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BUILDING AND STRUCTURAL SURVEYING N411

(One 3-hour paper)

(With effect from January 1980)

1. General: Definition of plane surveying; various types of surveying; qualities and functions of a surveyor.
2. Basic concepts: Natural and engineers scales; relation between accuracy of survey, the scale of the map of plan and its purpose; mistakes and errors; control checks; South African national control systems on position and height; radians, sexagesimal and centesimal angles; angles of direction, orientation; measures of area and volume; plane table.
3. Distance measurement (taping): Description, maintenance and handling of steel tapes; mention of chains and other types of tapes; corrections, temperature, pull, sag, slope, height above sea level; step chaining; sources of error and mistakes in taping, checks booking and reduction of results; chain surveying; taping in catenary (proof of formulae not required). Introduction to electronic distance measurement.
4. Minor instruments and components: Construction, handling, care and adjustment of Abney level and optical square, tachometer staves and levelling staves; compass; bubble tube sensitivity, axis of bubble; the use of bubbles in surveying instruments; telescopes - construction, including provision of cross-hairs (no defects); lines of sight and collimation; parallax and its elimination.
5. Practical work: Chaining; use of Abney level, optical square and plane table.

# BUILDING AND STRUCTURAL SURVEYING N521

(One 3-hour paper)

(With effect from January 1981)

## 1. Basic principles

The basic surveying terms and principles. Description of the terms surveying, level plane, horizontal plane, linear measurement, height and angular measurements. Methods of fixing a point, trilateration, intersecting arcs, rectangular offsets, triangulation, polar co-ordinates and control. The principle of working from the whole to the part. The difference between accuracy and precision. Characteristics of different types of errors.

## 2. Linear measurements

Methods of direct linear measurement. The uses of chains, tapes and bands. Measuring sloping distances using chain, tape and band by: Stepping; using a clinometer. Calculation of slope correction for distances measured on an incline. Graphical method used to correct distances measured on an incline. Ranging and measuring over a hill and through a depression. Measuring around a pond, across a river or busy road. Measuring when a building obstructs vision.

Description of equipment used for chain surveys. Linear survey methods. Measuring offsets and ties by optical square and tape. The recording of measurements taken in a field by a recognised booking method. Identification and correction of fieldwork errors. Factors which govern chain survey framework. The application of chain survey principles to a small practical situation. The plotting of survey lines including all detail.

## 3. Height measurement

Sources of vertical control. Datum as reference for bench marks. The use of maps to obtain the position of control points. Establishment of bench marks giving reasons for use.

Definitions of levelling terms

Levelling instruments. A brief description of traditional levelling methods and instruments including the spirit, water and Cowley levels; dumpy level; tilting level; automatic level. Checking accuracy of levelling instruments. The reading of the metric levelling staff. Recording and calculating-reduced levels by "rise and fall"

and "collimation" methods including inverted staff and application of the required checks and corrections. Flying, grid, reciprocal and cross sectional levelling methods. Sources of induced and instrumental errors.

4. Angular measurement

Basic construction of the theodolite. The various types of theodolite. Use of the theodolite to measure horizontal and vertical angles. Recording the readings from the theodolite. Tacheometry, calculation of horizontal and vertical components.

5. Building surveys

Surveying a small building. Instruments used for taking internal and external dimensions. Measuring and recording a building and its site. Running internal and external measurements taken horizontally and vertically. Plotting survey from field measurements. Calculations: Cut and fill e.g. for a road, plotting vertical sections, roads, drains, etc.

6. Setting out

Setting out procedure for a simple rectangular building. Equipment required. Possible constraints in setting out a building. Positioning of profiles and datum for a building. Discussion of how profiles are used with a traveller to control excavation and foundation levels.

Setting out and levelling of drainage work. Invert of a drain, a sight rail and a traveller. Calculating a suitable length of traveller and reduced levels of sight rails from given drawings. Establishing sight rails for horizontal position and depth control of a straight drain between manholes.

BUILDING AND STRUCTURAL SURVEYING N631

(One 3-hour paper)

(With effect from September 1981)

1. Angular measurement: Temporary adjustments to optical theodolites. Definitions of the terms : transit; swing; face; bisection of a target angle; angle of direction; direction measurement of angles by theodolite. Recording and reduction of angular observations. Measurement of angles of depression and elevation by theodolite. Computing of the true horizontal length from the slope distance and the angle of inclination. Operational errors and errors due to natural causes in measurement of angles.
2. Traversing: Definitions of the terms: traversing; open and closed traverses; the meridian; magnetic meridian; grid; arbitrary meridian; whole circle bearing. Reducing angles from traverse reading. Computing a theodolite traverse, including all adjustments. Plotting by co-ordinates. Computing the area inside a traverse. Plotting of a compass traverse including graphical corrections. Bowditch rule.
3. Contouring: Definitions of the terms: Contour line; vertical interval; gradient. Methods of contouring of an area by grid and radial line method and tachometric readings with tache and level. Plotting contours by graph and interpolation. Plotting ground sections from contoured drawings. Computing areas and volumes from contours, spot heights and ground sections. Measuring areas with a planimeter.
4. Plotting: Identification of survey symbols. Survey maps: types and scales. Difference between grid, true, and magnetic north. Position by grid references.  
  
Standard plotting instruments: beam compasses; french curves; flexible curves; railway curves; stencils; ink pens.  
  
Standard plotting materials: cartridge paper; linen; tracing film.  
  
Plotting of chain, traverse, and building surveys.
5. Setting out: The procedure for co-ordinated setting out. The procedure for setting out and levelling of foundations for a steel framed building. Checking verticality of tall buildings using theodolite, optical plumb, and plumb bob.  
  
Formwork: Horizontal and vertical control.
6. Road construction: Methods of surveying routes for roads excluding aerial survey. Setting out of centre line or offset line. Types of control used for embankments, cuttings and levels. Calculation and setting out of a horizontal circular curve by tangential angle using a theodolite and steel tape. Longitudinal and cross-sections. Volumes of cut and fill on a straight road with traverse sloping ground.