A CUBE DIAL ON A COLUMN – mostly SW/SE points

This dial was to be of a similar design as the first example, but to be primarily SE and SW as opposed to mostly South and mostly east and west. The design method was to be by using spreadsheets. This dial will be for Silver City, NM, whose coordinates are:

location lat:	32.75° N
location long:	108.2° W
magnetic declination:	10.6° E

In this supplement, SD (style distance) and style height (SH) are the angular measures for vertical declining dials.

The column was built, and like a prior dial column this used 12 of the 8x8x16 concrete blocks, a sack of pre mix concrete and some sacks of mortar.

The pedestal was built to fit in with the surrounding construction angles.

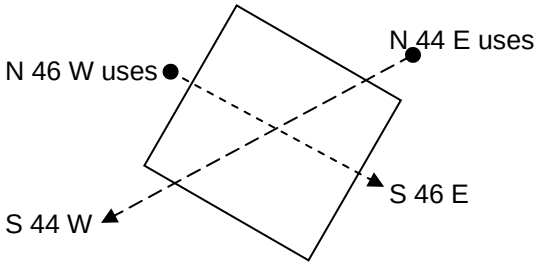
And when finished, the declinations were measured with two different compasses from several directions.

The southwest facing vertical surface faced magnetic 213 degrees, and the southeast vertical faced magnetic 123 degrees.

With an almost 11 degree magnetic declination to the east of true north this meant that the magnetic declination had to be added to the magnetic bearing to get the true bearing. Thus the faces were 224 degrees true and 134 degrees true respectively.

Now 224° is southwest, subtracting 180 for south we get S 44° W for the southwest dial plate.

And 134° is southeast which when subtracted from 180 gives S 46° E for the southeast facing dial plate.



SOUTH FACING DIAL PLATE

Having determined that the south facing plates were S 44°W and S 46° E, the hour line angles must be deduced, as well as the sub-style, and style height.

Also, the longitude is 108.2° which is 3.2° west of the legal time 105° meridian, that makes about a 12 minute difference.

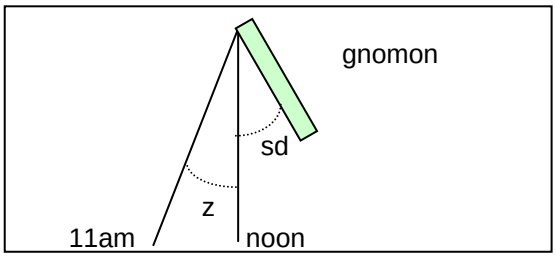
The formulae for south decliners are:-

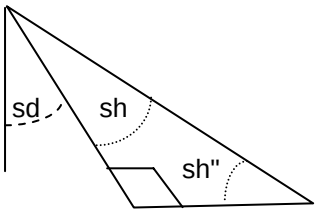
The hour line angles are based on: z = atan(cos(lat)/(cos(dec) cot(ha) + sin(dec) sin(lat))

Gnomon rotation or slewing is optional and if used employs the following formula:-

Gnomon offset from vertical is: **sd** = atan(sin(dec) / tan(lat)) **Style Distance**

Style and sub style angle is: **sh** = asin(cos(lat) * cos(dec)) **Style Height**





However, the reference-spreadsheets.xls file allows us to calculate these results.

The spreadsheet needs to consider longitude differences between the location and the legal meridian. While horizontal dials tend to be portable, a vertical declining dial is obviously tailored, this the final dial plate should also be tailored.

Note that while the angles of hour lines change when the longitude is considered, the style distance (SD) does not.

The hour line angles can be readily checked against the SHADOWS software, and the style distance SD, similarly. The style height in SHADOWS requires a conversion from linear dimensions to trigonometric to angular. They were within less than a degree. When using SHADOWS software remember to display the dial data with the longitude correction.

For the southwest face we derive the following data. This is noon to tea time.

ENTER minutes correction to a normal dial — This shifts hours lines appropriately

12

ENTER A LATITUDE

32.75

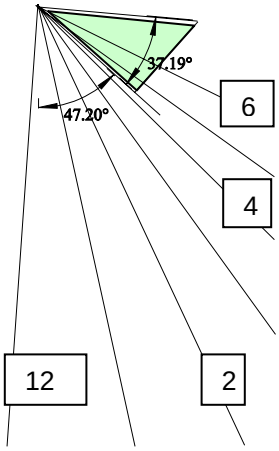
ENTER A WALL DECLINATION

44 SxxW is positive

Legal TIME hh.mm	LAT TIME hh.mm	Hour line angles from vertical. DEC SxxW 44
12.00	11.80	**-3.6**
12.50	12.30	**5.1**
13.00	12.80	**12.6**
13.50	13.30	**19.3**
14.00	13.80	**25.2**
14.50	14.30	**30.6**
15.00	14.80	**35.6**
15.50	15.30	**40.3**
16.00	15.80	**44.9**
16.50	16.30	**49.5**
17.00	16.80	**54.1**
17.50	17.30	**58.8**
18.00	17.80	**63.8**
	STYLE:SD	**47.2**
	STYLE:SH	**37.2**

Cross checking with other systems we find the style distance and style height are within tolerances. The 12:00 line (uses 11.8 not 12.0 because of longitude correction) is -3.6 and so on.

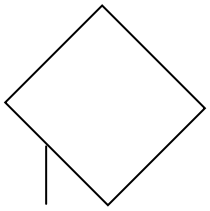
12:00	12:30	13:00	14:00	15:00	1600	SD	17:00	18:00
-3.6	5.1	12.6	25.2	35.6	44.9	47.2	54.1	63.8



The dial plate is shown to the right for 12 through 6pm.

The style is the short line between 4pm and 5pm.

The style height is shown by the shaded gnomon.



For the southeast face we derive the following data. This is breakfast to lunch time.

ENTER minutes correction to a normal dial

12

ENTER A LATITUDE

32.75

ENTER A WALL DECLINATION

46 SxxW is positive

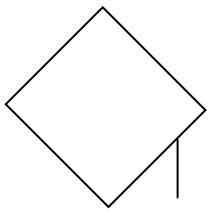
SxxE is negative

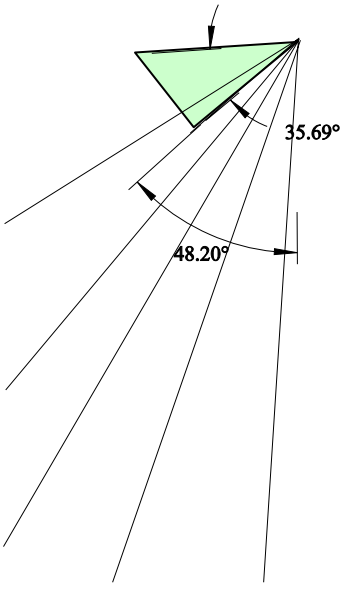
	Legal TIME	LAT TIME	TIME	-DEC SxxE
	hh.mm	hh.mm	hh.hh	-46
	6.00	5.80	5.80	**-67.2**
	6.50	6.30	6.30	**-62.2**
	7.00	6.80	6.80	**-57.5**
	7.50	7.30	7.30	**-52.9**
	8.00	7.80	7.80	**-48.5**
	8.50	8.30	8.30	**-44.1**
	9.00	8.80	8.80	**-39.7**
	9.50	9.30	9.30	**-35.0**
	10.00	9.80	9.80	**-30.0**
	10.50	10.30	10.30	**-24.5**
	11.00	10.80	10.80	**-18.4**
	11.50	11.30	11.30	**-11.5**
	12.00	11.80	11.80	**-3.5**
		STYLE:SD	**SD**	**-48.2**
		STYLE:SH	**SH**	**35.7**

Cross checking with other systems we find the style distance and style height are within tolerances. The 12:00 line (uses 11.8 not 12.0 because of longitude correction) is -3.5 and so on.

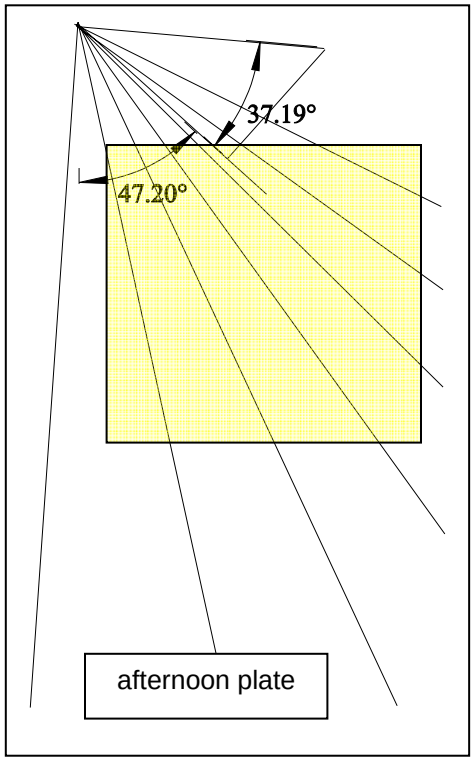
The schematic for the dial plate is to the right.

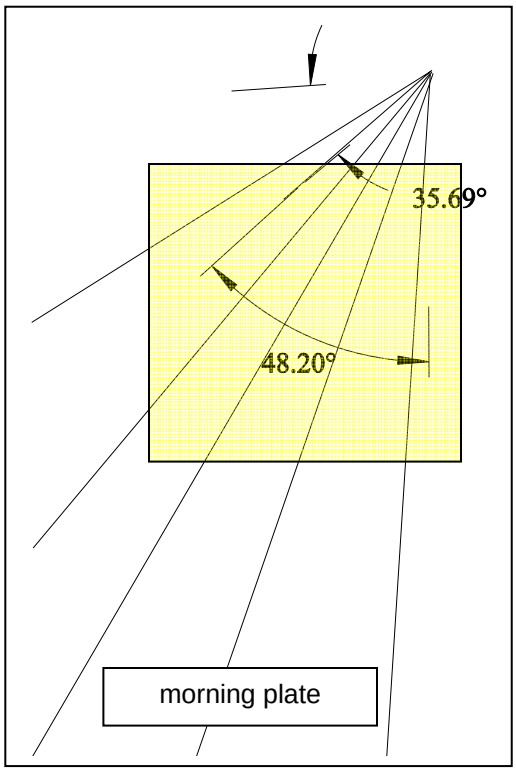
In this case, the sub-style and 0800 are within 0.3 degrees of each other and thus essentially co-located.





The next step is to decide what will be on the dial plates, and where. By drawing the sub-style by using the style distance (SD), as well as the style height (SH) and thus the style, it is very easy to decide what to have on the final dial plate, and what the gnomon will be like.





Two areas have been shaded as looking appropriate for the dial plates. The next step was to make the cardboard mockups.

A picture of one mockup is shown and it tested well, as did the second mock plate, thus the final dial plates were constructed.

It turned out that there was a protractor drafting error on the hour lines for the morning plate. There was no math error, only a drafting mistake. This emphasizes the need for care. Better to receive a wake up call and get the final plate correct than have to remove and redo it.

The northeast facing plate gets the sun also, so we may use the southwest plate's figures albeit mirrored.

ENTER minutes correction to a normal dial — This shifts hours lines appropriately

12

ENTER A LATITUDE

32.75

ENTER A WALL DECLINATION

44 SxxW is positive

SxxE is negative

57.25

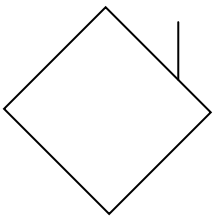
46

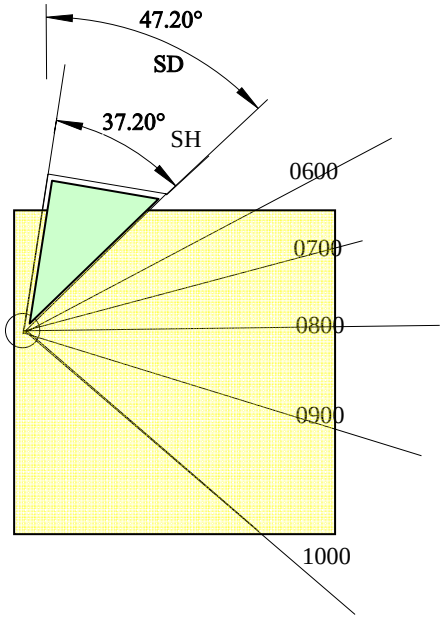
Legal TIME hh.mm	LAT TIME hh.mm	Hour line angles from vertical. DEC SxxW
		44
6.00	5.80	63.8
6.50	6.30	69.2
7.00	6.80	75.2
7.50	7.30	81.8
8.00	7.80	89.4
8.50	8.30	-82.0
9.00	8.80	-72.1
9.50	9.30	-61.0
10.00	9.80	-49.0
10.50	10.30	-36.6
11.00	10.80	-24.6
11.50	11.30	-13.5
12.00	11.80	-3.6
12.50	12.30	5.1
13.00	12.80	12.6
	STYLE:SD	47.2
	STYLE:SH	37.2

SD 47.2
SH 37.2

The hour line angle sign's change. What this means is that the passed through the horizontal. A depiction of the dial plate is shown to the right, and it may be tested, made, then installed on the northeast face.

The northwest facing plate had obstructions so no plate was designed for it, however the process is the same.





The northwest facing plate gets the sun also, so we may use the southeast plate's figures albeit mirrored.

VERTICAL GREAT DECLINER

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Assumed longitude and legal time meridian

This shifts hours lines appropriately

Your longitude:	108.20
Legal meridian:	105
Minutes applied	12

***** NW/SE and NE/SW not symmetrical is long corr**

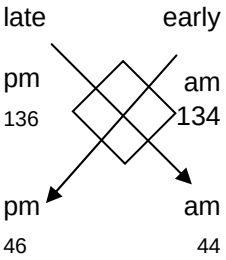
Legal → LAT

Assumed latitude

32.75

ENTER A WALL DECLINATION

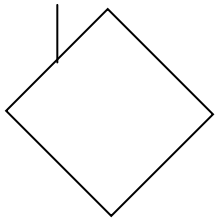
46 SxxW is positive
SxxE is negative

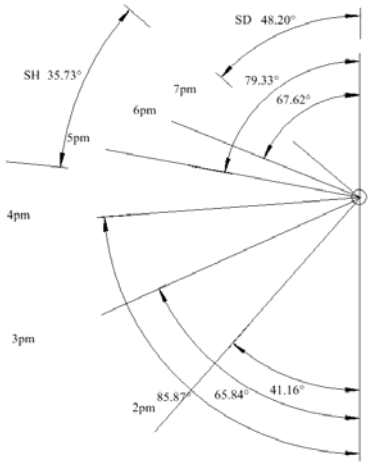


Hour line angles from vertical.

TIME hh.mm	TIME hh.mm	DEC SxxW 46
12.00	11.80	-3.5
12.50	12.30	5.7
13.00	12.80	16.3
13.50	13.30	28.1
14.00	13.80	40.8
14.50	14.30	53.5
15.00	14.80	65.6
15.50	15.30	76.4
16.00	15.80	85.8
16.50	16.30	-86.1
17.00	16.80	-79.0
17.50	17.30	-72.8
18.00	17.80	-67.2
STYLE:SD	**48.2**	**SD**
STYLE:SH	**35.7**	**SH**

The hour line angle sign's change. What this means is that the passed through the horizontal. A depiction of the dial plate is shown to the right, and it may be tested, made, then installed on the northwest face.





The first dial plate constructed was the North east facing plate. This used an iridescent white glass that throws a good shadow.

The dial plate was cut, each piece of glass foiled with 7/32 inch foil, tacked, and the back then soldered, and again the front. The gnomon was cut and applied, and roman numerals added.

Copper foil can alter the relative distances on the dial plate, especially when soldered. So the final glass plate was attached to a board along with the original model. The two being secured, they were rotated at various angles to the sun, here they show about 9:30 am. All the hour lines matched the model providing assurance that so far the final dial plate is correct.

That plate was affixed to the appropriate place on the cube on top of the column, this used a mastic, and along the top an epoxy. Mastic is not a prefect adhesive for glass but possible slightly better and thin set mortar.

Either way, the final cube will have a surround of grout or stucco which enhances adhesion by reducing water draining behind the dial plate.

The equinox line, at this declination, looks somewhat out of place especially since there are no solstice curves.

And the objective is that passers by be able to read the time with a minimum of confusion.

This particular face will only be seen by persons standing at the front door, thus confusion would be minimized. However the balance of the faces may not have an equinox line. That decision will wait for the next of the four dial plates to be constructed.

The final dial is shown to the left, looking from the front door south west, seeing the north east facing plate.