DEPARTMENT OF Consumer Affairs

BOARD OF REGISTRATION FOR PROFESSIONAL ENGINEERS
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October 2, 1978

MEMO TO: PROCTORS - LAND SURVEYOR EXAMINATION

SUBJECT: ERRATA

The 1978 Land Surveyor examination contains a few minor errors. They are as follows:

Problem C2 - the hyphen between the words East and one is meaningless. The hyphen should appear between the words one and half so as to read one-half (1/2).

Problem C4 - first word, second line should read plat in lieu of plot.

Problem C6 - 2nd paragraph - should read "explain why the underlined portion is incorrect".

This statement applies to all parts 1 through 20.

Subpart 6 should read "and the form it is to be".

Problem D1 - left side at bottom under Zone 5 Constants

ℓ = 0.57001 19219 (lower case ℓ)

2nd paragraph - should read probable error

right side at bottom

N = 798,283.13 feet

E = 2,545,947.50 feet

Problem D4 - The partial weights along left margin should be deleted.

Problem D6 - 4th line - the C-factor of the instrument, as determined by peg test, is - 0.150

Problem D7 - The station near BOB top left center of figure at the intersection 12-13-14-15-16-17 should be labeled as DON.

The partial weights along left margin should be deleted.

Paragraph 5 at bottom of page, part b - the word spherical should be changed to read geodetic.

Problem D8 - 1st paragraph under required
2nd line
Insert after "necessary for complete coverage" -
without sacrificing normal stereoscopic quality"

Examinees should be informed of these corrections at the beginning of each 4 hour period. The most important correction is the recognition of the underlined portions in Problem C6.

CALIFORNIA STATE BOARD OF REGISTRATION
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L S

LAND SURVEYOR
1978

C

PRINCIPLES AND PRACTICE

1. This examination is given in two four-hour periods on the same day. The subject matter relates to the principles and practice of Land Surveying. Part C is the first of two parts.

2. In the workbook, you are to work all of the six problems in this booklet.

3. You may withdraw from scoring any part of your work by isolating that part and writing VOID across it. Delineate the voided part clearly.

4. Enter your identification number in the upper right-hand corner on each page where space is provided.

5. Read the instructions on the workbook cover page.

6. After you have completed the examination, check the problem order, include all pages, and turn it in to the proctor.

7. You may keep this set of examination questions.

Department of Consumer Affairs
State Board of Registration for Professional Engineers
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1978

Problem C1 Wt. 5.0

Calculate the dimensions and write a metes and bounds description for that portion of the S 1/2 of the SE 1/4 of the SE 1/4 of Section 22 which lies east of Pratt Road. (Area not required.)

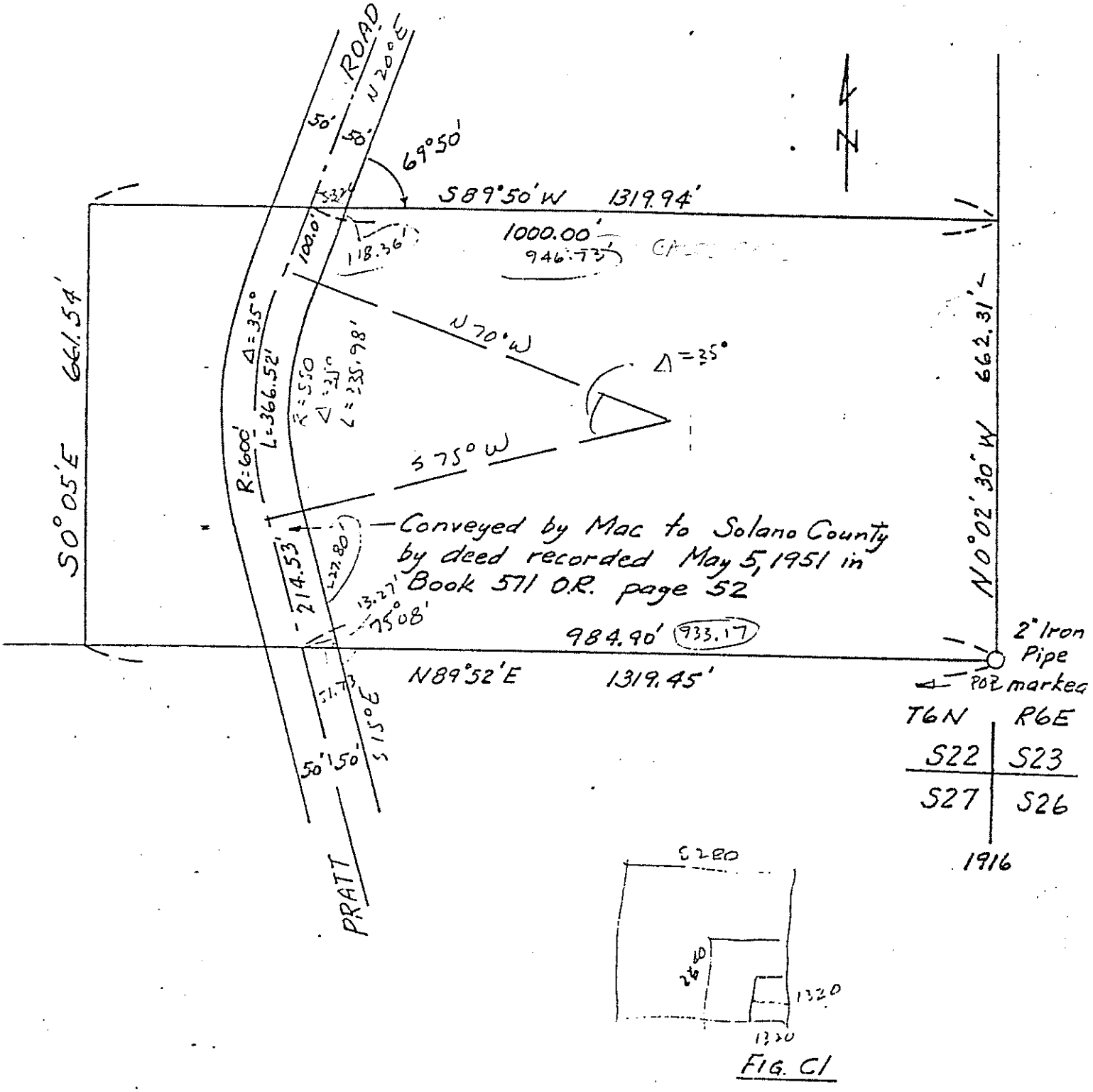


FIG. C1

Problem C2 Wt. 5.0

What are the dimensions and area of the East one-half of Lot 7?

AREA = $\left(\frac{a+b}{2}\right)(h)$

TOTAL = 11,000 sq ft

½ AREA = 5500 sq ft

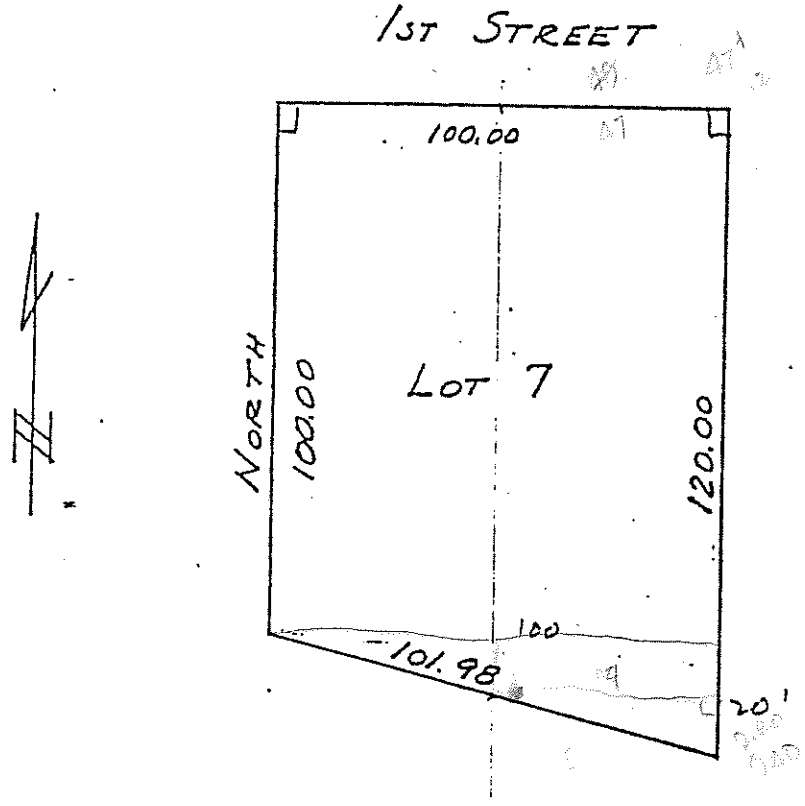
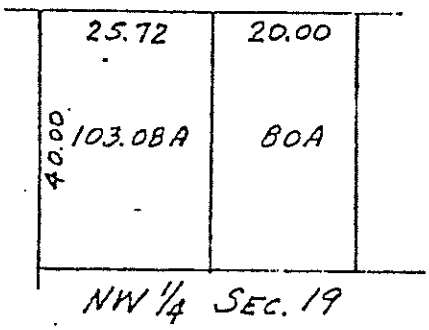


FIG. C2

Problem C3 Wt. 5.0

Discuss the legal, practical, technical and ethical considerations that must govern the decision to accept or reject a monument, found at or near the corner of a parcel of land, as marking the correct location of the corner.

Problem C4 Wt. 5.0



PLAT ~~plot~~ The figure at the left is a copy of the ~~plot~~ of the U.S. survey of this quarter section. Brown owns the entire quarter section and sells to Smith the "W 1/2 of the NW 1/4 of Sec. 19, containing 91.54 Acres." Shortly thereafter, he sells to Doe the "E 1/2 of the NW 1/4 of Sec. 19, containing 91.54 Acres."

Required:

Where shall the dividing line between Smith and Doe be run? Why?

Problem C5 Wt. 20.0

Figure "A" on the accompanying sketch is of Section 18, Township 14 North, Range 21 East, M.D.B. & M. Record data per G.L.O. notes and township plat are shown in parentheses. All other data shown is shown on a map of record and is assumed correct.

Figure "B" on the accompanying sketch is the southwest 1/4 of said Section 18. This sketch can be used for plotting your answer.

The following is the recorded chain of title with only the body of the descriptions indicated.

U.S.A. to Jones - 1896 Patent No. 4273 (found in Book 140 of Deeds at Page 69), being the east 1/2 of the southwest 1/4, and Lots 3 and 4 of Section 18, T. 14 N., R. 21 E., M.D.B. & M.

Allen to Hall - 1931 (found in Book 101 of Deeds, at Page 368) being all that portion of the north 1/2 of the southwest 1/4 of Section 18, T. 14 N., R. 21 E., M.D.B. & M., more particularly described as follows: Beginning at the west 1/4 corner of said Section 18, thence east 1320 feet to the True Point of Beginning, thence south 1320 feet, thence east 1320 feet, thence north 1320 feet, thence west 1320 feet to the True Point of Beginning.

Allen to Thomas - 1942 (found in Book 7, of Official Records, at Page 47) being the northwest 1/4 of the southwest 1/4 (Lot 3) of Section 18, T. 4 N., R. 21 E.

The remainder of Section 18 is non-patented land, title is vested in U.S. Government.

Your client, Mr. Hall, has hired you to research and survey his property in the southwest 1/4 of Section 18.

Required:

In answering questions 1, 2 and 3, show your work on Figure "B" or on a separate sketch, if you desire. You may use approximate method of calculation to the nearest foot.

1. Show the aliquot quarters of the southwest 1/4 of Section 18.

2. Show the ownerships in the southwest 1/4 of Section 18, based on the deed information given and show their relationship to Mr. Hall's property.

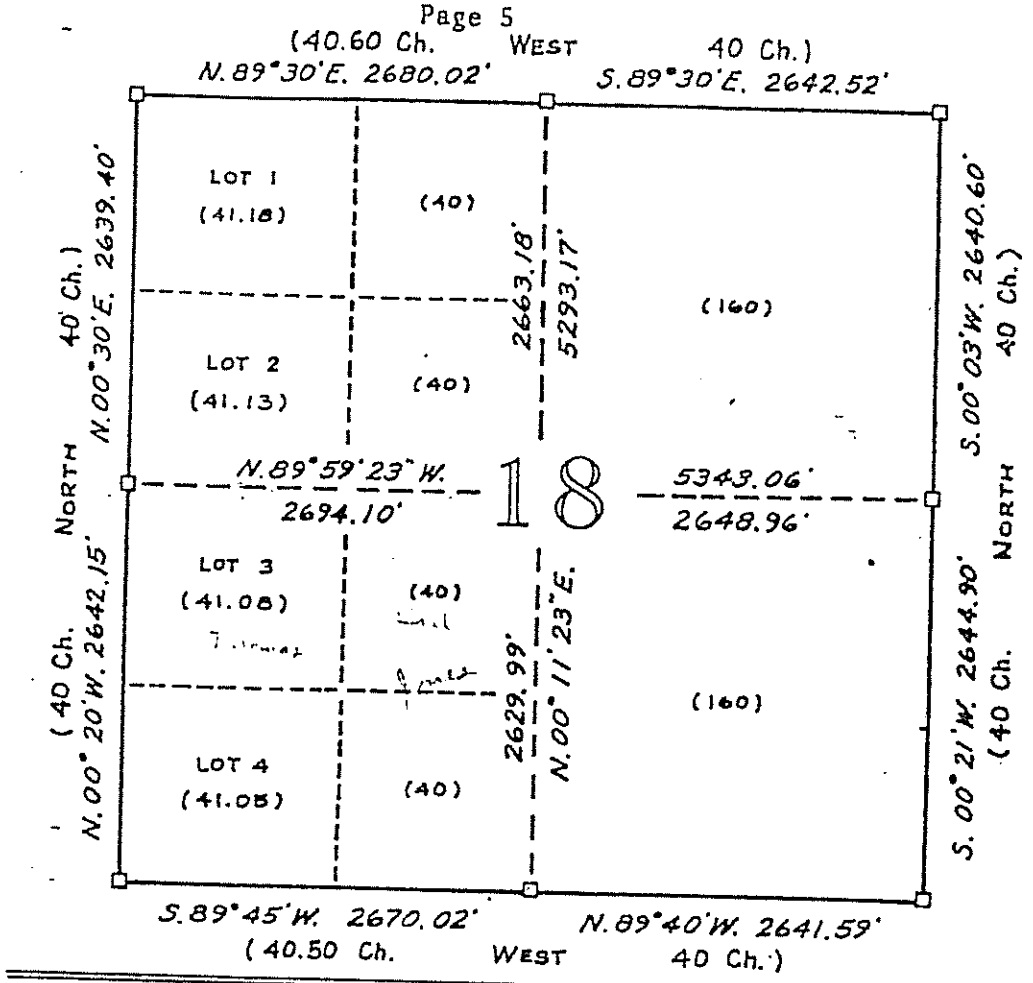
3. In your analysis of Mr. Hall's property, explain, as briefly as possible, how you arrived at your conclusions. What advice would you give your client, Mr. Hall, at this stage?

4. Your client, Mr. Hall, has approved a work order to proceed with the field survey. In your own words, explain where you would establish his boundary in the field and why.

NOTE:

You may copy Figure B in your workbook or do your work directly on Figure B - cut it out - and attach it securely to your workbook. If you choose to cut it out, please write your identification number on the loose portion.

FIGURE "A"



□ - INDICATES ORIGIN CORNER FOUND PER G.L.O. NOTE

( ) - RECORD PER G.L

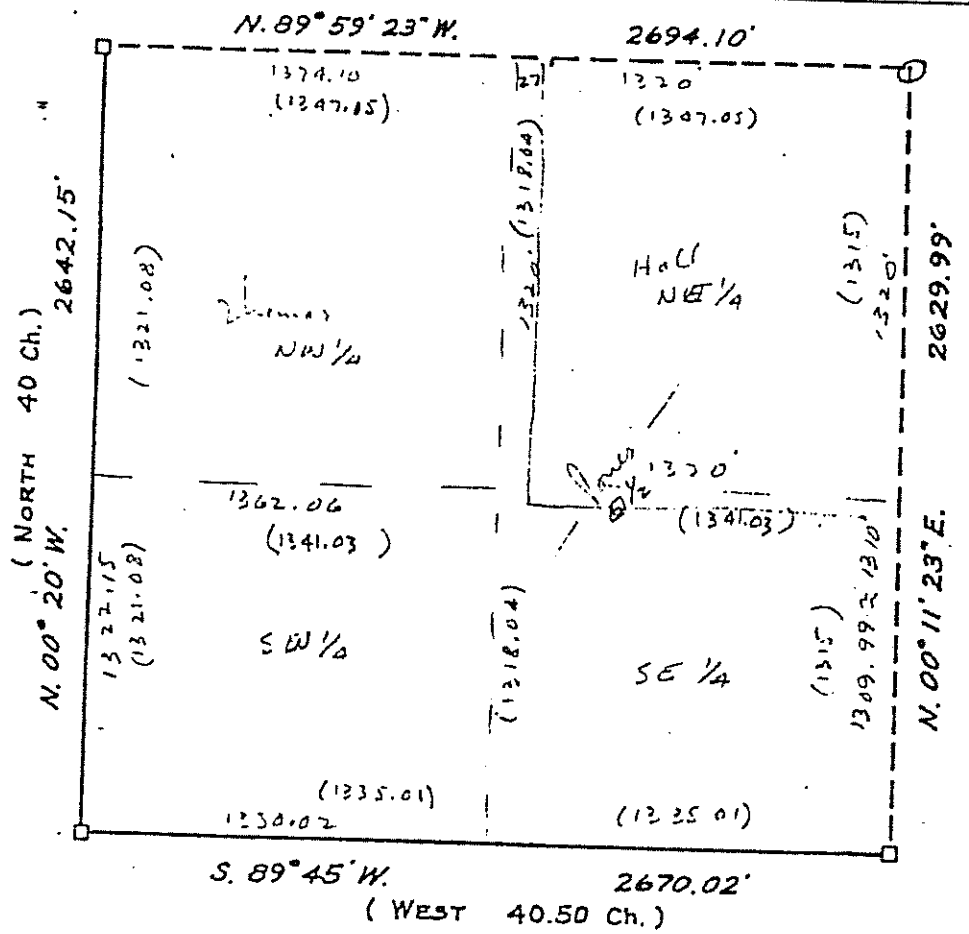
NOTE: ALL BEARINGS DISTANCES MEASURED UNLESS OTHERWISE NOTE

N

No Scale

FIGURE "B"

SW 1/4
SEC. 18



Problem C6 Wt. 10.0 (Answer All Parts)

The following questions relate to subdivisions in California. They are based on existing State laws in effect as of January 1978:

State whether each statement is true or false. If false, explain why the underlined portion is incorrect.

1. Any licensed Land Surveyor or Engineer can prepare a parcel map.

2. A parcel map is required for subdivision of 4 or less parcels, unlimited numbers of parcels of a gross acreage of 20 acres or more, and subdivisions of property in industrial or commercially zoned lands.

3. A final map is required for all subdivisions of 5 or more parcels.

4. A Parcel, Reversion to Acreage, or Final Map may be compiled from record.

5. When there is sufficient survey information existing on a filed map, and at least one of the boundary lines is monumented, a parcel map may be compiled as shown on record.

6. When a field survey is required for a parcel map, the minimum requirements for monumentation is up to the County and the from it is to be.

7. Only the County Surveyor may examine a parcel map.

8. A Certificate of Correction, or an amending map may be filed showing monuments set in error in the field.

9. The local agency may, by ordinance, delegate approval or conditional approval of parcel maps to the County Surveyor.

10. By State law, a tentative map shall expire 18 months after approval.

The following questions, relating to the Land Surveyors Act as published by the State of California, dated 1977, as to be answered by True or False:

11. A Record of Survey is required when a surveyor establishes points or lines that indicate (1) material discrepancy of record, (2) material evidence or physical change which does not show on another map or record, or (3) where the establishment of one or more lines, not of record, are created for the purpose of creating parcels for sale, lease or finance.

12. A Record of Survey shall be a map legibly drawn or printed in black, on polyester film or tracing cloth, 24" by 36" in size. 18"x26"

13. A Record of Survey shall show the nature of all monuments set and found, and the position or relationship to one another.

14. A surveyor, engineer, County Surveyor, County Recorder, or City Engineer may sign a Record of Survey Map.

15. A licensed land surveyor may use the title of Land Surveyor, Professional Engineer in land surveying, Land Survey Engineer, Survey Engineer, Geodetic Engineer, or Geometronic Engineer. §8751

Problem C6 Wt. 10.0 (Continued)

16. The State Board of Registration is vested the power to administer the requirements for, among other things, a Corner Record and the form they are to be submitted on.

17. A Corner Record can be used to show any corner replaced, or set, during a survey.

18. A licensed Land Surveyor must sign or seal and stamp with his license number all maps, plats, reports, descriptions or other documents prepared by him.

19. A person practices land surveying when he performs any of the following duties:

    a. Locates, relocates, establishes, re-establishes, or retraces any property line or boundary of any parcel of land or any road, right-of-way, easement, alignment or elevation for any of the fixed works embraced within the practice of civil engineering, as described in Chapter 7, Division 3 of the Land Surveyors Act.

    b. Procures or offers to procure land surveying work for himself or others.

    c. Manages, or conducts as manager, proprietor, or agent, any place of business from which land surveying work is solicited, performed or practiced.

20. A Record of Survey is a map to indicate what a surveyor did in the field and the only authorized persons that can sign this map are the surveyor who performed the survey, the County Surveyor, County Recorder, and in certain instances, the City Engineer.

CALIFORNIA STATE BOARD OF REGISTRATION
FOR PROFESSIONAL ENGINEERS

L S

LAND SURVEYOR
1978

D

PRINCIPLES AND PRACTICE

1. This examination is given in two four-hour periods on the same day. The subject matter relates to the principles and practice of Land Surveying. Part D is the second of two parts.

2. In the workbook, you are to work Problem D1 and D2 plus an optional selection to total 50 points.

3. You may withdraw from scoring any part of your work by isolating that part and writing VOID across it. Delineate the voided part clearly.

4. Enter your identification number in the upper right-hand corner on each page where space is provided.

5. Read the instructions on the workbook cover page.

6. After you have completed the examination, check the problem order, include all pages, and turn it in to the proctor.

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California
1978

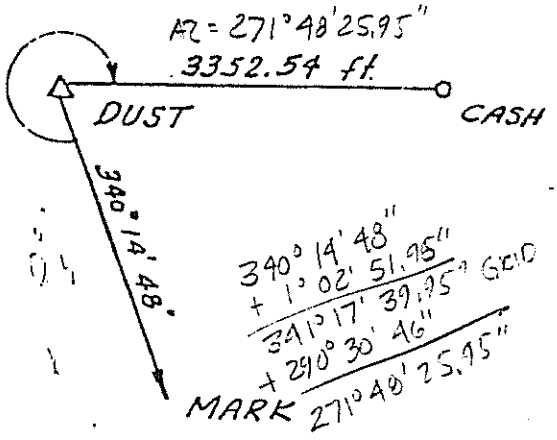
Problem D1 Wt. 10.0 Required

The length of line from DUST to CASH, measured by EDM and corrected for slope, elevation and scale factor is 3352.54 feet. The standard error of the EDM equipment is +0.02 ft. + 3 ppm. Unadjusted values for the angle at DUST measured from MARK to CASH are given below.

Required:

Determine the Zone 5 coordinates of CASH and the probable error of these coordinates (i.e., N = xxxx.xx ± xx; E = xxxx.xx ± xx). Assume the coordinates of DUST to be without error.

NOTE: A complete solution of this problem requires that all formulae and intermediate calculations be shown.



Measured Angle MARK-CASH

290° 30' 47"	
290° 30' 49"	
290° 30' 42"	4b"
290° 30' 44"	
290° 30' 46"	
290° 30' 48"	

Mean 290° 30' 46"

θ = 1° 02' 51.9564"

Zone 5 Constants

R_b = 30,649,424.27
C.M. = 118°00'
C = 2,000,000
ℓ = 0.57001 19219

Clarke 66 ellipsoid
R =

For DUST:

Latitude = 35° 40' 47.076" N
Longitude = 116° 09' 42.671" W
N = 798,283.13 feet
E = 2,545,947.50 feet

Geodetic azimuth (South = 0°) to MARK = 340° 14' 48"

START N 798,283.13
E 2,545,947.50 @ DUST

Az 271° 48' 25.95" dist. 3352.54'

GIVES N 793177.40' ± 0.02' @ CASH
E 2549293.37' ± 0.03'

ΔN = -105,727' × 3×10⁻⁶ = 0.0003' ± .02'
ΔE 3350.872' × 3×10⁻⁶ = 0.0101' ± .02'
ppm.

EDM STD DEV

Problem D2 Wt. 10.0 Required Answer All Parts

In your workbook, indicate whether each is true or false. If false, explain why the underlined portion of the statement is incorrect.

1. Where the boundary between the lands of adjoining owners is properly described in each of their respective deeds and the owners have acquiesced in a fence line that they both believed to be on their true boundary, their acquiescence becomes binding and neither party may thereafter claim to the described line.

T 2. The intention of the parties to a deed, when ascertained, controls the interpretation of the description.

F 3. When a deed description is open to dual interpretation, the interpretation most favorable to the grantor must be adopted. GRANTEE

F 4. Monuments set by a subdivider (or his surveyor) to mark the corners of a lot and relied upon by a purchaser of the lot as defining the boundaries of the lot, must yield to the boundaries as shown by the recorded plot of the subdivision.

F 5. Monuments mentioned in a deed description of the boundaries of land conveyed, control both bearings and distances given in the deed; in case of conflict, but only if the monuments were seen by the parties to the deed before its execution.

T 6. The Land Surveyors Act empowers the County Surveyor/Engineer to set standards for monumentation, survey procedure and accuracy of measurements used or shown on a Record of Survey map.

F 7. A deed conveying title to a lot, by reference to the recorded map of the subdivision that includes the lot, will also carry the grantor's title to the center of an adjoining street shown on the map, even though that street has been previously vacated and the deed specifically refers to the street as having been vacated.

F 8. Areas within Rancho grants which have been laid out, dimensioned, named and numbered similarly to Government sections are properly considered in the same category as regular Government sections, insofar as subdivision and corner restablishment are concerned.

F 9. The boundary of a parcel of land adjacent to a stream or other body of water, when patented, extends to and follows the meander line run by the Government surveyor. GOES TO CENTER OF STREAM

10. An easement for driveway purposes across the land of an adjoiner, acquired in connection with the land served by the easement, is called an easement in gross.

Problem D3 Wt. 5.0

This problem concerns the California Coordinate System established by state statute used to reference a fixed position on the ground.

Required:

Answer the following in your own words:

a. What is the basis for the primary control? What corrections must be applied to raw data to comply with the projection?

b. What is the relationship of coordinates to land title? What are the requirements of the Land Surveyors Act regarding coordinates?

c. What are the advantages in using the coordinate system in California? What are the disadvantages of use?

CONVERT FROM ONE ZONE TO ANOTHER

Problem D4 Wt. 5.0

a. At what time will the effects of a small error in the determination of observer's latitude be minimized when making azimuth observations on Polaris? TOP OR BOTTOM OF CULMINATION

b. At what time will the effects of a small error in the determination of the time of observation be minimized when making azimuth observations on Polaris? EAST OR WEST ELONGATION

c. Explain the differences between astronomic azimuth, geodetic azimuth and state plane grid azimuth.

d. Explain the strengths and weaknesses inherent in the method of determining azimuth by observation of the sun's altitude.

A) SUN EASY TO FIND

B) HARD TO TRACK, MOVES FAST

Problem D5 Wt. 5.0

Discuss each of the following statements. If the statement is true, explain why it is true; if the statement is false, explain why it is false. Your explanation of the reasons for your conclusions will be the basis for evaluation.

a. Correct standard time is recorded when determining the declination of the sun. The standard time recorded is then corrected to local time. Local time is then increased (in California) by 8 hours to determine Greenwich Mean Time. Having the Greenwich time, the declination of the sun may then be looked up in an ephemeris. (Daylight Savings Time is not included in this problem)

b. A level line at sea level is parallel with a level line at 8,000 feet elevation.

Problem D6 Wt. 10.0

Bouchard & Moffett Pg 72,73
KISSAM Pg 476

A collection of rod readings is shown below. These readings were taken over a section of line of three-wire levels run in both directions using a precision self-leveling level and invar-faced rods graduated in centimetres with readings estimated to the nearest millimetre. The C-factor of the instrument is -0.150, the stadia constant is 0.335 and the average rod temperature is 30°C. & determined by peg test is

Required:

a. Arrange these notes on your workbook paper as would be done in a field book, showing all data normally shown in field notes of precise leveling.

b. Reduce and analyze the notes, showing all intermediate steps and checks. Note any deviations from acceptable practices and/or limits and proceed to a determination of the mean difference in elevation for the section. State any assumptions you make. Compute and apply all applicable corrections for systematic errors. Express the difference in elevation in metres.

c. Determine and state the highest order of leveling for which this run would qualify. Use the latest published standards for vertical control surveys.

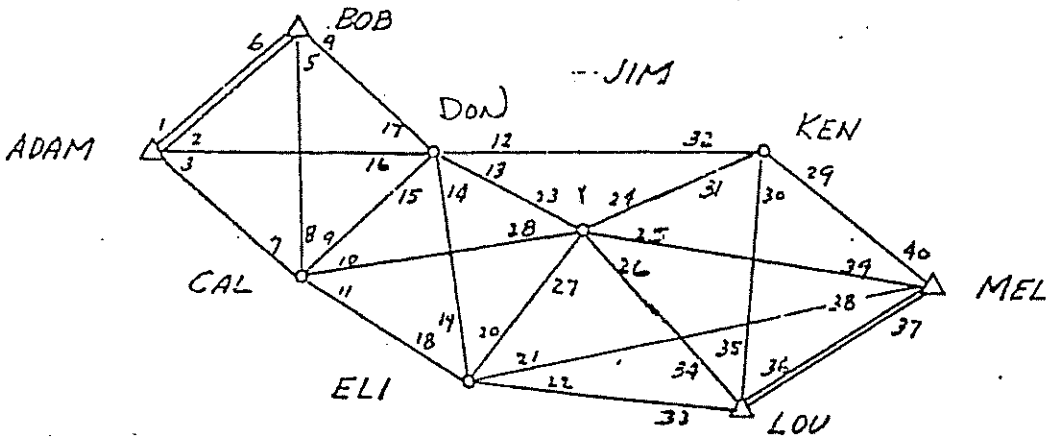
d. Discuss the concept of orthometric correction: What it is, what it does, when it is used and the kind of work to which it is normally applied. Would it be likely to be applied to the data in this problem? Why?

KISSAM Pg 340, 339 fig 12-2

ROD READINGS — THREE-WIRE LEVELS

Forward Run +	Forward Run -	Backward Run +	Backward Run -
234	2392	1831	721
198	2359	1802	693
162	2327	1773	666
1455	1629	3077	171
1384	1557	3057	151
1313	1484	3037	131
158	3250	3332	298
135	3227	3310	277
112	3203	3288	257
126	3125	1854	1811
117	3106	1784	1742
088	3087	1714	1672
808	1832	2603	240
777	1795	2563	202
747	1779	2524	164

Problem D7 Wt. 10.0



Assume that this figure is to be given a rigorous least-squares adjustment using directions and condition equations.

△ = Fixed station
0 • = New station
All stations occupied
All lines observed both ways

Required:

In your workbook, indicate each part by number and your answer by writing in the letter which corresponds to the answer of your choice.

1.0 1. The correct number of angle condition equations is

(a) 10 (b) 12 (c) 15 (d) 16 (e) 20

2.0 2. The correct number of side condition equations is

(a) 1 (b) 4 (c) 5 (d) 9 (e) 12

2.0 3. The total number of condition equations necessary to achieve the complete adjustment of the figure is

(a) 11 (b) 13 (c) 17 (d) 21 (e) 25

1.5 4. Angle equations are written using in particular which of the following

(a) Triangles with smallest angles
(b) Triangles with largest angles
(c) All possible triangles
(d) The best chain of triangles
(e) The most direct route

1.5 5. Spherical excess does which of the following

(a) Amounts to approximately one second (arc) per angle per 75 sq. miles
(b) Converts plane angles to ~~spherical~~ angles
(c) May be properly applied to the angles of a traverse extending over long distances to correct for convergence of the meridians.
(d) Converts the sum of the angles of a plane triangle to the sum of the angles of the corresponding spherical triangle.
(e) Both a and d.

Problem D7 Wt. 10.0 (Continued)

1.5 6. "Strength of figure" is a measure of

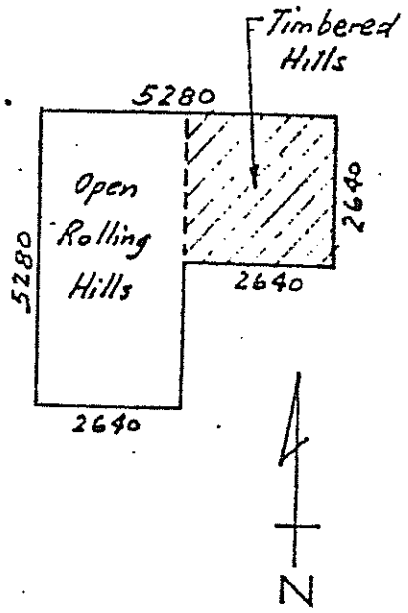
(a) The mathematical consistency of a triangulation network.
(b) The accuracy of the measured angles.
(c) The sines of the distance angles.
(d) The reliability of computed lengths within a triangulation network.
(e) The accuracy of the measured lengths.

1.5 7. If the method of "variation of coordinates" was to be used, the total number of condition equations would be

(a) 5 (b) 7 (c) 10 (d) 14 (e) 18

Problem D8 Wt. 15.0

The sketch at the right represents an area for which you are to furnish aerial topographic mapping. The portion on the left (west) is open, rolling terrain; the shaded portion on the right is hilly and timber-covered. Maximum relief encountered is 500 feet. The mapping is to be done at a manuscript scale of 1" = 200' with a 5-foot contour interval. You have available for use aerial cameras with 8.25-inch, 6-inch or 3.5-inch focal length lenses, producing a 9"x9" negative. You will be using a Kelsh plotter with a C-factor of 1200.



Required:

Design a flight plan for the photography, based on the minimum number of photographs necessary for complete coverage. In your design, indicate the following:

a. Percent forward lap

b. Percent side lap

c. Flight height above mean terrain

d. Focal length of camera(s) used

e. Number, direction and spacing of flight lines four Runs N S

f. Total number of photographs; scale of photographs 10

g. Total number of stereo models 80

h. Effective stereoscopic area of each model