LAND SURVEY-2

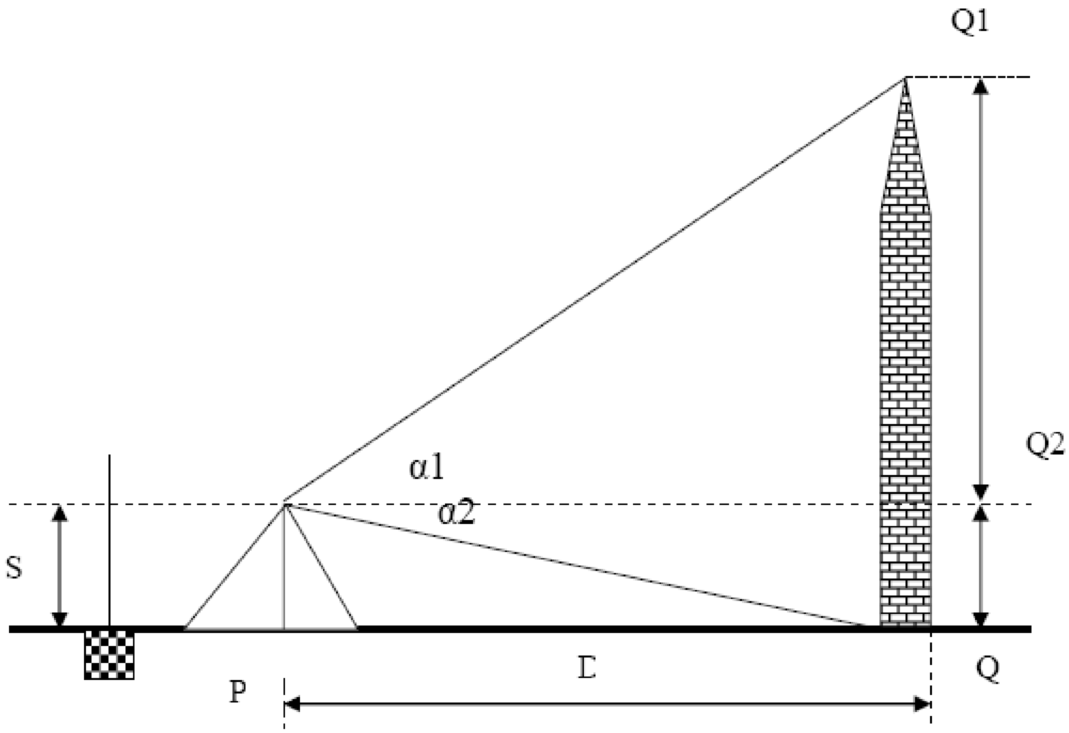
LAB MANNUAL

CONTENTS

DETERMININGANHEIGHTOFOBJECTBY MEASURINGVERTICALANGLE

OBJECTIVE:

Determiningaheightofobjectbymeasuringverticalangle.



EQUIPMENTS:

1. Theodolite
2. LevelingStop
3. TapeorChain
4. Pegs
5. Plumbbob

PROCEDURE:

1. SetuptheinstrumentatstationP.
2. Performalltemporaryadjustments.
3. Bringthelineofcollimationhorizontal
4. Entertheinitialreadingsinthetabularform.
5. SwingthetelescopeandtakestaffreadingoverthegivenB.M.
6. Swingthetelescopetowardstheobject.

7. Releasetheverticalclampscrew,sightthetopoftheobjectQ1,andclamptheverticalclampscrew .

8. ReadCandDverniersandenterthereadings.

9. Releasetheverticalclampscrew,sightthebottomoftheobjectQ,andclampthescrew.

10. Readvernierreadingsandenterinthetabularform.

11. MeasuretheHorizontaldistancebetweentheinstrumentstationandtheobject.

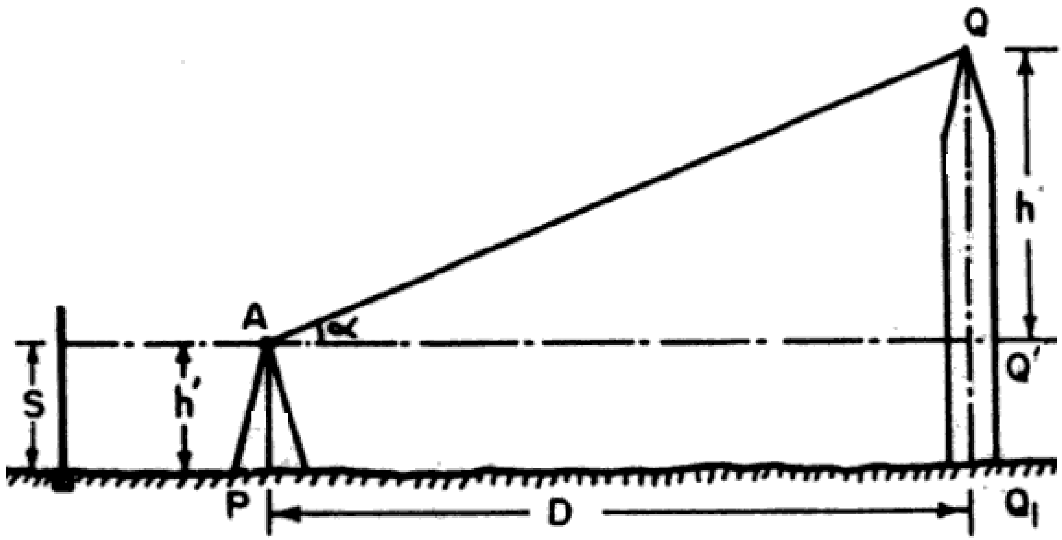
12. Theaboveprocedurewillberepeatedwiththefacerightobservation.

13. Theaverageofthetwoobservationsbytransitingthetelescopetakenwithdifferentfaceswillbev erticalangle.

14. CalculatetheheightofthetoppointQ1fromhorizontalline(h1)andheightofthebottompointQ0fr om horizontalline(h2)byusingformula h=dtanα

Methods:

1. MeasurementofHeightofanobjectwhenbaseisaccessible(onlevelground)



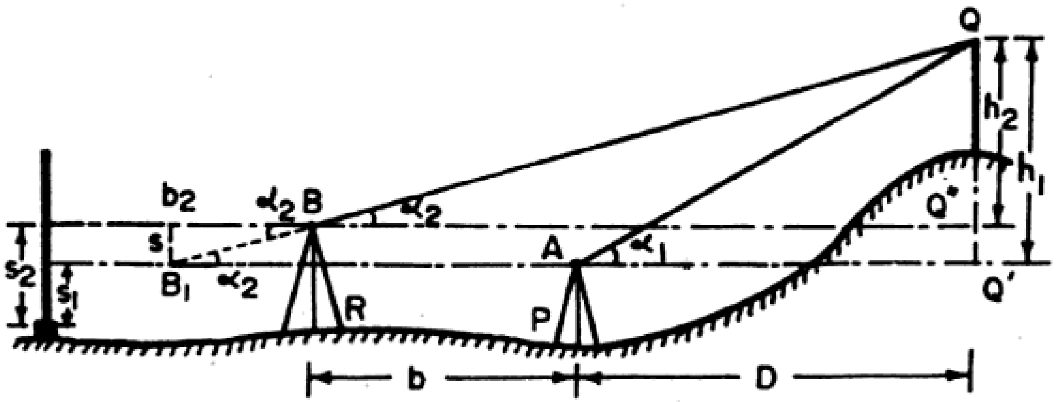
BASE ACCESSIBLE

h=Dtanα

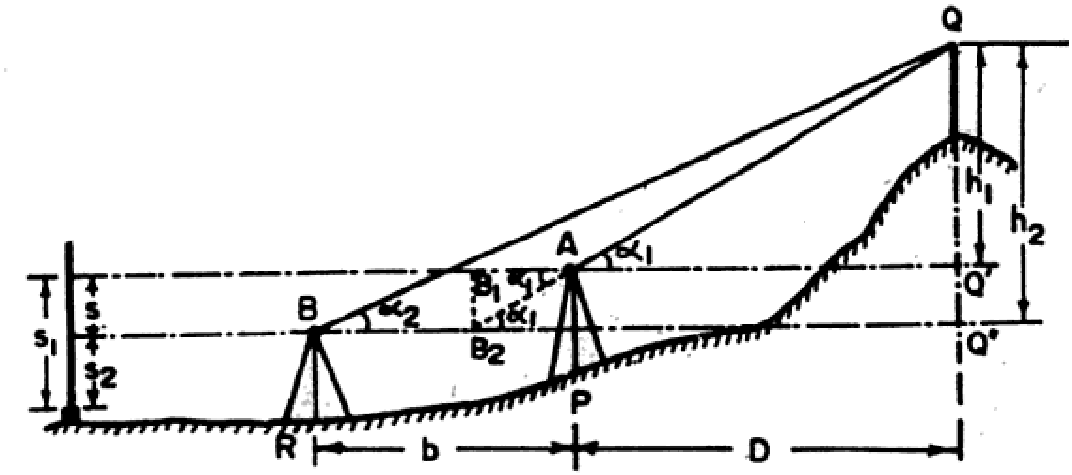
Heightoftheobject=s+h

R.L.oftopoftheobject=R.L.ofB.M.+s+h

2. MeasurementofHeightofanobjectwhenbaseisinaccessible



When P is Lower than R



When P is higher than R

$$D = \frac{(b \pm s \cot \alpha_2) \tan \alpha_2}{\tan \alpha_1 - \tan \alpha_2}$$

Use + sign with $s \cot \alpha_2$ when the instrument axis at A is lower and − sign when it is higher than at B.

$$\text{R.L. of } Q = \text{R.L. of B.M.} + S_1 + h_1$$

$$h_1 = D \tan \alpha_1$$

DETERMINATIONOFCONSTANTSOFTACHEOMETER

OBJECTIVE

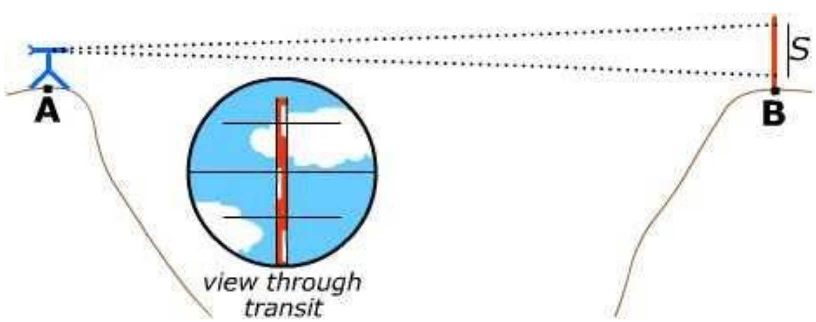
Todeterminethemultiplyingconstantandadditiveconstantofthegiventheodolite.

EQUIPMENTS

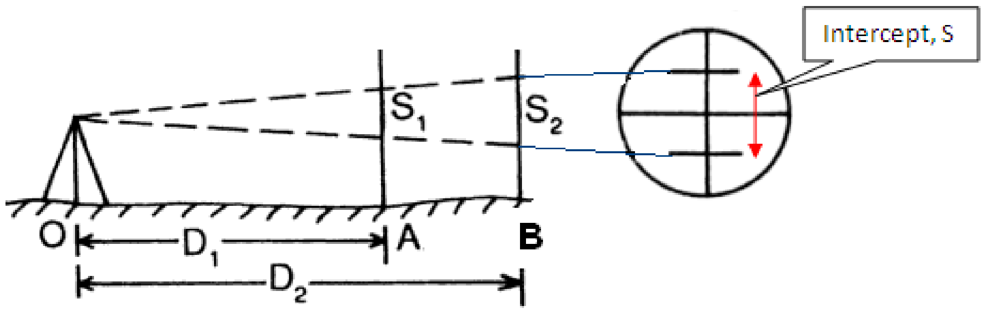
- Theodolite
- RangingRods
- LevellingStaff
- Tape

PROCEDURE

1. Stretchthechaininthefieldanddrivepegsat10m,20minterval.
2. Setthetheodoliteatthezeroanddothetemporaryadjustments.
3. Keep the staff on the pegs and observe the corresponding staff intercepts with horizontalsite.
4. Substitute the values of distance (D) and staff intercept (s) for different points in theequation D = ks + C, where k & s are the tacheometric constants. k is the multiplyingconstant& Cistheadditiveconstant.
5. Solvethesuccessivepairsof equationstogetthevalueofk&Candfindouttheaverageofthesevalues.



MeasurementofHorizontalDistance



Instrument Station	StaffS tation	Distance	StadiaReading			StadiaInt ercept (S)
			Top	Middle	Bottom	
O	A					
	B					

D=KS+C

D_1=K.S_1+C1D_2

=K.S_2+C2

SolveTwoEquations&findK&C

RESULT:

Multiplyingconstant,K=A

dditiveconstant,S =

MEASUREMENTOFHORIZONTALDISTANCE&VERTICALHEIGHTSUSINGTACHEOMETRICSURVEYING

OBJECTIVE:

DeterminationofelevationofpointsbyTacheometricsurveying

EQUIPMENT:

- Tacheometerwithtripod,
- Tape,
- Levelingstaff,
- Rangingrods

THEORY:

The Tacheometer is an instrument which is generally used to determine the horizontal aswell as vertical distance . it can also be used to determine the elevation of various pointswhichcannotbedeterminebyordinaryleveling.Whenoneofthesightishorizontalandstaffheld vertical then the RLs of staff station can be determined as we determine in ordinaryleveling .But if the staff station is below or above the line of collimation then the elevation ordepressionofsuchpointcanbedeterminedbycalculatingverticaldistancesfrominstrumentaxis to the central hair reading and taking the angle of elevation or depression made by lineofsighttotheinstrumentmadebyline ofsighttotheinstrumentaxis.

Procedure:

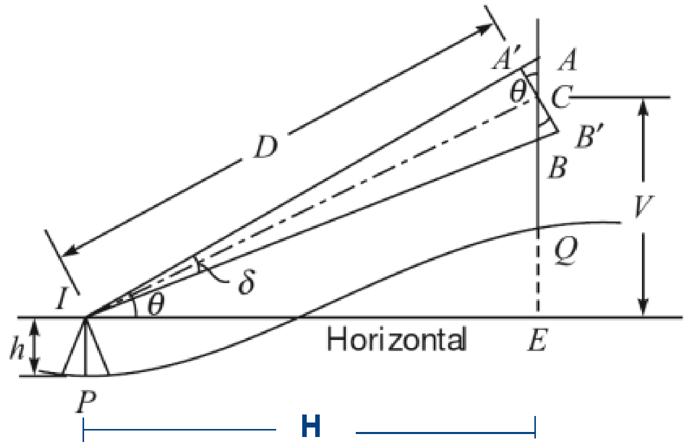
1) Setuptheinstrumentinsuchawaythatallthepointshouldbevisiblefromtheinstrumentstation.

2) Carryout the temporary adjustment and set vernier zero reading making line of sighthorizontal.

3) TakethefirststaffreadingonBenchmarkanddetermineheightofinstrument.

4) Then sight the telescope towards the staff station whose R.Ls are to be calculated.Measure the angle on vernier if line of sight is inclined upward or downward and also notethethreecrosshairreadings.

5) DeterminetheR.Lsofvariouspointsbycalculatingtheverticaldistance

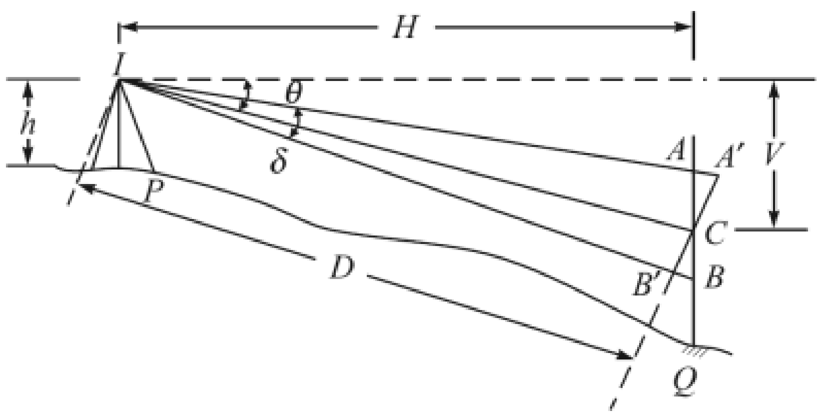


Inclined sight (elevation)

$$H = D\cos\theta = KS\cos^2\theta + C\cos\theta$$

$$V = \frac{1}{2}KS\sin 2\theta + C\sin\theta$$

$$\text{R.L. of } Q = \text{R.L. of } P + h + V - CQ$$



Inclined sight (depression).

$$D = KS\cos\theta + C$$
$$H = D\cos\theta = KS\cos^2\theta + C\cos\theta$$
$$V = D\sin\theta = KS\sin\theta\cos\theta + C\sin\theta$$
$$\text{R.L. of } Q = \text{R.L. of } P + h - V - CQ$$

SIMPLECURVESETTING BYOFFSETSFROMLONGCHORDMETHOD

OBJECTIVE:

Tosetoutasimplecurvebylinearmethod(offsetsfromlongchordmethod)

EQUIPMENT:

- CrossStaff,
- Arrows,
- Rangingrod
- Tape

THEORY:

Linearmethodsareusedwhen:-

1. Highdegreeofaccuracyisnotrequired
2. Thecurveisshort

Linearmethodsforsettingoutcurveinclude

1. **Byordinatesoroffsetsfromlongchord.**
2. Byoffsetsfromtangents(T)
   a. Perpendicularoffsets
   b. Radialoffsets

ELEMENTSOFSIMPLECIRCULARCURVE

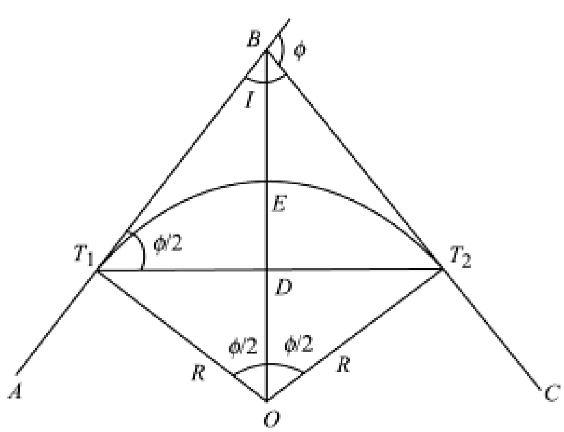


Fig. 10.10 Notations for Circular Curves

1. *AB* and *BC* are known as the *tangents* to the curve (Fig. 10.10).
2. *B* is known as the *point of intersection* or *vertex*.
3. The angle ϕ is known as the *angle of deflection*.
4. The angle *I* is called the *angle of intersection*.
5. Points T_1 and T_2 are known as *tangent points*.
6. Distances BT_1 and BT_2 are known as *tangent lengths*.
7. When the curve deflects to the right, it is called a *right-hand curve*, when it deflects to the left, it is said to be a *left-hand curve*.
8. *AB* is called the *rear tangent* and *BC*, the *forward tangent*.
9. The straight line T_1DT_2 is known as the *long chord*.
10. The curved line T_1ET_2 is said to be the *length of the curve*.
11. The mid-point *E* of the curve T_1ET_2 is known as the *apex* or *summit of the curve*.
12. The distance *BE* is known as the *apex distance* or *external distance*.
13. The distance *DE* is called the *versed sine* of the curve.
14. *R* is the *radius* of the curve.

Offsets or Ordinates from a Long Chord

Let *AB* and *BC* be two tangents meeting at a point *B*, with a deflection angle ϕ. The following data are calculated for setting out the curve (Fig. 10.11).

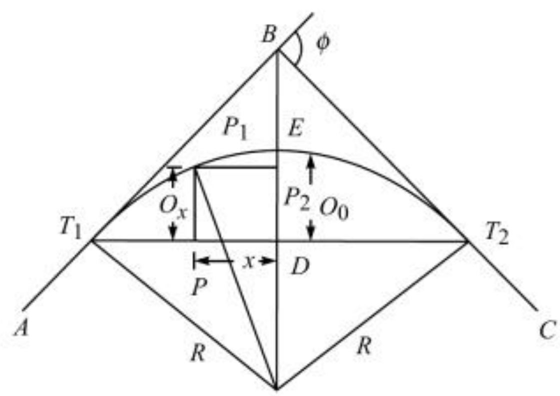


Fig. 10.11 Offsets from a Long Chord

1. The tangent length is calculated according to the formula; TL = $R \tan \phi/2$
2. Tangent points T_1 and T_2 are marked.
3. The length of the curve is calculated according to the formula:

$$\text{CL} = \frac{\pi R \phi^\circ}{180^\circ}$$

4. The chainages of T_1 and T_2 are found out.
5. The length of the long chord (L) is calculated from

$$L = 2R \sin \phi/2$$

6. The long chord is divided into two equal halves, the left half and the right half. Here the curve is symmetrical in both the halves.

7. The mid-ordinate O_0 is calculated as follows:
   (a) $O_0 = DE$ = versed sine of curve $= R(1 - \cos \phi/2)$ (10.3)
   (b) Again, $OF = R$ and $OD = R - O_0$

From triangle OT_1D, $OT_1^2 = OD^2 + T_1D^2$

or $$R^2 = (R - O_0)^2 + \left(\frac{L}{2}\right)^2$$

or $$R - O_0 = \sqrt{R^2 - (L/2)^2}$$

or $$O_0 = \sqrt{R^2 - (L/2)^2} \qquad (10.4)$$

Thus, the mid-ordinate O_0 can be calculated from Eq. (10.3) or (10.4).

8. Considering the left half of the long chord, the ordinates O_1, O_2, … are calculated at distances X_1, X_2,… taken from D towards the tangent point T_1.

   The formula for the calculation of ordinates is deduced as follows.

   Let P be a point at a distance x from D. Then PP_1 (O_x) is the required ordinate. A line P_1P_2 is drawn parallel to T_1T_2. From triangle OP_1P_2,

$$OP_1^2 = OP_2^2 + P_1P_2^2$$

or $$R^2 = \{(R - O_0) + O_x\}^2 + x^2$$ [where, $OP_2 = (R - O_0) + O_x$]

or $$R - O_0 + O_x = \sqrt{R^2 - x^2}$$

or $$O_x = \sqrt{R^2 - x^2} - (R - O_0) \qquad (10.5)$$

9. The ordinates for the right half are similar to these obtained for the left half.

SETTINGOUT OF SIMPLECIRCULAR CURVEBYRANKINEMETHOD

OBJECTIVE:

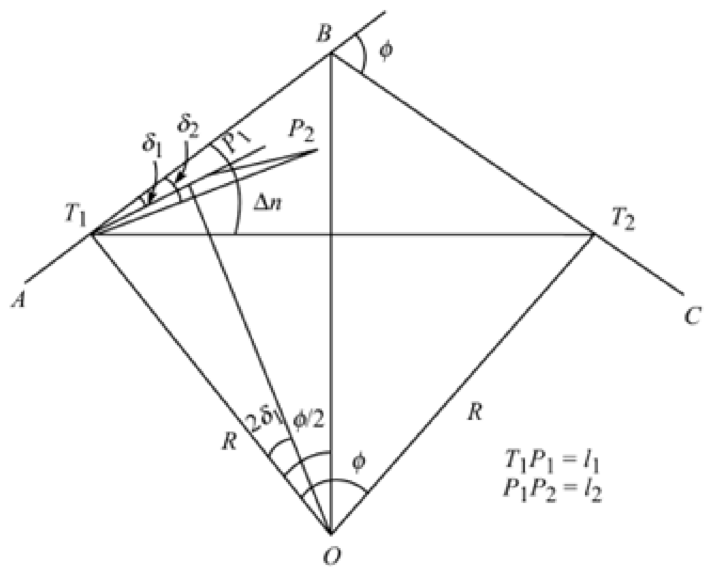
SettingoutofsimplecircularcurvebyRankinemethodoftangentialangle.

EQUIPMENT:

- TheodolitewithTripod
- Rangingrods
- Arrows
- Tape

HorizontalCurveSettingbyRankingMethod

Let AB and BC be two tangents intersecting at B, the deflection angle being ϕ (Fig. 10.18). The tangent length is calculated and tangent points T_1 and T_2 are marked.



Instrumental Method

Let P_1 = first point on the curve,

$T_1P_1 = l_1$ length of first chord (initial sub-chord)

δ_1 = deflection angle for first chord

R = radius of the curve

Δ_n = total deflection for the chords

Here, $\angle T_1OP_1 = 2 \times \angle BT_1P_1 = 2\delta_1$

Again,

Chord $T_1P_1 \sim$ Arc T_1P_1

Now,

$$\frac{\angle T_1 OP_1}{l_1} = \frac{360°}{2\pi R}$$

$$2\delta_1 = \frac{360° \times l_1}{2\pi R}$$

or

$$\delta_2 = \frac{360° \times l_1}{2 \times 2\pi R} \text{ degrees } = \frac{360 \times 60 \times l_1}{2 \times 2 \times \pi R} \text{ mins}$$

$$= \frac{1,718.9 \times l_1}{R} \text{ mins}$$

Similarly,

$$\delta_2 = \frac{1,718.9 \times l_2}{R} \text{ mins}$$

$$\delta_3 = \frac{1,718.9 \times l_3}{R} \text{ mins} \quad \text{and so on.}$$

Finally,

$$\delta_n = \frac{1,718.9 \times l_n}{R} \text{ mins}$$

Again, when degree of curve D is given,

$$\delta_1 = \frac{D \times l_1}{60} \text{ degrees}$$

$$\delta_2 = \frac{D \times l_2}{60} \text{ degrees} \quad \text{and so on.}$$

Finally,

$$\delta_n = \frac{D \times l_n}{60} \text{ degrees}$$

Arithmetical check: $\delta_1 + \delta_2 + \delta_3 + \ldots + \delta_n = \Delta_n = \phi/2$

PROCEDURE:

1. SetthetheodoliteatthepointofcurveT1.
2. Withboththeplatesclampedtozero,directthetheodolitetobisectthepointofintersec tionV.Thelineofsightisthusinthedirectionofthereartangent.
3. Releasethevernierplateandsetangle1onthevernier.ThelineofsightisthusdirectedalongchordT1A.
4. WithzeroendoftapepointedatT1andarrowheldatadistanceT1A=calongit,swingthetape aroundT1tillthearrowisbisectedbythecross hairs.
5. ThusthefirstpointAisfixed.
6. Setthesecond deflectionangle2onthevernierso thatthelineofsightisdirectedalongT1B.
7. WiththezeroendofthetapepinnedatA,andanarrowheldatdistanceAB=Calongit,swingthetap earoundAtillthearrowisbisectedbythecrosshairs,thusfixingthepointB.
8. Repeatsteps4and5tilllastpointisreached.

Reading Topographic MapsandMakingCalculations

Atopographicmapisprintedonaflatpieceofpaperyetitprovidesapictureoftheterrainandman-madefeaturesthroughtheuseofcontourlines,colorsandsymbols.Contourlinesrepresenttheshapeandelevationoftheland,suchasridges,valleys,andhills.Colorsandsymbolsareusedtorepresentotherfeaturesontheland,suchaswater,vegetation,roads,boundaries,urbanareasandstructures.

TheUSGSproducesaseriesoftopographicmapsthatareextremelyaccurate.TheUnitedStateswassystematicallydividedintoprecisequadranglesbasedonlatitudeandlongitudelinesandthesemapsarecommonlyreferredtoas“quads.”

Thischapterstartswithtipsonhowtoreadthemarginsofatopographicmap.Thenitdescribeshowtointerpretcontourlines.Finally,itcovershowtoestimateslope,aspect,acreage,distances,andpercentcontainedusingatopographicmap.

ReadingtheMargins

ThissectionaddresseshowtoreadtheinformationthatisinthemarginsofaUSGStopographicmap.Itstarts withtheupperleftcornerofthemapandmovesclockwisearoundthemap.

AgencyorAuthorWhoCreatedMap(upperleftcornerofmap)

InFigure2-1,theUnitedStatesDepartmentoftheInteriorGeologicalSurveyistheagencythatcreatedthemap.Thissame informationcanalsobefoundinthebottomleftcorner.

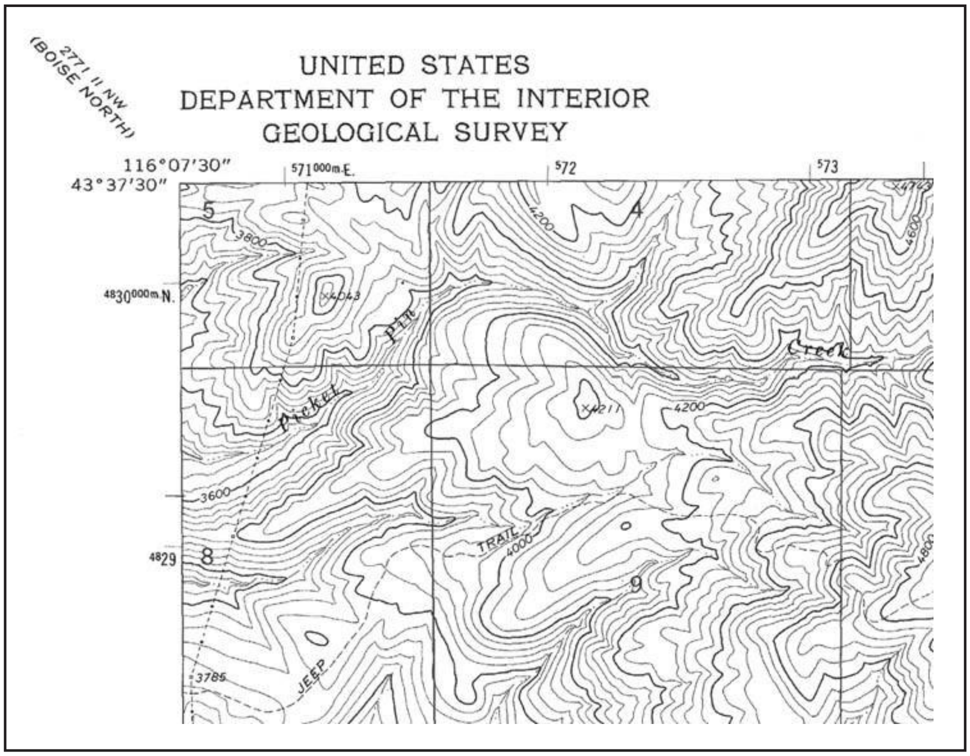


Figure2-1.Agencyorauthorwhocreatedmap.

MapTitle(upperrightcornerofmap)

This corner section provides the name of quadrangle, state (and sometimes the county) where thequadrangleislocated,andmapseries.Quadranglesareoftennamedafteraprominenttownorfeaturethatis inthequadrangle.InFigure2-2,thenameofthequadrangleis“LuckyPeak”whichislocatedinIdaho. The map series indicates how much land area is on the map; for example, in Figure 2-2 theLuckyPeakquadrangleisa7.5minuteserieswhichindicatesitcoversafoursidedareaof7.5minutesoflati tudeand7.5minutesoflongitude.

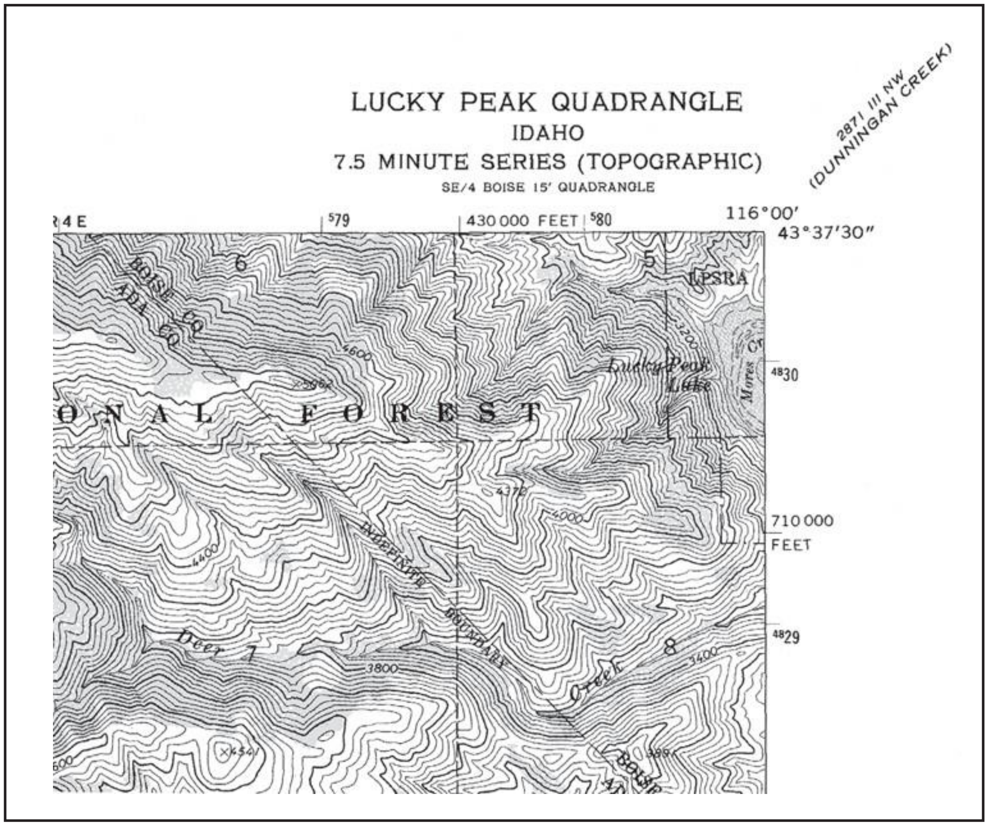


Figure2-2.Maptitle.

Road Classification (bottom right corner of

map) Roadandtrailsymbolsmaybefoundinthislegend(Figure2-

3).**RevisionDate(bottomrightcornerofmap)**

Somemapshavearevisiondate,whichiswhenthemapwaslastupdated.Ifthemapisold,itmaynotbeaccurate.InFigure2-3therevisiondateis1972.Refertothe“MapProductionInformation”blockinthebottomleftcornerforadditionalinformationonmapdates.

QuadrangleLocation(bottomrightcornerofmap)

Thelocationofthequadrangleispinpointedonamapofthestate(Figure2-3).

AdjoiningQuadrangleLegend(cornersofmap)

Namesofadjoiningquadranglesarefrequentlyindicatedinthecornermarginsof USGStopographicalmaps; *Mayfield*isthejoiningquadrangleinFigure2-3.

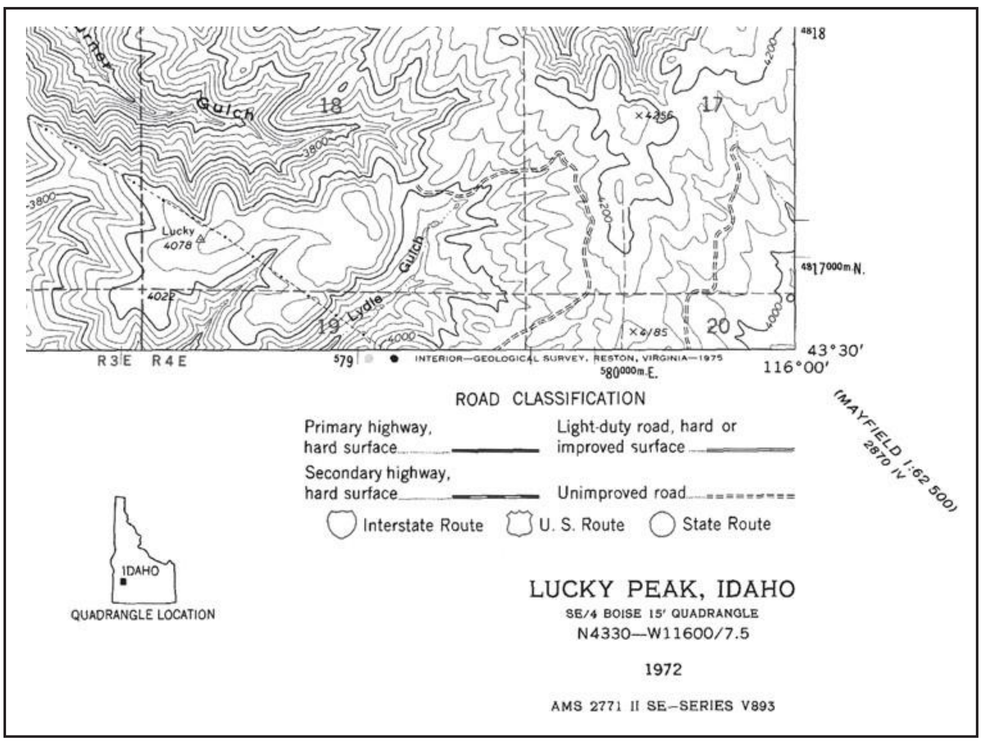


Figure2-3.Roadclassification,revisiondate,quadranglelocationandadjoiningmaps.

Sometopographicmapswillhaveanadjoiningquadranglelegend(Figure2-4).

1	2	3
4	PEARL	5
6	7	8

1. NORTHEAST EMMETT
2. MONTOUR
3. HORSESHOE BEND
5. CARTWRIGHT CANYON
6. STAR
7. EAGLE
8. BOISE NORTH

Figure2-4.Exampleofanadjoiningquadranglelegend.

MapScale(bottomcenterofmap)

Themapscaleindicatestheratioorproportionofthehorizontaldistanceonthemaptothecorrespondingh orizontaldistanceontheground(Figure2-5).

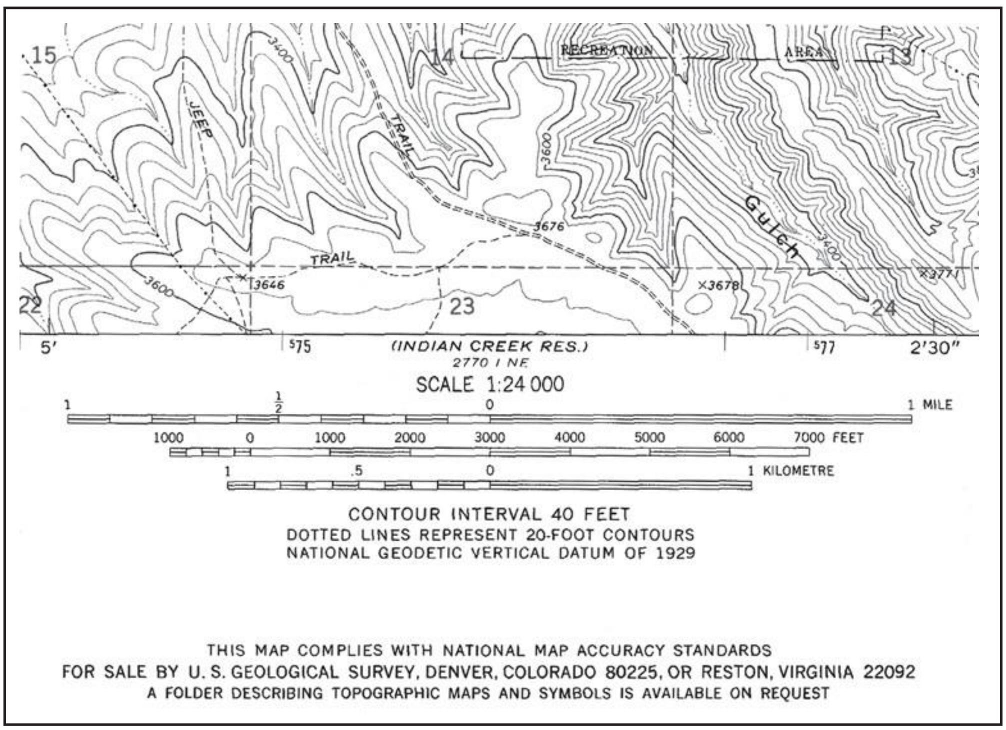


Figure2-5.Mapscale(fractionalscaleandbarscale)andcontourinterval.

Therearetwotypesofscalesonthetopographicmap:

- FractionalScale

  Thefractionalscaleexpressestheratioofthemapdistancetothegrounddistanceinlikeunitsofmeasurements.Itisusuallywrittenasafractionorratio.Forexample,themapinFigure2-5hasamapscaleof1:24,000whichmeansoneinchonthemapis24,000inchesontheground.

  Typically, USGS produces maps using the 1:24,000 scale, but will also produce maps using1:62,500and1:250,000scale.The1:24,000scaleprovideslargerandclearerdetailsthanthe1:250,000,butitdoesnotcoveraslargeanarea.

  The maps produced at a 1:24,000 scale (1 inch represents 24,000 inches or 2000 feet) arecommonlyknownas7.5-minutequadranglemaps;eachmapcovers7.5minutesoflatitudeand 7.5 minutes of longitude, which is approximately 8 miles (north/south) and 6 miles (east/west).TheprimaryscaleusedinAlaskatopographicmapsis1:63,360(1inchrepresents1mile)duetothesizeofthestate.TheAlaskaquadranglemapcovers15minutesoflatitudeandvariesfrom20–36minutesoflongitude.

- BarorGraphicScale

  Agraphicscaleorcomparisonscaleisentirelydifferentfromtherepresentativefractionscale.Itusuallycomparesmapdistancestothegrounddistanceindifferentunitsofmeasurements.

  Usuallyagraphicscaleisalinemarkedoffonamapindicatingsomanyinchesormillimetersequaltosomanyfeet,kilometers,chains,ormilesontheground.Acomparisonscaleof1inchto2000feetmeansthat1inchonthemapisproportionedto2000feetontheground.Wearecomparinginchesandfeetwhicharedifferentunitsofmeasurement.

ContourInterval(bottomcenterofthemap)

Contour interval is the difference in elevation between two adjacent contour lines. In Figure 2-5, thecontourintervalis40feet.OnUSGSmaps,contourintervalsareusually1,5,10,20,40,and80feet.If the contour interval is not printed on the map, it can be calculated (which is discussed later in thischapter).

NorthArrow,Declination,andMapProductionInformation(bottomleftcornerofmap)

It is common practice for maps to be oriented with true north at the top. Most USGS maps have asymbolofarrowspointingtothegeographicNorthPole(shownbyastar),magneticnorth(MN)andgridnorth(GN).Gridnorthshowsthedifferencebetweengeographicnorth(latitude/longitude)andtheUTMgrid.

InFigure2-6,themagneticnorthis18.5degreeseast.ThedifferencebetweenthegeographicNorthPoleandmagneticnorthisthemagneticdeclinationforthatmap.

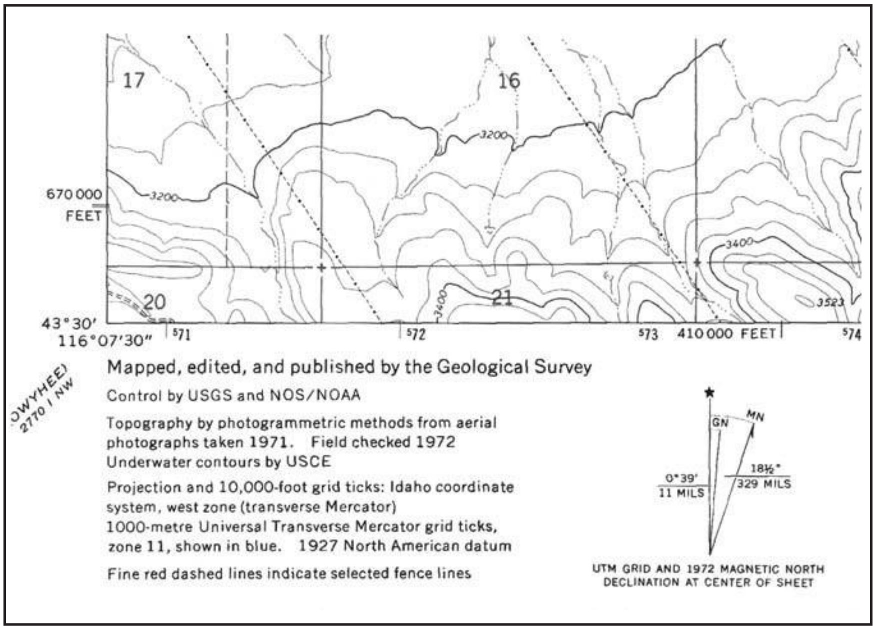


Figure2-6.Northarrowandmagneticdeclination.

If the declination is not indicated on the arrow diagram, it can be found in the "Map ProductionInformation"whichisinthelowerleftcornerofthemap(Figure2-7).Themapproductioninformationsection provides additional information on how and when the map was created. Sometimes themagneticdeclinationisprintedhere.

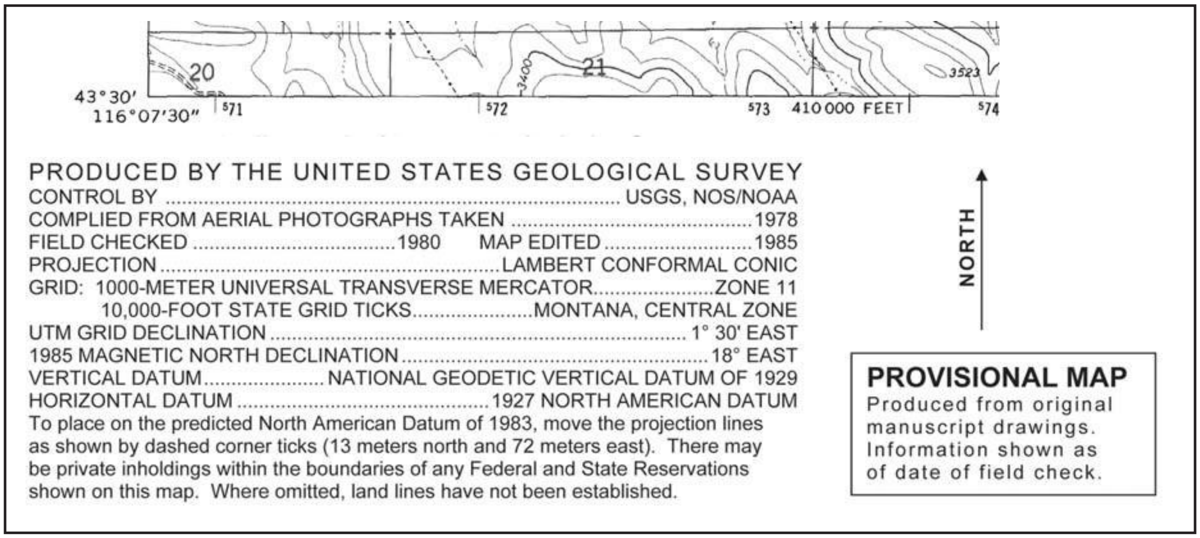


Figure2-7.Mapproductioninformationblockoftenincludesrevisiondates,datum,andUTMzone.

DatumandUTMZone

ThedatumandUTMzone,whichareextremelyimportantwhenusingaGPSreceiver,canalsobefoundinthisblock(Figure2-7).Verticalandhorizontaldatumsmaybelistedonthemap;however,ifthemaplistsonlyonedatumthentheverticalandthehorizontaldatumarethesame.

LatitudeandLongitude(edgesofmap)

Latitudeandlongitudelinesareindicatedwithfineblacktickmarksalongtheedgesofthemap(Figure2-8).Topographicmapsdonotshowthelatitude/longitudelines–justthetickmarks.Thenumbersnexttothetickmarksindicatedegrees(°),minutes(')andseconds(").
On1:24,000scalemaps,latitudeandlongitudetickmarksareindicatedevery2.5minutes.

- Longitudetickmarksareonthetopandbottomedgesofthemapandlatitudetickmarksareontherightandleftedges.Notethatthedegreesmaybeleftoff(asanabbreviation)andyoumayonlyseetheminuteand/orseconddesignations.

- Referencecoordinatesforlatitudeandlongitude(degrees,minutes,andseconds)areblackandlocatedonthefourcornersofthemap.

- Theintersectionoflatitudeandlongitudelinesarenotedbycross-marks(+).

Whenreadinglatitude/longitude,paycloseattentiontotheunits(degrees,minutes,seconds)becauseitiseasytomisreadthem.RefertoChapters3and6foradditionalinformationonlatitudeandlongitude.

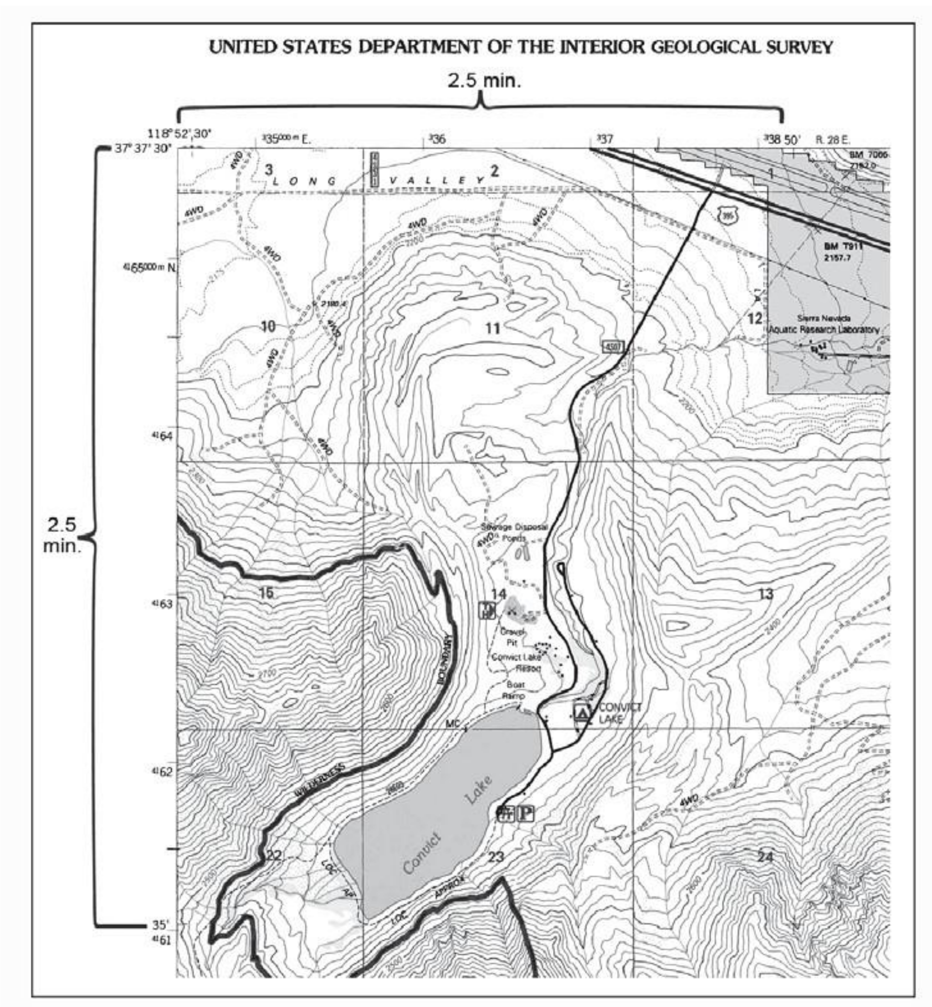


Figure2-8. Longitudetickmarks(50'),latitude tick marks (35'),referencecoordinates (118°52'30"and37°37'30"), andcross-mark(+)inbottomrightcorner.

UniversalTransverseMercator(UTM)(edgesofmap)

Prior to 1978, USGS topographic maps used blue tick marks along the edge of the map to illustratewhere the UTM grid lines were located. Since 1978, USGS topographic maps actually show
UTMgridlines(black)onthemapandthecoordinatevaluesareinthemargin.OnUSGStopographicmaps, 7.5quadrangle,theUTMgridlinesaremarkedat1,000meterincrements(Figure2-9).

- Abbreviatedeastingvalues,forexample^{3}**36**,arelocatedonthetopandbottomedgesofthemap.
- Abbreviatednorthingvalues,forexample^{41}**64**,arelocatedontherightandleftedgesofthemap.
- ReferencecoordinatesforUTMarelocatednearthesoutheastandnorthwestcornersofthemap.Noticethatthelargeboldnumbersincreaseasyougonorthandeast.

RefertoChapters3and6foradditionalinformationonUTM.

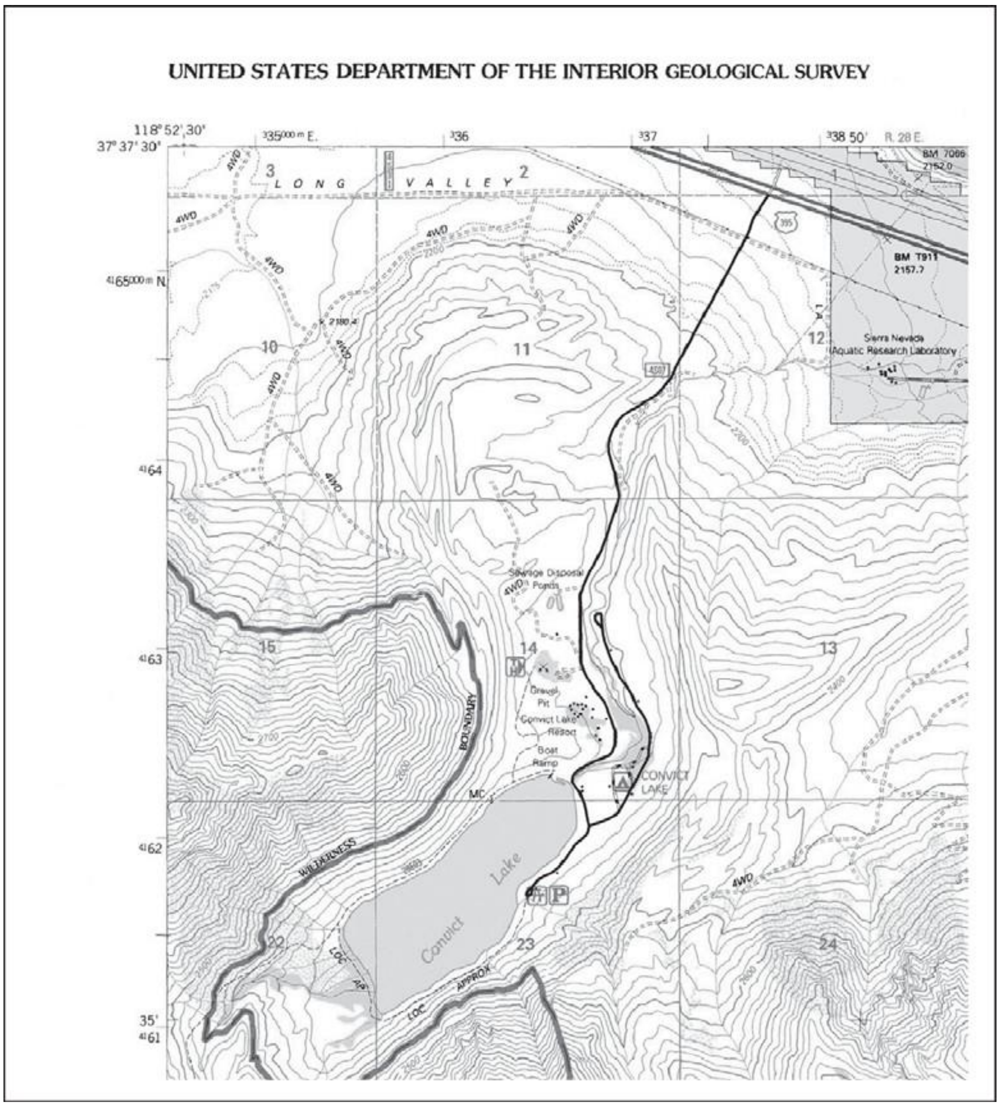


Figure2-9. Easting(^{3}36,^{3}37,^{3}38) **andnorthing (**^{41}64,^{41}63,^{41}62,^{41}61) **value tick marksandreferencecoordinates(**^{3}35^{000m}**E.and** ^{41}65^{000m}**N.).**

Section,Township,andRange(edgesofmap)

Section,township,andrangenumbersarered.

- Sectionnumbersmaybeprintedalongtheedge,buttheyaretypicallyprintedinthecenterofthesection .InFigure2-10,someofthesectionnumbersinclude15,16,17,18,19.
- Townshipnumbersareprintedalongtherightandleftedgeofthemap.InFigure2-10,thetownshipnumbersareT.2SandT.3S.
- Rangenumbersareprintedonthetopandbottomedgeofthemap.InFigure2-10,therangenumbersareR.1EandR.2E.

RefertoChapter3foradditionalinformationonsection,township,andrange.

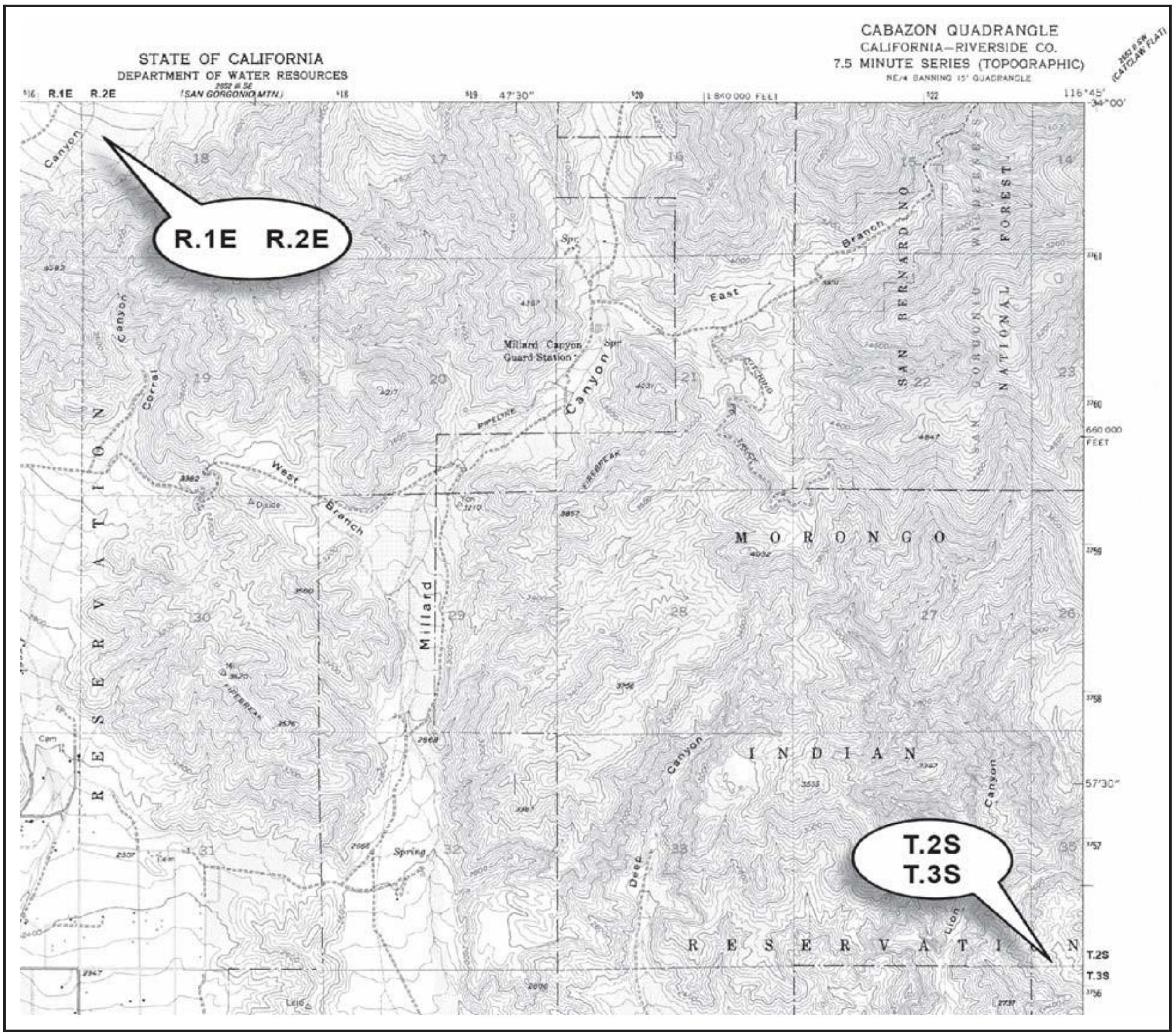


Figure 2-10.Sections,townships,and range.

InterpretingContourLines

Contourlinesonamapshowtopographyorchangesinelevation.Theyrevealthelocationofslopes,depressions,ridges,cliffs,heightofmountainsandhills,andothertopographicalfeatures.Acontourlineisabrownlineonamapthatconnectsallpointsofthesameelevation.Theytendtoparalleleachother,each approximately the shape of the one above it and the one below it. In Figure 2-11, compare thetopographicmapwiththelandscapeperspective.

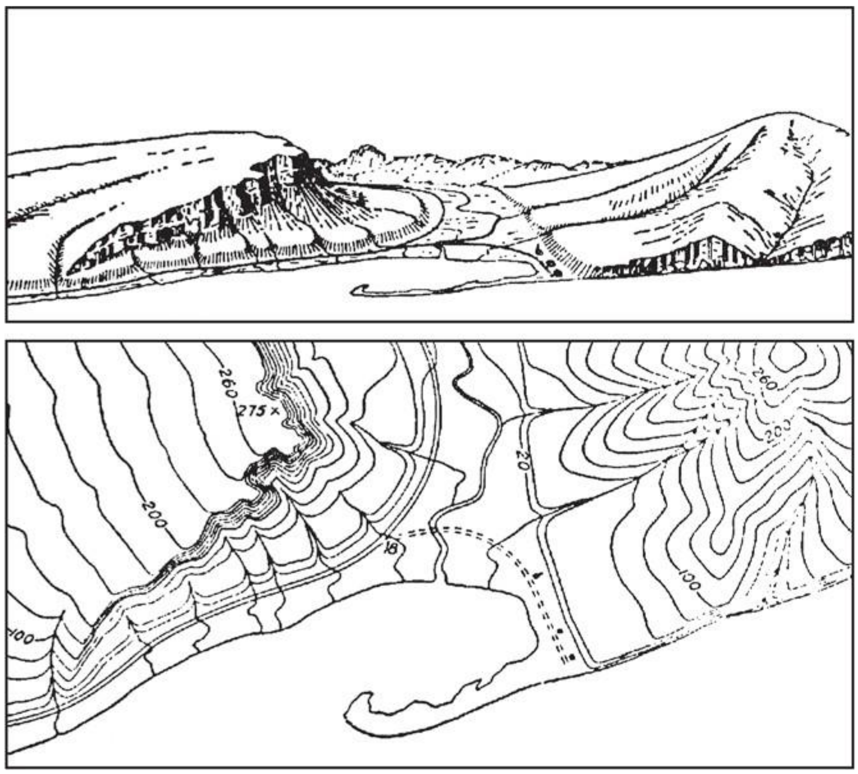


Figure2-11.Acontourmapandwhatitlookslikefromalandscapeperspective.Notethatcontourlinesarefarapartforlevel land andalmost touch for cliffs.

ContourCharacteristics

Contourshavegeneralcharacteristics;someofwhichareillustratedinFigures2-12and2-13.

- Concentriccirclesofcontourlinesindicateahill.
- Evenlyspacedcontoursindicateuniformslope.
- Widelyspacedcontoursindicateagentleslope.
- Widelyspacedcontoursatthetopofahillindicateflathilltop.
- Closetogethercontoursindicatesteepslope,wall,orcliff.
- Closetogethercontoursatthetopofahillindicateapointedhilltop.
- Crossingortouchingcontoursindicateoverhangingcliff.

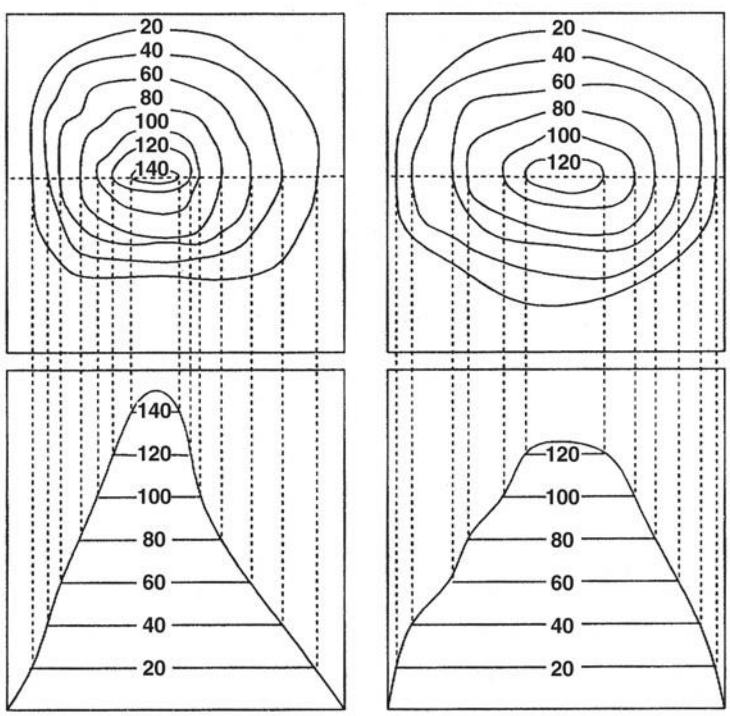


Figure 2-12. Evenly and widely spaced contoursindicatetypeofslopeandshapeofhilltop.

- Jagged,roughcontoursindicatelargeoutcropsofrocks,cliffs,andfracturedareas.
- “V”shapecontoursindicatestreambedsandnarrowvalleyswiththepointofthe“V”pointinguphillorupst ream.
- “U”shapecontoursindicateridgeswiththebottomofthe“U”pointingdowntheridge.Asaddleisaridge betweentwohillsorsummits.
- “M”or“W”shapecontoursindicateupstreamfromstreamjunctions.
- Circleswithhachuresorhatchlines(shortlinesextendingfromthecontourlineatrightangles)indic ateadepression,pit,orsinkhole.
- Spotelevations(heightofidentifiablefeatures)suchasmountainsummits,roadintersections,andsurf acesoflakesmayalsobeshownonthemap.

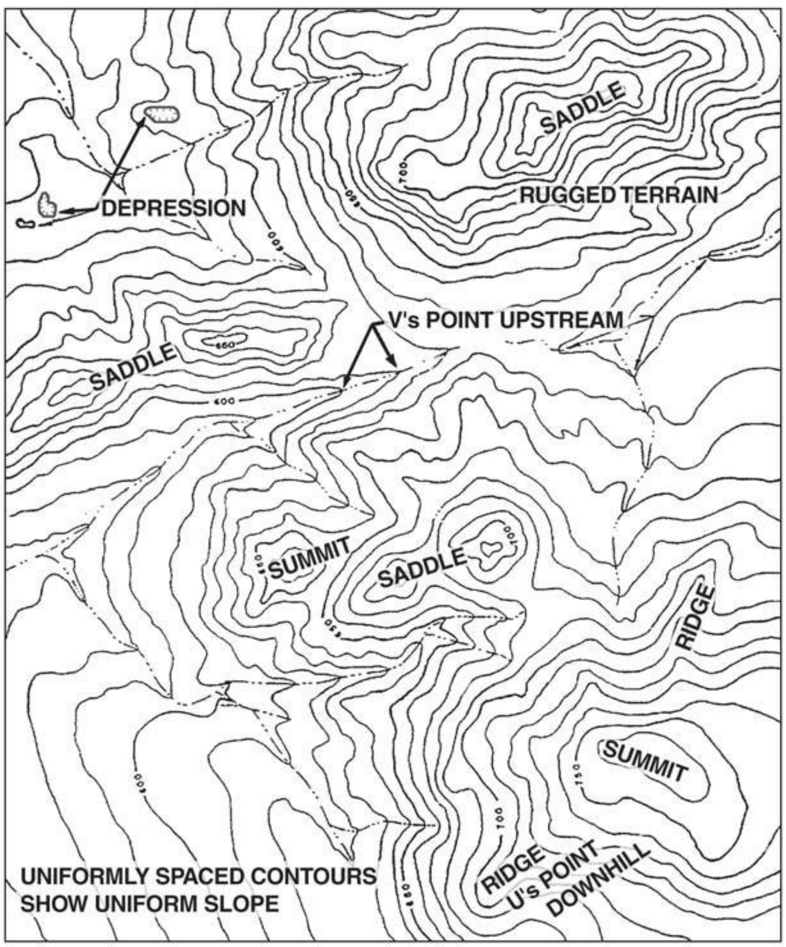


Figure2-13.Contourlinesandtopographicfeatures.

ContourInterval

Contourintervalisthedifferenceinelevationbetweentwoadjacentcontourlines.OnUSGSmaps,contou rintervalsareusually1,5,10,20,40,and80feet.Occasionallyyouwillfindamapwitha 25footcontourintervalormetricunits,butnotoften.Tomakethecontourseasiertoread,everyfifthone is the **index contour** which is printed darker and has the elevation in feet from mean sea levelmarkedontheline(Figure2-14).Thethinnerorlightercoloredcontourlinesarecalled**intermediatecontours**.

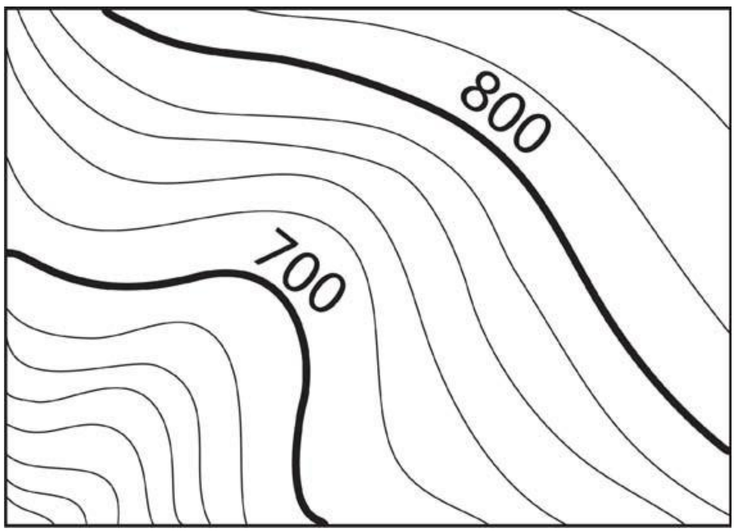


Figure2-14.Topographicmapshowingelevationoftwoindexcontours(700and800).

Thecontourintervalistypicallyprintedatthebottomofthemap;however,ifthecontourintervalisunknown,t hereisawayitcanbecalculated.FollowthestepsinTable2-1tocalculatethecontourintervalofthetopographicmapbelow.

Table2-1.Calculatingthecontourinterval.

Steps	Directions
1	Find two index contours near each other: The index contours marked **4400** and **4600.**
2	Determine the **difference** in elevation between the two index contours: 4600 ft. – 4400 ft. = **200 ft.**
3	Count the number of contour lines between the two index contours: There are **5** lines. **Note:** There are actually 4 contour lines between the two index contours, but you always count one of the index contours as well as all of the contours in between.
4	Divide the difference (step 2) by the number of lines (step 3): 200 ft. ÷ 5 = **40 ft.** This is the contour interval.