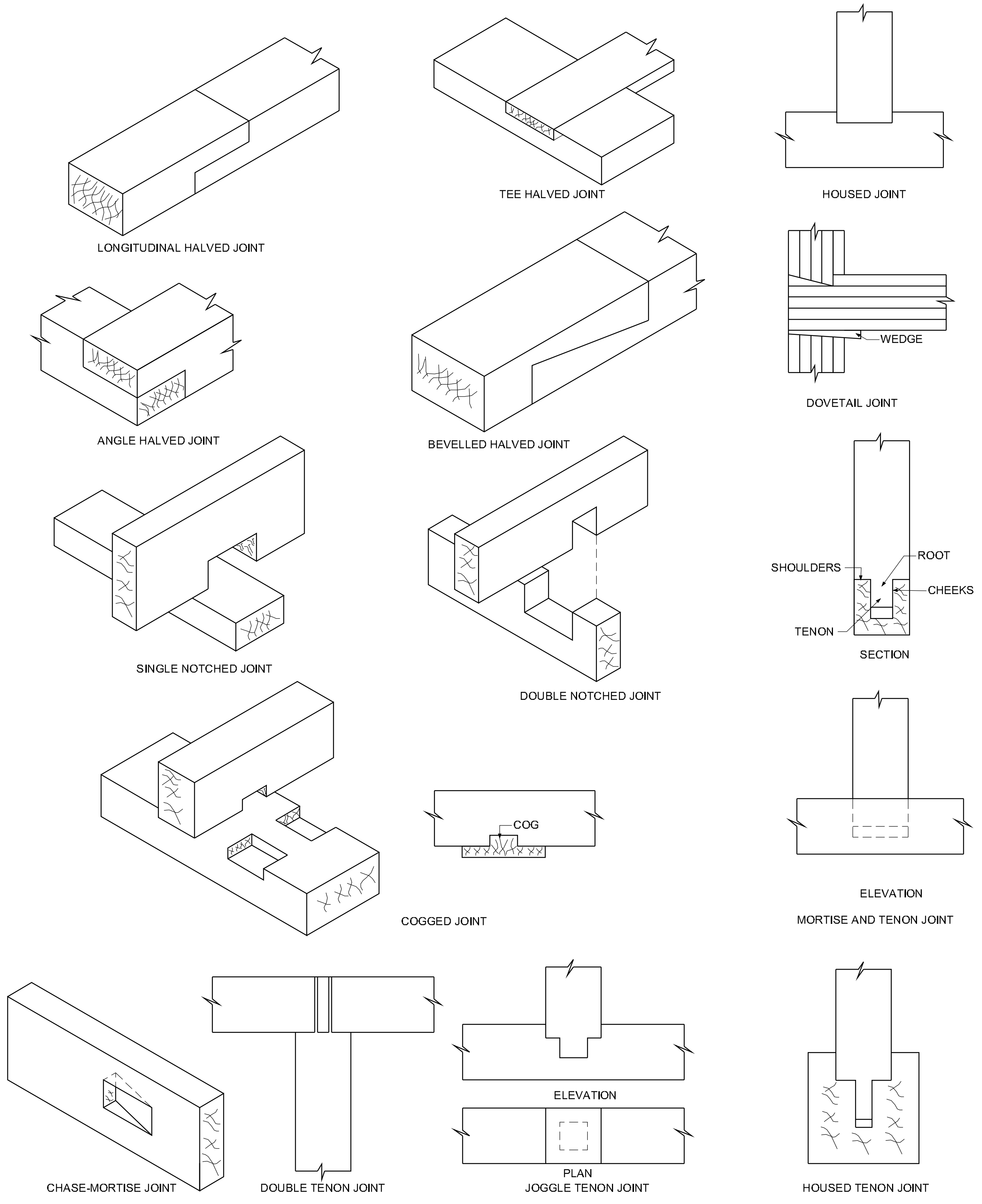
Draw the oblique shouldered joints.

Fig 3



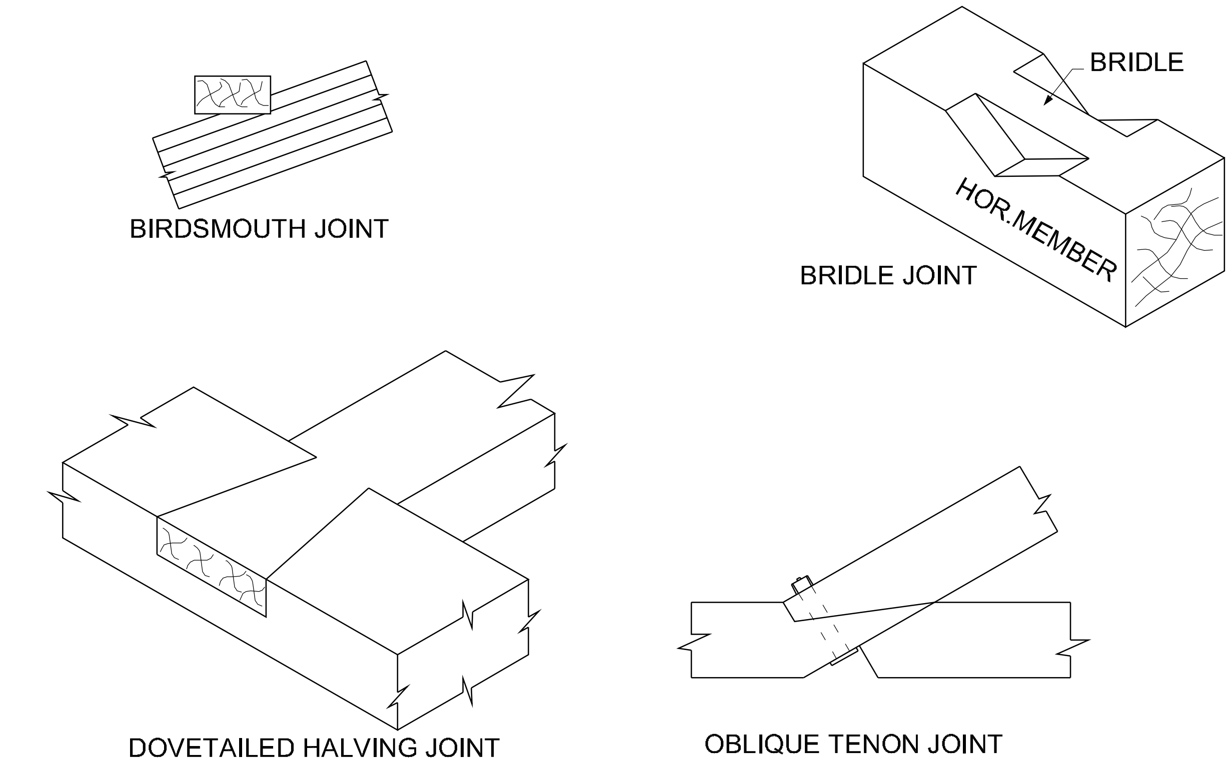
ANGLE JOINTS

Fig 4



BEARING JOINTS

Fig 5

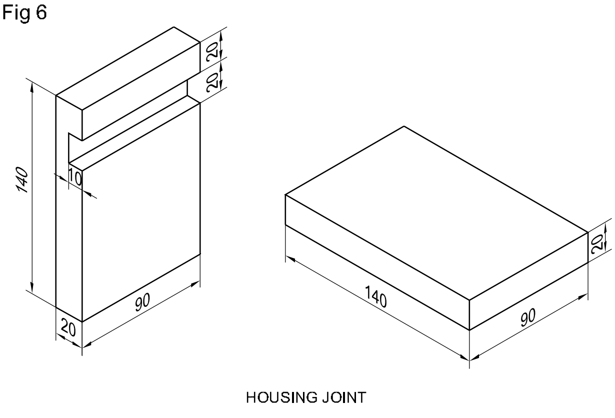


OBLIQUE SHOULDERED JOINTS

— — — — — — — —

TASK 4: **Draw the views of through housing joint (Fig 6)**

Fig 6

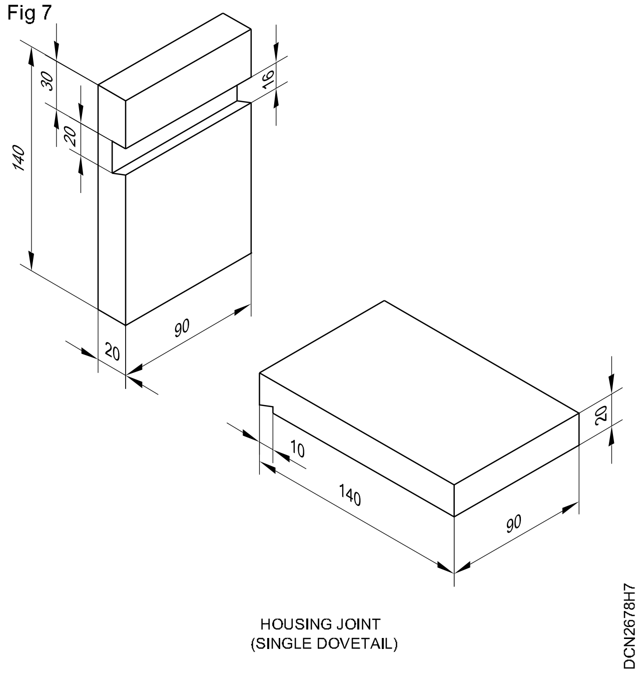


HOUSING JOINT

— — — — — — — —

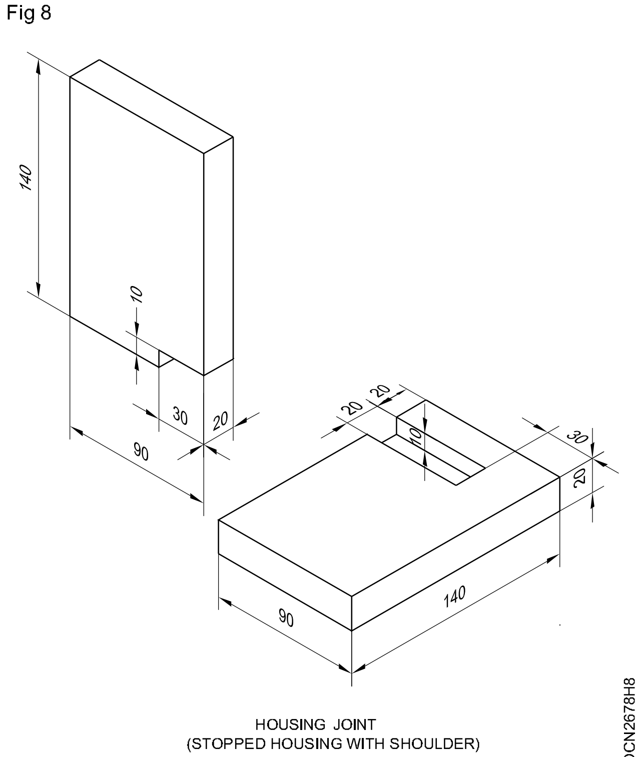
TASK 5: **Draw the views of housing joint (Single dovetail) (Fig 7)**

Fig 7



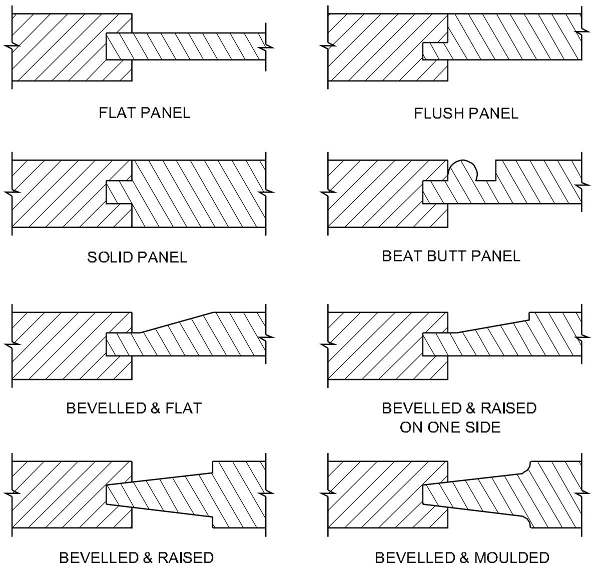
TASK 6: **Draw the views of housing joint (stopped housing with shoulder) (Fig 8)**

Fig 8



TASK 7: **For the given different verities of panels, prepare the drawing proportionately (Fig 9)**

Fig 9

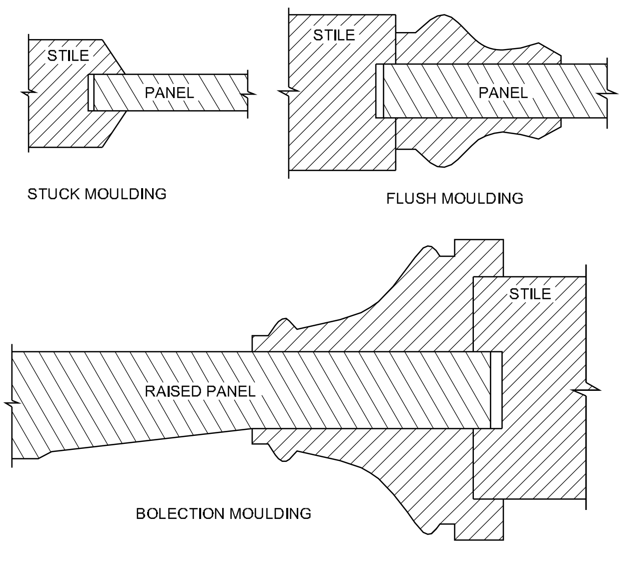


DIFFERENT VARIETIES OF PANELS

— — — — — — — —

TASK 8: **For the given different forms of moulding, prepare the drawing propertionaly (Fig 10)**

Fig 10



FORMS OF MOULDING

— — — — — — — —

Types of doors - I

Objectives: At the end of this exercise you shall be able to
- **draw the views of ledged and battened door**
- **draw the views of ledged, battened and braced door**
- **draw the views of ledged, battened, braced and framed door.**

PROCEDURE

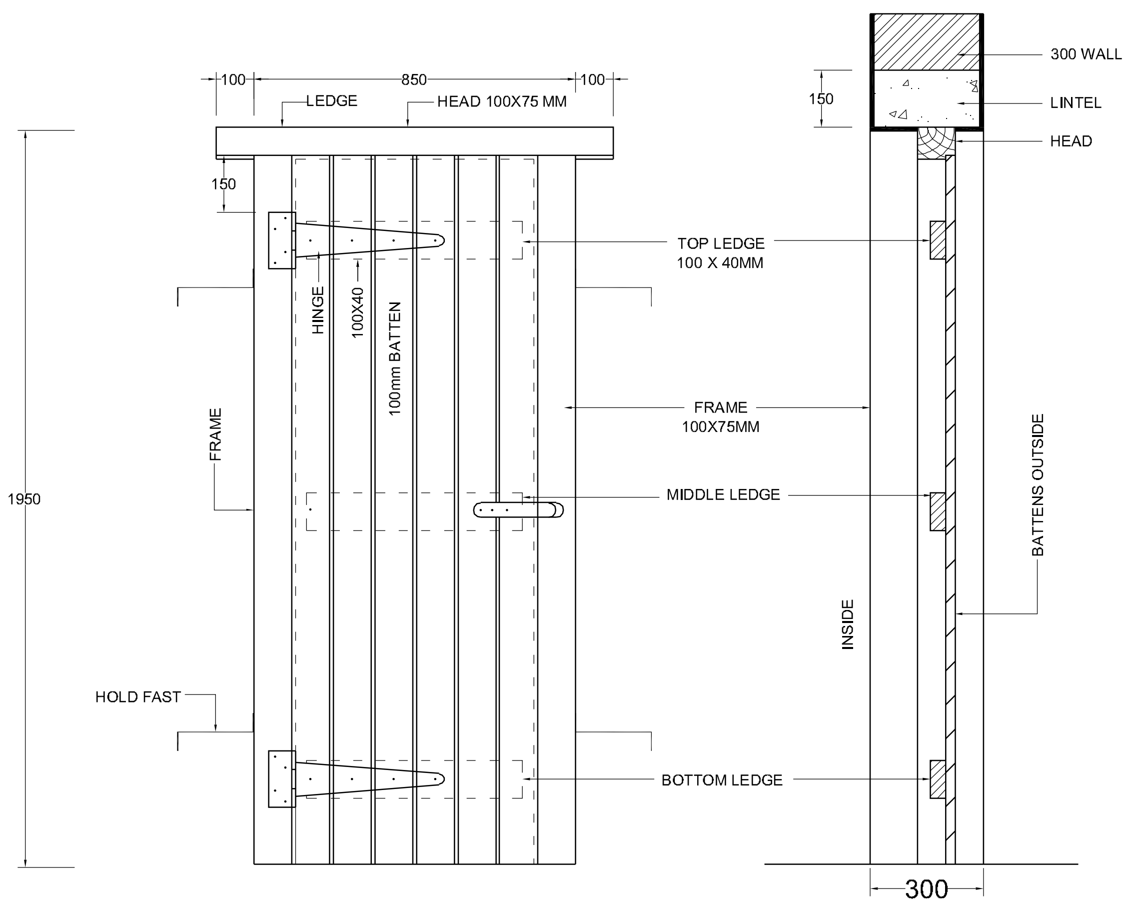
TASK 1; **Draw the, elevation and vertical section of ledged and battened door (Fig 1)**

DATA

Width of wall	- 300 mm.
Height of lintel	- 150 mm.
Size of door	- 850 x 1950 mm.
Frame size	
Head frame	- 100 x 75 mm.
Post	- 100 x 75 mm.
Ledge	- 100 x 40 mm -3 Nos.
Batten	- 32 mm thick - 6 Nos.
Length of hinges	- 400 mm -2 Nos.

- Draw the door opening, size 850 x 1950 mm.
- Draw two door posts, thickness 75 mm and height 1875 mm, at a distance of 700 mm apart.
- Draw door head 75 mm thick and 1050 mm length.
- Draw batten 6 nos, 117 mm width between the posts.

Fig 1



LEDGED AND BATTEN DOOR

DCN2679H1

- Draw top, middle and bottom ledges, of size 100 x 40 mm as shown in figure.
- Draw two hinges of length 400 mm at a suitable position.
- Develop the vertical section and fili the details as shown in figure.
- Complete the drawing.

— — — — — — — —

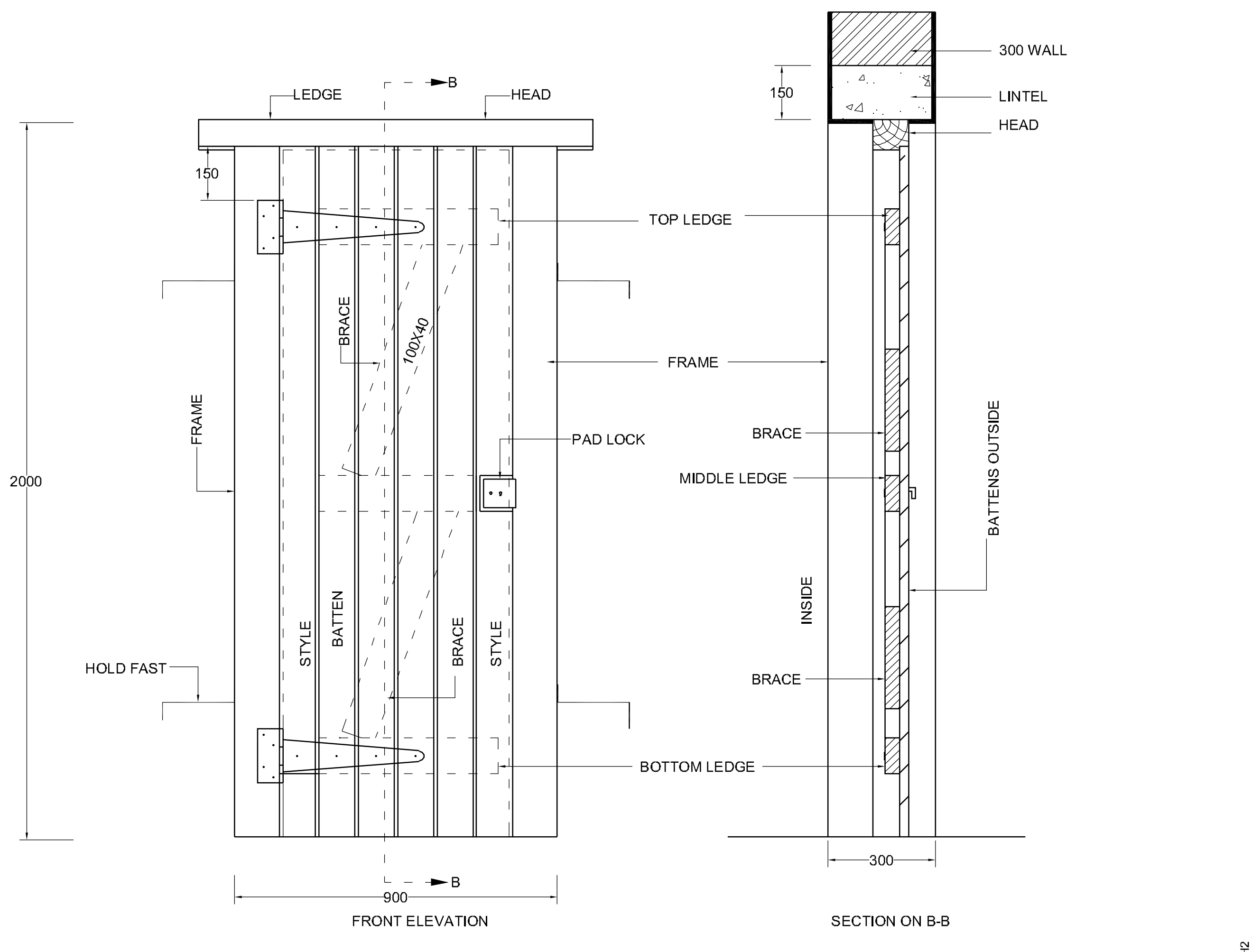
TASK 2: **Draw the vertical section, and elevation of ledged, battened and braced door (Fig 2)**

DATA

Width of wall	- 300 mm.
Height of lintel	- 150 mm.
Size of door	- 750 x 1950 mm.
Frame size:	
Head frame	- 100 x 75
Post	- 100 x 75 mm.
Ledge	- 100 x 40 mm -3 Nos.
Brace	- 100 x 40 mm -2 Nos.
Batten	- 32 mm thick - 5 Nos.
Length of hinges	- 400 mm -3 Nos.

- Draw the door opening, size 850 x 1950 mm.
- Draw two door posts, thickness 75 mm height 1875 mm, at a distance of 700 mm apart.
- Draw door head 75 mm thick and 1050 mm length.
- Draw batten 6 nos, 117 mm width between the posts3.
- Draw top, middle and bottom ledges, of size 100 x 40 mm as shown in figure.
- Draw two hinges of length 400 mm at a suitable position.
- Draw braces inclined between top and middle ledges and middle and bottom ledges.
- Develop the vertical section, fill the details and Complate the drawing.

Fig 2



LEDGED, BATTENED, BRACED AND FRAMED DOORS

— — — — — — — —

TASK 3 **Draw the vertical section, elevation of leged, framed and braced door.**

DATA

Width of wall - 300 mm.

Height of lintel - 150 mm.

Size of door - 900 x 2000 mm.

Frame size:

Head frame - 100 x 75.

Post - 100 x 75 mm.

Ledge - 100 x 30 mm -3 Nos.

Batten - 30 mm thick - 4 Nos.

Styles - 125 x 40 mm thick, 2 Nos.

Length of hinges - 400 mm -3 Nos.

- Draw the door opening, size 900 x 2000m.
- Draw two posts, thickness 75 mm and height 1925 mm, at a distance of 750 mm apart.
- Draw door head 75 mm thick and 1200 mm length.
- Draw styles 125 x 40 mm thick 2 Nos.
- Draw battens 4 Nos, 125 mm width between the styles.
- Draw top, middle and bottom ledges as shown in figure.
- Draw the hinges 400 mm - 2 Nos.
- Draw braces inclined between top and middle ledges and middle and bottom ledge.
- Develop the vertical section and mark the symbol and complete the drawing.

— — — — — — — —

Types of doors - II

Objectives: At the end of this exercise, you shall be able to, draw the views of
- **panelled door**
- **panelled and glazed door.**

TASK 1: **Draw the vertical section, elevation of panelled door (Fig 1)**

DATA

Width of wall - 300 mm.

Height of lintel - 150 mm.

Size of door - 1000 x 2000 mm.

Frame size:

Head frame - 90 x 70 mm.

Post - 90 x 70 mm.

Vertical styles - 95 x 35 mm -4 Nos.

Top rail - 95 x 35 mm.

Lock rail - 150 x 35 mm.

Mid rail - 95 x 35 mm.

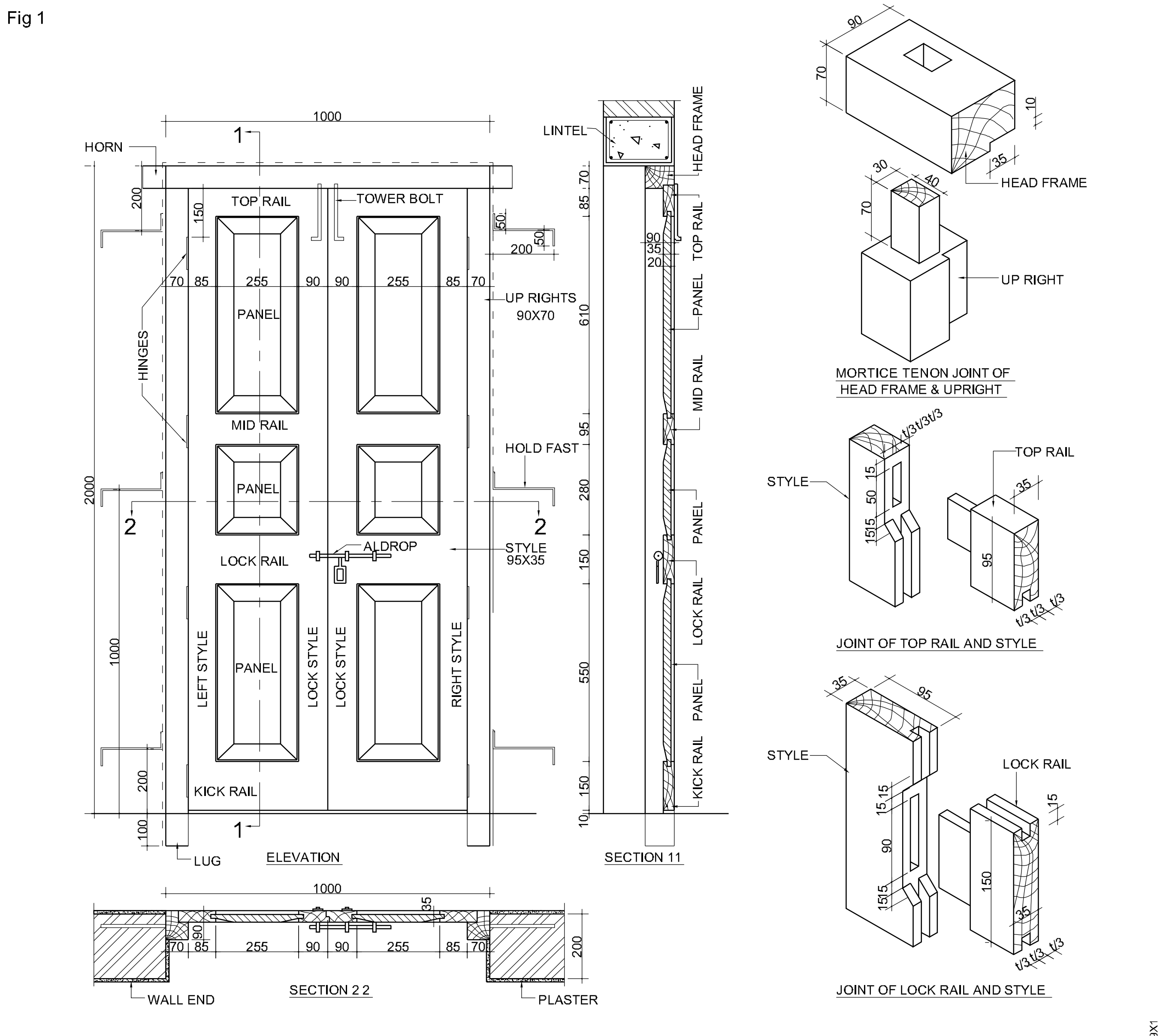
Butt hinges - 100 mm 4 Nos.

Pannel - 6 Nos. of equal size, 20 mm thick.

- Draw door opening, size 1000 x 2000 mm.
- Draw two post 70 mm thick, height 1930 mm at a distance of 860 mm apart.
- Draw door head 70 mm thick 1300 mm length inclied the horn.
- Draw style of size 95 x 35 mm near the two post.
- Draw top rail 95 x 35 mm.
- Draw panel size 20 mm thick.
- Draw widrail 95 x 35 mm.
- Draw lock rail 150 x 35 mm.
- Draw the bottom rail 150 x 35 mm.
- Draw panels and butt hinges as shown in figure.
- Mark the aldrop in lock rail and complete the drawing.
- Draw the vertical section and mark the symbols and complete the drawing.

— — — — — — — —

Fig 1



PANELLED DOOR

TASK 2: **Draw the elevation and vertical section of panalled and glazed door (Fig 2)**

DATA

Width of wall - 300.

Height of lintel - 150 mm.

Size of door - 1000 x 2000 mm.

Frame size -

Head frame - 90 x 70 mm.

Post - 90 x 70 mm.

Vertical styles - 95 x 35 mm thick 4 Nos.

Top rail - 95 x 35 mm.

Lock rail - 195 x 35 mm.

Bottom - 195 x 35 mm.

Butt hinges - 100 mm 4 Nos.

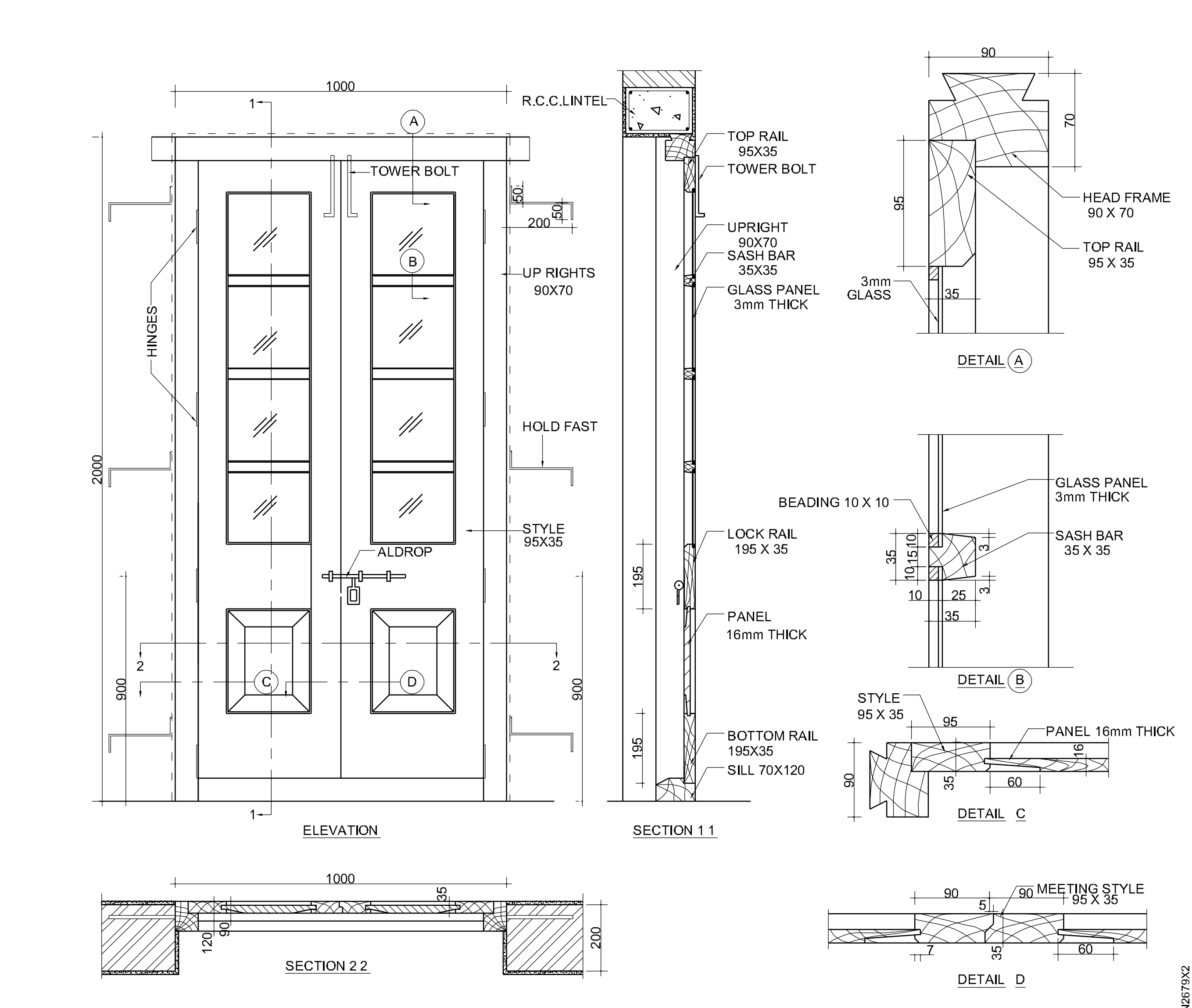
Pannel - 6 Nos. of equal size, 20 mm thick.

Glass = 3 mm thick 8 Nos.

Sash = 35 x 35 mm.

- Draw door opening 1000 x 2000 mm.
- Draw two posts 70 mm thick, height 1930 mm at a distance of 860 mm apart.
- Draw door head 70 mm thick.
- Draw style of size 95 x 35 mm near the two post.
- Draw top rail 95 x 35 mm.
- Draw sash bar and glass panel as shown in figure.
- Draw the lock rail and mark the aldrop.
- Develop the vertical section mark the symbols and complete the drawing.

Fig 2



HALF GLAZED DOOR

— — — — — — — —

Types of doors - III

Objectives : At the end of this exercise, you shall be able to
- **draw the section and elevation of the flush doors**
- **draw the elevation of collaposible door.**

TASK 1: **Draw the elevation and section of soild or laminated flush door (Fig 1a)**

DATA

Size of door - 1000 x 2000.

Post - 80 x 120 mm - 2 Nos.

Head - 80 x 120 mm.

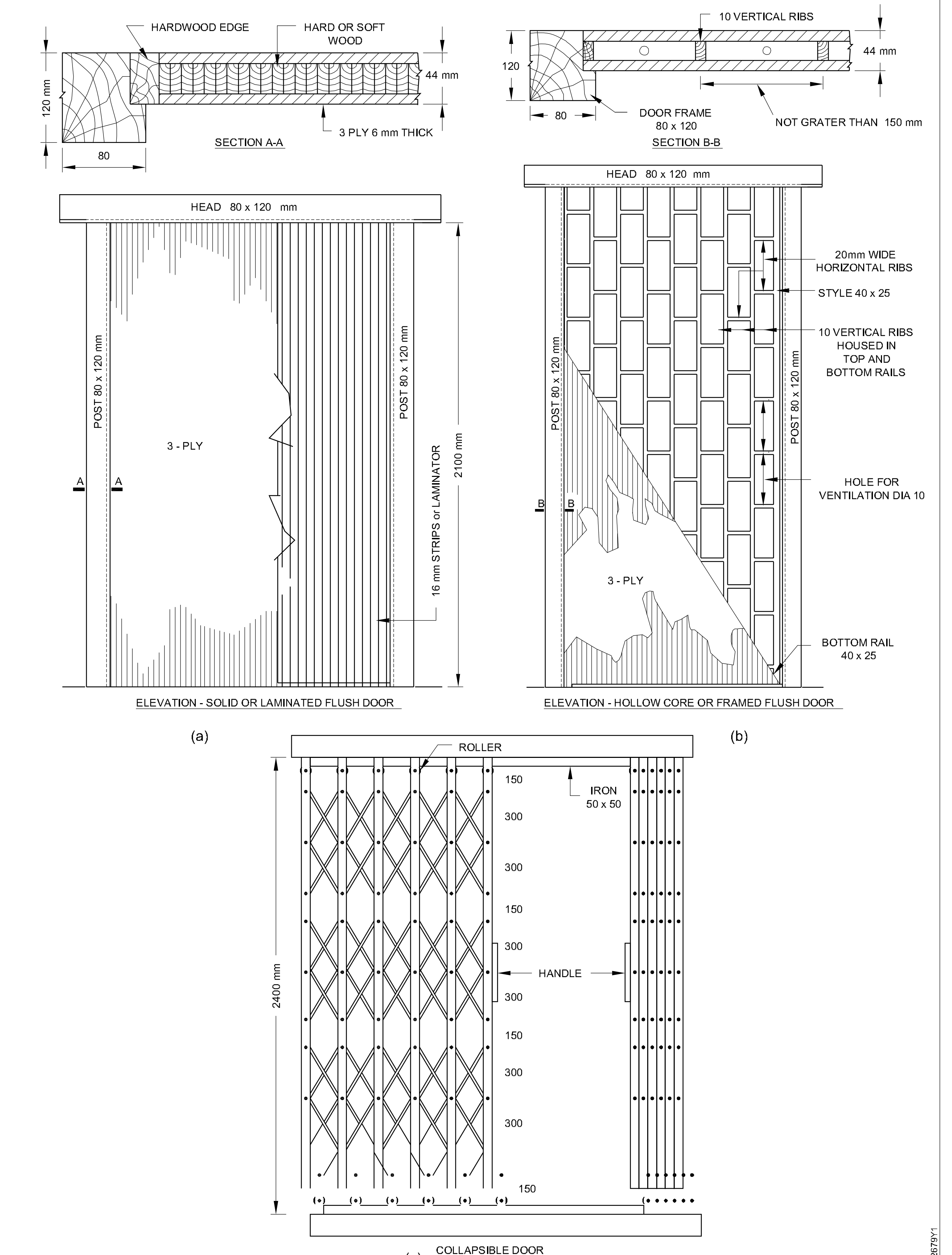
3 ply - 6 mm thick.

Thickness of shutter 44 mm.

- Draw the door opening, size of 1000 x 2100 mm.
- Draw two posts of thickness 80 mm, and height 1920 mm at a distance of 840 mm apart.
- Draw a head 80 mm thickness over the post.
- Draw parallel strips 16 mm each as shown in fig 1.
- Draw the details of section as shown in fig 1.
- Complete the drawing.

— — — — — — — —

Fig 1


HARDWOOD EDGE
HARD OR SOFT WOOD
120 mm
44 mm
3 PLY 6 mm THICK
80
SECTION A-A
10 VERTICAL RIBS
120
44 mm
80
DOOR FRAME 80 x 120
NOT GRATER THAN 150 mm
SECTION B-B
HEAD 80 x 120 mm
POST 80 x 120 mm
3 - PLY
A
A
POST 80 x 120 mm
16 mm STRIPS or LAMINATOR
2100 mm
ELEVATION - SOLID OR LAMINATED FLUSH DOOR
HEAD 80 x 120 mm
20mm WIDE HORIZONTAL RIBS
STYLE 40 x 25
10 VERTICAL RIBS HOUSED IN TOP AND BOTTOM RAILS
POST 80 x 120 mm
POST 80 x 120 mm
HOLE FOR VENTILATION DIA 10
B
B
3 - PLY
BOTTOM RAIL 40 x 25
ELEVATION - HOLLOW CORE OR FRAMED FLUSH DOOR
(a)
(b)
ROLLER
IRON 50 x 50
150
300
300
150
300
HANDLE
300
150
300
300
150
2400 mm
COLLAPSIBLE DOOR
(c)
DCN2679Y1

DOORS

TASK 2: **Draw the elevation and section of framed flush door (Fig 1b)**

DATA

Horizontal ribs	- 20 mm wide.
Vertical ribs	- 10 mm.
Ventilaling hole	- 10 mm.
Bottom rail	- 40 x 25.

- Draw the door opening, 1000 x 2100 mm.
- Draw two points of thickness 80 mm, and height 1920 mm at a distance of 840 mm apart.
- Draw a head 80 mm thickness over the post.
- Draw horizontal & vertical ribs of 20 mm width as shown in fig 1.
- Draw bottom rail of size 40 x 25 mm.
- Draw the details of section as shown in figure.
- Complete the drawing.

— — — — — — — —

TASK 3: **Draw the elevation of collapsible door (Fig 1c)**

DATA

Size of door = 2400 x 3000 mm.

Double channels 20 x 10 x 2 mm.

Spacing of vertical channels 100 to 120 mm.

Flat iron 20 mm wide, 5 mm thick.

- Draw the door opening size 2400 x 3000 mm.
- Draw 10 vertical channels in open condition of left side and vertical channels in closed condition on right side.
- Draw the flats diagonally between the channels as shown in the figure. Mark the rivert heads at the junction of channels and plats.
- Complete the drawing.

— — — — — — — —

Types of windows & ventilator

Objectives: At the end of this exercise, you shall be able to
- **draw the elevation and vertical section of panelled windows**
- **draw the elevation and vertical section of steel windows**
- **draw the elevation and cross section of ventilators.**

PROCEDURE

TASK 1: **Draw elevation and vertical section of paneled window (Fig 1a)**

DATA

Window opening	= 750 x 1200 mm.
Frame size	= 110 x 75 mm.
Head	= 75 x 110 mm.
Post	= 75 x 110 mm - 2 Nos.
Hanging style	= 75 x 32 mm - Nos.
Meeting style	= 75 x 32 mm - Nos.
Top rail	= 75 x 32 mm.
Frieze rail	= 75 x 32 mm.
Bottom rail	= 75 x 32 mm.
Panel	= 348 x 162 x 20 mm - 6 Nos.
Projection of horn	= 150 mm on both sides.

- Draw the window opening of size 750 x 1200 mm.
- Draw two posts of 75 mm thick and 1050 mm height at distance of 600 mm apart.
- Draw a sill of 75 mm thick and 900 mm length below the post.
- Draw the head of 75 mm thick and 900 mm length over the post.
- Draw the hanging style of width 75 mm near the posts.
- Draw the two meeting styles of width 75 mm in the middle.
- Draw top rail and bottom rail of height 75 mm between the styles.
- Draw three panels of height of 258 mm and two friexe rail of 75 mm height between the top and bottom rail.
- Draw thevertical section as shown in fig 1.

— — — — — — — —

TASK 2: **Draw the elevation and details of steel window (Fig 1b)**

DATA

Size of window	= 900 x 1200 mm.
No of glazed panel	= 8 Nos.
Sash bar	= 20 x 20 x 3 mm.
Mullion	= 45 x 25 x 3 mm.
Head, silk, post	= 24 x 35 x 3 mm.

- Draw the window opening of size 900 x 1200 mm.
- Draw head, sill, posts of size 24 x 35 x 3 mm as shown in fig.
- Draw mullion in the middle of frame.
- Draw eight glass panels of same size in each shutter.
- Draw sash bar of 20 mm width between the panels.
- Complete the drawing.

— — — — — — — —

TASK 3: **Draw the elevation and cross section of ventilators (Fig 1c)**

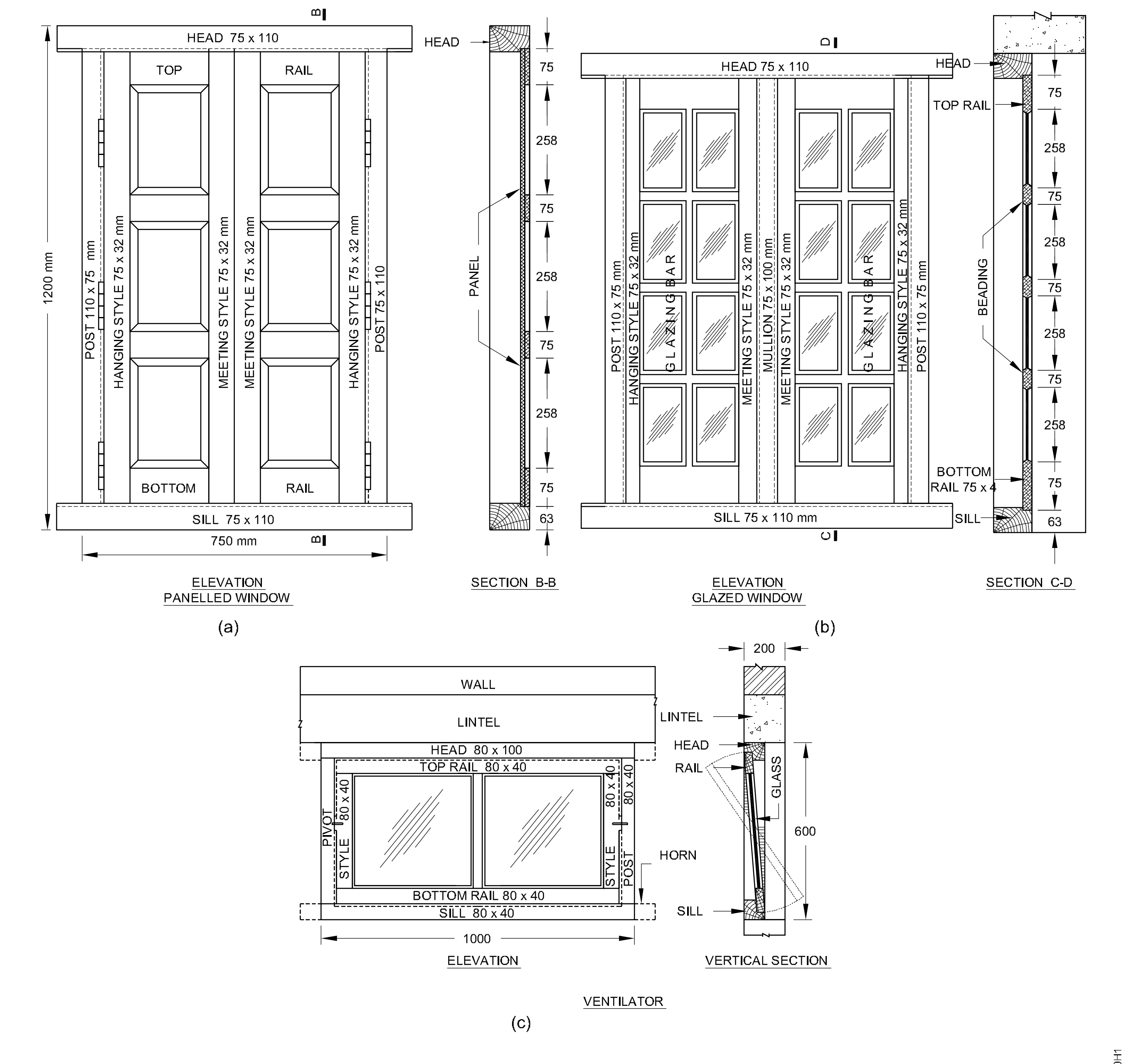
DATA

Size of ventilator	- 1000 x 600 m.
Head	- 80 x 100 mm.
Sill	- 80 x 40 mm.
Top rail	- 80 x 40 mm.
Bottom rail	- 80 x 40 mm.
Style	- 80 x 40 mm.

- Draw the an opening of size 1000 x 600 mm.
- Draw the posts of thickness 80 mm at a distance of 840 mm apart.
- Draw a sill of thickness 80 mm and length 1300 mm below the post.
- Draw a head of thickness 80 mm and length 1300 mm over the post.
- Draw two styles of 80 mm width near the post.

- Draw top and bottom rails of 80 mm width.
- Draw two glass panels.
- Complete the elevation as shown in fig.
- Draw the section of ventilator as shown in fig 1.
- Complete the drawing.

Fig 1



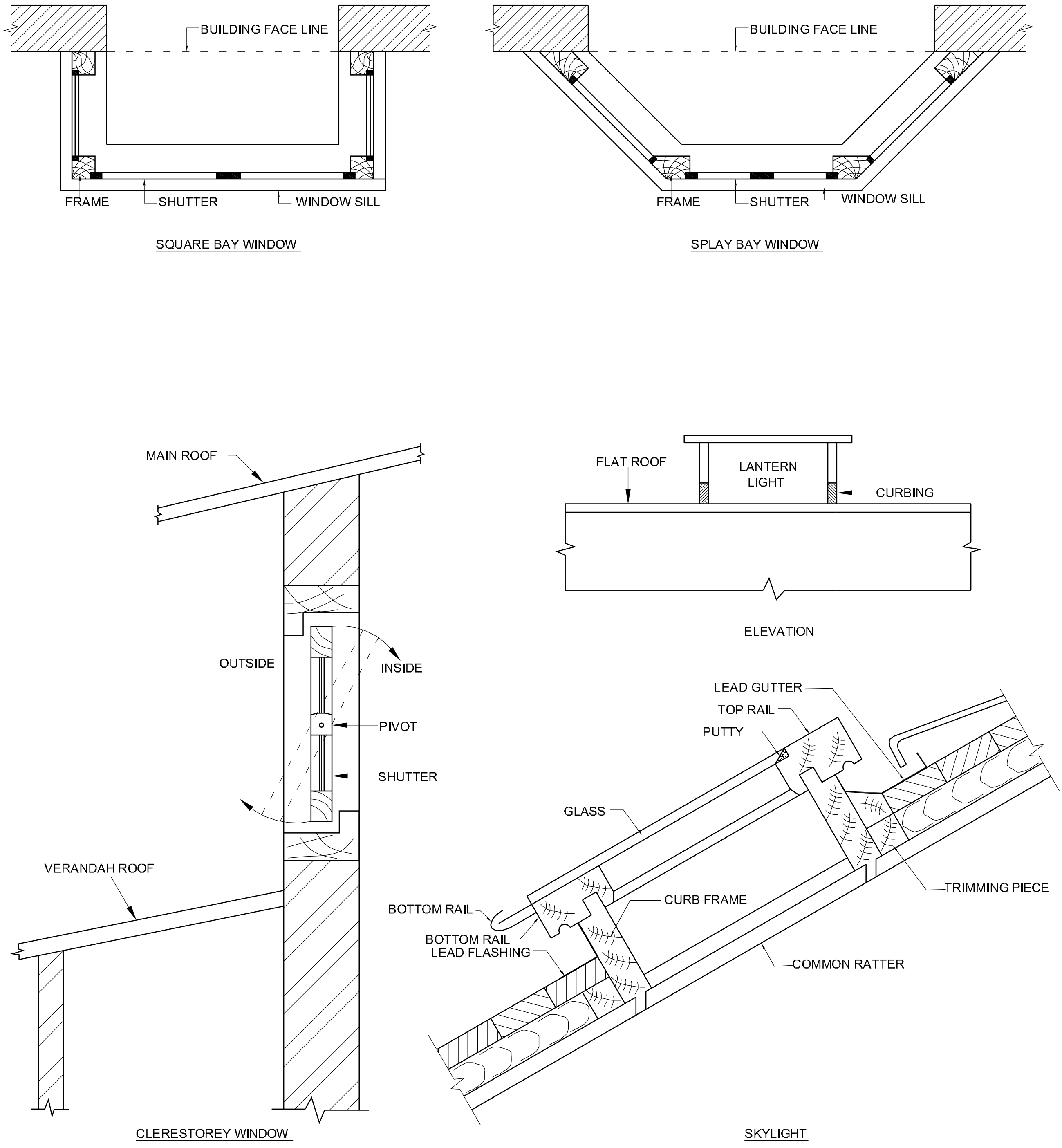
WINDOWS AND VENTILATORS

Different types of windows

Objectives : At the end of this exercise, you shall be able to
- **draw the different types of windows**
- **identify the location of windows.**

1.Draw bay window. 2.Draw corner window. 3.Draw clerestorey window. 4.Draw lantern light window.
5. Sky light window.

Fig 1



DIFFERENT TYPES OF WINDOWS

Wiring diagram of a residential building

Objectives: At the end of this exercise you shall be able to
- **draw the wiring diagram of a building**
- **summarise the number of electrical points.**

DATA

Sizes of rooms are given in the plan.

PROCEDURE

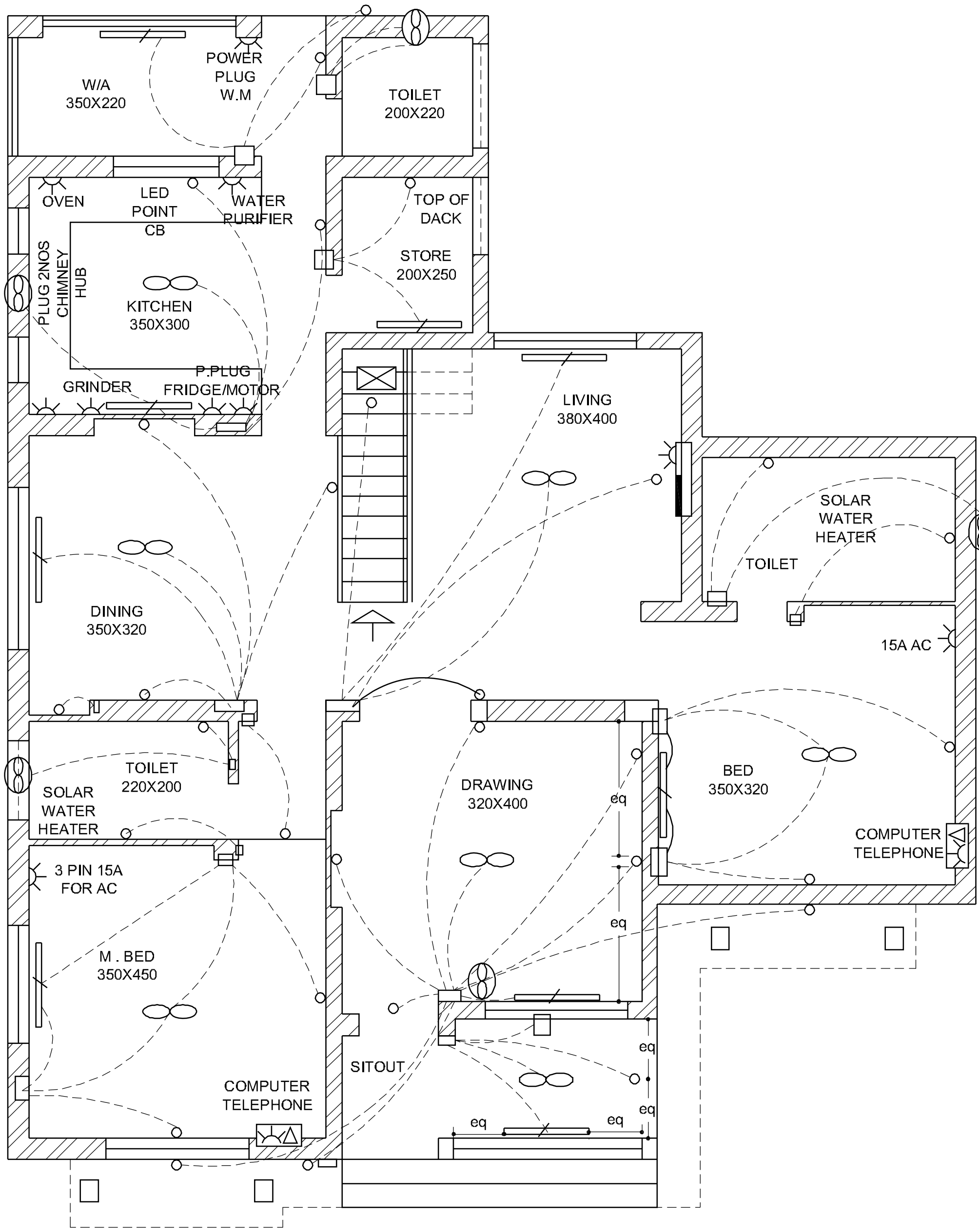
1 Draw the plans.

2 Draw the symbols of fittings. (Fig 1)

3 Summarise the points of electrical fittings. (Fig 2)

Summarization sheet for electrical points									
Sl.No	**Rooms**	**Equipments Number**				**No.of Switches**			
1	Sit out	1	2	1	0	6		1	0
2	Drawing room	1	3	1+2	0	8	1	1	-
3	Master bed	1	3	1	0	7	2	2	2
4	Toilet	0	2	0	1	4	0	0	0
5	Dining	1	4	1	0	7	0	1	0
6	Living	1	2	1	0	8	0	1	1
7	Bed	1	2	1	0	5	2	1	2
8	Toilet	0	2	0	1	3	0	0	0
9	Kitchen	1	2	1	1	12	0	1	6
10	Store	1	1	0	0	3	0	0	0
11	Work Area	1	2	0	0	5	0	1	1
12	Toilet	0	2	0	1	3	0	0	0
	Total	9	28	6	4	71	5	9	12

Fig 1

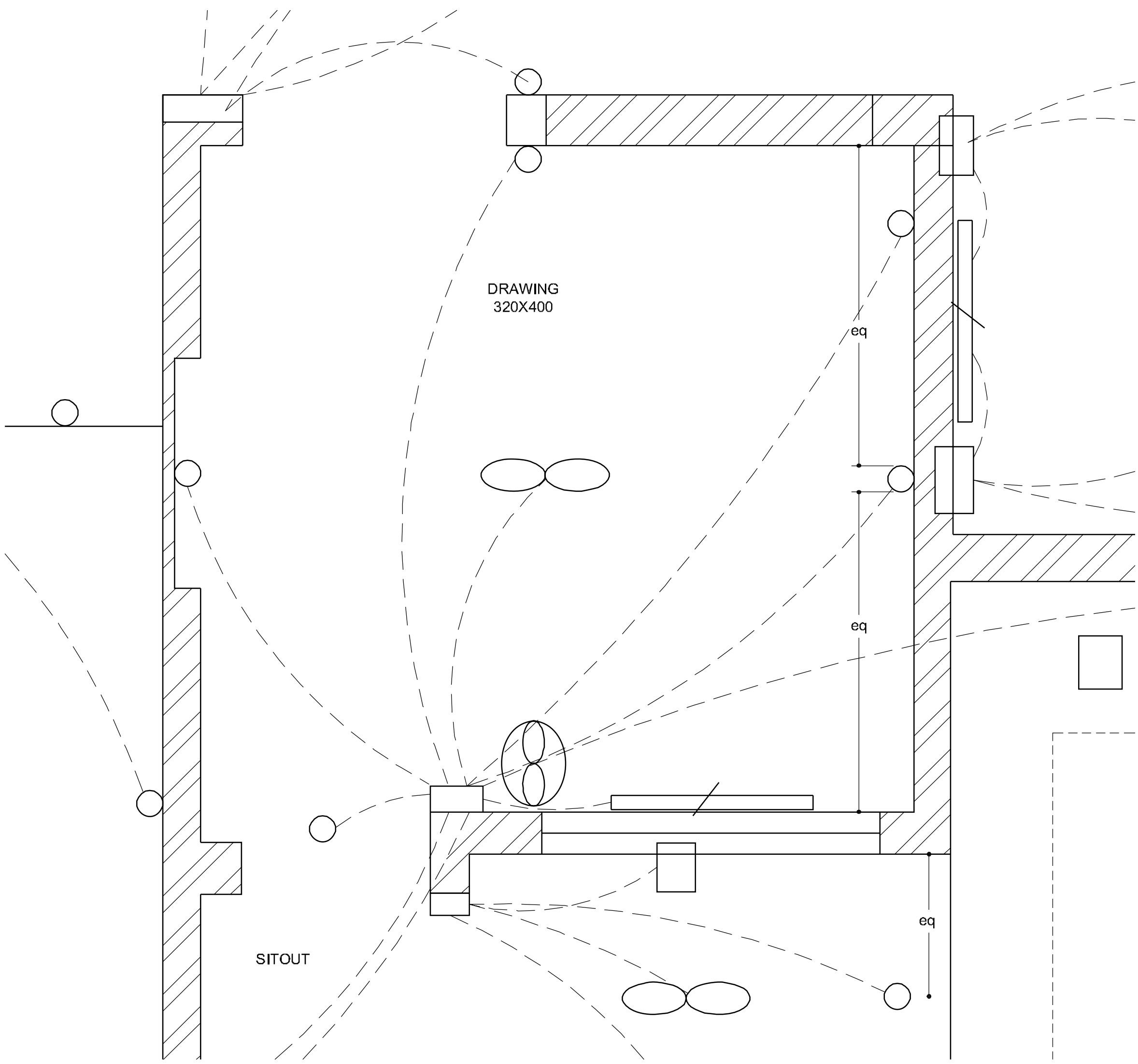


LEGEND		
S. No.	PARTICULARS	SYMBOL
1	POWER POINT	
2	TUBE LIGHT	
3	SWITCH BOARD	□
4	T.V. POINT	
5	TELEPHONE POINT	△
6	CEILING FAN	
7	WALL FAN	
8	FANCY LIGHT	○
9	EXHAUST FAN	
10	D.B.	⊠
11	A.C. POWER PLUG	

WIRING DIAGRAM OF A RESIDENTIAL BUILDING

DCN2781H1

Fig 2



LEGEND		
S. No.	PARTICULARS	SYMBOL
1	POWER POINT	
2	TUBE LIGHT	
3	SWITCH BOARD	
4	T.V. POINT	
5	TELEPHONE POINT	
6	CEILING FAN	
7	WALL FAN	
8	FANCY LIGHT	
9	EXHAUST FAN	
10	D.B.	
11	A.C. POWER PLUG	

WIRING DIAGRAM OF A RESIDENTIAL BUILDING

DCN2781H2

Types of ground & upper floors

Objectives: At the end of this exercise, you shall be able to
- **draw section of a timber ground floor**
- **draw isometric view of brick floor**
- **draw isometric view of flag stone**
- **draw the section of concrete floor**
- **draw the section of terrazzo floor**
- **draw the section of mosaic floor.**

PROCEDURE

TASK 1**: Draw the section of a timber ground floor (Fig 1a)**

DATA

Wall	200 mm thick.
Base concrete	- 150 mm thick.
Sleeper walls	- 100 mm thicks, at 1500 mmc/c.
Wallplate	- 100 mm thick.
D.P.C	- 25 mm thick.
Bridging joint	- 50 x 180 mm.
Floor boards	- 32 mm thick.

- Draw the section of wall above and below ground floor.
- Draw the base concrete, 150 mm depth.
- Draw the sleeper wall of height 1000 mm at 1500 mm c/c.
- Draw the section of wall platel 100 mm x 100 mm, over 300 mm thick D.P.C on end wall and centre of sleeper wall.
- Draw the elevation of bridging joint 180 mm depth over these wall plates.
- Draw the section of floor boards, 32 mm thick over joint.
- Finish the drawing with proper conventional symbols.

— — — — — — — —

TASK 2**: Draw the isometric view of brick floors (Fig 1b)**

- Draw the sub-grade with 100 mm thick lean concrete as shown in figure.
- Draw 12 mm thick lime/ cement mortar over this subgrade.
- Draw the isometric view of bricks laid on edges as shown in figure.

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TASK 3**: Draw the isometric view of flag stone floor (Fig 1c)**

DATA

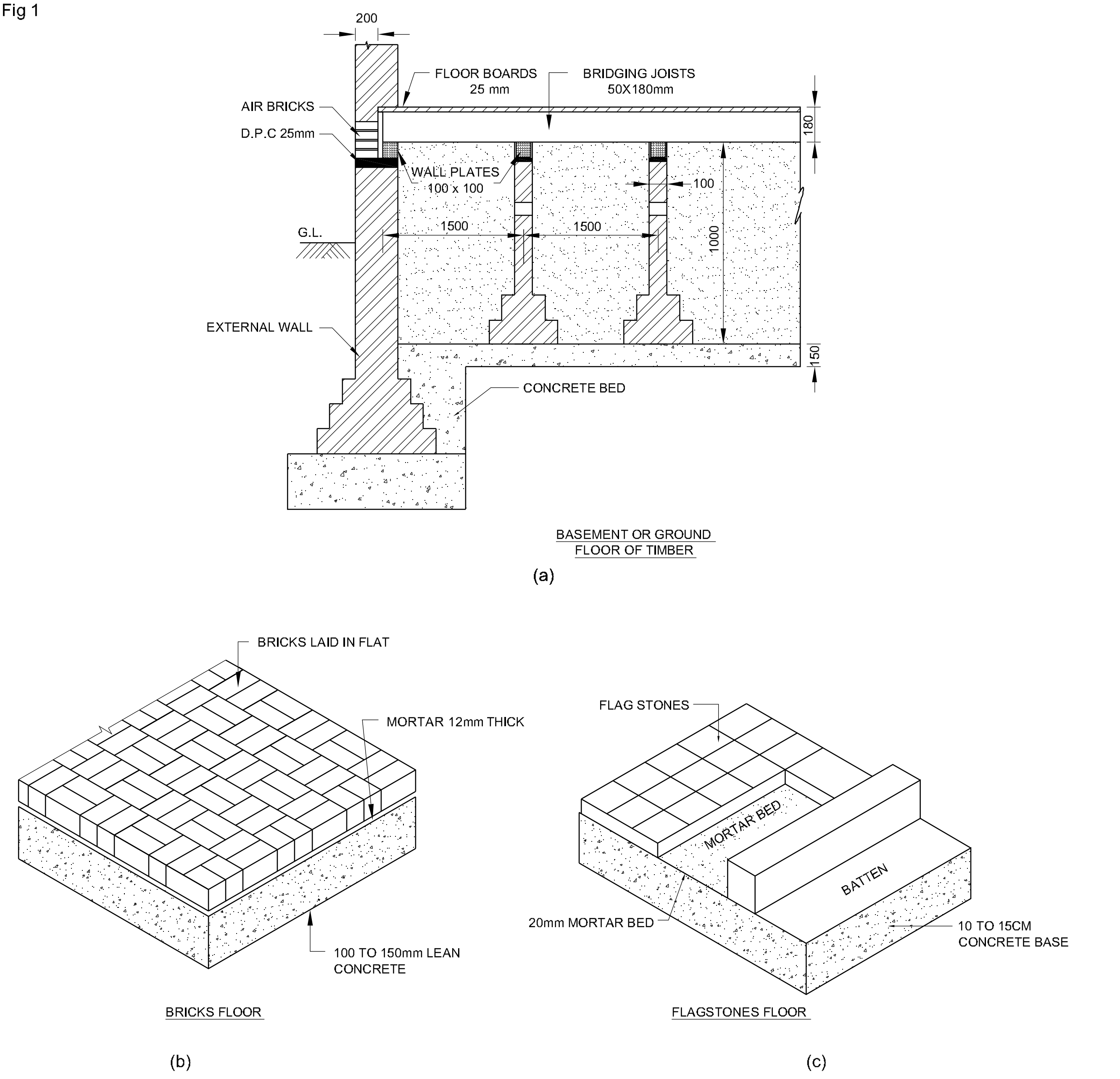
Stone size - 60 x 45 x 20 mm.

Depth of concrete for subgragde - 100 mm.

Mortar bed - 20 mm thick.

- Draw the sub grade with 100 mm thick lean concrete as shown in figure.
- Draw 20 mm thick lime / cement mortar over this sub grade.
- Draw the stone slabs over this mortar bed as shown in figure.

Fig 1



FLOORS (GROUND)

— — — — — — — —

TASK 4**: Draw the section of cement concrete floor (Dimensions are given in) (Fig 2a)**

- Draw section of a wall, with basement.
- Draw a line to mark to ground level.
- Show hard earth filling, of suitable (it may varies) thickness above ground level.
- Draw 100 mm thick base concrete above earth fill.
- Draw 25mm thick floor finish with cement plastering.

— — — — — — — —

TASK 5**: Draw the section of terrazzon floor (Fig 2b)**

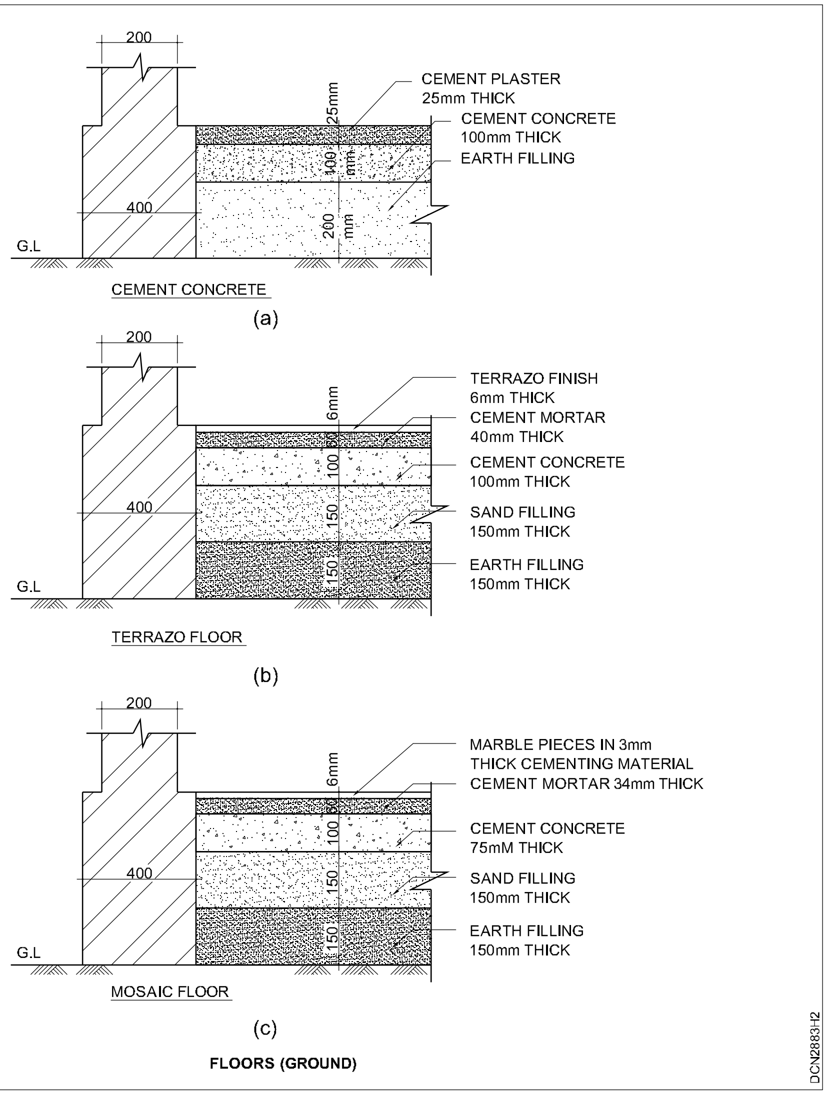
- Draw section of a wall with basement.
- Draw a line to mark ground level.
- Show well consolidated earth fill above ground level.
- Draw 150 mm thick sand filling above earth fill.

- Draw 75 mm thick cement concrete over sand filling.
- Draw 34 mm thick cement mortar.
- Draw 6 mm thick terrzzo flooring.

TASK 6**: Draw the section of mosaic floor (Fig 2c)**

- Draw section of a wall with basement.
- Draw a line to mark ground level.
- Show well consolidated earth fill above ground level.
- Draw 150 mm thick sand filling above earth fill.
- Draw 75 mm thick cement concrete over sand filling.
- Draw 34 mm thick cement mortar.
- Show 6 mm thick marble chips is cementing materials, as mosaic flooring.

Fig 2



FLOORS (GROUND)

Draw the types of upper floors

Objectives: At the end of this exercise, you shall be able to
- **draw plan and section of single joist timber floor**
- **draw plan and section of double joist timber floor**
- **draw plan and section of triple of framed timer floor**
- **draw the section of brick jack arch floor**
- **draw the section of concrete jack arch floor.**

PROCEDURE

TASK 1 **: Draw plan and detailed section of a single joist timber floor (Fig 1a)**

DATA

Room size	- 300 x 4900 mm.
Wall	- 300 mm thick.
Bridging joist	- 50 x 100 mm at 350 mm c/c.
Herring bone strutting	- 32 x 50 mm.
Floor board	- 32 mm.
Wall plate	- 100 x 75 mm.
Wedge	- 75 x 100 mm.

- Draw the plan of the room 3000 x 1900 mm, width wall thickness 300 mm.
- Draw wall plate 100 mm wide on longer side, in dashed line.
- Draw 75 mm thick wedges on shorter walls.
- Draw the bridging joists, 50mm width at 350 mm c/c in shorter span.
- Draw 32 mm wide strut in the middle of shorter span and between the bridging joists.
- Show the boarding of 32 mm thick at one corner and complete the drawing as shown in figure.

— — — — — — — —

TASK 2**: To draw the section along long span (Section AA) (Fig 1b)**

- Draw the section of wall.
- Draw the wedge 75 mm wide and 100 mm height, attached to the wall.
- Draw bridging joists 50 mm wide, 100 mm depth, first one attached to the wedge and others, 350 mm c/c.
- Draw the struts 32 x 50 mm diagonally between the joists
- Draw the floor board 32 mm thick on the bridging joist.
- Draw the ceilling joining the bridging joist at bottom and complete the drawing.

— — — — — — — —

TASK 3**: To draw the section along shorter span (Section BB) (Fig 1c)**

- Draw the section of wall.
- Draw wall plate 75 mm wide, 100 mm height, inside the wall.
- Draw bridging joist 100 mm height over this wall plate.
- Draw a 32 mm thick borad over the joist, starting from the side of wall.
- Show air space as shown in figure.
- Draw ceiling under the bridging joist, and complete the drawing.

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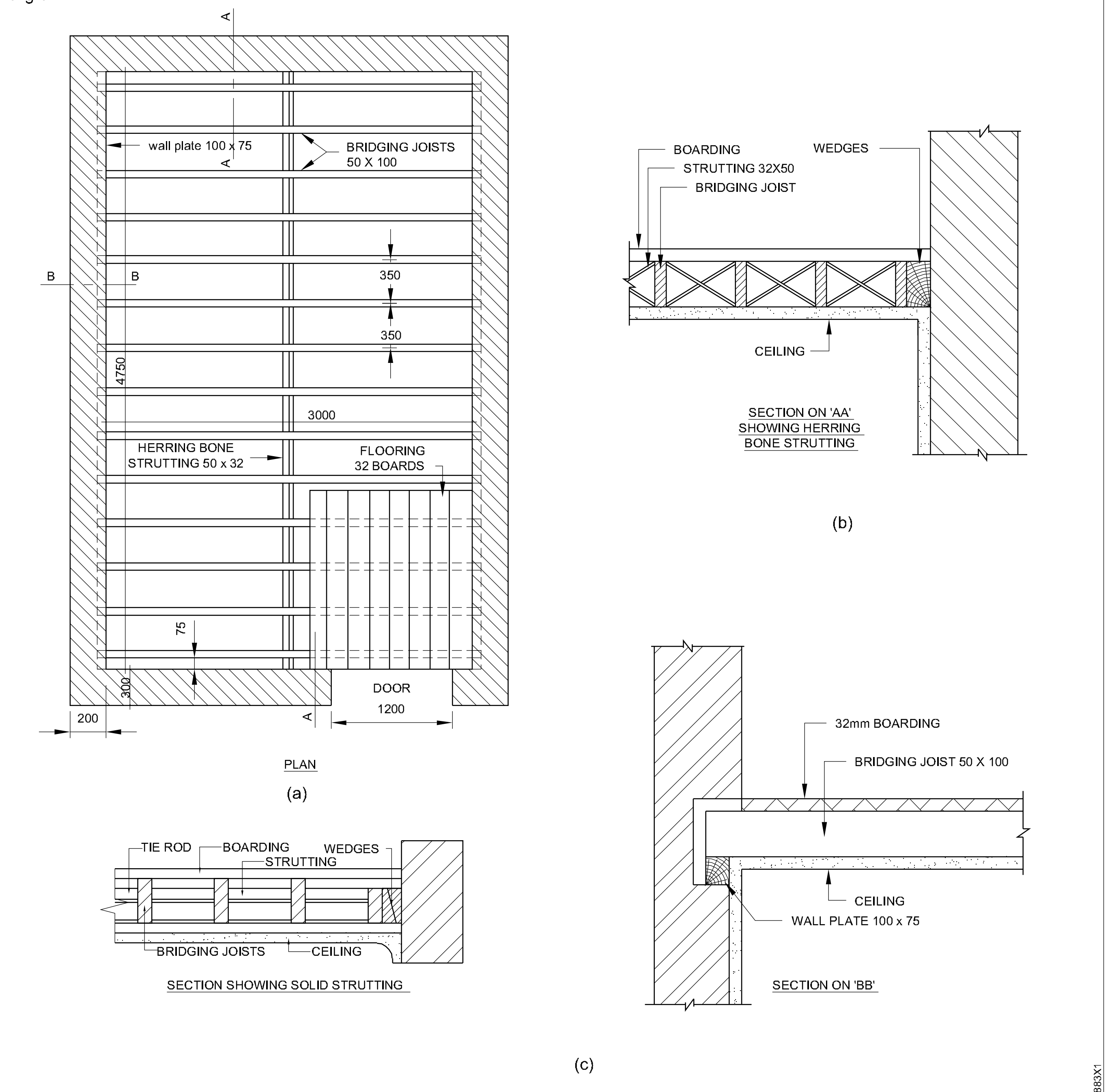
Fig 1



SINGLE JOIST FLOOR

TASK 4**: Draw the plan and detailed section of a double joist timber floor (Fig 2a)**

DATA

Wall thickness - 300 mm.

Room size - 5500 x 8000 mm.

Binders - 180 x 380 mm at 2000 mm c/c.

Bed stone - 250 x 120 x 600 mm.

Bridging joist - 150 x 50 mm.

Struts - 100 x 32 mm.

Boarding - 32 mm thick.

Wall plate - 120 x 80 mm.

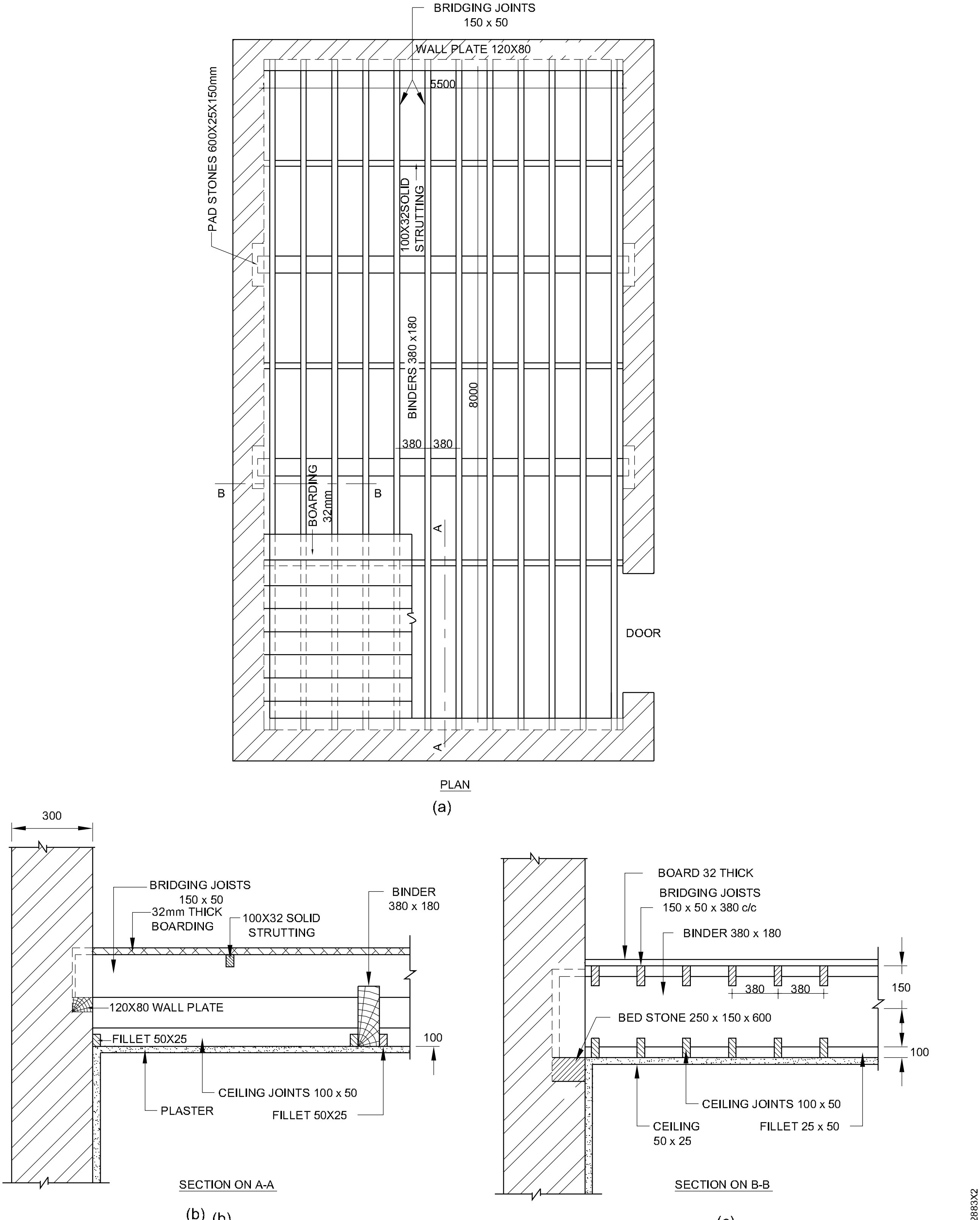
Ceiling joist - 50 x 100 mm.

Fillet - 50 x 25 mm.

- To draw sectional plan.
- Draw sectional plan of room with all thickness 300 mm.
- Draw binders in shorter span, 2000 mm c/c.
- Draw bed stone 250 x 600 in the wall below the binders.
- Draw wall plate 75 mm inside the wall, in shorter span.

- Draw bridging joist 50 x 150 mm, 380 mm c/c along longer span.
- Draw the struts in between the bridging joist, in each span.
- Draw 32 mm thick boarding in one corner as shown in figure.

Fig 2



DOUBLE JOIST TIMBER FLOOR

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TASK 5 **: To draw the section near the wall along long span (Section AA) (Fig 2b)**

- Draw the section of wall.
- Draw the ceiling joist, binders, bridging joist, board etc. as shown in figure.

— — — — — — — —

TASK 6**: To draw the section near the wall along short span (Section BB) (Fig 2c)**

- Draw the section of the wall.
- Draw the section of floor as shown in figure.

— — — — — — — —

TASK 7 **: To draw plan and section of triple joist timber floor (Fig 3)**

DATA

Bridging joist	- 7.5 x 15 cm.
Bider	- 28 x 15 cm.
Pad stone	- 25 x 12 x 60.
Struting	- 10 x 3.2 cm.
M.S Gider	- 38 x 10.5 cm.
Wall plate	- 12 x 8 cm.

- Draw a room of width 8 m. and suitable length with wall thickness of 300 mm.
- Draw wall plates size 12 x 8 cm on two sides as shown.
- Draw bridging joist of size 7.5 x 15 cm connecting the wall plate at 38 cm c/c.
- Draw M.S girder of size 38 x 10.5 cm at 3 m c/c.
- Draw pad stone of size 25 x 15 x 60 cm on left side wall with equal spacing.
- Draw binders of size 28 x 15 cm laid over the pad stone block.
- Draw wooden boarding 32 mm at left side corner.
- Draw wooden lines AA and BB as shown in figure.
- Draw section AA and BB as shown in figure.

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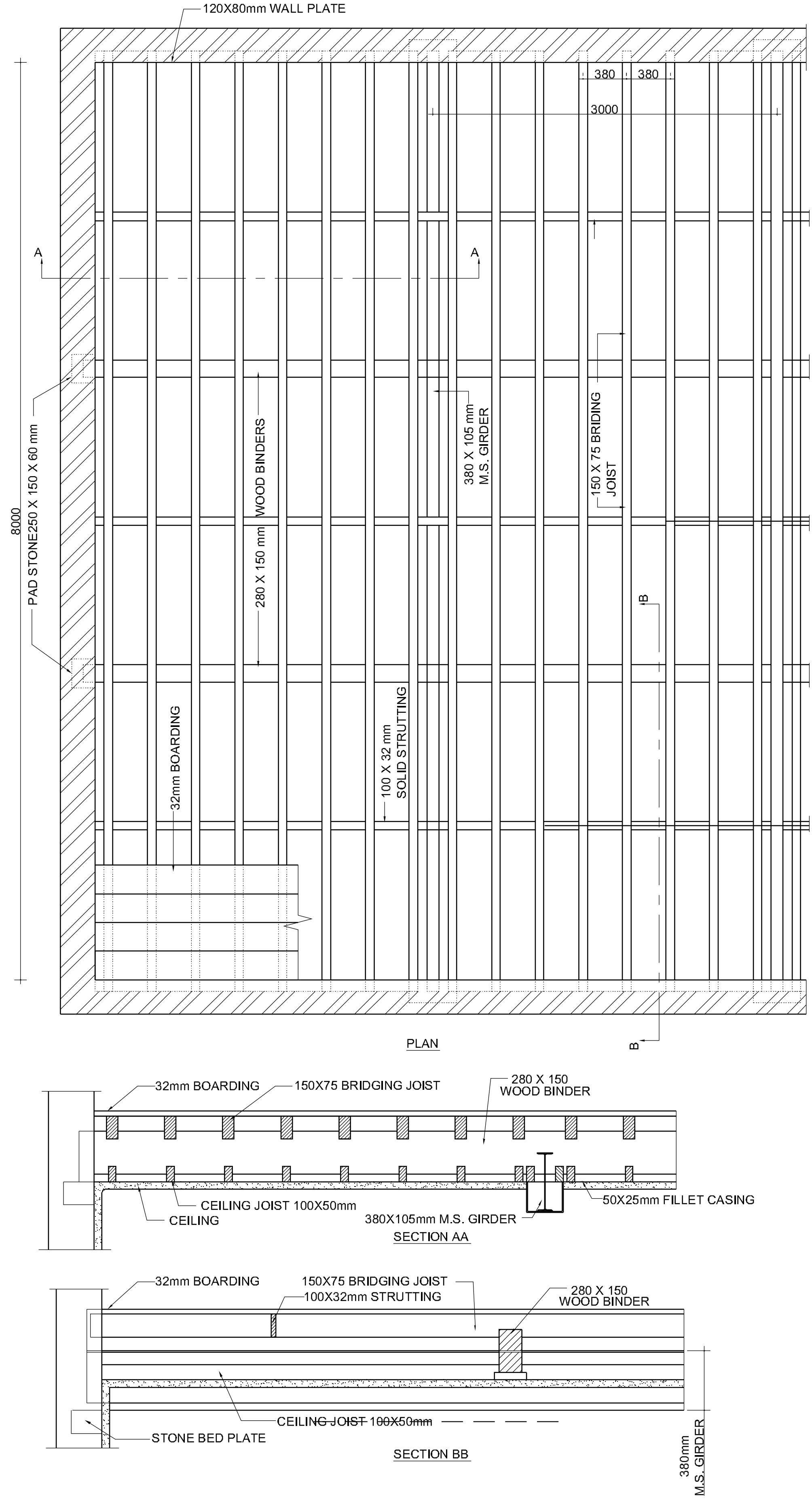
TASK 8: **Draw the section of brick jack arch floor (Fig 4a)**

DATA

Span	- 1500 mm.
R.S.J	- 400 x 165 mm.
Tie rod	- 20 mm.

- Draw the section of wall 300 mm thick.
- Draw the R.S.J of size 400 x 165 mm in to the wall.
- Draw the second R.S.J at a distance of 1500 mm from the first R.S.J.
- Draw the arch joining the two bottom flangers as shown in figure 4a.
- Draw the brick on edge forming arch shape.
- Draw a tie rod connecting the two R.S.J.
- Draw a horizontalk line 100 mm above the crown.
- Draw the title flooring showing 25 mm thick.
- Name and dimension the drawing.

Fig 3



FRAMED TIMBER FLOOR

DCN2883X3

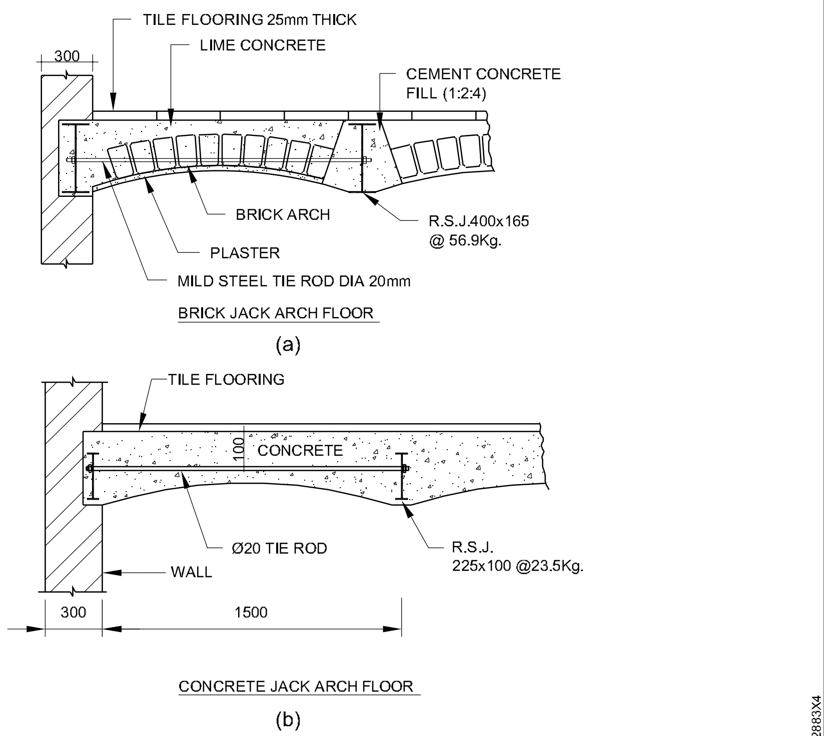
TASK 9 : **Draw the section of concrete jack arch floor (Fig 4b)**

DATA

Span	- 1500 mm.
R.S.J	- 225 x 100 mm.
Tie rod	- 20 mm.

- Arrange the position, in the layout for drawing details of concrete jack arch floor.
- Select the scale and draw the section of wall 300 mm thick.
- Draw the R.S.J of size 225 x 100 mm in to wall.
- Draw the second R.S.J at a distance of 1500 mm from the first R.S.J.
- Draw the arch joining the two bottom flanges as shown in figure.
- Show the concrete forming arch shape.
- Draw a tie rod connecting the two R.S.J.
- Draw a horizontal line 100 mm above the crown.
- Draw the tile flooring showing 25 mm thick.
- Name and dimension the drawing.

Fig 4



TYPES OF UPPER FLOORS

— — — — — — — —

Stairs (as per shape)

Objective : At the end of this exercise you shall be able to
- **draw the plan and section of straight stair.**

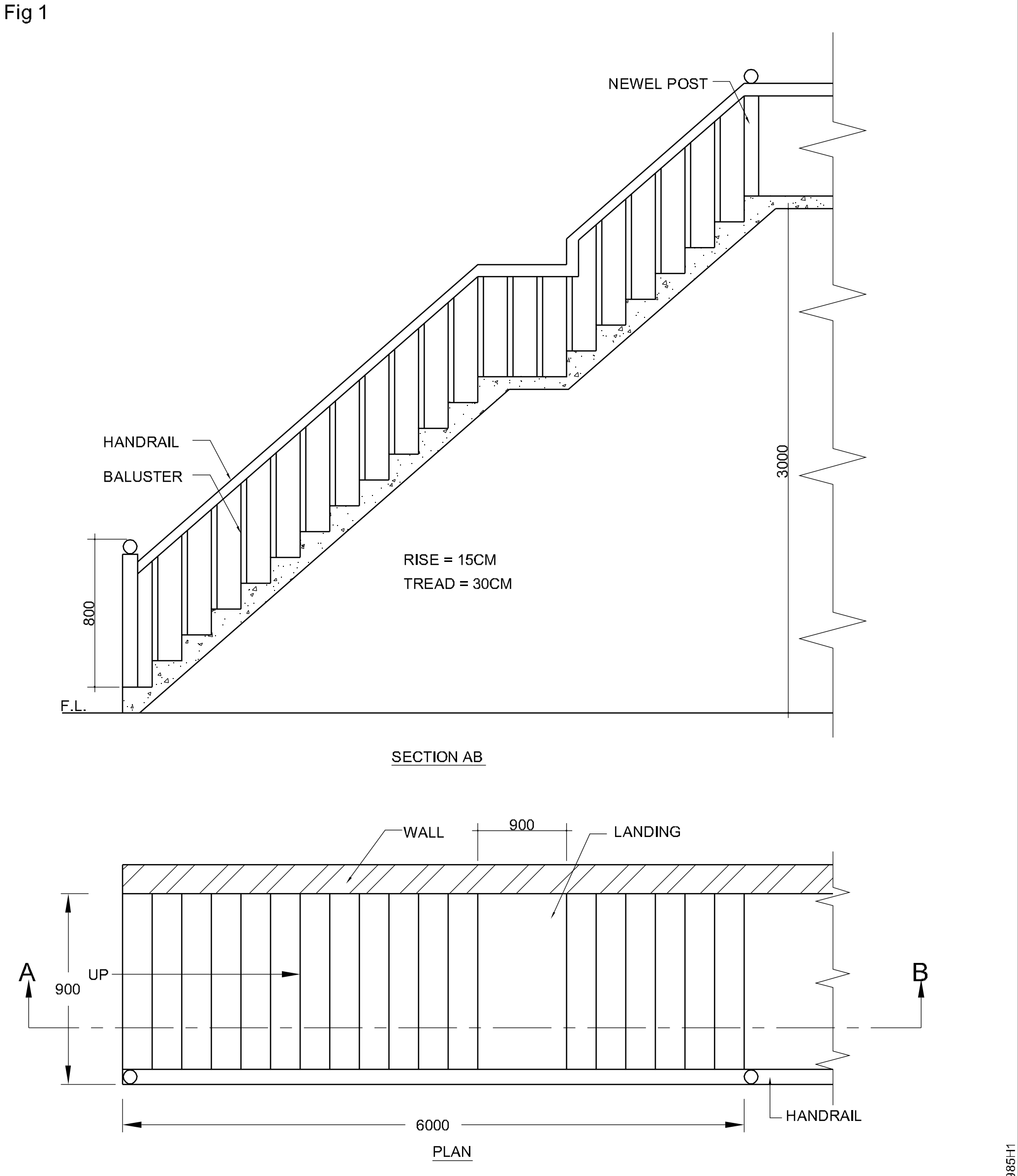
PROCEDURE

TASK 1: **Draw the plan and section of straight stair (Fig 1)**

DATA

Height of upper floor	3m.
The total runs of straight stair	6m.
R.C.C waist	10cm thick.
The rise	15cm.
The Tread	30cm.
No.of Steps in the flight	= 20 Nos.
Width of stair	0.90m.
The handrail G.I pipe	50mm Dia.
Newel post G.I pipe	75mm 80cm height.

Fig 1



STRAIGHT STAIR

The baluster 25mm G.I pipe and missing data may be assumed.

I PLAN

- Select scale 1:50.
- Draw plan of the straight stair with proper number of treads.
- Draw the landing after twelve risers.
- Draw the treads (6 Nos) after the landing.
- Dimension the drawing properly.

II Sectional Elevation

- Draw upward projector lines to mark the risers from each tread and complete the section as indicated in figures.
- Draw hand rail details.
- Fully dimension the drawing.

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Quarter turn newelstair

Objective : At the end of this exercise you shall be able to
- **draw the plan and section of quarter turn newelstair.**

TASK 1: **Draw the plan and section of quarter turn newelstair. (Fig 1)**

DATA

Stair room size	= 2.4 x 4.6m.
Height between floors	= 315 cm.
Tread	= 30cm.
Rise	= 15 cm.
Width of landing	= 1m.
Width of stair	= 1m.
Wall thinkness	= 20cm.
R.C.C slab thickness	= 12 cm.
No.of risers 1st flight	= 12 Nos.
No.of risers 2nd flight	= 9 Nos.
Hand rail, newel post, baluster	= 25 mm.

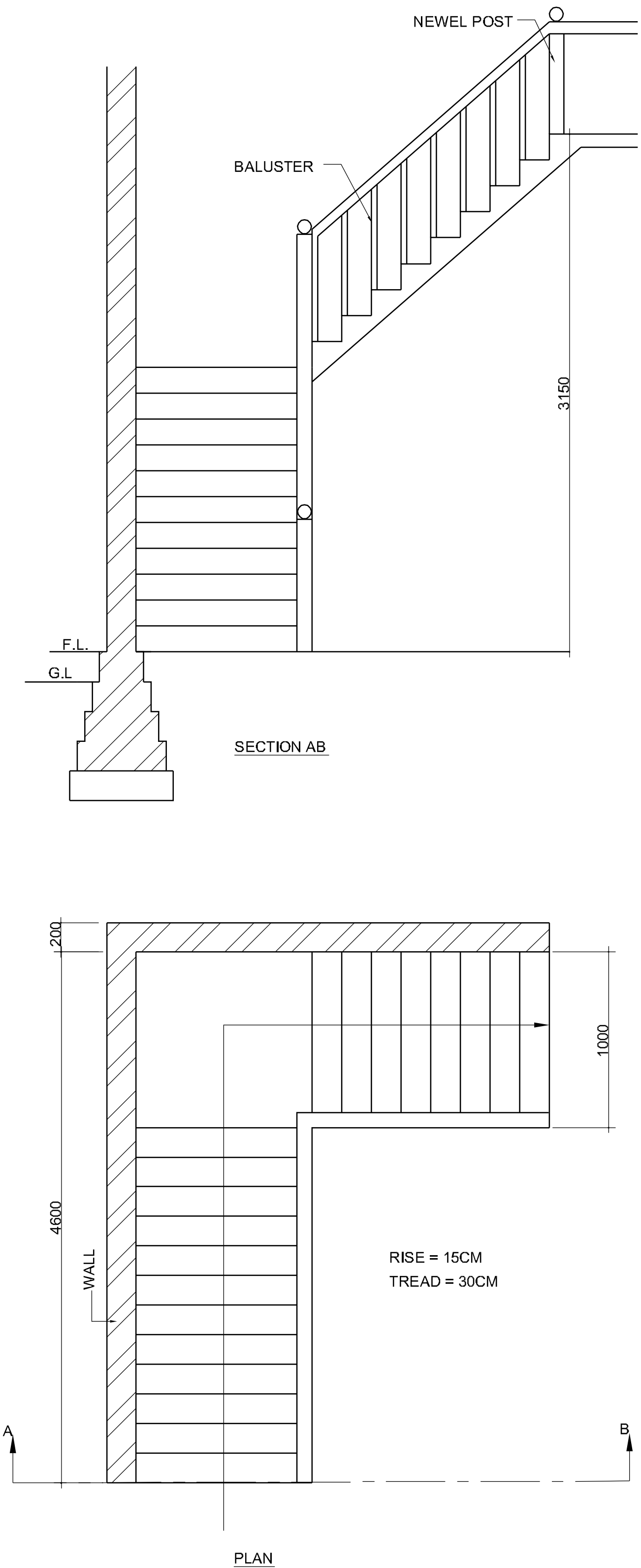
I PLAN

- Draw the plan of quarter turn newel stair as per given data with proper number of treads.
- Draw the landing after 12 risers.
- Draw the treads (8 Nos) after the landing on rightside.
- Draw the Hand rail in plan.

II Draw the elevation

- Draw the projectors up ward from each tread to mark the risers.
- Draw the hand rail details as per the drawing.
- Dimension the drawing properly.

Fig 1



STRAIGHT STAIR

Half turn stair (geometrical)

Objective : At the end of this exercise, you shall be able to,
- **draw the plan and section of half turn stair geometrical.**

TASK 1: **Draw the plan and section of half turn stair (geometrical) (Fig 1)**

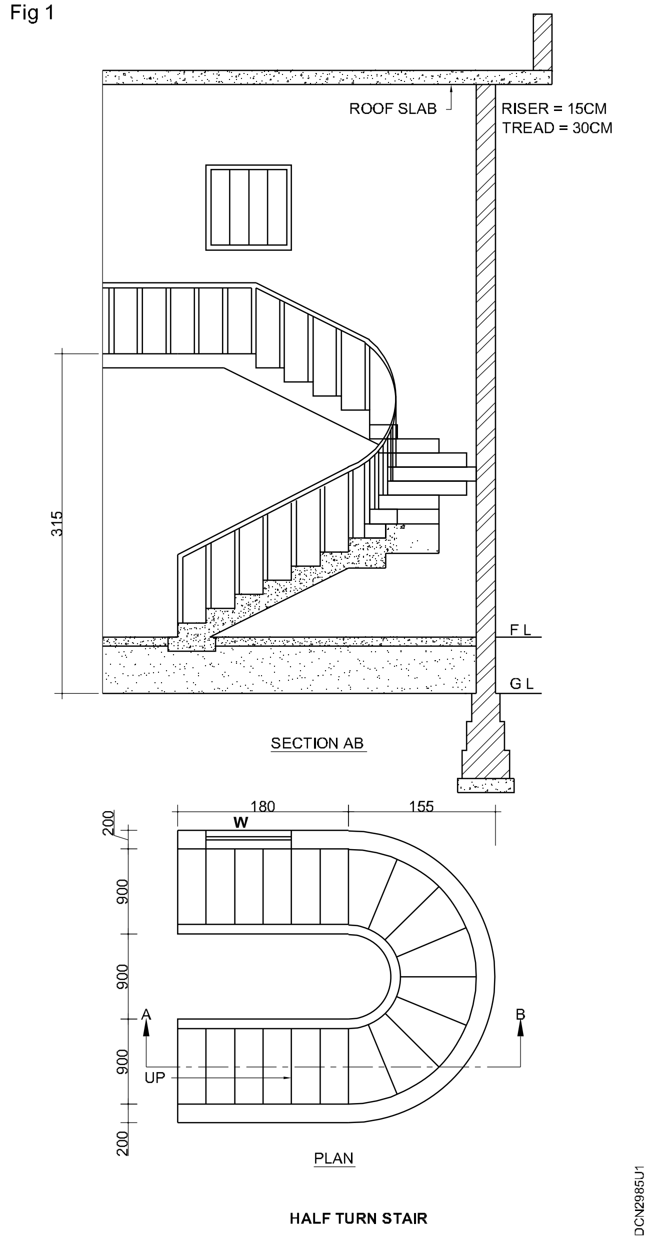
DATA

Height between floors	= 3m.
Tread	= 30cm.
Rise	= 15cm.
Width of stair	= 0.90m.
Open space	= 0.90m.
Wall thickness	= 20cm.
R.C.C slab thickness	= 12cm.
No.of steps	= 20 Nos.
Hand rail, newel post,	
baluster	= 25 mm,
balustrade height	=80cm.
Window style	= 1350 mm x 1450 mm.

PLAN
- Draw the plan of the stair room and treads as per given data.
- Draw the radiating treads from the centre.
- Draw handrail and window in plan.
- Complete the drawing with necessary dimensions.

ELEVATION
- Draw the upward projector lines from end of each tread to show the risers.
- Complete the drawing as per given data as shown in figure.
- Draw hand rail details as per data given.
- Draw elevation of the window.
- Dimension the drawing properly.

Fig 1



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Bifurcated stair

Objective : At the end of this exercise, you shall be able to,
- **draw the plan and section of bifurcated stair.**

TASK 1**: Draw the plan and section of bifurcated stair (Fig 1)**

DATA

Height between floors = 3m.

Tread = 30cm.

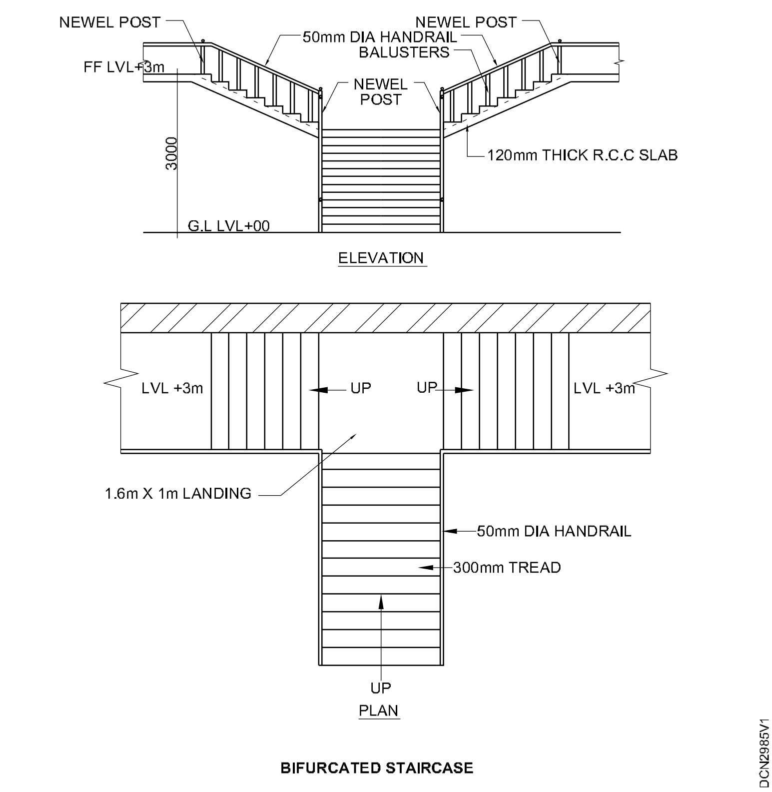
Rise = 15cm.

Middle landing	= 1m (width).
Width of stair	= 1m.
Wall thickness	= 20 cm.
R.C.C slab thickness	= 12 cm.
No.of risers in 1st flight	= 12 Nos.
No.of risers in 2nd flight	= 8 Nos.

Hand rail, newel post, baluster = 25 mm.

- Draw the plan of differential stair in 1:50 scale as per given data.
- To develop the elements, draw projections upwards form each tread.
- Complete the elevation as indicated in fig 1.

Fig 1



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Three quarter turn stairs

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

- **draw the plan and section of three quarter turn stairs.**

TASK 1: **Draw the plan and section of turn stairs. (Fig 1)**

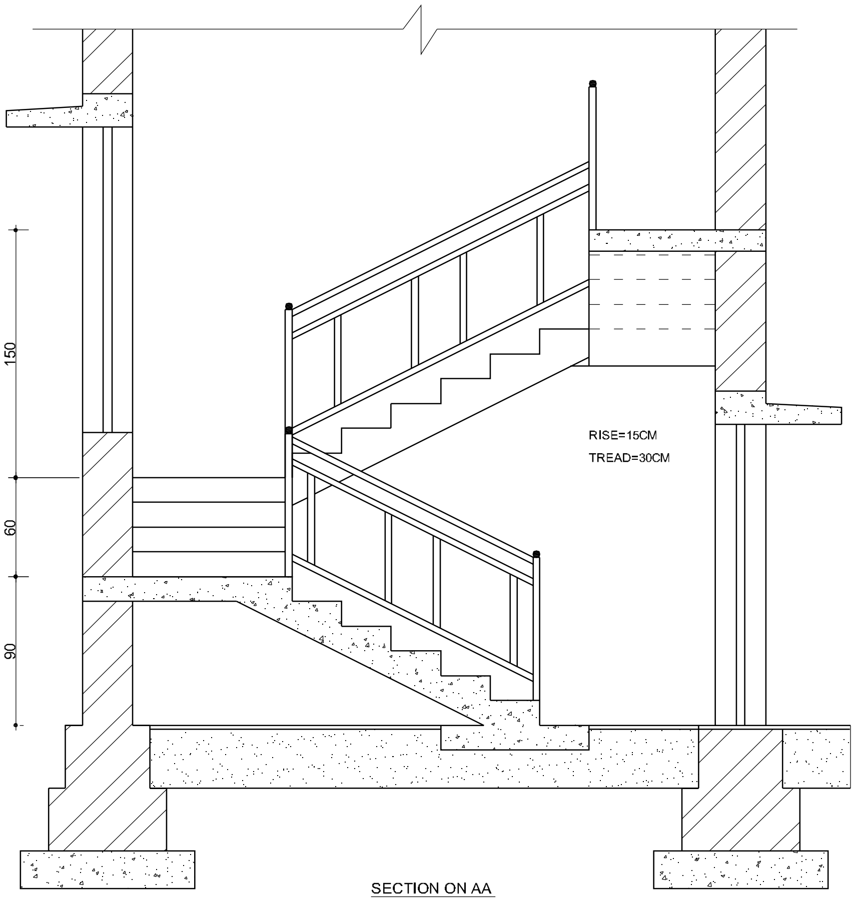
DATA

Room size	= 3.50 x 2.90m.
Wall	= 30cm.
Height between floor	= 3.00m.
Tread	= 30 cm.
Rise	= 15 cm.
Width of stair	= 1.00m.
Width of stair	= 1.00m.
Open well rectangle	= 150 x 90 cm.

R.C.C. waist	= 12.5 cm.
R.C.C. Beam	= 20 x 25cm.
Nosing	= 2.5 cm.
Hand rail	= 50 mm.
Baluster	= 25mm, 80cm height.
Balustrade	= with glass and wooden combination.

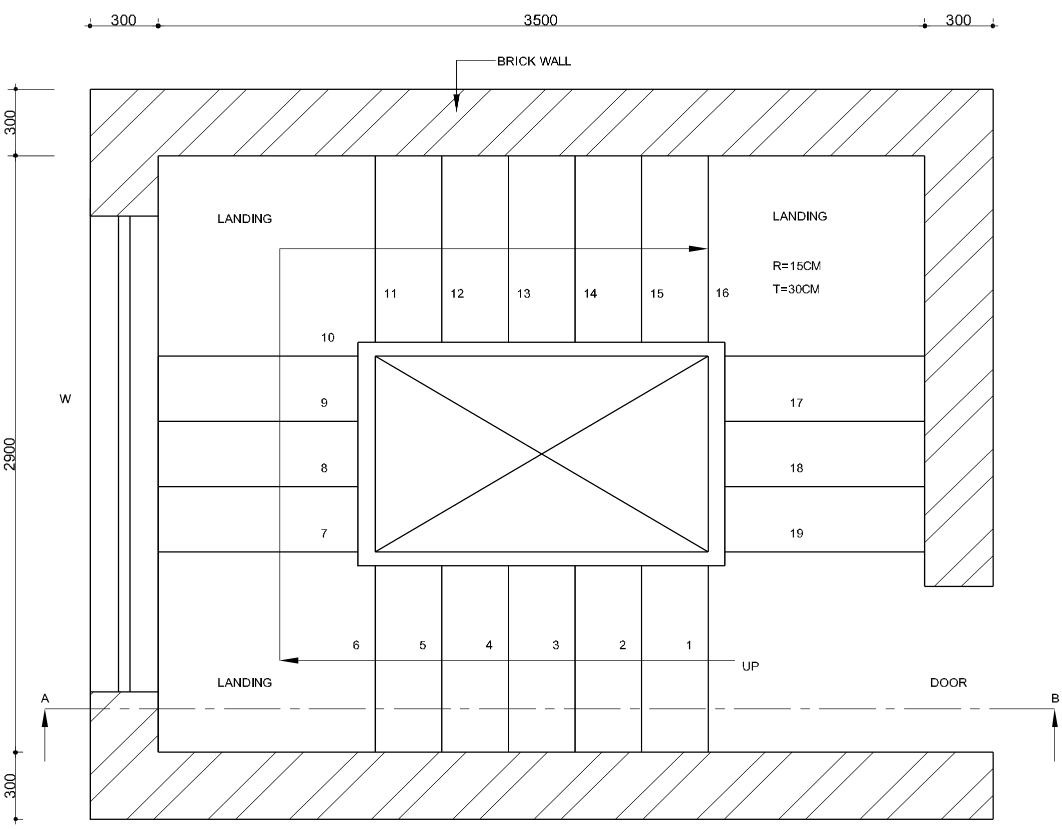
Same as previous exercise considering given data.

Fig 1



SECTION ON AA

THREE QUARTER TURN OR "WIDE U"

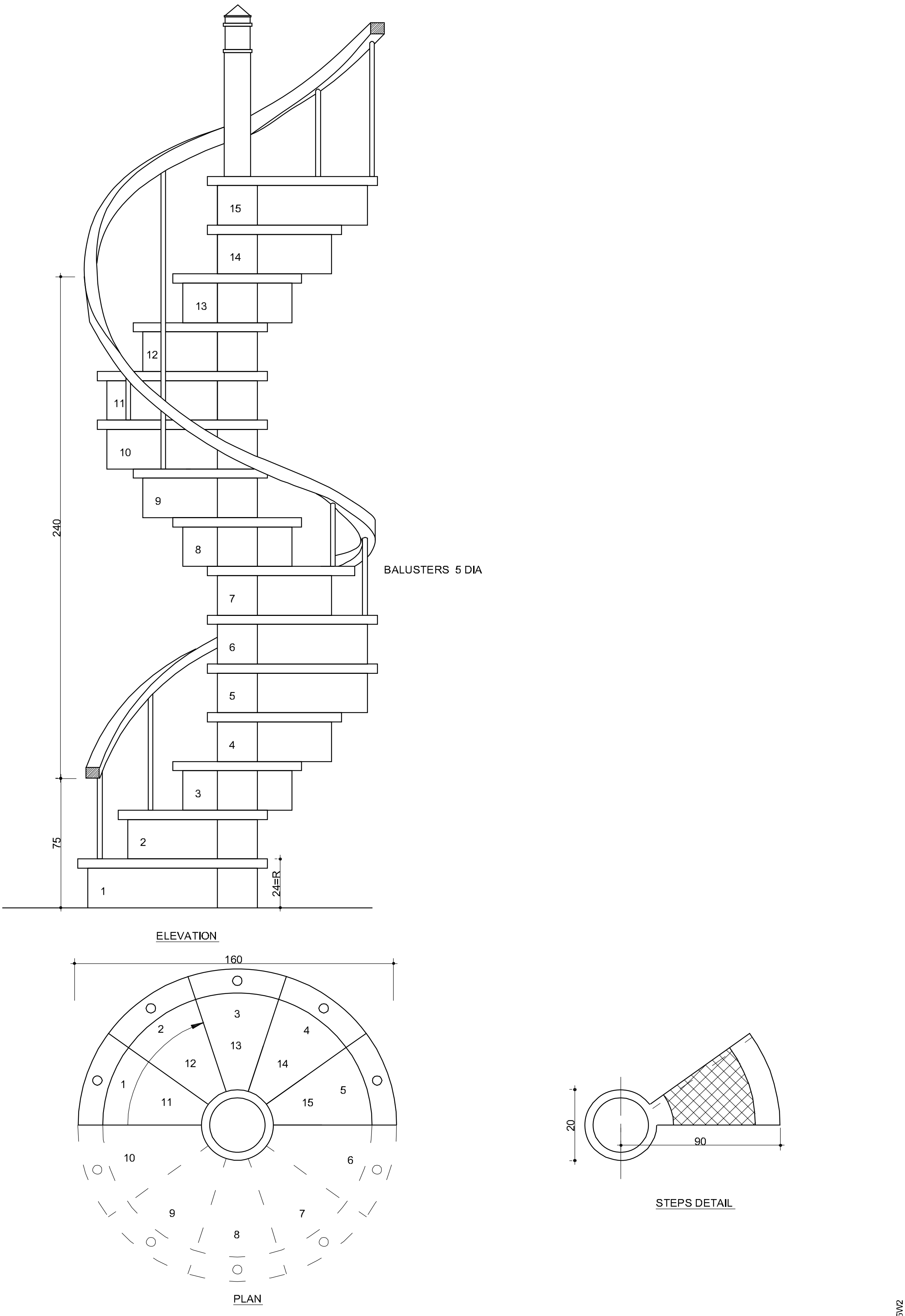


PLAN

THREE QUARTER TURN OR "WIDE U"

DCN2985W1

Fig 2



STEEL SPIRAL STAIR

Spiral stair

Objective : At the end of this exercise, you shall be able to,
- **draw the plan and section of spiral stairs.**

TASK 1**: Draw the plan and section of spiral stairs (Fig 1)**

DATA

Height of floor	= 3m.
Wall	= 30cm.
Tread	= 19cm inner circle and 56cm outer circle.
Rise	= 21.80cm.
Width of stair	= 0.80cm.
R.C.C Waist	= 12.5cm.
R.C.C Pilar	= 20cm.
Hand rail	= 50mm.
Baluster	= 25mm.

- Draw the column dia 20cm.
- Draw the outer circle of 0.9m radius.
- Divide the circle in to 10 Equal parts.
- Draw the 10 Winders.
- Draw the outer circumference of handrail of 50mm.
- Draw the complete plan.
- Develop the elevation by projecting each and very points form plan as shown.
- Draw the balusters and handrail and complete the elevation.
- Complete the plan and elevation of spiral stair.

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Half turn stair R.C.C open well

Objective : At the end of this exercise, you shall be able to,
- **draw the plan and section of halfturn stair RCC open well.**

TASK 1: Draw the plan and section of halfturn stair RCC open well (Fig 1, Fig 2, & Fig 3)

DATA

Room size	= 6 x 2.50m.
Wall	= 30 cm.
Height of floor	= 2.975 m.
Tread	= 25 cm.
Rise	= 17.5 cm.
Width of stair	= 1.00 m.
Width of landing	= 1.00 m.
Open well rectangle	= 50 cm width.
R.C.C waist	= 12.5 cm.
R.C.C Beam	= 20 x 25 cm.
Nosing	= 2.5cm.
Hand rail	= 50 mm.
Baluster	= 25 mm.

- Draw the plan of room with size 6 x 2.5m.
- Draw the width of stair as1 m.
- Draw the treads 25 cm wide and complete the plan as shown in figure.
- To develop the section, draw projectors upwards from each tread.
- Complete the section as indicated in the figure.

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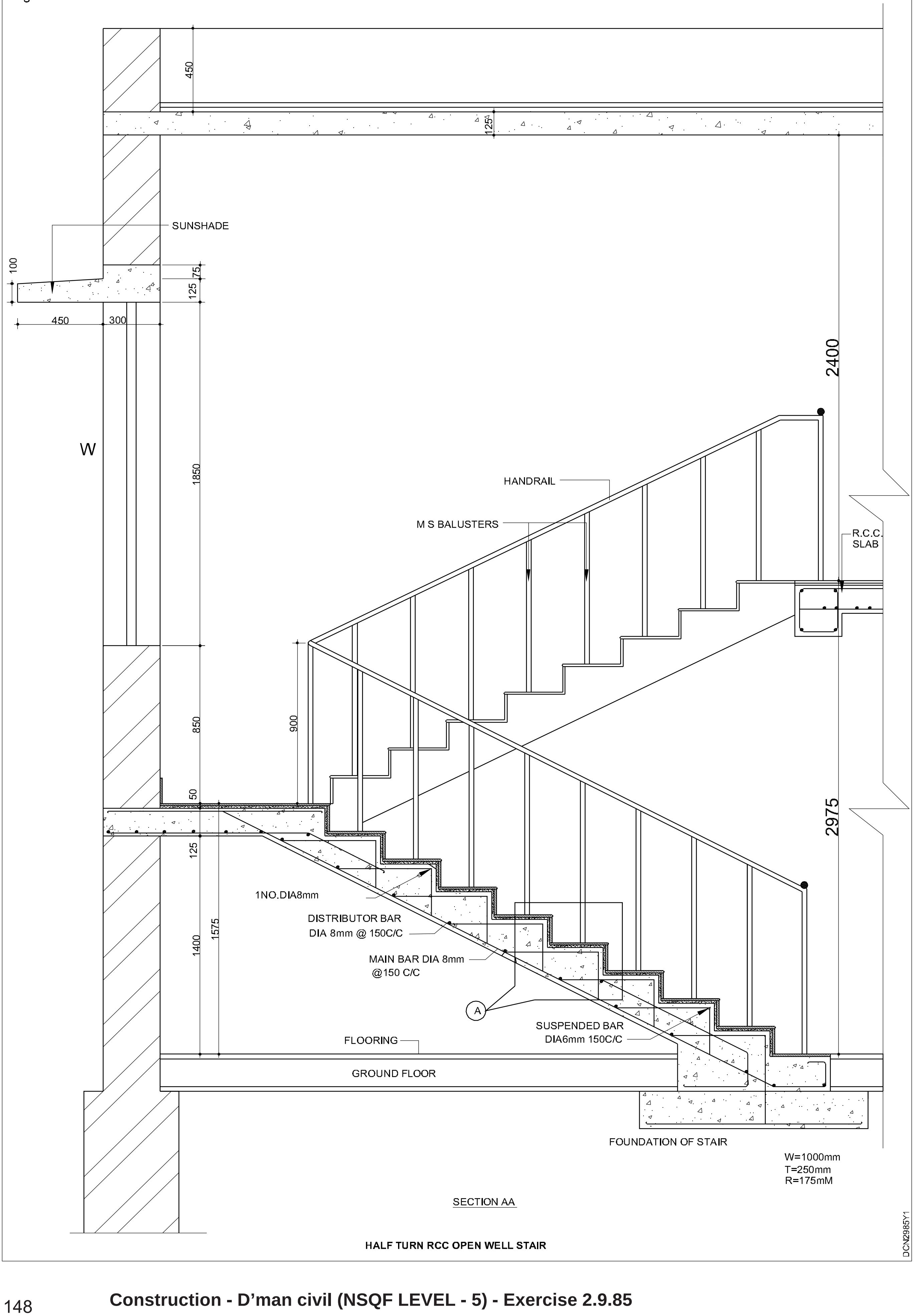
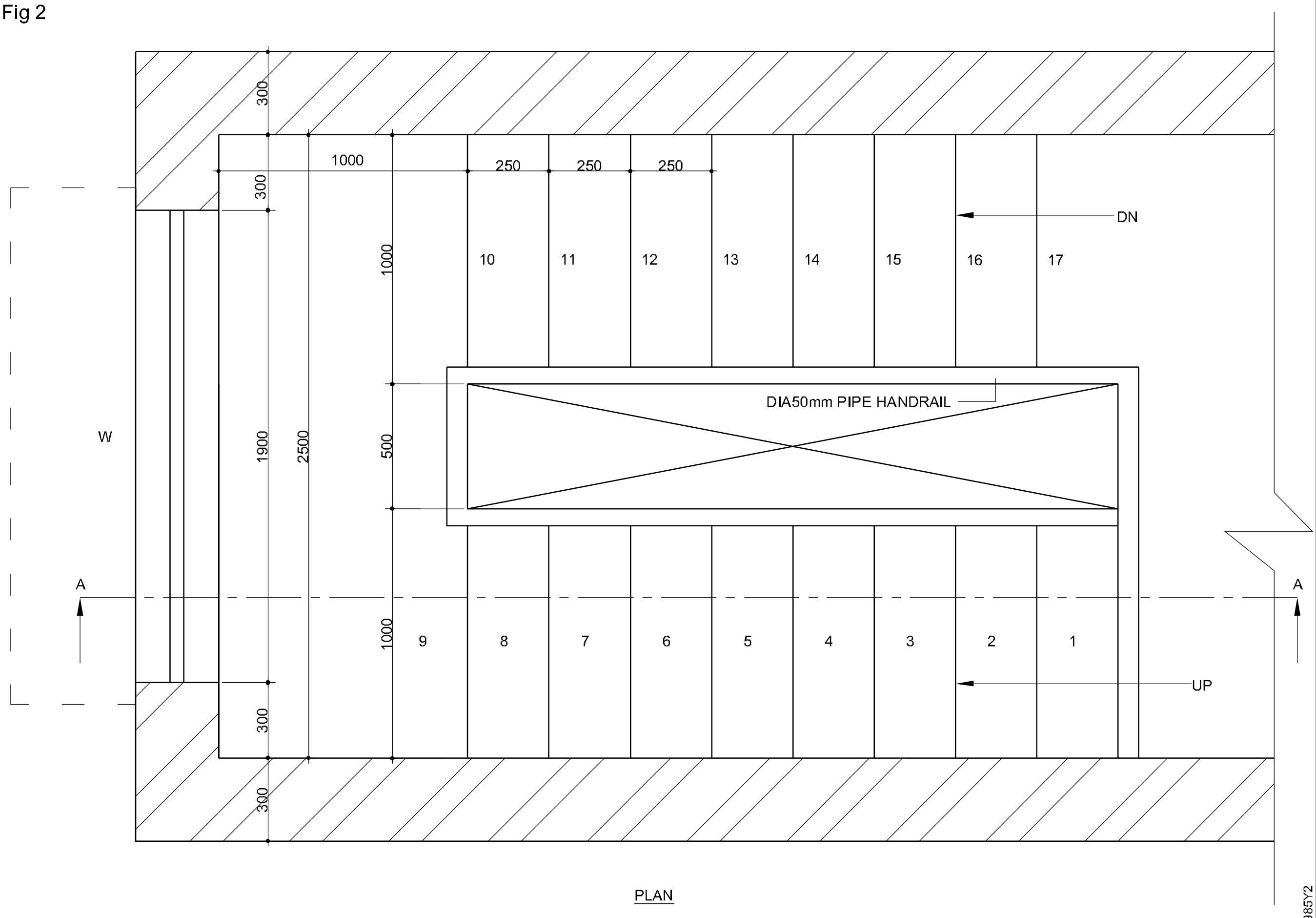
Fig 3



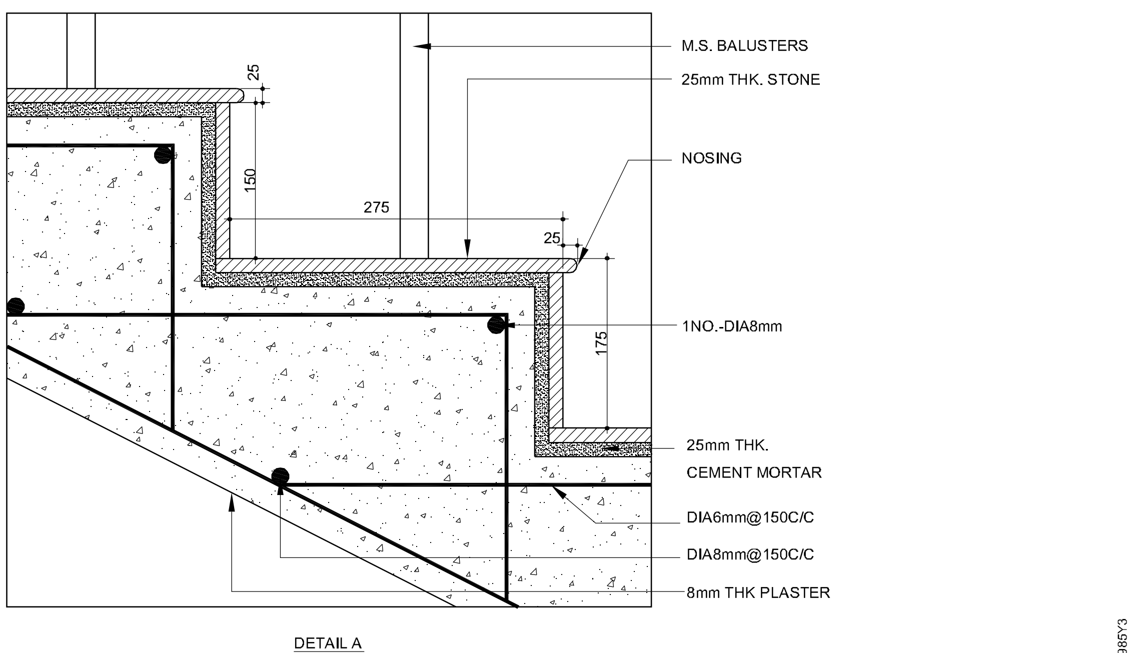
HALF TURN RCC OPEN WELL STAIR

Fig 2



HALF TURN RCC OPEN WELL STAIR

Fig 3



HALF TURN RCC OPEN WELL STAIR

Brick stair

Objective : At the end of this exercise you shall be able to
- **draw the plain and section of brick stair.**

PROCEDURE

TASK 1**: Draw the plan and section of brick stair (Fig 1)**

Data

Tread = 0.30m.

Wall = 30cm.

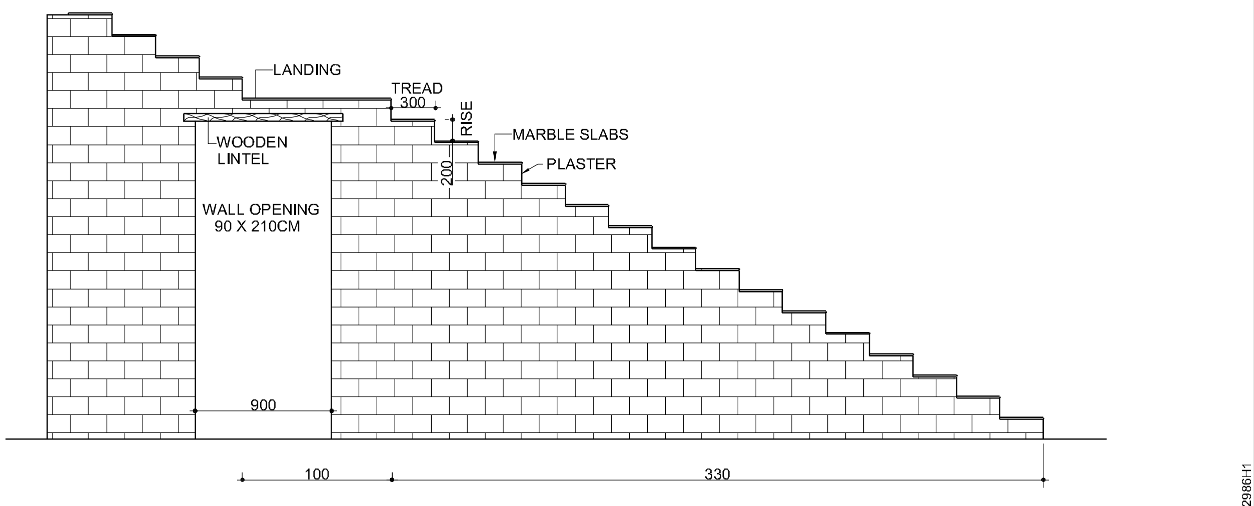
No.of steps 1st flight = 1 nos.

Size of opening below the landing = 0.90 x 2.10m.

Wooden lintel = 0.30 x 0.10 cm.

- Draw the elevation of stretcher course of a solid wall as shown.
- Draw an opening as shown.
- Draw a lintel over opening as shown and complete the drawing as shown.

Fig 1



BRICK STAIR

Stone Stair

Objective : At the end of this exercise, you shall be able to,
- **draw the plan and section of stone stair.**

TASK 1**: Draw the section of staright flight stone stair composed of rectangular steps both ends resting on walls**

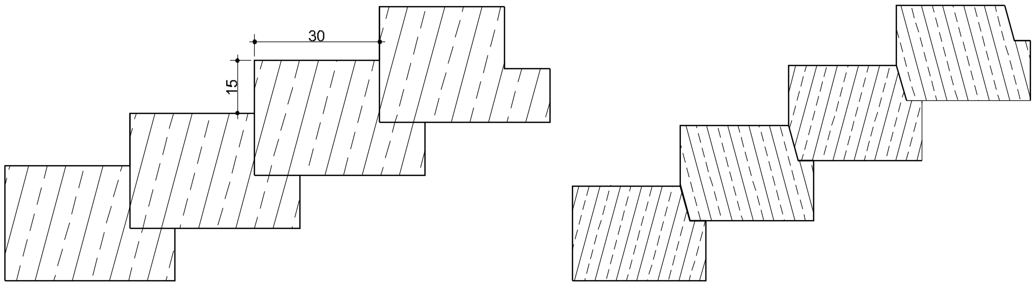
DATA

Rise = 15 cm.

Going = 30 cm.

- Draw tread 30 cm wide.
- Draw rise 15 cm.
- Draw the stone stairs with rectangular steps and complete the figure as shown in figure. (Fig 1)

Fig 1



(A) RECTANGULAR STONE STAIR WITH RECTANGULAR STEPS

TASK 2 **: Draw the section of staright flight stone stair composed of spandril steps both ends resting on walls.**

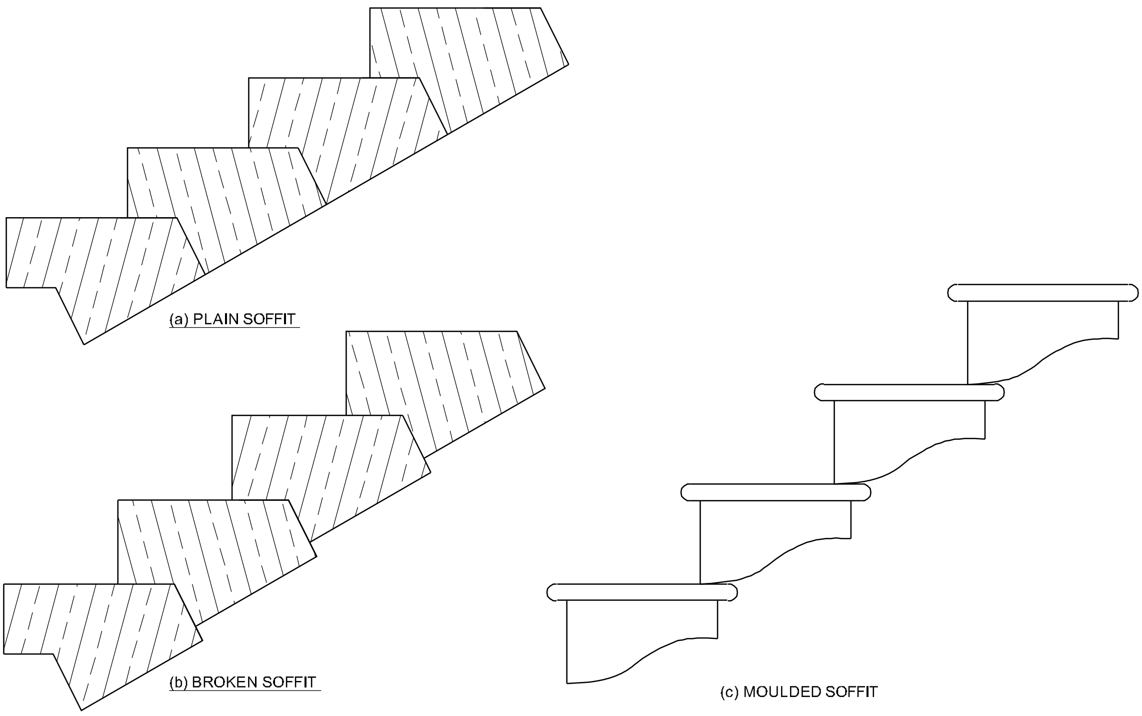
DATA

Rise = 15 cm.

Going = 30 cm.

- Draw the stair with spandril steps with plan soffit, broken soffit and moulded soffit.
- Complete the drawing as in figure. (Fig 2)

Fig 2



(B) STONE STAIR WITH SPANDRIL STEPS

STONE STAIR

Wooden stair

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

- **draw the plain and section of wooden stair.**

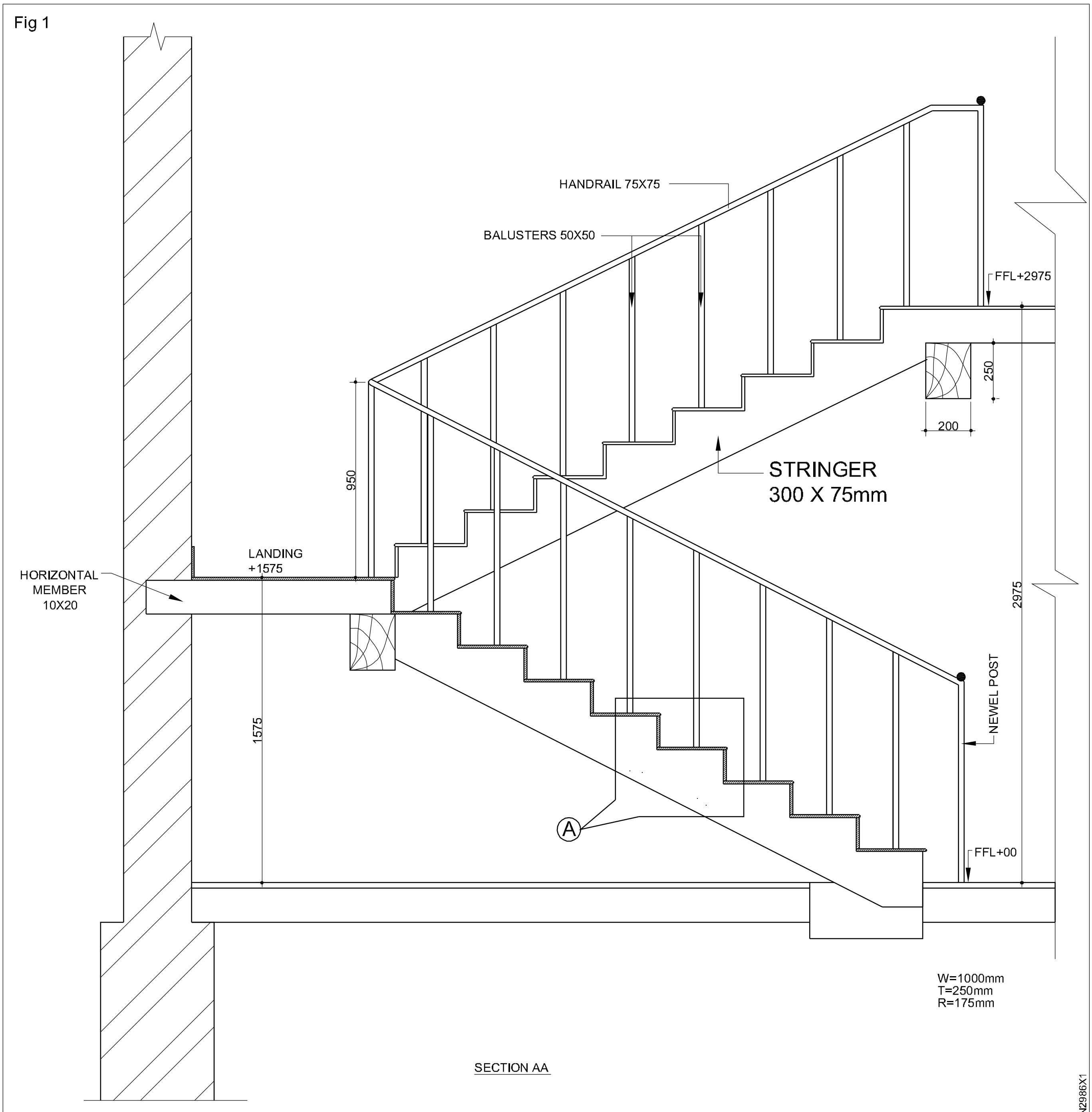
TASK 1 **: Draw the plan and section of moving stairs (esclators)**

DRAW THE PLAN AND SECTION OF WOODEN STAIRS (Fig 1, 2 & 3)

DATA

Room Size	= 6 x 2.50m.
Wall	= 30 cm.
Height of floor	= 1.50m.
Tread	= 25cm.
Rise	= 17.5cm.
Width of stair	= 1.00m.
Plank	= 12.5cm.
Nosing	= 2.5cm.

Fig 1

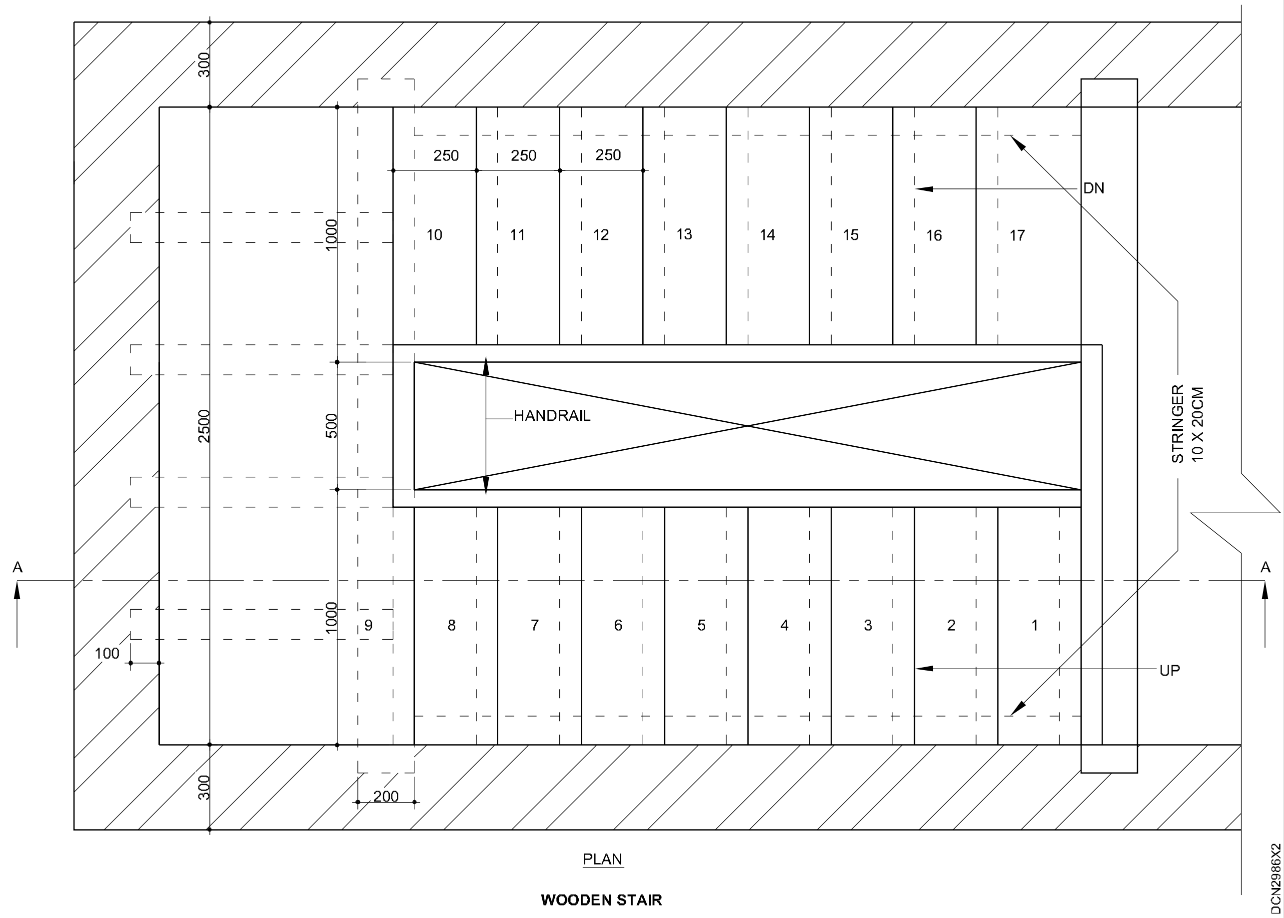


WOODEN STAIR

Hand rail	= 50mm.		Horizontal member	= 10 x 20cm.
Baluster	= 25mm.		Wooden beam	= 20 x 25cm.
Width of landing	= 1m.			
Open well space	= 50cm. (rectangle)			
Stringer beam	= 10 x 20cm.			

Complete the drawing showing all details as shown in figures.

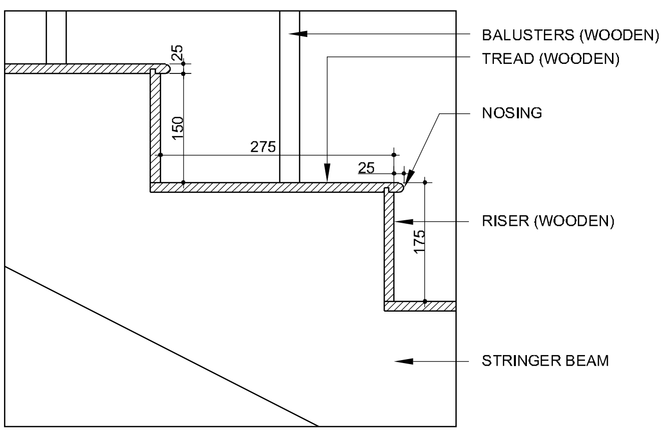
Fig 2



PLAN

WOODEN STAIR

Fig 3



DETAIL A

WOODEN STAIR

Metal stair

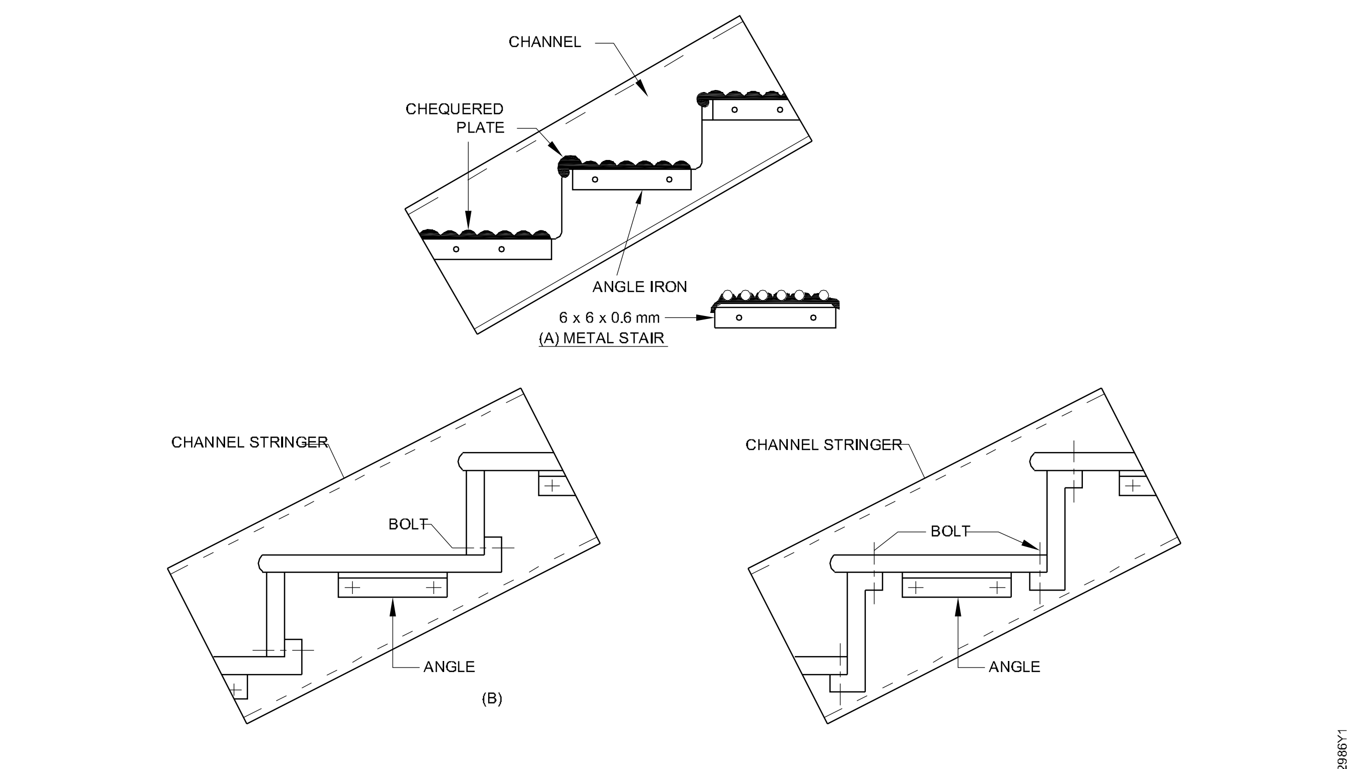
Objective : At the end of this exercise, you shall be able to,
- **draw the section of metal stair**.

TASK 1 **: Draw the section of metal stairs (Fig 1)**

Rise	= 15cm.
Tread	= 30cm.
Two side channel stringer ISA	= 150 x 150 x 12mm.
Angle iron	= 6 x 6 x 0.6mm.
Chequered plate	= 6 x 6 x 0.4mm.

- Draw two side channel stringer.
- Draw tread and rise angle plate and fittings fasterning nut, bolt, weld, etc.
- Complete the plan and section as given in figure.

Fig 1



STEEL STAIR

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Half turn stair R.C.C dog legged

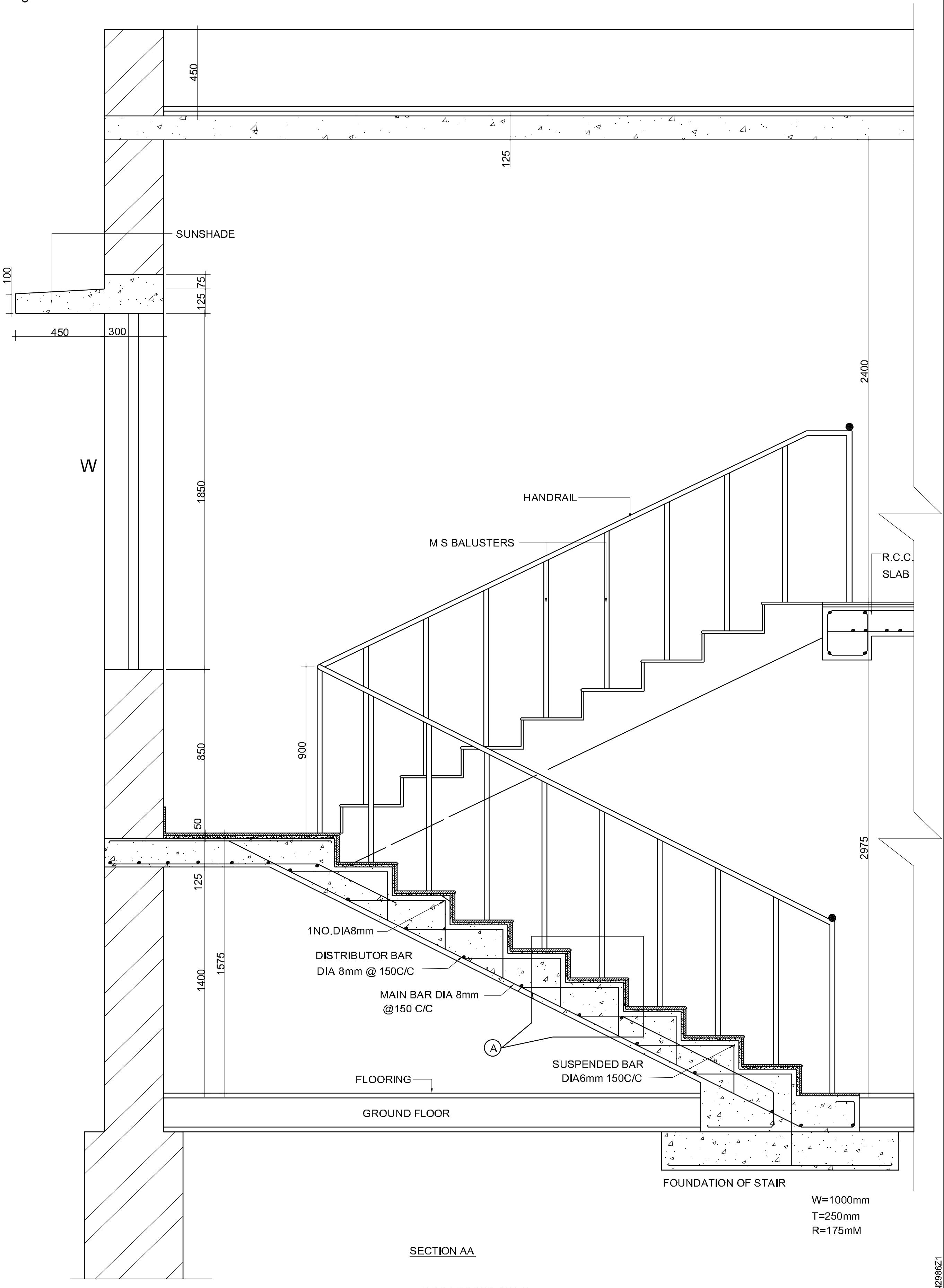
Objective : At the end of this exercise, you shall be able to,
- **draw the plan and section of halfturn stair R.C.C dog legged.**

TASK 1 **: Draw the plan and section of halfturn stair RCC dog legged (Fig 1)**

DATA

Room sizes	= 5 x 2m.
Wall	= 30 cm.
Height of floor	= 2.975m.
Tread	= 25cm.
Rise	= 17.5cm.
Width of stair	= 1m.
Width of landing	= 1m.

Fig 1



DOG LEGGED STAIR

R.C.C Slab	= 12cm.
R.C.C Beam	= 20 x 30 cm.
Hand Rail	= 25 mm.
Baluster	= 25mm.

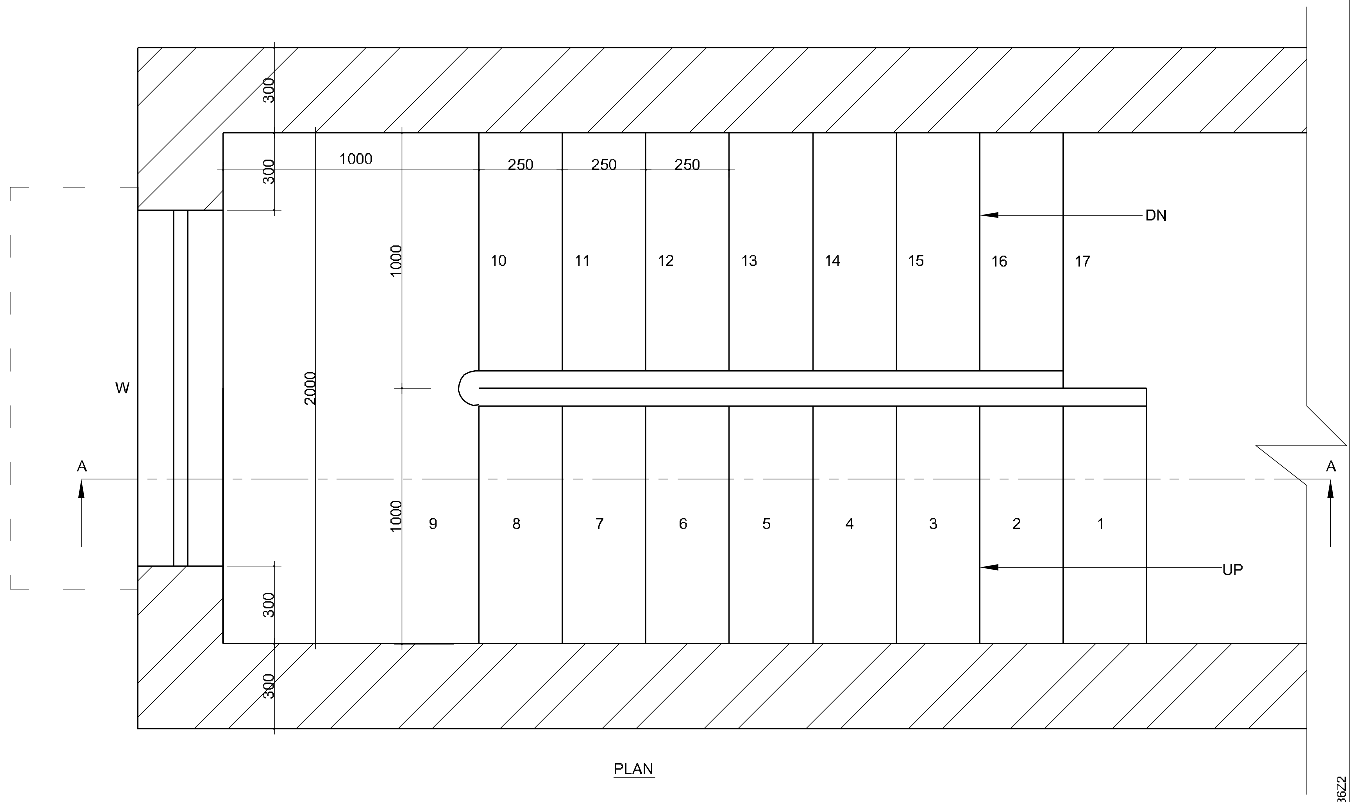
PLAN

- Draw the plan of half turn R.C.C dog legged stair room as per data given with proper number of treads as shown figure 2.
- Draw the landing after nine risers.
- Draw the window in plan.
- Dimension the drawing properly.

Section Elevation

- Draw the Sectional Elevation of the stair by drawing projectors upward from each treads.(fig 1)
- Draw the handrail details as pre given datas.
- Draw the Elevation of the window.
- Dimension the drawing properly.

Fig 2



DOG LEGGED STAIR

Lift or elevators

Objectives : At the end of this exercise you shall be able to
- **prepare the data table of the different loading capacity of lift**
- **draw the schematic diagram of lift well etc for a load of 10 persons**
- **draw the typical arrangements of a lift.**

PROCEDURE

TASK 1: **Draw the plan and section of lift well (Fig 1)**

Load		Car inside		Lift Well		Entry	Entry
Persons	**Kg**	**A**	**B**	**C**	**D**	**E**	**F**
4	272	110	70	190	130	80	160
6	408	110	110	190	160	80	160
8	544	130	110	190	190	80	160
10	680	135	130	190	210	80	160
13	884	200	110	250	190	90	160
16	1088	200	130	250	210	100	160
20	1360	200	155	250	240	100	160

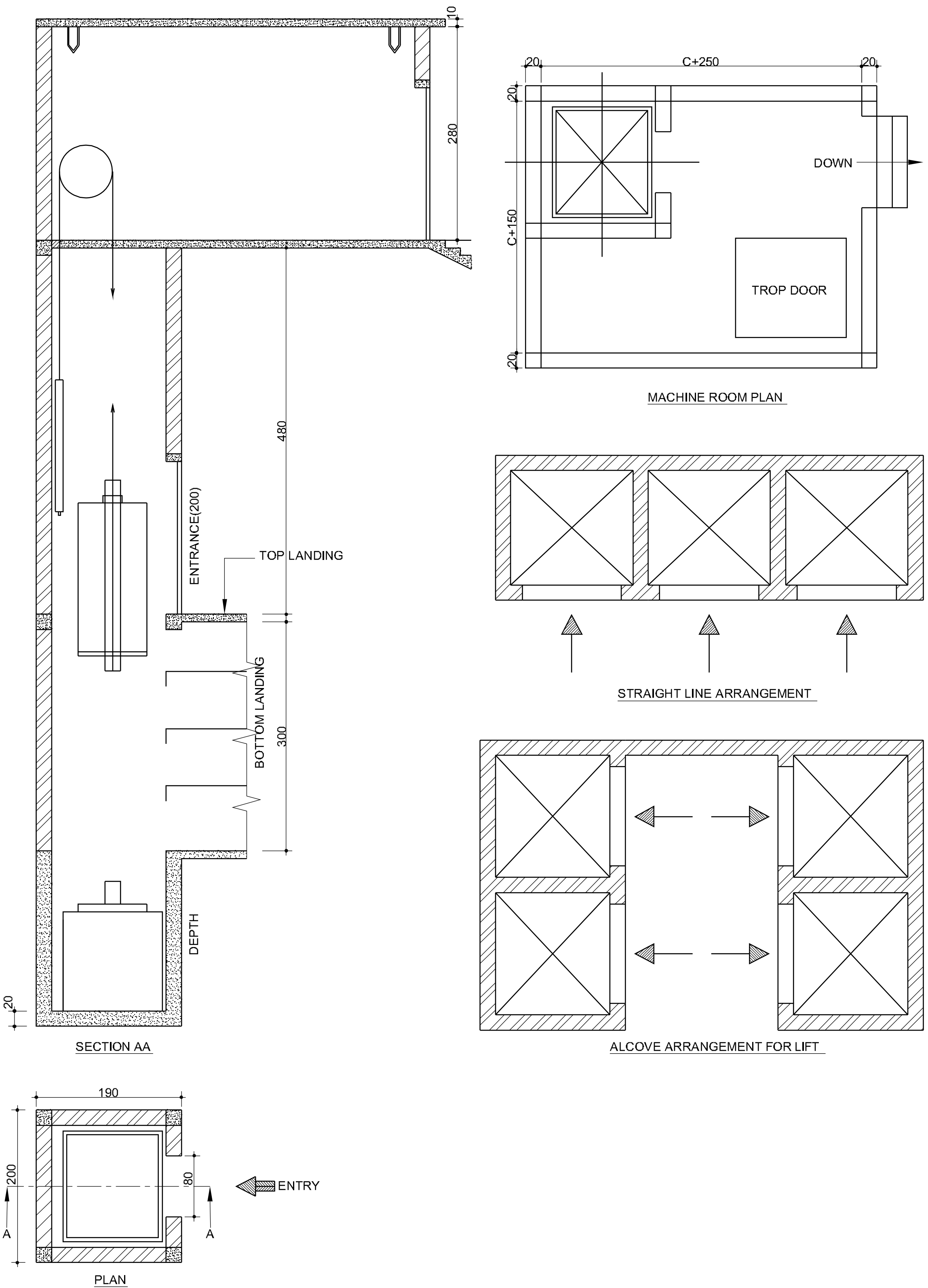
- Draw the size of machien room.
- Draw the lift well 1.90 x 1.53m.
- Draw the wall thickness 30cm.
- Draw the headroom height 2.2m.
- Develop the elevation by projecting each and every point from plan as shown in figure 1.
- Complete the plan and section of lift well.

The total head room has been calculated on the basis of car height of 2.2m.

In the case of manually operated doors clear entrance will be reduced by the amount of projection of handle on the landing door.

Four and six passenger's lifts are generally limited to a speed of 1 m/s.

Fig 1



DCN2987H1

ESCALATOR AND LIFT WELL

Moving stairs (escalators)

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

- **draw the plan and section of moving stairs (escalators).**

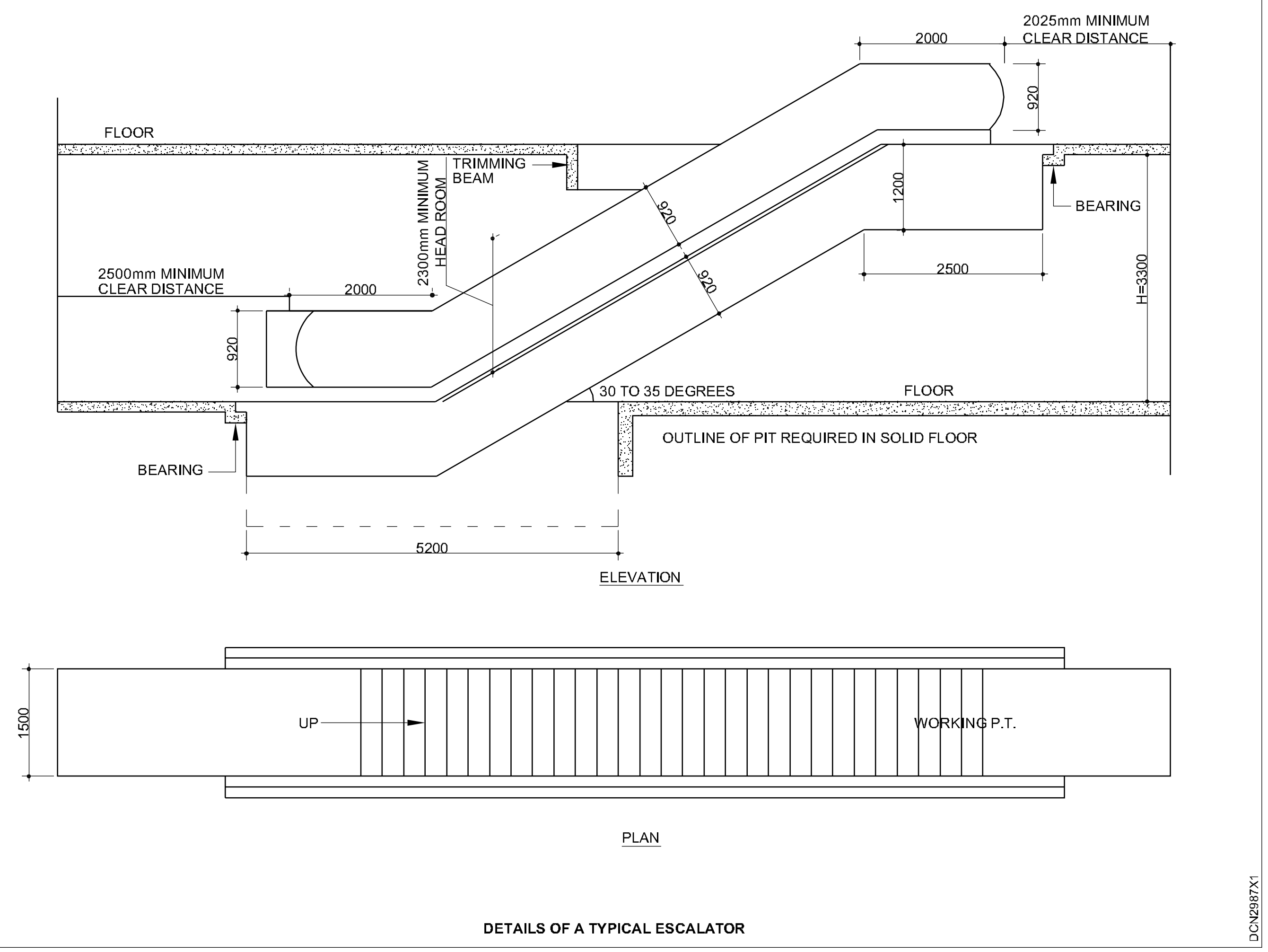
TASK 1 **: Draw the plan and section of moving stairs (escalators). (Fig 1)**

DATA

Room size	= 6 x 2.50 m.
Wall	= 30 cm.
Height of floor	= 3.30 m.
Width of landing	= 1 m.
Width of stair	= 1.50 m.

Complete the drawing showing all details as shown in figure 1.

Fig 1



DETAILS OF A TYPICAL ESCALATOR

— — — — — — — —

Ramp

Objective : At the end of this exercise, you shall be able to,
- **draw the plan and section of ramp.**

TASK 1 **: Draw the plan section of simple ramp (Fig 1)**

<u>DATA</u>

Length = 5 m,

Breadth = 3m.

Slope 1 in 10, Level difference 20 cm.

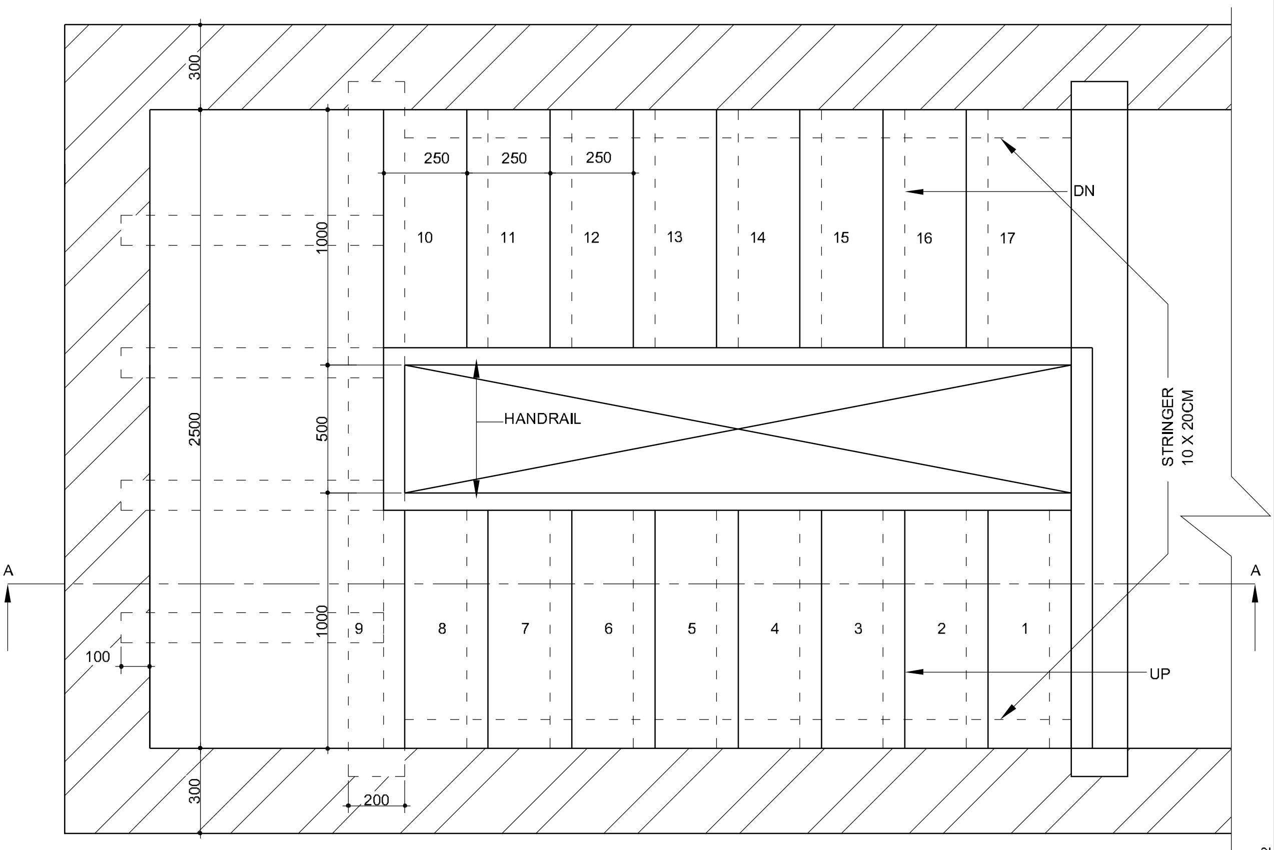
12 mm thick cement plaster over c.c. 1:2:4.

Hand rails 50mm dia GI pipes on both sides.

Baluster 25mm dia GI pipe and newel post 50 mm dia GI pipe.

- Select a Scale of drawing 1:25.
- Draw plan of Ramp as per given data as shown Figure 1.
- Draw sectional elevation by projecting the plan as per given data as shown in figure 1. (To develop the sectional view draw upward projector from each end and complete and the section)
- Draw hand rail retails (Belastor, Newel post, etc) as per data given.
- Dimension the drawing as shown in figure 1.

Fig 2



PLAN

WOODEN STAIR

Types of sloped roofs

Objectives : At the end of this exercise you shall be able to
- **draw the sectional elevation of lean-to-roof**
- **draw the sectional elevation of couple roof.**

PROCEDURE

TASK 1 **: Draw the sectionof lean-to-roof to a scale 1:50 (Fig 1a)**

DATA

Clear span = 2000mm.

Thickness of main wall = 200mm.

Thickness of verandah wall = 200mm.

Cross section size of wall plate = 150 x 100mm. (varandah wall)

Cross section size of bressumer = 100 x 200mm. (main wall)

Cross section size of rafter = 50 x 125 mm.

Cross section size of battens = 50 x 30 mm at 350 mm C/C.

Cross section size of leave boards = 25 x 200 mm.

Elevation projection = 600mm.

Pitch of the roof = 30° or 1/3 of span.

Width of corbal stone = 450mm.

- Draw main wall and verandah wall 2000mm clear span between them.
- Draw wall plate on the top of verandah wall.
- Draw rafer at angle 30° to the horizontal above the wall plate.
- Draw corbel and bressmer in the main wall, at the position where rafter touches the main wall as show in figure.
- Draw battens above the rafter.
- Draw roof tiles above the battens.
- Draw eave board at end of rafter.
- Complete the drawing as shown in figure 1.

— — — — — — — —

TASK 2: **Draw the sectional elevation of coupleroof (Fig 1b)**

Draw the section of couple roof to a scale 1:50.

DATA:

Span = 3000mm.

Thickness of main wall = 200mm.

Cross section size of wall plate = 150 x 100mm.

Cross section size of Ridge piece = 80 x 200mm.

Cross section size of common rafter = 50 x 125mm.

Cross section size of battens = 50 x 30mm at 350 mm C/C.

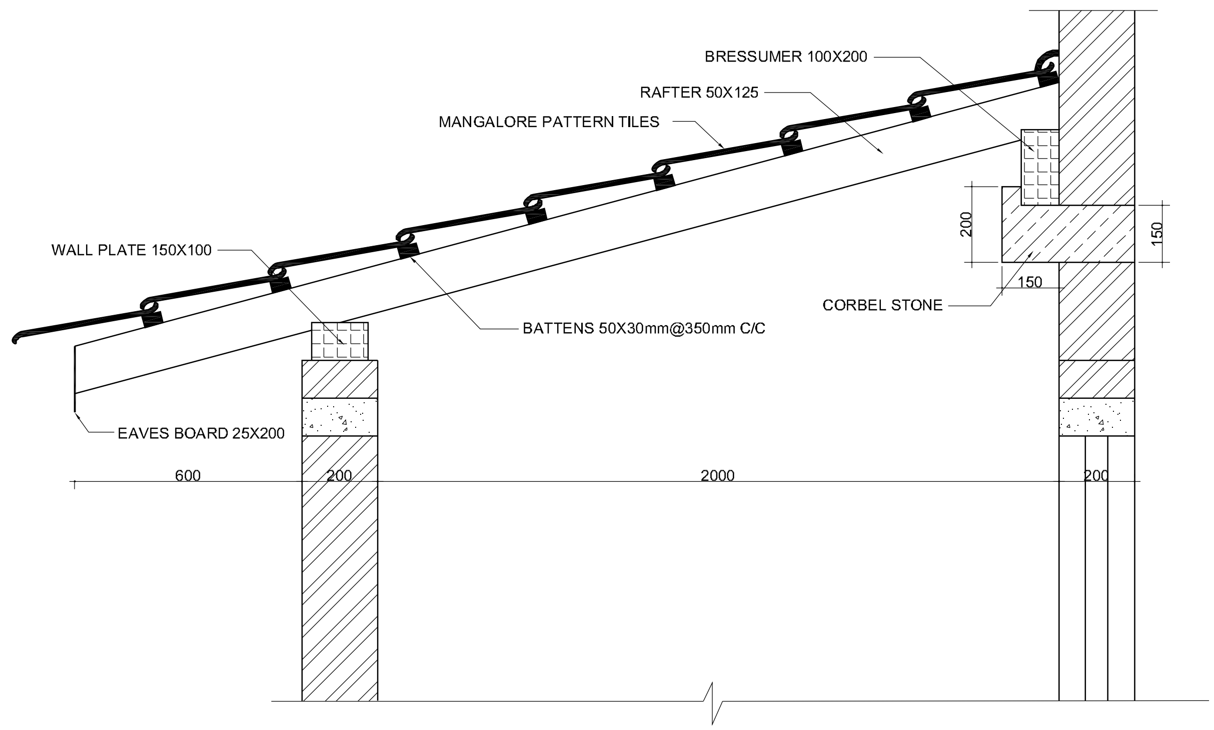
Cross section size of eave boards = 25 x 200mm.

Eave projection = 600mm.

Pitch of the roof = 30° or 1/3 of span.

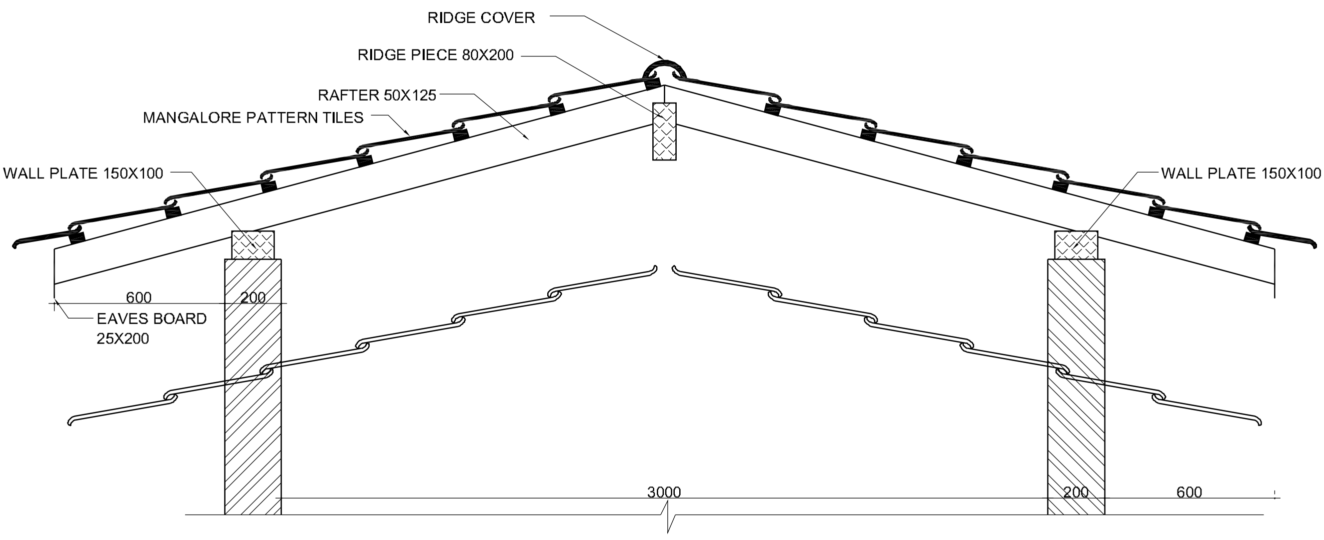
- Draw the main wall with 3000 mm clear span.
- Draw wall plate above the top of main wall.
- Draw common rafter with 30° slope above the top wall plate.
- Draw ridge piece at the junction of common rafter.
- Draw eaves board at the end of common rafter.
- Draw battens above the common rafter.
- Draw roof tiles above the battens.
- Draw ridge cover above ridge piece.
- Completer the drawing as shown in figure 1.

Fig 1



LEAN TO ROOF

(a)



COUPLE ROOF

(b)

TYPE OF SLOPE ROOFS

Types of sloped roofs

Objectives : At the end of this exercise, you shall be able to,
- **draw the sectional elevation of couple close roof**
- **draw the sectional elevation of single collar roof**
- **draw the sectional elevation of collar and scissors roof.**

TASK 1 **: Draw the section of couple close roof to scale 1:50 (Fig 1a)**

DATA

Span = 4000mm.

Thickness of main wall = 200mm.

Cross section size of wall plate = 150 x 100 mm.

Cross section size of Ridge piece = 80 x 200mm.

Cross section size of Common rafter = 50 x 125mm.

Cross section size of tie joist = 40 x 150mm.

Cross section size of battens = 50 x 30mm at 350 mm C/C.

Eaves projection = 600mm.

Pitch of the roof = 30^{o} or 1/3 of span.

- Draw the main walls with 4000 mm clear span.
- Draw wall plate above the top of main wall.
- Draw common rafter with 30^{o} slope above the top of wall plate.
- Draw ridge piece at the junction of common rafter.
- Draw tie joist horizontally above the wall plate.
- Draw eaves board at the end of common rafter.
- Draw battens above the common rafter.
- Draw roof tiles above the battens.
- Draw roof ridge cover above ridge piece
- Complete the drawing as shown in figure 1.

— — — — — — — —

TASK 2 **: Draw the sectional elevation of single collar roof (Fig 1b)**

Draw the section of single collar roof to a single 1:50.

DATA

Span = 5000mm.

Thickness of main wall = 200mm.

Cross section size of wall plate = 150 x 75mm.

Cross section size of Ridge piece = 80 x 200mm.

Cross section size of common rafter = 50 x 125mm.

Cross section size of collar = 40 x 125mm.

Cross section size of battens = 50 x 30mm at 350 mm C/C.

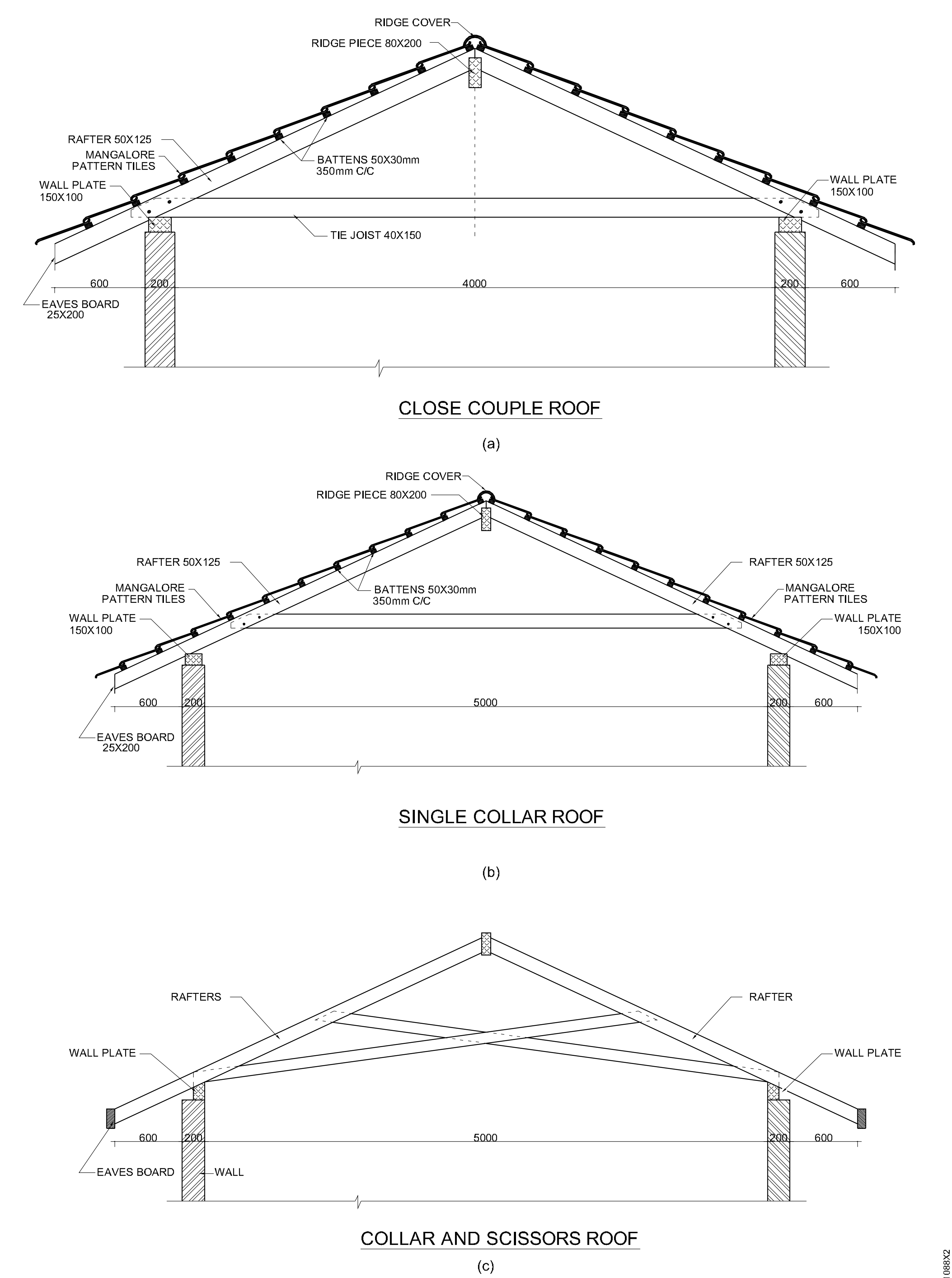
Cross section size of eaves boards = 25 x 200mm.

Pitch of the roof = 30^{o} or 1/3 of span.

- Draw the main walls with 5000 mm clear span.
- Draw wall plate above the top of main wall.
- Draw common rafter with 30^{o} slope above the top of wall plate.
- Draw ridge piece at the junction of common rafter.
- Draw collar horizontally from the middle of common rafter.
- Draw eave board at the end of common rafter.
- Draw battens above the common rafter.
- Draw roof tiles above the battens.
- Complete the drawing as shown in figure 1.

— — — — — — — —

Fig 1



TYPE OF SLOPE ROOFS

Task 3**: Draw the section of collar and scissors roof (Fig 1c)**

Draw the section of collar and scissors roof to a scale 1:50.

Data

Span = 5000 mm.

Thickness of main wall = 300mm.

Cross section size of wall plate = 150 x 75 mm.

Cross section size of ridge piece = 80 x 200mm.

Cross section size of common rafter = 50 x 125mm.

Cross section size of scissors = 50 x 125 mm.

Cross section size of battens = 50 x 30 mm at 350 mm C/C.

Cross section size of eave boards = 25 x 20 mm.

Elevation projection = 600mm.

Pitch of the roof = 30^o or 1/3 of span.

- Draw the main walls with 5000 mm clear span.
- Draw wall plate above the top of main wall.
- Draw common rafter with 30^o slope above the top of wall plate.
- Draw ridge piece at the junction of common rafter.
- Draw scissors from common rafters as shown in figure 1.

— — — — — — — —

Draw types of sloped roofs

Objective : At the end of this exercise, you shall be able to,
- **draw the section of double or purlin roof.**

TASK 1 **: Draw the section of double for purlin roof (Fig 1a)**

Draw the section of double or purlin roof to a scale 1:50.

DATA

Span = 5000mm.

Thickness of main wall = 300 mm.

Cross section size of wall plate = 150 x 75 mm.

Cross section size of Ridge piece = 80 x 200mm.

Cross section size of Common rafter = 50 x 125 mm.

Cross section size of tie joist = 50 x 100 mm.

Cross section size of battens = 50 x 30mm at mm C/C.

Cross section size of elevation boards = 50 x 200mm.

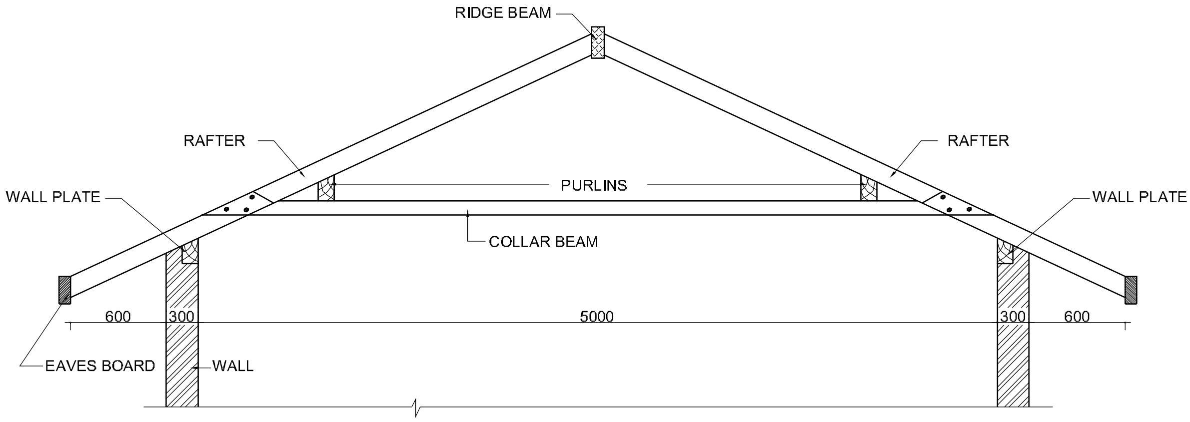
Elevation projection = 600 mm.

Pitch of the roof = 30^o or 1/3 of span.

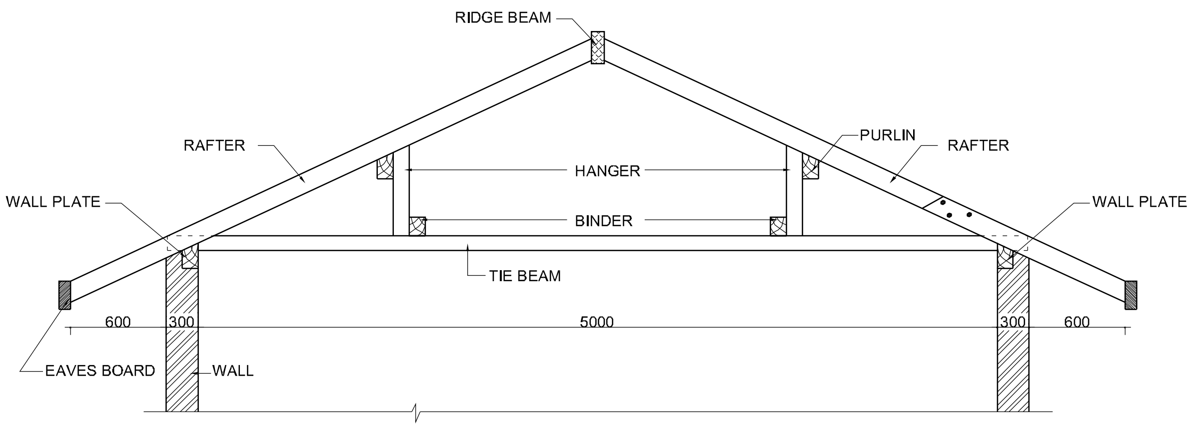
- Draw the main walls with 5000mm clear span.
- Draw wall plate above the top of main wall.
- Draw common rafter with 30^o slope above the top of wall plate.
- Draw ridge piece at the junction of common rafter.
- Draw collar beam and purlins from common rafter as shown in figure.
- Draw eave board at the end of common rafter.
- Draw battens above the common rafter.
- Draw roof tiles above the battens.
- Draw elevation board at the end of common rafter.
- Draw battens above the common rafter.
- Complete the drawing as shown in figure 1.

— — — — — — — —

Fig 1



(a) DOUBLE OR PURLIN ROOF



(b) RAFTER AND PURLIN ROOF

TYPE OF SLOPE ROOFS

DCN21088Y1

Steel roof truss

Objectives: At the end of this exercise you shall be able to
- **draw the elevation of steel truss**
- **draw details of joint of steel.**

PROCEDURE

TASK 1 **: Draw the elevation of steel truss (Fig 1a)**

Draw the section of steel truss to a scale 1:50.

Data

Span	= 7200mm.
Thickness of main wall	= 300mm.
Tie beam	= ISA 75 x 75 x 6.
Principal rafter	= 2 - ISA 75 x 75 x 6.
Purlin	= ISA 100 x 75 x 6.
Struts	= ISA 65 x 65 x 6.
Gusset plate	= 6 mm thick.
Gusset angle	= 2 - ISA 75 x 75 x 75 x 6.
Base plate	= 300 x 250 x 10.
Anchor bolt	= 20 mm dia.

- Draw the centre line of the steel truss, as per the inclindations in the key diagram.
- Draw the thickness of the members parallel to the centre line.
- Draw the gusset plate and rivets.
- Complete the drawing as shown in figure 1.

— — — — — — — —

TASK 2**: Draw the details of base connection of steel truss (ISOMETRIC VIEW) (Fig 1b)**

Draw the section of steel roof truss a scale 1:10.

DATA

Thickness of mail wall	= 300 mm.
Tie beam	= ISA 75 x 75 x 6.
Principal rafter	= 2 - ISA 75 x 75 x 6.
Gusset plate	= 6 mm thick.
Gusset angle	= 2 - ISA 75 x 75 x 6.
Base plate	= 300 x 250 x 10.
Anchor bolt	= 20 mm dia.

- Draw the isometric view of wall.
- Draw the base plate above wall.
- Draw gusset angle and gusset plate.
- Draw the principal rafter and tie beam.
- Complete the drawing as shown in figure 1.

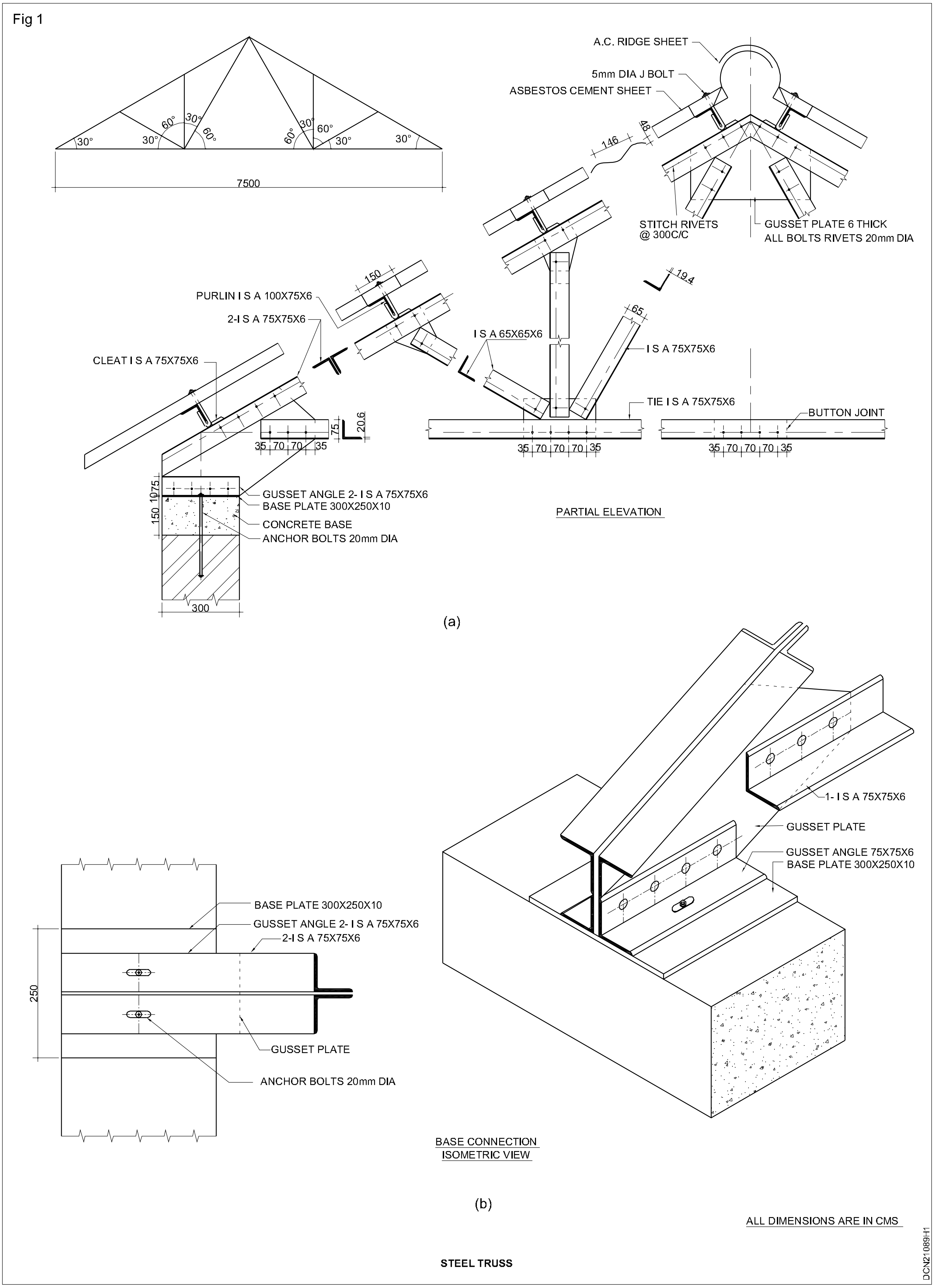


Fig 1
30°
60°
7500
A.C. RIDGE SHEET
5mm DIA J BOLT
ASBESTOS CEMENT SHEET
146
48
STITCH RIVETS @ 300C/C
GUSSET PLATE 6 THICK
ALL BOLTS RIVETS 20mm DIA
19.4
PURLIN I S A 100X75X6
150
2-I S A 75X75X6
65
I S A 65X65X6
I S A 75X75X6
CLEAT I S A 75X75X6
TIE I S A 75X75X6
BUTTON JOINT
20.6
75
35 70 70 35
35 70 70 70 35
GUSSET ANGLE 2- I S A 75X75X6
BASE PLATE 300X250X10
CONCRETE BASE
ANCHOR BOLTS 20mm DIA
PARTIAL ELEVATION
300
(a)
1- I S A 75X75X6
GUSSET PLATE
GUSSET ANGLE 75X75X6
BASE PLATE 300X250X10
BASE PLATE 300X250X10
GUSSET ANGLE 2- I S A 75X75X6
2-I S A 75X75X6
250
GUSSET PLATE
ANCHOR BOLTS 20mm DIA
BASE CONNECTION
ISOMETRIC VIEW
(b)
ALL DIMENSIONS ARE IN CMS
STEEL TRUSS
DCN21089H1

Tubler steel truss

Objectives: At the end of this exercise, you shall be able to
- **draw the elevation of tubler steel truss**
- **draw details of tubler steel truss.**

TASK 1 **: Draw the elevation of tubular steel truss (Fig 1)**

Draw the elevation of tublar steel truss a scale 1:50.

DATA

Span	= 10000mm.
Thickness of main wall	= 250mm.
Dia of principal rafter	= 50mm.
Tie beam	= 50mm.
Purlin	= 50mm.
Struts	= 25mm.
Centre post	= 40mm.
Base plate	= 250 x 250 x 10.
Bolts	= 12 mm dia.

- Draw the centre line of the tubular steel truss.
- Draw the thickness of the members parallel to the centre line.
- Complete the drawing as shown in figure 1.

— — — — — — — —

TASK 2 **: Draw the details of base connection of tubular truss at A,B & C (Fig 1)**

Draw the section of tubular steel truss a scale 1:10.

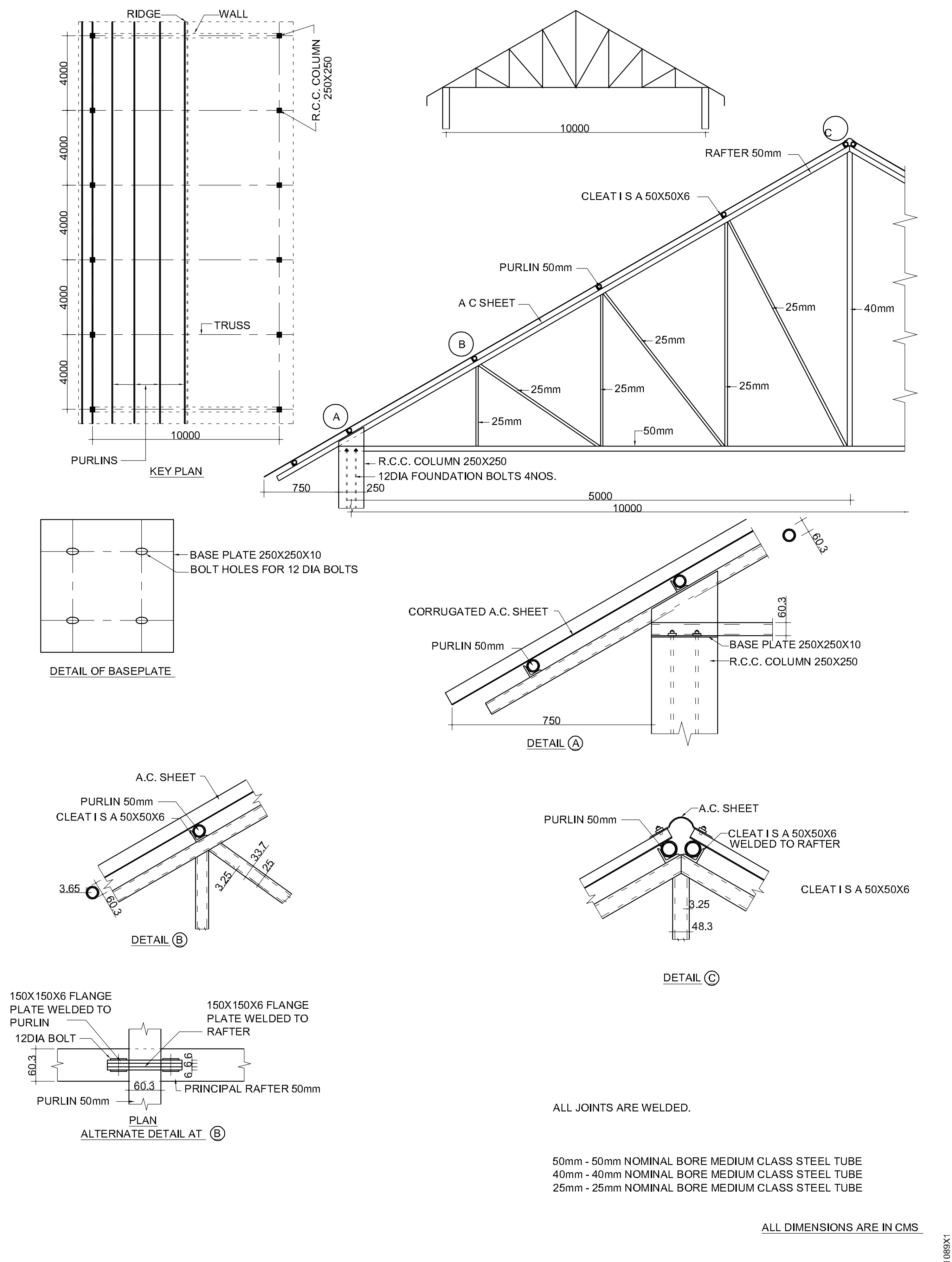
Data

Thickness of main wall	= 250mm.
Dia. of principal rafter	= 50mm.
Tie Beam	= 50mm.
Purlin	= 50mm.
Struts	= 25mm.
Centre post	= 40mm.
Base plate	= 250 x 250 x 10.
Bolts	= 12 mm dia.

- Draw the wall.
- Draw the base plate above wall.
- Draw bolts.
- Draw the principal rafter and tie beam.
- Complplate the drawing as shown in figure 1.

— — — — — — — —

Fig 1



TUBULAR STEEL TRUSS

King post roof truss

Objectives : At the end of this exercise you shall be able to
- **draw the elevation of king post truss**
- **draw details of each joint of king post truss.**

PROCEDURE

TASK 1 **: Draw the elevation of king post roof truss (Fig 1)**

Draw the section of king post truss a scale 1:50.

DATA

Span = 700 cm.

Thickness of main wall = 30cm.

Cross section size of wall plate = 10 x 15cm.

Cross section size king post = 10 x 10cm.

Cross section size of principle rafter = 10 x 15cm.

Cross section size of struts = 10 x 10cm.

Cross section size of Tie Beam = 10 x 20mm.

Cross section size of commonrafter = 5 x 10mm.

Cross section size of ridge piece = 5 x 17.5cm.

Cross section size of purlin = 7.5 x 17.5cm.

Size of cleat = 20 x 10 x 2.5cm.

Cross section size of battens = 5 x 3cm @ 35cm C/C.

Cross section size of eaves boards = 5 x 20cm.

Eaves projection = 60cm.

Pitch of the roof = 30^{o} or 1/3 of span.

- Draw two main walls with clear span 7000mm.
- Draw concrete bed block 300 x 100 mm on the top of main wall.
- Draw 7600 x 200 mm rectangle for tie beam.
- Draw centre line of king post truss.
- Draw centre line of struct .(30^{o} inclination)
- Draw wall plate at the end of tie beam as shown in figure 1.
- Draw the centre line of principle rafter.
- Draw parallel line from the centre line to inside and outside according to the size of members. (king post, strut, principle rafter)
- Draw ridge piece above the king post.
- Draw purlin above the principle rafter.
- Draw cleat to support the purlin.
- Draw common rafter above the purlin.
- Draw battens above the comon rafter.
- Draw the roof tiles above the battens.
- Draw eave boards at the end of common rafter.
- Complete the drawing as shown in figure 1.

— — — — — — — —

TASK 2 **: Draw the details of ridge connection king post truss (Fig 1 - #A)**

Draw the detail (A) of king post truss in a scale 1:10.

DATA

Cross section size of king post =10 x 10 cm.

Cross section size of principle rafter = 10 x 15cm.

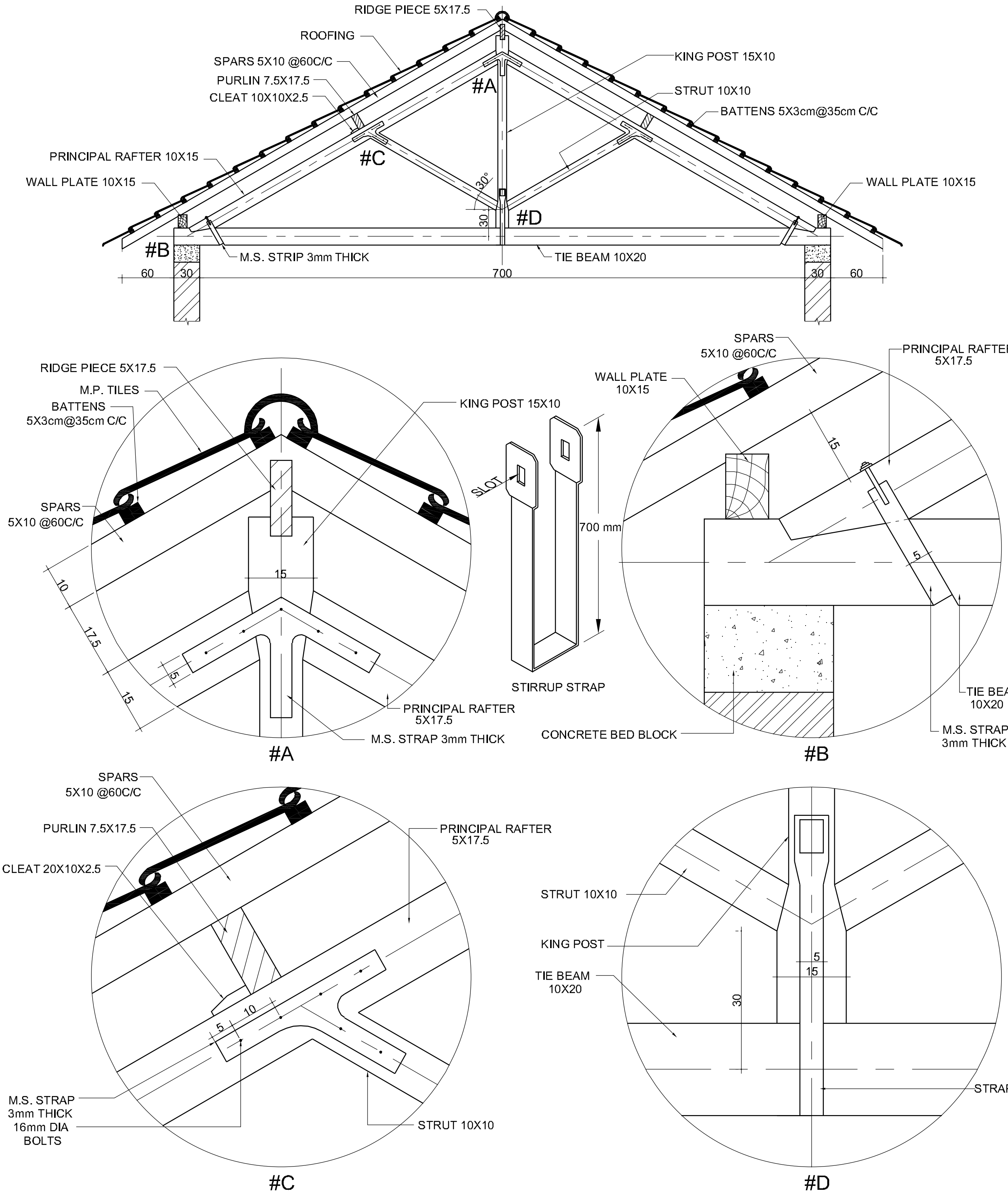
Cross section size of common rafter = 5 x 10 cm.

Cross section size of ridge piece = 5 x 17.5 cm.

- Draw the king post and principle rafter.
- Draw ridge piece above the king post.
- Draw common rafter above the priniciple rafter.
- Draw M.S strap at connection of strut and principle rafter.
- Draw battens above the common rafter.
- Draw tiles above the battens.
- Complete the drawing as shown in figure A.

— — — — — — — —

Fig 1



ALL DIMENSIONS ARE IN CMS

DCN21090H1

KING POST ROOF TRUSS

TASK 3 **: Draw the details of wall, tie beam, principle rafter of king post roof truss (Fig 1 - #B)**

Draw the detail (B) of king post truss a scale 1:10.

DATA

Thickness of main wall = 30 cm.

Cross section size of wall plate = 10 x 15 cm.

Cross section size of principle rafter = 10 x 15 cm.

Cross section size of common rafter = 5 x 10 cm.

Cross section size of Tie beam = 10 x 20 cm.

- Draw the section of main wall.
- Draw 300 x 100 mm rectangle for concrete bed block.
- Extend the bed block top line to the right.
- Draw 200 mm parallel line above the block. (Tie beam)
- Draw wall plate, principle rafter, M.S strap, common rafter etc and complete the drawing as shown in figure B.

— — — — — — — —

TASK 4**: Draw the details of strut and principle pafter connection of king post truss (Fig 1 - #C)**

Draw the details C of king post truss in a scale 1:10/

DATA

Cross section size of struts = 10 x 10 cm.

Cross section size of principle rafter = 10 x 15 cm.

Cross section size of common rafter = 5 x 10 cm.

Cross section size of purlin = 7.5 x 17.5 cm.

Size of cleat = 20 x 20 x 5 cm.

- Draw 30^{o} inclined parallel lines for principal rafter.
- Draw strut.
- Draw purlin and cleat above the principle rafter.
- Draw common rafter above the purlin.
- Draw M.S strap.
- Complete the drawing as shown in figure C.

— — — — — — — —

TASK 5 **: Draw the details of beam, king post & strut connection of king post truss (Fig 1- #D)**

Draw the detail (D) of king post truss in a scale 1:10.

DATA

Cross section size of king post = 10 x 10 cm.

Cross section size of struts = 10 x 10 cm.

Cross section size of Tie beam = 20 x 10 cm.

Cross section size of ridge piece = 5 x 17.5 cm.

- Draw the tie beam and king post.
- Draw the strut both sides of the king post
- Draw M.S strap at connection of tie beam and king post.
- Complete the drawing as shown in figure D.

— — — — — — — —

Queen post roof truss

Objectives : At the end of this exercise, you shall be able to,
- **draw the elevation of queen post truss**
- **draw details of each joint of queen post truss.**

TASK 1 **: Draw the elevation of queen post roof truss (Fig 1)**

Draw the section of queen post truss a scale 1:50.

DATA

Span = 1200 cm.

Thickness of main wall = 30 cm.

Cross section size of wall plate = 10 x 15 cm.

Cross section size of queen post = 15 x 17.5 cm.

Cross section size of principle rafter = 15 x 17.5 cm.

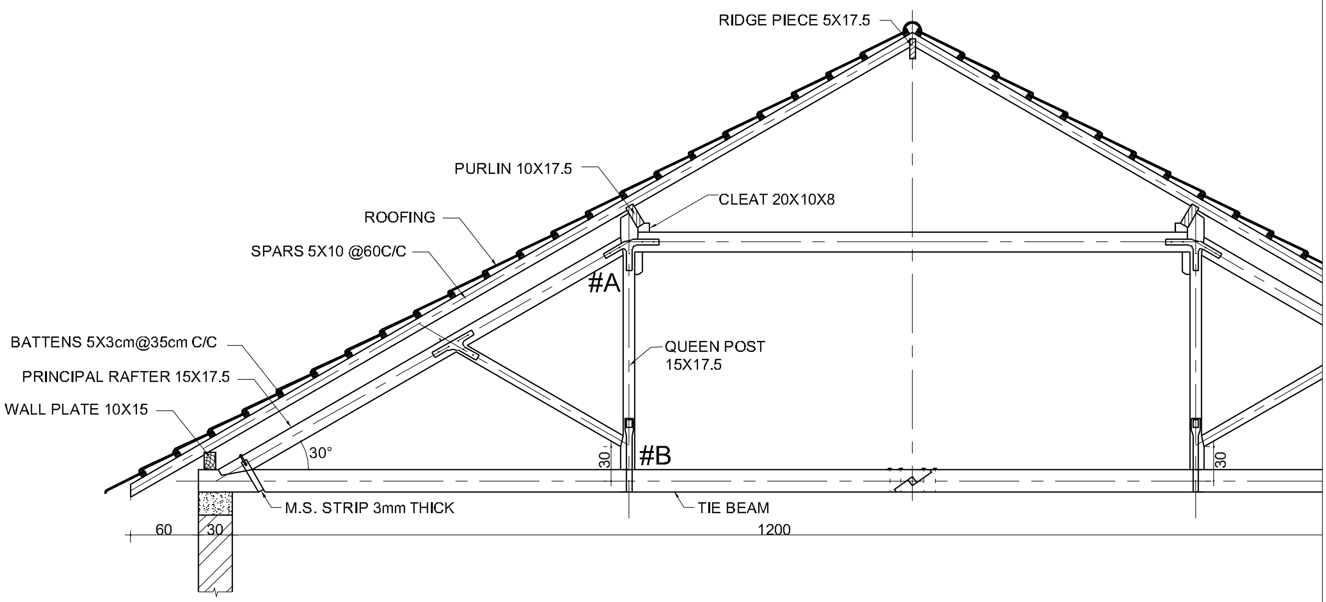
Cross section size of top joist = 15 x 17.5 cm.

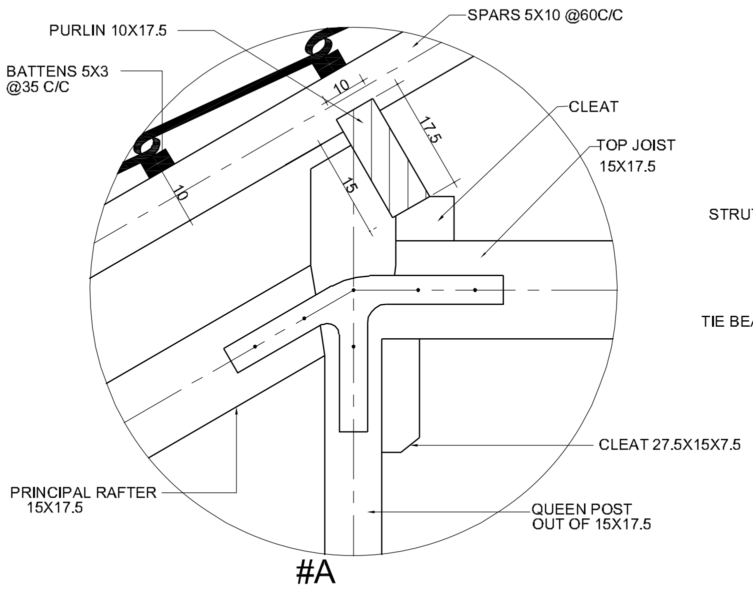
Cross section size of struts = 15 x 10 cm.

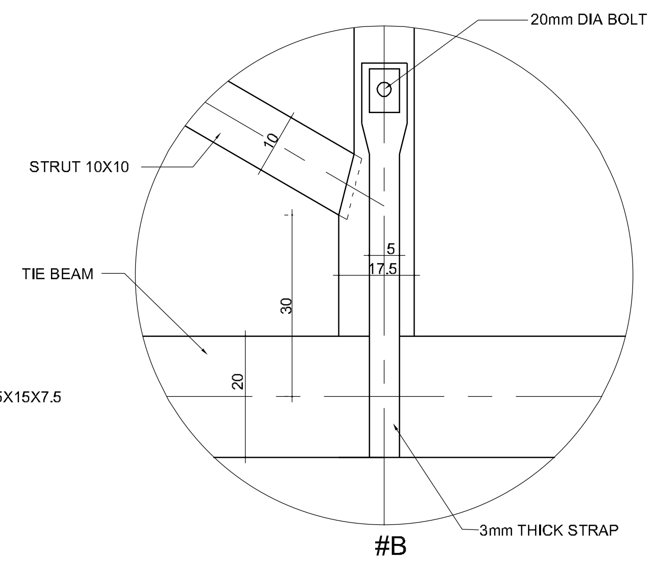
Cross section size of Tie beam = 15 x 20 cm.

Cross section size of common rafter = 5 x 10 cm.

Fig 1







ALL DIMENSIONS ARE IN CMS

DCN21090X1

QUEEN POST ROOF TRUSS

Cross section size of ridge piece = 5 x 17.5 cm.

Size of cleat = 20 x 10 x 8 cm.

Cross section size of battens = (5 x 3) cm @ 35cm C/C.

Cross section size of elevation boards = 5 x 20 cm.

Elevation projections = 60 cm.

- Pitch of the roof = 30° or 1/3 of span.
- Draw two main walls by with clear span 1200 cm.
- Draw concrete bed block 300 x 100 mm on the top of main wall.
- Draw 1260 x 20 cm rectangle for tie beam.
- Draw centre line of queen post truss.
- Draw wall plate at the end of tie beam a shown in figure 1.
- Draw lines parallel to the centre line to show the thickness of members. (queen post, top joist, strut, principal rafter)
- Draw purlin above the principal rafter.
- Draw Cleat to support the purlin.
- Draw common rafter above the purlin.
- Draw battens above the common rafter.
- Draw the roof tiles above the battens.
- Draw eave boards at the end of common rafter.
- Complete the drawing as shown in figure.

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TASK 2 **: Draw the details of top joist queen post & principle rafter connection of queen post truss (Fig 1 - #A)**

Draw the detail (A) of king post truss in a scale 1:10.

DATA

Cross section size of queen post = 15 x 17.5 cm.

Cross section size of top joist = 15 x 17.5 cm.

Cross section size of principal rafter = 15 x 17 .5 cm.

Cross section size of = 10 x 17.5 cm.

Cross section size of = 5 x 10 cm.

- Draw the queen post.
- Draw the top joist on the right side of queen post.
- Draw the principal rafter left side of the queen post.
- Draw M.S strap at connection of tie beam and queen post.
- Draw the cleat and common rafter.
- Draw the roof tiles over the common rafter.
- Complete the drawing as shown in figure A.

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TASK 3 **: Draw the details of the beam, queen post & strut connection of queen post Truss (Fig 1 - #B)**

Draw the detail (B) of king post truss in a scale 1:10.

DATA

Cross section size of queen post = 15 x 17.5 cm.

Cross section size of struts = 15 x 10 cm.

Cross section size of Tie beam = 20 x 15 cm.

Cross section size of ridge piece = 5 x 17.5 cm.

- Draw the tie beam and queen post.
- Draw the strut left side of the queen post.
- Draw M.S strap at connection of tie beam.
- Complete the drawing as shown in figure B.

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Preparation of site map and models

Objectives: At the end of this project you shall be able to
- **prepare map by using varions leveling instruments**
- **preparing the model of different types of doors and windows**
- **preparing a building drawing.**

TASK 1**: Prepare your I.T.I site map by using survey instruments.**

Instructor should guide the trainees to prepare the site map.

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Task 2**: Design a building drawing with architech**

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Task 3**: Prepare the models of doors and windows following door models may be prepared.**

- Ledged and battern door.
- Panelled door.
- Half glassed door.
- Collapsible door.

Windows.

- Panelled windows.
- Squre bay windows.

Note: Instructor should guide the trainees in preparing of the project work.

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