Home Work

CEST 50B Plane Surveying Applications
State Plane Coordinate Problems
NAD27

1. You are calculating the state plane coordinates from geographic coordinates in Zone II of California. The geographic coordinates of Pt. "Stooges" are 38°16'27.54" N, 122°41'55.08" W. The elevation of Pt. "Stooges" is 1234.56'.

   - What are the Lambert Coordinates of Pt. "Stooges"?
   - What is the Elevation Factor (E_f)
   - What is the Scale Factor (S_f)
   - What is the Combination Factor (C_f)
   - What is the Convergence Angle (θ)

Zone II Constants

Central Meridian = 122°00'00"

R_b=26,312,257.65

C=2,000,000

ℓ=0.6304679732

Radius of the Earth=20,906,000'

2. You are computing the geographic coordinates from state plane coordinates in Zone II of California. The Lambert Coordinates of Pt. "Rascal" are 284,424.65 N, 1,792,003.29 E. The elevation of Pt. "Rascal" is 6543.21'.

   - What are the Geographic Coordinates of Pt. "Rascal"?
   - What is the Elevation Factor (E_f)
   - What is the Scale Factor (S_f)
   - What is the Combination Factor (C_f)
   - What is the Convergence Angle (θ)

Zone II Constants

Central Meridian = 122°00'00"

R_b=26,312,257.65

C=2,000,000

ℓ=0.6304679732

Radius of the Earth=20,906,000'

California Coordinate System 1927
State Plane Coordinate Computations – Plane Coordinates to Latitude/Longitude

Constants for Zone: ☐ I ☐ II ☐ III ☐ IV ☐ V ☐ VI ☐ VII

Station Name:	
N_{Sta} =	E_{Sta} =
Central Meridian =	ℓ =
C =	R_b=

Compute the Radius of Curvature at the Station (R_{Sta}):

$R_{Sta} = \sqrt{(R_b - N_{Sta})^2 + (E_{Sta} - C)^2}$: _____

R_ϕ = _____ *(From Projection Tables choose the next larger "R")*

Enter the (ϕ) for R_ϕ = _____ *(Deg. & Min. from Projection Tables for R_ϕ)*

Tab. Diff. For 1" of (ϕ) : _____ *(Enter the "Tab Diff. For 1" of ϕ" for the Degrees & Minutes of ϕ_{Sta} from the projection tables)*

Compute the difference in Radii (ΔR):

$\Delta R = (R_\phi - R_{Sta})$: _____ *(From Above)*

Compute Seconds of (ϕ) for the Station: should (0 → 60")

Divide "(ΔR)" by "Tab. Diff. For 1" of (ϕ)" _____ *(From Above)*

Station Latitude (ϕ_{Sta}) = [ ] (Combine Deg. & Min. & Seconds of ϕ *from above)*

Compute the convergence angle (θ):

$\theta = \sin^{-1}[(E_{Sta} - C) \div R_{Sta}]$: _____ *(Answer in Decimal Degrees)*

Compute the difference in Longitude ($\Delta\lambda$):

$\Delta\lambda = (\theta) \div (\ell)$: _____ *(Answer in Decimal Degrees)*

Station Longitude (λ_{Sta}) = Central Meridian - $\Delta\lambda$ = [ ]

California Coordinate System 1927
State Plane Coordinate Computations – Latitude/Longitude to Plane Coordinates

Constants for Zone: ☐ I ☐ II ☐ III ☐ IV ☐ V ☐ VI ☐ VII

Station Name:	
ϕ_{Sta} =	λ_{Sta} =
Central Meridian =	ℓ =
C =	R_b=

Enter the Degrees & Minutes of ϕ_{Sta} _____ *(From Above)*

R_ϕ = _____ *(Enter the "R" for the Degrees & Minutes of ϕ_{Sta} from the projection tables)*

Tab. Diff. For 1" of (ϕ) : _____ *(Enter the "Tab Diff. For 1" of ϕ" for the Degrees & Minutes of ϕ_{Sta} from the projection tables)*

Seconds of ϕ_{Sta} _____ *(Enter the Seconds only from ϕ_{Sta} above)*

Compute the ΔR per 1" of (ϕ) :

Multiply "Tab. Diff. For 1" of (ϕ)" & "Seconds of ϕ_{Sta}" _____ *(From Above)*

Compute the Radius of Curvature at the State (R_{Sta}):

R_{Sta} = (R_ϕ) - (ΔR per 1" of (ϕ)) = _____ *(From Above)*

Compute the difference in Longitude ($\Delta\lambda$):

$\Delta\lambda$ = (Central Meridian - λ) : _____ *(Convert Answer to Dec. Deg.)*

Compute the convergence angle (θ):

θ = ($\Delta\lambda$) x (ℓ) : _____ *(Answer in Dec. Deg.)*

Station Northing (N_{Sta}) :

R_b - (R_{Sta} cos (θ)) = ☐

Station Easting (E_{Sta}) :

C + (R_{Sta} sin (θ)) = ☐

Lambert Projection for California II

Table I (Cont'd)

Lat.	R_b feet	Y' y value on central meridian feet	Tabular difference for 1 sec. of lat.	Scale in units of 7th place of logs	Scale expressed as a ratio
38° 16'	26,093,743.52	218,514.13	101.15983	+68.5	1.0000158
17	26,087,673.93	224,583.72	101.15967	+50.8	1.0000117
18	26,081,604.35	230,653.30	101.15967	+33.5	1.0000077
19	26,075,534.77	236,722.88	101.15950	+16.6	1.0000038
20	26,069,465.20	242,792.45	101.15933	0.0	1.0000000
38° 21'	26,063,395.64	248,862.01	101.15933	-16.2	0.9999963
22	26,057,326.08	254,931.57	101.15933	-32.1	0.9999926
23	26,051,256.52	261,001.13	101.15917	-47.6	0.9999890
24	26,045,186.97	267,070.68	101.15917	-62.8	0.9999855
25	26,039,117.42	273,140.23	101.15900	-77.5	0.9999822
38° 26'	26,033,047.88	279,209.77	101.15900	-92.0	0.9999788
27	26,026,978.34	285,279.31	101.15900	-106.0	0.9999756
28	26,020,908.80	291,348.85	101.15900	-119.7	0.9999724
29	26,014,839.26	297,418.39	101.15900	-133.0	0.9999694
30	26,008,769.72	303,487.93	101.15900	-146.0	0.9999664
38° 31'	26,002,700.18	309,557.47	101.15900	-158.6	0.9999635
32	25,996,630.64	315,627.01	101.15900	-170.8	0.9999607
33	25,990,561.10	321,696.55	101.15900	-182.7	0.9999579
34	25,984,491.56	327,766.09	101.15900	-194.2	0.9999553
35	25,978,422.02	333,835.63	101.15900	-205.4	0.9999527
38° 36'	25,972,352.48	339,905.17	101.15917	-216.2	0.9999502
37	25,966,282.93	345,974.72	101.15917	-226.6	0.9999478
38	25,960,213.38	352,044.27	101.15933	-236.7	0.9999455
39	25,954,143.82	358,113.83	101.15917	-246.4	0.9999433
40	25,948,074.27	364,183.38	101.15950	-255.7	0.9999411
38° 41'	25,942,004.70	370,252.95	101.15933	-264.7	0.9999391
42	25,935,935.14	376,322.51	101.15967	-273.3	0.9999371
43	25,929,865.56	382,392.09	101.15967	-281.5	0.9999352
44	25,923,795.98	388,461.67	101.15967	-289.4	0.9999334
45	25,917,726.40	394,531.25	101.16000	-296.9	0.9999316
38° 46'	25,911,656.80	400,600.85	101.16000	-304.1	0.9999300
47	25,905,587.20	406,670.45	101.16017	-310.8	0.9999284
48	25,899,517.59	412,740.06	101.16033	-317.3	0.9999269
49	25,893,447.97	418,809.68	101.16050	-323.3	0.9999256
50	25,887,378.34	424,879.31	101.16067	-329.0	0.9999242

Lambert Projection for California II

Table II (Cont'd)

1" of Long. = 0".63046797 of θ

Long.		θ			Long.		θ			Long.		θ		
122°	31'	-0°	19'	32".6704	123°	06'	-0°	41'	36".6532	123°	41'	-1°	03'	40".6359
	32	-0	20	10.4985		07	-0	42	14.4813		42	-1	04	18.4640
	33	-0	20	48.3266		08	-0	42	52.3093		43	-1	04	56.2921
	34	-0	21	26.1547		09	-0	43	30.1374		44	-1	05	34.1202
	35	-0	22	03.9827		10	-0	44	07.9655		45	-1	06	11.9482
122°	36'	-0	22	41.8108	123°	11'	-0	44	45.7936	123°	46'	-1	06	49.7763
	37	-0	23	19.6389		12	-0	45	23.6216		47	-1	07	27.6044
	38	-0	23	57.4670		13	-0	46	01.4497		48	-1	08	05.4325
	39	-0	24	35.2951		14	-0	46	39.2778		49	-1	08	43.2605
	40	-0	25	13.1231		15	-0	47	17.1059		50	-1	09	21.0886
122°	41'	-0	25	50.9512	123°	16'	-0	47	54.9340	123°	51'	-1	09	58.9167
	42	-0	26	28.7793		17	-0	48	32.7620		52	-1	10	36.7448
	43	-0	27	06.6074		18	-0	49	10.5901		53	-1	11	14.5729
	44	-0	27	44.4354		19	-0	49	48.4182		54	-1	11	52.4009
	45	-0	28	22.2635		20	-0	50	26.2463		55	-1	12	30.2290
122°	46'	-0	29	00.0916	123°	21'	-0	51	04.0743	123°	56'	-1	13	08.0571
	47	-0	29	37.9197		22	-0	51	41.9024		57	-1	13	45.8852
	48	-0	30	15.7478		23	-0	52	19.7305		58	-1	14	23.7133
	49	-0	30	53.5758		24	-0	52	57.5586		59	-1	15	01.5413
	50	-0	31	31.4039		25	-0	53	35.3867	124°	00'	-1	15	39.3694
122°	51'	-0	32	09.2320	123°	26'	-0	54	13.2147	124°	01'	-1	16	17.1975
	52	-0	32	47.0601		27	-0	54	51.0428		02	-1	16	55.0256
	53	-0	33	24.8882		28	-0	55	28.8709		03	-1	17	32.8536
	54	-0	34	02.7162		29	-0	56	06.6990		04	-1	18	10.6817
	55	-0	34	40.5443		30	-0	56	44.5271		05	-1	18	48.5098
122°	56'	-0	35	18.3724	123°	31'	-0	57	22.3551	124°	06'	-1	19	26.3379
	57	-0	35	56.2005		32	-0	58	00.1832		07	-1	20	04.1660
	58	-0	36	34.0285		33	-0	58	38.0113		08	-1	20	41.9940
	59	-0	37	11.8566		34	-0	59	15.8394		09	-1	21	19.8221
123°	00'	-0	37	49.6847		35	-0	59	53.6674		10	-1	21	57.6502
123°	01'	-0	38	27.5128	123°	36'	-1	00	31.4955	124°	11'	-1	22	35.4783
	02	-0	39	05.3409		37	-1	01	09.3236		12	-1	23	13.3063
	03	-0	39	43.1689		38	-1	01	47.1517		13	-1	23	51.1344
	04	-0	40	20.9970		39	-1	02	24.9798		14	-1	24	28.9625
	05	-0	40	58.8251		40	-1	03	02.8078		15	-1	25	06.7906

CEST 50B Plane Surveying
State Plane Coordinate System

North American Datum 1927 (NAD27)
California Coordinate System 1927 (CCS27)

CONSTANTS for	ZONE I	ZONE II
C	2,000,000	2,000,000
Central Meridian	122° 00'	122° 00'
R_b	24,792,436.23	26,312,257.65
ℓ	0.65388 43192	0.63046 79732

CONSTANTS for	ZONE III	ZONE IV
C	2,000,000	2,000,000
Central Meridian	120° 30'	119° 00'
R_b	27,512,992.04	28,652,931.96
ℓ	0.61223 20427	0.59658 71443

CONSTANTS for	ZONE V	ZONE VI
C	2,000,000	2,000,000
Central Meridian	118° 00'	116° 15'
R_b	30,649,424.27	32,271,267.72
ℓ	0.57001 19219	0.54951 75982

CONSTANTS for	ZONE VII
C	4,186,692.58
Central Meridian	118° 20'
R_b	35,055,396.31
ℓ	0.56124 32071

1/27/04 Lab

CEST 50B Plane Surveying
NAD27 REDUCING MEASURED DISTANCES TO GRID DISTANCES

Procedures Converting Ground Distances to Grid Distances.

1. Calculate the Elevation Factor **(E_f)**
2. Calculate the Scale Factor **(S_f)**
3. Compute the Combination Factor **(C_F)**
4. Compute Grid Distance **(GD)**
5. Convert Geodetic Azimuth to Grid Azimuth **(GAz)**

1. Elevation Factor: (E_f)

$$E_f = R \div (R + H)$$

R = Radius of the Earth (20,906,000')
H = Average Elevation of Line, between end points.

2. Scale Factor: (S_f)

S_f = ***An approximate scale factor, may be interpolated from the projection tables of a specific zone. It is based on the latitude of the point, or the average latitude of the line.***

3. Combination Factor: (C_F)

$$C_F = (E_f \times S_F)$$

4. Reducing Horizontal (Ground) Distance to Grid Distance: (GD)

$$(GD) = HD \times C_F$$

5. Convert Geodetic Azimuth to Grid Azimuth: (GAz)

$$(GAz) = \text{Geodetic Azimuth} - (\theta)$$

(θ) = Convergence Angle

$(\theta) = (\Delta\lambda \times \ell)$

ℓ = Zone constants

$\Delta\lambda = (C - \lambda)$
C = Zone Constant
λ = longitude