RECLINING DECLINING DIALS THAT FACE ANY WHICH WAY

These were once common as a demonstration of skill many years ago. Some diallists suggest an empirical approach by locating the horizontal line, align a horizontal plate along it, establish the gnomon, drop the gnomon's points to the inclined declined surface below, build that gnomon, and mark the hours as the sun shines. Others offer a geometric or trigonometric technique. One author suggests this is a problem for the diallist entirely of their own making and easily avoided. Rather than repeat by rote such alternatives, the suggestion here is to use CAD by applying equatorial dial radials to the surface.

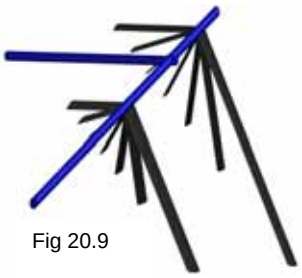


Fig 20.9

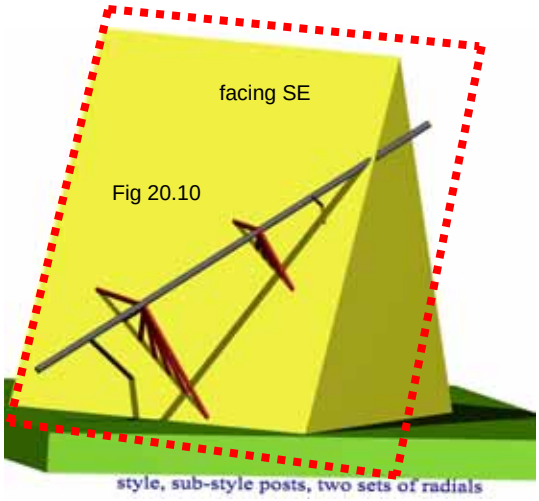


Fig 20.10

We could use the same method as used in chapter 18 with the wine glass which used the 3d intersect tool, however, for flexibility, we shall use the 3d subtract tool instead.

Figure 20.9 above has a style set at latitude oriented to the pole, and two sets of radials. There are 7 radials, covering noon to 6, each being 15 degrees apart and perpendicular to the style. In CAD this is done by making one radial and then radial copying it. The two radial sets and the style are combined with 3d-add. Two sets of radials are needed in order to draft hour lines. This dial is sloped 25° off vertical, declining exactly 45°.

Then build the slope, here a 65° recliner that declines 45°, i.e. South 45° East. This is shown in figure 20.10. Then additional radials perpendicular from the dial plate to the style, that will establish the style distance and height angles in a later step. This is done by setting the work plane to the sloped surface, also visible in figure 20.10, drawing two cylinders and bringing them up to the style. They are not 3d-added to the style because when the 3d subtract happens it would complicate drafting the hour lines in a subsequent step.

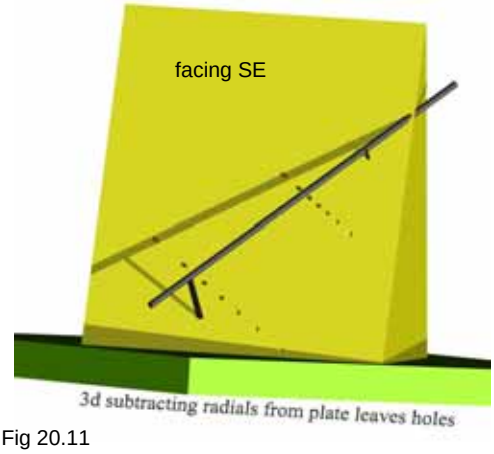


Fig 20.11

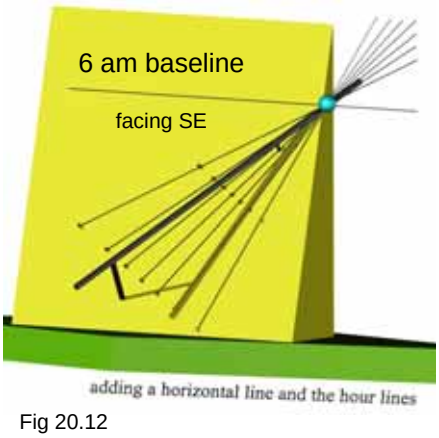


Fig 20.12

The next step is to use the 3d subtract tool to subtract the hour lines from the dial plate. Figure 20.11 shows the dial plate and the holes.

Then, with the work plane on the slope of the dial plate, draw a horizontal line and then lines from each pair of pair of holes made by the equatorial radials, as shown in figure 20.12.

Having drafted the hour lines, they can then be measured with the angular dimension tool. The accuracy of this system depends on the accuracy of the draft hour lines, which in turn depend on the accuracy of the equatorial radials. Figure 20.13 shows the resulting hour lines, they are using 6 am as the base line.

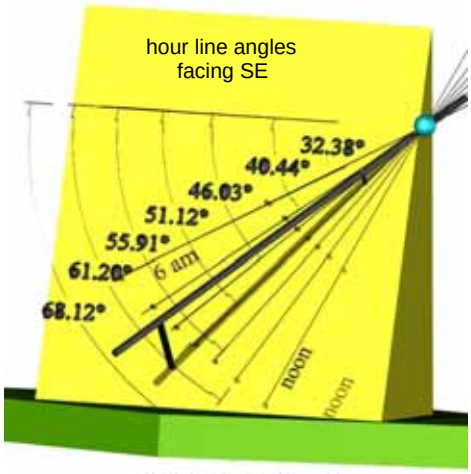
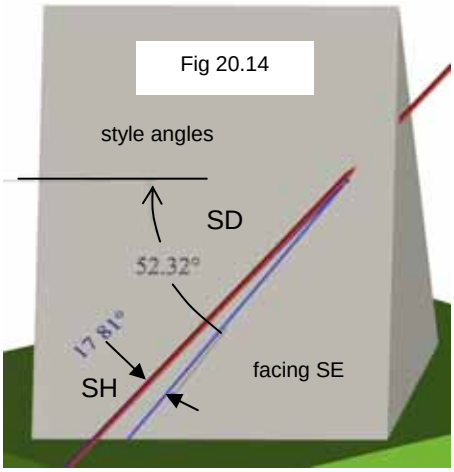


Fig 20.13

The hour line angles were compared with calculated angles, and were within about a degree.

The style distance can be measured at the same time as the hour line angles, however the style height requires the work plane to be correctly set up, since angles are measured based on the work plane. Work planes are one of the key secrets to effective CAD usage.

Figure 20.14 shows the angles for the gnomon. This establishes the south east face. The southwest face is a mirror image as this dial is declining 45 degrees, mid way between 0 and 90.



The SD and SH values were compared with calculated values and were within a degree.

The northwest face is a mirror of the northeast face similarly, however because this particular dial inclines, the north east and west faces differ from their southern counterparts. One of the northerly faces must be designed in addition to those southerly faces.

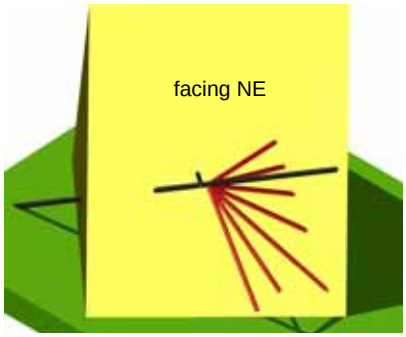


Fig 20.15

Figure 20.15 has a style and equatorial radials and the dial face is now facing northeast. In figure 20.16 the 3d subtract method has again been employed, however there is a difference. Only one set of radials was used, and only one post to hold the style up from the sub-style.

The reference for style height is simply the dial plate itself. The reference for style distance and the hour lines is a horizontal line from where the style itself intersects the dial plate. The hour line angles were measured with the angular dimension tool, see figure 20.16. Then in figure 20.17 the style height and style distance were measured also.

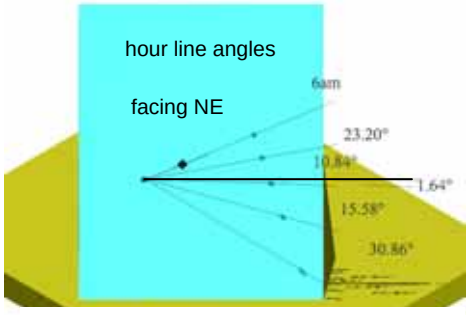
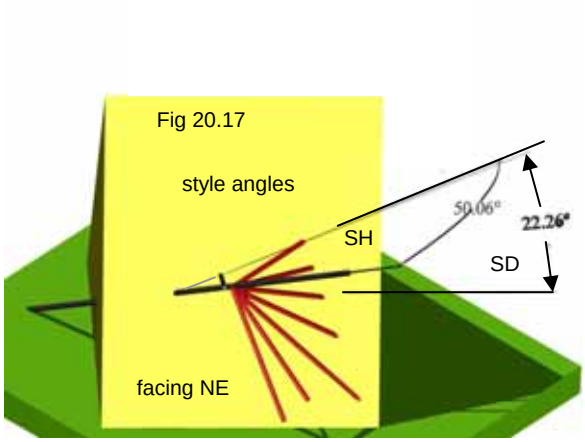


Fig 20.16

The hour line angles and style distance and height were within a degree of calculated values. It is critical that the style be accurately placed, failure here will cause variances of several degrees. As always, these final values should be verified with a model.



A completed dial is pictured below, and it truly is a problem of the diallists own making and easily avoided!

SOME RULES OF THUMB

Some useful rules of thumb are that in the northern hemisphere, north facing dials indicate clockwise, south facing dials indicate counter-clockwise.

This section and chapter 18 were intended to encourage the use of CAD in the field of gnomonics rather than to be a definitive treatise,

The completed dial, showing 7 am on the southeast and north east faces.

Thus, the north faces have been designed, they mirror each other because of the declination being 45 degrees.

The set of four faces may then be applied to a base, this would be one with 65° slopes.

A spreadsheet was used to compare the CAD derived values with those produced by other means, such as by calculation or by using software designed for sundial design. The only purpose of this spreadsheet was to show the accuracy obtainable.

SOUTH EAST FACE

	math	CAD	DIFF
12	67.1	68.1	-1.0
11	60.1	61.2	-1.1
10	55.4	55.9	-0.5
9	49.8	51.1	-1.3
8	45.9	46.0	-0.1
7	40.3	40.4	-0.1
6	32.8	32.4	0.4
		fig 20.13	
SD	51.43	52.3	-0.9
SH	17.7	17.8	-0.1
		fig 20.14	

NORTH EAST FACE

	math	CAD	DIFF
6	22.6	23.2	-0.6
7	11	10.8	0.2
8	1.2	1.6	-0.4
9	14.7	15.6	-0.9
10	30.2	30.4	-0.2
		fig 20.16	
SD	22.34	22.7	-0.3
SH	50.1	50.1	0.1
		fig 20.17	