2012 PROFESSIONAL LAND SURVEYOR EXAMINATION REFERENCE LIST

The following is a list of recommended references for the Professional Land Surveyor examination. References included in the list should be considered suggested material only.

1. **Boundary Control and Legal Principles** (any edition)
2. **Evidence and Procedures for Boundary Location** (any edition)
3. **Manual of Surveying Instructions 2009;** by BLM – DOI (2009)
4. **Global Positioning System: Theory and Practice;** by B. Hofmann-Wellenhof, H. Lichtenegger, and J. Collins
5. **Guide to GPS Positioning;** by David Wells (Dec 1986)
6. **Land Survey Descriptions;** by Gurdon H. Wattles and William C. Wattles (Jun 1, 1974)
7. **Surveying, 9th Edition;** by Francis H. Moffitt and Harry Bouchard (Jan 1992)
8. **Water Boundaries;** by George M. Cole
9. **Elements of Photogrammetry;** by Paul R. Wolf (any edition)
10. **2011 Minimum Standard Detail Requirements for ALTA / ACSM Land Title Surveys;** ACSM
11. **California Professional Land Surveyors' Act 2011**
12. **California Subdivision Map Act 2011**
13. **California Public Resources Code**
14. **Geometric Geodetic Accuracy Standards and Specifications for using GPS Relative Positioning Techniques;** Federal Geodetic Control Committee
15. **Black's Law Dictionary** (any edition)
16. **Analysis and Adjustment of Survey Measurements;** by Edward M. Mikhail and Gordon Gracie (Oct 1981)
17. **Writing Legal Descriptions;** by Gurdon H. Wattles and Jacob F. Rem (Jun 1, 1979)

C. Calculations and Compilations 7%
   1. Mapping methods and/or projections
   2. Graphical terrain representations
   3. Geoid, ellipsoid, and orthometric heights
   4. State Plane Coordinate Systems
   5. GPS data reduction and analysis
   6. Control network calculations, analysis and adjustments
   7. Determination of bearings/azimuths
   8. Area/volume calculations
   9. Horizontal and vertical alignment calculations
   10. Construction staking calculations (e.g., plan interpretation)

D. Documentation 7%
   1. Survey maps/plats
   2. Survey reports
   3. Descriptions

IV. Business/Professional Practices 15%

A. Project planning (e.g., parameters, costs)
B. Contracts
C. Risk management (e.g., liability, safety procedures, insurance)
D. Ethics
E. Communications (oral, written, graphical)
F. Quality assurance procedures

V. Types of Surveys 15%

A. ALTA/ACSM surveys
B. Control and geodetic surveys
C. Construction surveys (e.g., construction calculations and staking)
D. Boundary surveys
E. Route and right-of-way surveys
F. Topographic surveys by field methods
G. Topographic surveys by photogrammetry

NCEES PRINCIPLES AND PRACTICE OF SURVEYING (PS)
EXAM SPECIFICATIONS

Effective Beginning with the October 2005 Examinations

- The exam is a 6-hour open-book exam. It contains 67 multiple-choice questions in the 4-hour morning session, and 33 multiple-choice questions in the 2-hour afternoon session. Examinee works all questions.
- The exam uses the US Customary System (USCS) of units.

Knowledge	Approximate Percentage of the Examination
I. Standards and Specifications	**15%**
A. Federal statutes, laws, rules and regulations	
B. U.S. Public Land Survey System	
C. U.S. National Map Accuracy Standards	
D. ALTA/ACSM Surveys	
E. Geodetic control network and mapping accuracy standards	
F. FEMA	
II. Legal Principles	**25%**
A. Common/case law boundary principles	
B. Sequential and simultaneous conveyances	
C. U.S. Public Land Survey System	
D. Controlling elements in legal descriptions	
E. Riparian and littoral rights	
F. Property title issues (e.g., encumbrances, interpretation, deficiencies)	
G. Sovereign land rights (e.g., navigable waters, eminent domain)	
H. Prescriptive rights/adverse possession	
I. Easement rights	
J. Parol evidence	
III. Professional Survey Practices	**30%**
A. Research	8%
1. Public/private record sources	
2. Project planning (e.g., photogrammetric, geodetic, boundary)	
3. Control datums and easement rights	
4. Control network accuracy standards	
B. Field Procedures	8%
1. Instrument operations and usage	
2. Monumentation (e.g., identification, classification, perpetuation)	
3. Survey control (e.g., boundary, topographic, photogrammetric)	
4. GPS operations	
5. Construction staking	

V. Consultation and Legal (Continued)

K108 Public Resources Code (survey relevant sections)
K109 Civil Code (survey relevant sections)
K110 Code of Civil Procedure (survey relevant sections)
K111 Penal Code (survey relevant sections)
K112 Government Code (survey relevant sections)
K113 Health and Safety Code (survey relevant sections)
K114 Public Contract Code (survey relevant sections)
K115 Evidence Code (survey relevant sections)
K116 court decorum
K117 public meeting procedures

V. Consultation and Legal (14%)

Consultation and legal pertains to professional consultation expertise provided to the public as the practice of land surveying relates to legal and contractual obligations.

Job Tasks

59 Administer an oath for boundary evidence

60 Communicate accuracies of maps or survey data

61 Represent clients (e.g., depositions, public hearings)

62 Provide expert witness testimony

63 Provide professional surveying consultation

64 Provide litigation support (e.g., land boundary matters, datums, engineering projects)

65 Provide land planning services (e.g., prepare tentative maps)

66 Provide references for Land Surveyor candidates

67 Provide recommendations in accordance with the Subdivision Map Act and Professional Land Surveyors Act

Knowledge Areas

Knowledge of:

K01 Professional Land Surveyors' (PLS) Act

K02 Subdivision Map Act (SMA)

K03 impact of local ordinances

K20 state and local agency processing requirements for maps and related documents (e.g., submittal, review, filing)

K25 appropriate communication methods (e.g., verbal and written)

K33 effects of unwritten rights on boundaries

K39 effect of riparian and littoral rights on boundaries

K40 effect of cloud on title

K44 effect of ground movement on boundaries (e.g., earthquakes, subsidence, slides)

K47 effects of leases

K51 physical evidence that may indicate unwritten rights (e.g., adverse possession, prescriptive rights).

K79 researching relevant case law (e.g., boundary issues, liability)

K89 Code of Regulations (Board Rules)

K90 Streets and Highway Code (survey relevant sections)

K105 methods of disclosing and depicting encroachments

K107 evidence documentation.

IV. Mapping and Document Preparation (Continued)

K27 public lands survey system

K45 procedures, standards and requirements for ALTA/ACSM surveys

K53 types of legal descriptions (e.g., strip, metes and bounds, lot and block, aliquot)

K54 exceptions and reservations of legal descriptions

K56 projections, datums and epoch dates

K63 California Coordinate Systems

K65 methods and procedures to produce control networks within accuracy standards (e.g. Public Resources Code, NGS Standards, FGCS Standards)

K72 field notes and staking reports

K74 methods to produce digital terrain models

K76 GIS metadata

K81 parol evidence (e.g., use, methods to document, and effects of)

K89 Code of Regulations (Board Rules)

K90 Streets and Highway Code (survey relevant sections)

K91 signing and sealing requirements

K92 preparation of legal descriptions

K93 components of a legal description (e.g., preamble, body)

K94 elements of topographic maps (e.g., contours, features, symbols, legend, metadata)

K95 elements of corner records (legal content required)

K96 elements of records of survey (legal content required)

K97 methods and procedures for preparing corner records and records of survey

K98 elements of parcel maps (legal content required)

K99 elements of final maps (legal content required)

K100 elements of tentative maps (legal content required)

K101 requirements for signatures (e.g., trustee, owner, beneficiaries)

K102 graphical methods to represent land boundaries and related information

K103 depicting physical evidence that may indicate unwritten rights

K104 GIS software

K105 methods of disclosing and depicting encroachments

K106 reports, documents and exhibits creation

K107 evidence documentation

IV. Mapping and Document Preparation (28%)

Mapping includes meeting specified accuracy standards and collecting, analyzing, interpreting developing, reducing , and adjusting data (e.g., Control, Geodetic, Topographic, Photogrammetric, California Coordinate System, horizontal and vertical datums) for the purpose of preparing graphic and/or mathematic representations of existing physical features, terrain, monuments, and geospatial positions. Document Preparation includes preparing necessary documents, legal descriptions, maps and exhibits based on clients' needs and contractual obligations and providing documentation of surveys based on all applicable statutes, rules and regulations.

Job Tasks

44 Perform FEMA flood certification

45 Prepare legal descriptions (e.g., easements, lot line adjustments, other interests in real property)

46 Ensure survey documents comply with State law, local ordinance and the appropriate standard of care prior to execution

47 Prepare ALTA/ACSM surveys

48 Create digital terrain model (DTM)

49 Create topographic map from various sources (e.g., photogrammetric, field survey, LiDAR, GIS)

50 Create control maps or reports

51 Create boundary maps

52 Create exhibit maps (e.g., court, easement, aerial)

53 Prepare maps, plats, exhibits and documents for filing and/or recordation (e.g., records of survey, corner records, lot line adjustment, subdivision map, condo documents)

54 Prepare staking reports (e.g., cut-sheets, plots)

55 Compile and provide geographic information system (GIS) data

56 Establish and maintain a geographic information system (GIS) land cadastre

57 Provide geodetic control (e.g., GIS, preliminary, design)

58 Provide mapping services (e.g., GIS, topographic, hydrographic, photogrammetric)

Knowledge Areas

Knowledge of:

K01 Professional Land Surveyors' (PLS) Act

K03 impact of local ordinances

K12 National Standard for Spatial Data Accuracy (NSSDA)

K21 methods to identify mapping requirements and criteria

III. Field Work (Continued)

K51 physical evidence that may indicate unwritten rights (e.g., adverse possession, prescriptive rights)

K55 horizontal and vertical control

K61 error sources (e.g., multipath, data input, instrument calibration)

K63 California Coordinate Systems

K64 real-time-networks (e.g., processes, redundancy, accessibility, accuracy)

K65 methods and procedures to produce control networks within accuracy standards (e.g. Public Resources Code, NGS Standards, FGCS Standards)

K68 methods to obtain bearings or azimuths related to geodetic, magnetic, grid or astronomic north

K69 survey calculations (e.g., horizontal and vertical alignments, volumes, grade)

K70 mathematics (e.g., algebra, trigonometry, geometry)

K71 accuracy required for construction staking

K72 field notes and staking reports

K73 basis of control values and their relation to maps and construction plans (e.g., basis of bearing, benchmark)

K80 types, uses, capabilities of survey equipment

K81 parol evidence (e.g., use, methods to document, and effects of)

K82 procedures to recover and perpetuate control monuments

K83 methods and requirements for collecting field positions and attributes

K84 methods and requirements for performing as-built surveys

K85 field procedures for photogrammetric control layout

K86 field survey methods, procedures and standards

K87 field practices and procedures for construction staking.

K88 methods to maintain and calibrate equipment

III. Field Work (20%)

Field work includes the process of performing field observations by collecting field data in accordance with accepted standards of practice and in compliance with all applicable status, rules and regulations.

Job Tasks

30 Perform topographic surveys

31 Perform control surveys

32 Perform boundary surveys

33 Perform as-built surveys

34 Perform PLSS surveys

35 Perform monitoring surveys

36 Perform cadastral surveys

37 Recognize and locate field features relevant to the survey (e.g., boundary evidence, topographic features)

38 Perform construction staking

39 Set, replace or remove monuments

40 Verify character and position of given horizontal and vertical control points

41 Perform hydrographic survey (e.g., bathymetric, tidal datum, riparian boundary)

42 Communicate with clients and contractors while in the field

43 Communicate with the general public while in the field

Knowledge Areas

Knowledge of:

K06 right of entry laws, rules and regulations

K07 capabilities and limitations of current technologies (e.g., GPS, laser scanning, levels, total stations)

K08 interpretation of elements in construction plans and specifications pertaining to staking

K25 appropriate communication methods (e.g., verbal and written)

K27 public lands survey system

K43 monument recovery and re-establishment procedures

K45 procedures, standards and requirements for ALTA/ACSM surveys

K48 methods and procedures for retracement and re-establishment of railroads rights-of-way.

II. Research, Pre and Post Field Analysis (Continued)

K59 geoid, ellipsoid and orthometric heights

K60 conversion between grid and ground distances

K61 error sources (e.g., multipath, data input, instrument calibration)

K62 calculating and analyzing errors

K63 California Coordinate Systems

K64 real-time-networks (e.g., processes, redundancy, accessibility, accuracy)

K65 methods and procedures to produce control networks within accuracy standards (e.g. Public Resources Code, NGS Standards, FGCS Standards)

K66 procedures for analysis, reduction, and adjustment of raw data to obtain coordinate values

K67 requirements for aerial survey data collection

K68 methods to obtain bearings or azimuths related to geodetic, magnetic, grid or astronomic north

K69 survey calculations (e.g., horizontal and vertical alignments, volumes, grade)

K70 mathematics (e.g., algebra, trigonometry, geometry)

K71 accuracy required for construction staking

K72 field notes and staking reports

K73 basis of control values and their relation to maps and construction plans (e.g., basis of bearing, benchmark)

K74 methods to produce digital terrain models

K75 sources of research data (e.g., public, quasi-public, private)

K76 GIS metadata

K77 methods for identifying and resolving errors in research data (e.g., map or deed misclosure)

K78 source, type and accuracy of digital data (e.g., metadata, GIS)

K79 researching relevant case law (e.g., boundary issues, liability)

II. Research, Pre and Post Field Analysis (Continued)

K30 water boundaries

K31 hierarchy of evidence (e.g., CCP 2077)

K32 relationship of land grants between private, state and federal (e.g., Rancho)

K33 effects of unwritten rights on boundaries

K34 boundary resolution

K35 evaluation of field evidence

K36 methods of establishing boundaries

K37 types and components of title documents (e.g., title report, chain of title, lot and block report)

K38 types of conveyances and their effects of ownership on property (e.g., fee vs. easement, grant deed, quitclaim deed)

K39 effect of riparian and littoral rights on boundaries

K40 effect of cloud on title

K41 methods for calculating and adjusting boundary surveys

K42 error analysis

K43 monument recovery and re-establishment procedures

K44 effect of ground movement on boundaries (e.g., earthquakes, subsidence, slides)

K45 procedures, standards and requirements for ALTA/ACSM surveys

K46 easements, rights-of-way and other encumbrances

K47 effects of leases

K48 methods and procedures for retracement and re-establishment of railroads rights-of-way

K49 criteria for acceptance or rejection of monuments

K50 tidal cycles and datums

K51 physical evidence that may indicate unwritten rights (e.g., adverse possession, prescriptive rights)

K52 controlling elements of legal descriptions

K53 types of legal descriptions (e.g., strip, metes and bounds, lot and block, aliquot)

K54 exceptions and reservations of legal descriptions

K55 horizontal and vertical control

K56 projections, datums and epoch dates

K57 transformation between epoch dates

K58 transformation between datums and projections

II. Research, Pre and Post Field Analysis (25%)

Research, Pre and Post Field Analysis includes determining, evaluating, analyzing, reducing and adjusting field collection data in accordance with accepted standards of practice and in compliance with all applicable statutes, rules and regulations and to meet accuracy standards for design of improvements.

Job Tasks

18 Ensure use of proper control datums and epochs (e.g., plane coordinates, NAVD88 / NGVD29, epoch 1991.35 / 2007.00)

19 Analyze project data (e.g., recorded maps, deeds, control data, title data, land planning requirements)

20 Identify conflicts within the drawing set

21 Conduct project research

22 Prepare construction staking layout and drawings

23 Perform surveying calculations (e.g., boundary, construction staking, control, topographic)

24 Analyze field evidence together with recorded and unrecorded documentation to determine boundaries, easements, and possible encroachments

25 Identify conflicts between project drawings and existing field conditions (e.g., construction plans, condo plans)

26 Determine accuracies of maps and measured survey data

27 Evaluate relevance and spatial relationships of maps and measured survey data

28 Identify boundary conflicts

29 Compile and provide geographic information system (GIS) data

Knowledge Areas

Knowledge of:

K08 interpretation of elements in construction plans and specifications pertaining to staking.

K09 elements required for an aerial flight plan (e.g., photogrammetric, LiDAR)

K10 procedures for preparation for aerial mapping and contouring

K11 procedures for preparation for terrestrial mapping and contouring (e.g., total station, GPS, LiDAR)

K13 when records of survey are required

K14 when corner records are required

K27 public lands survey system

K28 sequential conveyances (e.g., senior, junior rights)

K29 simultaneous conveyances

I. Project Management (Continued)

K05 laws and ordinances pertaining to setting of monuments (e.g., PLS Act § 8771-8772, SMA § 66495-66498, local ordinances)

K06 right of entry laws, rules and regulations

K07 capabilities and limitations of current technologies (e.g., GPS, laser scanning, levels, total stations)

K08 interpretation of elements in construction plans and specifications pertaining to staking

K09 elements required for an aerial flight plan (e.g., photogrammetric, LiDAR)

K10 procedures for preparation for aerial mapping and contouring

K11 procedures for preparation for terrestrial mapping and contouring (e.g., total station, GPS, LiDAR)

K12 National Standard for Spatial Data Accuracy (NSSDA)

K13 when records of survey are required

K14 when corner records are required

K15 when parcel maps are required

K16 when final maps are required

K17 when tentative maps are required

K18 map waivers (e.g., SMA § 66428)

K19 exceptions to SMA (e.g., § 66412)

K20 state and local agency processing requirements for maps and related documents (e.g., submittal, review, filing)

K21 methods to identify mapping requirements and criteria

K22 project location, objectives and constraints

K23 appropriate types of data required

K24 contractual agreements (e.g., cost estimates, scope of services, limitations)

K25 appropriate communication methods (e.g., verbal and written)

K26 project constraints and objectives (e.g., location, physical, regulatory, environmental, legal, political)

I. Project Management (13%)

Project Management includes assessing needs of clients, gathering and analyzing data from public and private sources to define project scope of services, negotiating and preparing the final contract, supervising resources necessary to meet contractual obligations, and exercising independent control and direction of land surveying work.

Job Tasks

01 Communicate survey practice to the public and potential clients

02 Negotiate and secure a written contract with client

03 Offer land surveying services

04 Procure land surveying services

05 Direct personnel for office and field survey tasks

06 Coordinate projects with third parties (e.g., agencies, consultants)

07 Identify project standards (e.g., mapping, accuracy requirements, client needs, methodology, quality assurance)

08 Develop project standards (e.g., mapping, accuracy requirements, client needs, methodology, quality assurance)

09 Prepare proposals (e.g., scope, schedule, budget)

10 Preserve monuments in accordance with State law

11 Manage a land surveying business, organization or department

12 Establish and maintain GPS real-time network

13 Make survey records available to the public

14 Maintain an index for survey records available to the public

15 Utilize the Subdivision Map Act

16 Utilize the Professional Land Surveyors Act

17 Assess project needs (e.g., legal requirements, client needs, local ordinance requirements)

Knowledge Areas

Knowledge of:

K01 Professional Land Surveyors' (PLS) Act

K02 Subdivision Map Act (SMA)

K03 impact of local ordinances

K04 project requirements

General Definition of California Professional Land Surveying Practices:

The practice of land surveying in the State of California consists of determining, establishing, reporting and mapping the positions, contours and/or geospatial configuration of points, physical features, property interests, boundary and/or property lines by applying the principles of surveying, mathematics, measurement and law to meet the distinctive requirements of the State of California to protect the health, safety and welfare of the public.

(b) $Z_1 = X_1^2\left(\frac{L_2}{L_1}\right)\left(\frac{G_2 - G_1}{200\ L}\right)$ (b) $Z_2 = X_2^2\left(\frac{L_1}{L_2}\right)\left(\frac{G_2 - G_1}{200\ L}\right)$

3. Calculating High or Low Point on Curve:

Note: Two answers will be determined by solving the equations below. Only one answer is correct. The incorrect answer is where $X_T > L_1$ on the left side of the VPI or where $X_T > L_2$ on the right side of the VPI.

a. Assume high or low point occurs left of VPI to determine the distance, X_T, from VPC:

$$X_T = \frac{L_1}{L_2}\left[\frac{G_1 L}{(G_1 - G_2)}\right]$$

Note: Does $X_T > L_1$? If yes, this answer is incorrect and the high or low point is on the right side of the VPI. (Go to step d. to solve for the high or low point elevation.) If no, then this is the correct answer and proceed with steps b. and c. below.)

b. To determine high or low point stationing (where $X_T < L_1$):

$$STA_{\ HIGH\ OR\ LOW\ POINT} = VPC\ STA. + X_T$$

c. To determine high or low point elevation on vertical curve (when $X_T < L_1$):

$$ELEV_{HIGH\ OR\ LOW\ POINT} = ELEV.VPC - \frac{L_1}{L_2}\left[\frac{LG_1^2}{(G_2 - G_1)200}\right]$$

d. If $X_T > L_1$ from step a., the high or low point occurs right of the VPI. Determine the distance X_T from the VPT:

$$X_T = \frac{L_2}{L_1}\left[\frac{G_2 L}{(G_2 - G_1)}\right]$$

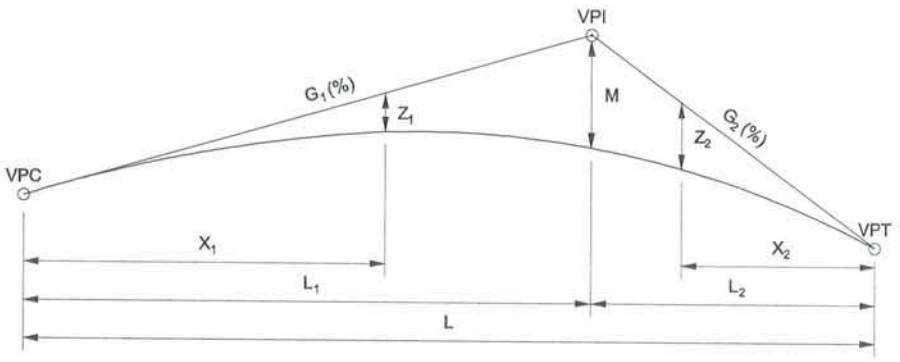
e. To determine high or low point stationing:

$$STA_{\ HIGH\ OR\ LOW\ POINT} = VPT\ STA. - X_T$$

f. To determine high or low point elevation on the vertical curve:

$$ELEV_{HIGH\ OR\ LOW\ POINT} = ELEV.\ VPT - \frac{L_2}{L_1}\left[\frac{LG_2^2}{(G_2 - G_1)200}\right]$$

Unsymmetrical Vertical Curves



M = Offset from the VPI to the curve (external distance), m

Z = Any tangent offset, m

L = Horizontal length of vertical curve, m

L_1 = Horizontal distance from VPC to VPI, m

L_2 = Horizontal distance from VPI to VPT, m

X = Horizontal distance from VPC or VPT to any ordinate "Z," m

G_1 & G_2 = Rates of grade, expressed algebraically, percent

NOTE: ALL EXPRESSIONS TO BE CALCULATED ALGEBRAICALLY
(Use algebraic signs of grades; grades in percent.)

1. Elevations of VPC and VPI:

$$ELEV.\ OF\ VPC = ELEV.VPI - G_1\left(\frac{L_1}{100}\right)$$

$$ELEV.\ OF\ VPT = ELEV.VPI + G_2\left(\frac{L_2}{100}\right)$$

2. For the elevation of any point "X" on the vertical curve:

$$CURVE\ ELEV. = TAN.ELEV. + Z$$

Where:

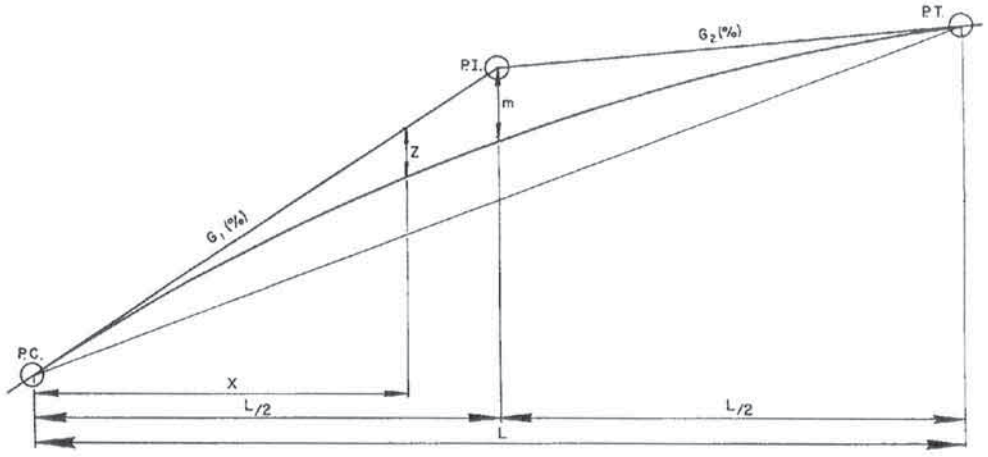
Left of VPI (X_1 measured from VPC):

(a) $$TAN.ELEV. = VPC\ ELEV. + G_1\left(\frac{X_1}{100}\right)$$

Right of VPI (X_2 measured from VPT):

(a) $$TAN.ELEV. = VPT\ ELEV. - G_2\left(\frac{X_2}{100}\right)$$

Symmetrical Vertical Curves



m = Mid-ordinate, in feet
Z = Any tangent offset, in feet
L = Horizontal length of vertical curve, in stations
X = Horizontal distance from P. C. or P. T. to any ordinate "Z," in stations
G_1 & G_2 = Rates of grade, expressed algebraically, as a percentage

All expressions to be calculated algebraically.

Elevation of P. I. = Elevation of P. C. + $G_1 \frac{L}{2}$

Elevation of P. T. = Elevation of P. C. + $(G_1 + G_2) \frac{L}{2}$

$$m = \frac{(G_2 - G_1)\,L}{8} = \frac{1}{2}\left(\frac{\text{Elev. of P.C. + Elev. of P.T.}}{2} - \text{Elev. of P.I.}\right)$$

For offset "Z" at distance "X" from P. C. or P. T.:

$$Z = m\left(\frac{X}{L/2}\right)^2 \text{ or } Z = \frac{X^2 (G_2 - G_1)}{2L}$$

For slope "S" of a line tangent to any point on the vertical curve at an "X" distance measured from the P. C.:

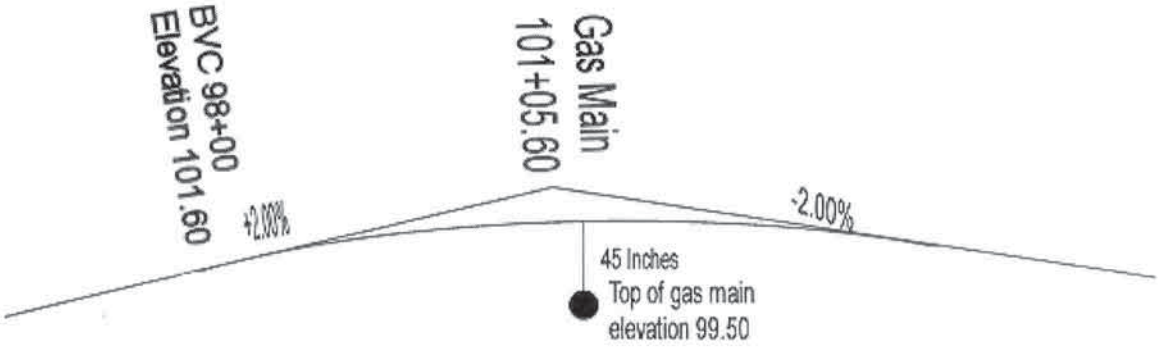
$$S = G1 - \left[X\left(\frac{G_1 - G_2}{L}\right)\right]$$

Calculating High or Low Point on Curve

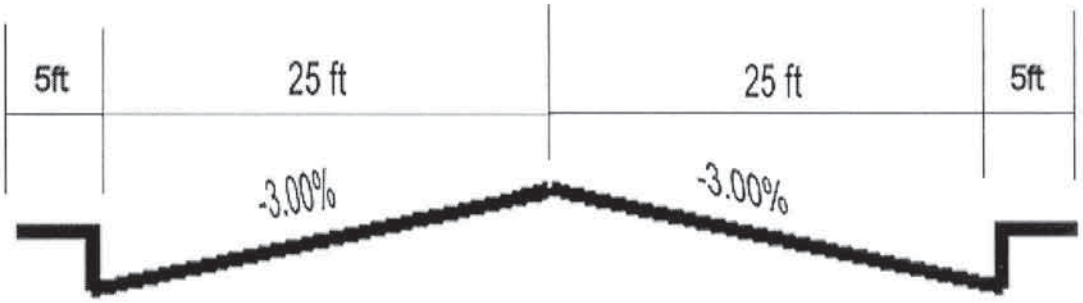
$X_T = \frac{L\,G}{G_1 - G_2}$ Where "X_T" equals the horizontal distance, in stations, from the P. C. to the high or low point on the curve.

Elevation of high or low point on curve equals: Elevation of P. C. $- \frac{1}{2}\left(\frac{L\,G_1^2}{G_2 - G_1}\right)$

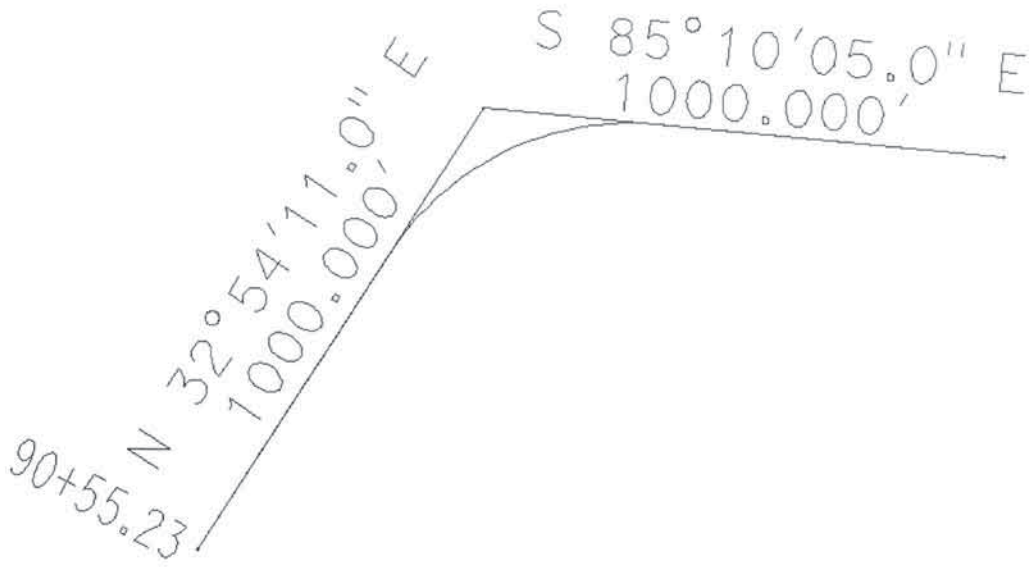
Street Profile



Typical Street Section



Construction Staking Problem
Horz and Vertical Curve



A. Two street centerlines intersect as shown above. A curve with a radius of 550.00 ft. will connect the streets. Compute the following:

1) BC Station : _____

2) EC Station: _____

3) Tangent Length: _____

4) Length of Curve: _____

5) Delta: _____

6) A total station is set up on the PC backsighting the PI. Compute the angle and distance to station 101+05.60. _____

B. During construction a buried gas main was discovered at station 101+05.60 crossing the road perpendicularly. Use the typical street section, elevations, and grade information shown below to design a vertical curve. The minimum distance from the top of the AC to the top of the gas main must be 45 inches. Compute:

The length of the vertical curve: _____
The Station and elevation of the EVC: _____