

Introduction

What is surveying? Collection, processing & management of spatial information

Why is it important? Land ownership, engineering, mining, marine navigation, mapping, etc.

What is geomatics? Study of Earth

What is geosensing? Measurement of the Earth from remote, moving platforms

To define a horizontal plane: vertical axis matches gravity vector. Plane tangent to level surface. Long distances you can't use earth as a plane, need to account for the curvature

the vertical rate of change is higher than horizontal

vertical/elevation angle: angle to a point with respect to horizontal plane

zenith angle: angle to a point with respect to the zenith (vertical direction)

horizontal angle: angle between two points measured in the horizontal plane

Field notes: accuracy, integrity, legibility, arrangement, clarity. Pencil. Cross mistakes. Evidence

Module 2 - leveling

Process of determining elevation (heights) or difference in elevation

level surface: curved surface orthogonal to plumb line everywhere

Module 2 - leveling (cont)

vertical line: direction of gravity (indicated by plumb line)

collimation axis: horizontal plane of instrument

vertical datum: any level surface to which heights are referred

mean sea level: mean height of ocean level taken from 26 gauges over 19 years

tidal datum: avg. of all high water over 19 years

elevation: vertical distance above datum

BM: permanent monument which elevation is known

earth curvature

systematic error. if BS&FS distances are the same then effect is cancelled

refraction

difference in temperature & pressure with altitude rises difference in refraction index of atm. systematic error.

meter

feet

Instrumentation

height difference: dumpy, tilting, automatic level

distance: steel band (account T & F pull); nylon tape; electronic distance measurement

angular: theodolite; electronic theodolite

distance+angular: total station

Instrumentation (cont)

other: global positioning system (gps); laser scanner

Module 1

Significant Figures SG

accuracy: # of digits recorded

add/subtract: leftmost, rightmost sg

multiplication: least # sg of factors

Errors

Sources: natural, instrumental & personal

-mistakes/gross error or blunder. ex: read a tape incorrectly

-systematic. physical or geometric law can correct. ex: thermal expansion of steel band

-random. can't be corrected or modeled.

Precision & Accuracy

accuracy: nearness to true value. error is random.

precise: consistency of a group of observations, may contain systematic error

probability (most probable #) $\bar{D} = (\sum D/n)$; (residual) $v = D - \bar{D}$

surveys contain redundant info: analysis of residuals for accuracy and remain systematic error. more equation than unknowns assumes normally distributed random error.

error propagation

root mean square error $RMSE = \sqrt{((\sum (D - \bar{D})^2)/n)}$

standard deviation $\sigma = \pm \sqrt{((\sum v^2)/(n-1))}$

Module 6

Lidar: light detection and ranging. Mainly concerned with the precise timing and range determination of the return signal. generally based on pulse lasers

Laser: light amplification by stimulated emission of radiation. safety concerns: MPE (max. permissible exposure) parameter: exposure duration/- pulse width

Cadastral surveying

tenure: legal structure by which land is owned

Land tenure components:

1- method of transferring ownership (title) via deeds (written documents which contain description of the property)

2- permanently marked boundaries on the ground

3- officially maintain ownership records. (county clerk's office or US bureau of land management- BLM)

4- official legal description common law: law that has been developed on the basis of preceding rulings by judges

statutory law: written laws passed by legislative and government of a country and those which have been accepted by society

Types of cadastral surveying:

1- original: land has not yet been measured and lines of ownership set



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Cadastral surveying (cont)

2- retracement: purpose of relocating or reestablishing previously surveyed boundary lines. restore boundary markers to their original location, not to correct them. General priorities: senior rights; intent of parties; call for a survey; monuments (natural, artificial); measurements (distance, direction, area, coordinates)

3- subdivision survey: establish new smaller parcels of land within lands already surveyed

property description methods:

1- metes and bounds: Colonial method. giant description. start with a point of commencement (POC)

2- block and lot: reference a plat that has been filed in the clerk's office. simple, concise and fewer conflicts. descriptions usually created simultaneously and thus are not subjected to senior rights: excess or deficiency found in prorated equally.

3- coordinates: state plane coordinates. Pros: virtual monument that does not degrade; easily re-established; concise. Cons: reference/datum is not static due to earth movement.

4- public land survey system PLSS

Cadastral surveying (cont)

Adverse possession: gain title to a land that is not yours. requirements: actual possession; exclusive possession; open & notorious possession; hostile possession; continuous possession (depends on state). may require a "color of title" (claim to a parcel of real property based on some written instrument, though a defective one)

Units of Linear measurement

1m=100cm=1000mm

1km=1000m

1ft=0.3048m[international]

1in=25.4mm

1ft=12in

1ch=20.1168m=66ft

1yard=3ft

1mile=5280ft=80ch

1nautical mile=6076.10ft

1ha=10000m²=100mx100m

1ac=1chx10ch

1ac=43560ft²=66ftx660ft

1ac=0.4047ha

degree=(radx180°)/π

rad=(degree*π)/180°

0.1°=6'

0.01°=36"

0.001°=3.6"

0.0001°=0.36"

1rad=57.2958°=206264.8"

Module 3

Chaining: nylon tape/steel band.

Error: incorrect length, temperature, incorrect tension.

Edm: classified accord:

1- radiation source: optical or microwave

2-measurement principal: phase difference or pulse

pulse method: Problems: energy does not behave like a box.

gaussian shape signal processing issue. more convenient type but not as accurate

phase method: ambiguity: unknown integer # of cycles between the instrument & reflector. Large wave lengths could measure distance without amb. Since n=0 when you are within one cycle

3- whether a reflector is required or not

Module 7

Compound curve: different radius of curvature

broken-back curve: 2 difference curves connected by a tangent

reverse curve: S shape

spiral: has variable radius of curvature and provides a smooth transition from tangent to a certain radius of curvature

centripetal: force you feel toward the center of radius of curvature. Counter-balanced by: superelevation (e) and side friction factor (fc)

Module 7 (cont)

centrifugal: imaginary force that drivers feel pushing them outward due to frame of reference.

Superelevation: limits related to: climate, terrain conditions, type of area, frequency of slow moving vehicles

side friction: used to maintain path on curve.

PLSS

why? recognition of the value of grid-system subdivision and need of the colonies to revenue from the sale of public lands

designed to maximize number of regular sized sections and minimize field work

boundaries: unchangeable.

1mile=80chain and 1acre=-10ch²

broken into: quadrangles; townships; section; 1/4 section

discrepancies thrown into sections bordering NW township

surveys proceed S->N and E->W

Colonial survey: metes & bounds. often dictated by the topography and other pre-existing landmarks

Module 4

Bearing: horizontal angle between the line and the chosen direction north

Azimuth: bearing referred to true north



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Module 4 (cont)

deflection angle: counter-clock angle. note: back bearing: forward $+180^\circ$

compass: angular survey measurement. bearing wrt magnetic N

geodetic azimuth: magnetic azimuth+declination. Magnetic pole is always moving, declination not constant

agonic line: zero declination, mag & rotational pole at the same meridian

angular measurement: theodolite levelled so that horizontal angle or directions are measured in horizontal plane.

double centering: angles are measured twice: face left and face right (rotated 180°). Eliminating systematic errors

closing the horizon: method which all angles at a station are measured

theodolite errors: collimation error: systematic. the collimation axis is not orthogonal to the trunnion axis. Collimation axis traces out a flat cone rather than a vertical plane.

Module 5

Traversing: control for construction set-out. cadastral surveys to locate or establish boundaries.

traverse station: temporary or permanent point of the traverse

Module 8

Low point: defines location of catch basin for drainage

high point defines limits of drainage area for roadways

Design of vertical curve

crest: sight distance, appearance, safety, comfort

sag: headlight sight distance, rider comfort, drainage, appearance

comfort: change in grade, design speed

appearance: change in grade



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