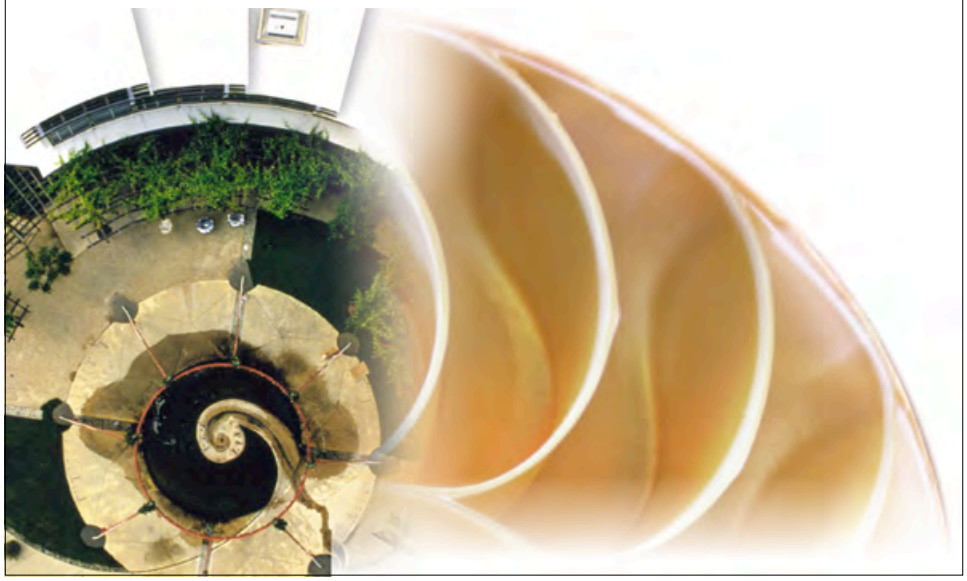
Analysis and Design Tools

ARCH 331/431 Spring 2008
Lecture 10



announcements 5/1/08

Information Meeting:

INDIA program winter 2009

Friday May 2, 12:30, Gould 208P

Assignment 4:

Shading Model Studies

Available Friday, 5pm; due in 2 weeks (week 7)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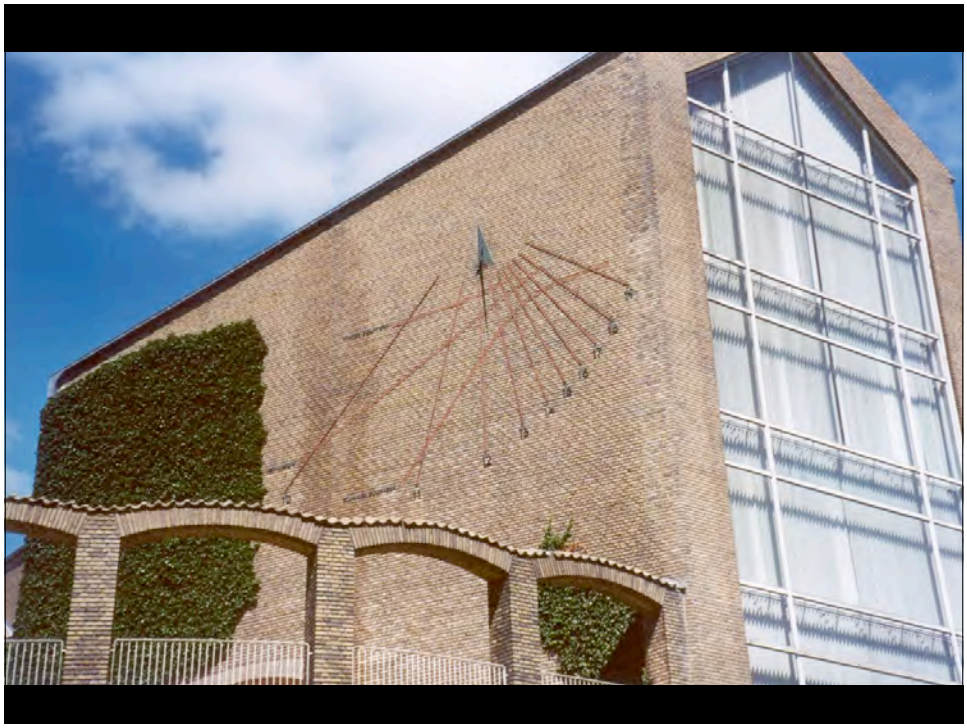
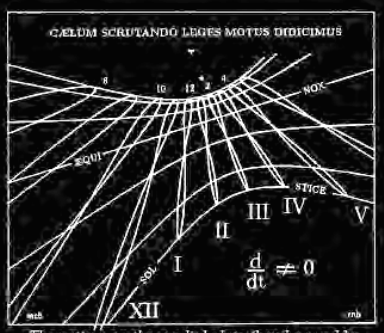
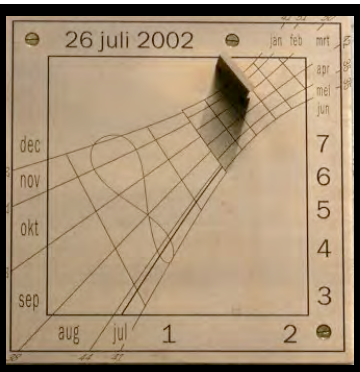
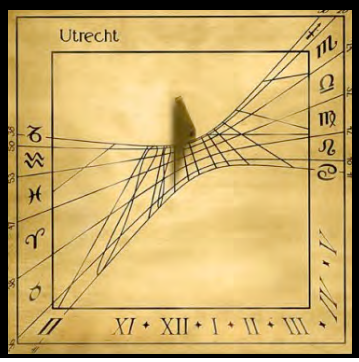


Contemporary vertical dials

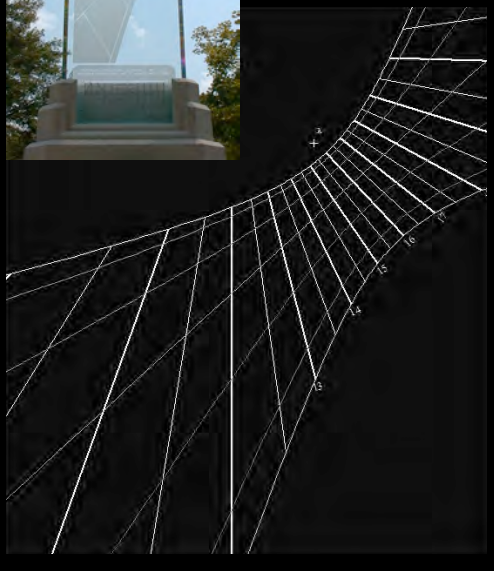


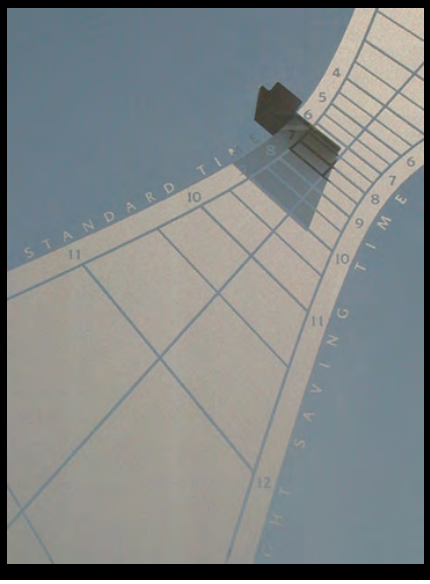
The pattern on the sundial plate (hand carved by Mark Bracewell). The small circle shows the position of the oculus, the small cross shows where a line through the center of the oculus parallel to the Earth's axis intersects the plate.





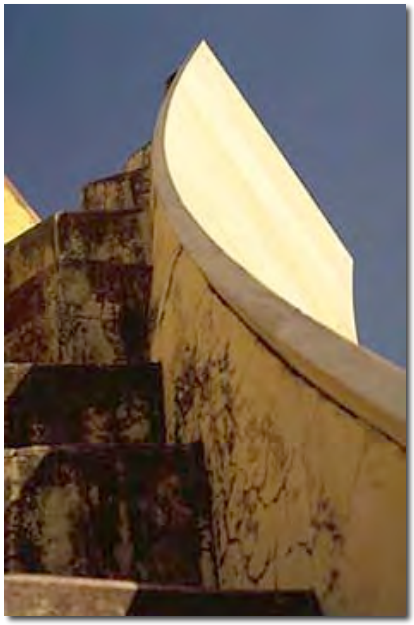
A contemporary vertical sundial in glass

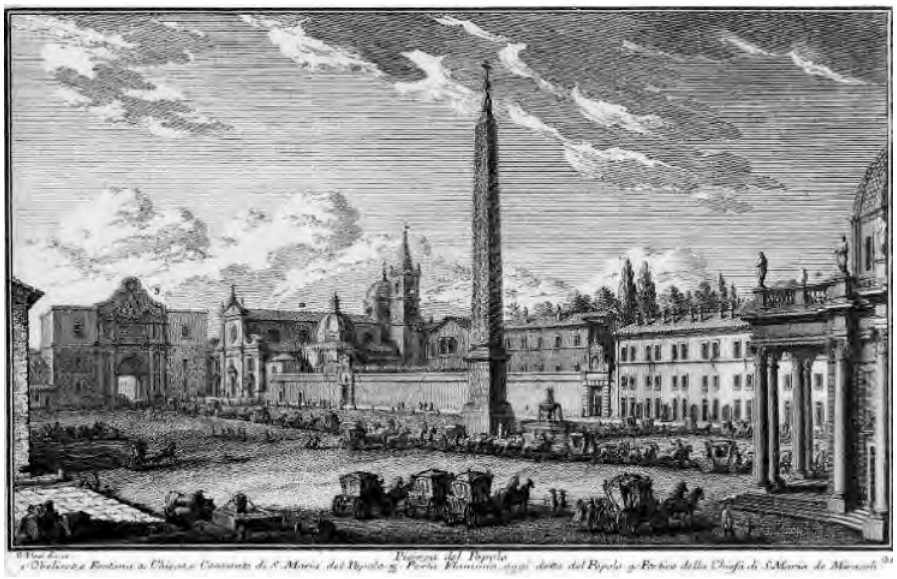




The Jantar-Mantar of Delhi

These are extraordinary structures – basically buildings and spaces as instruments of observation.





Another type of horizontal sundial uses a vertical gnomon – often called Flagpole Plots

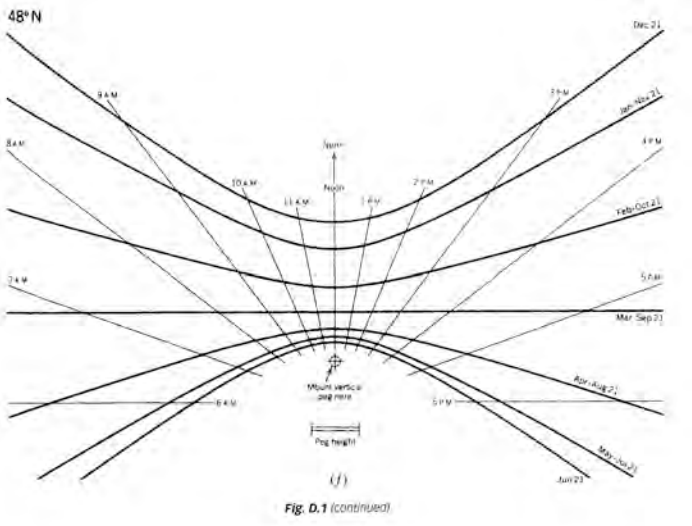
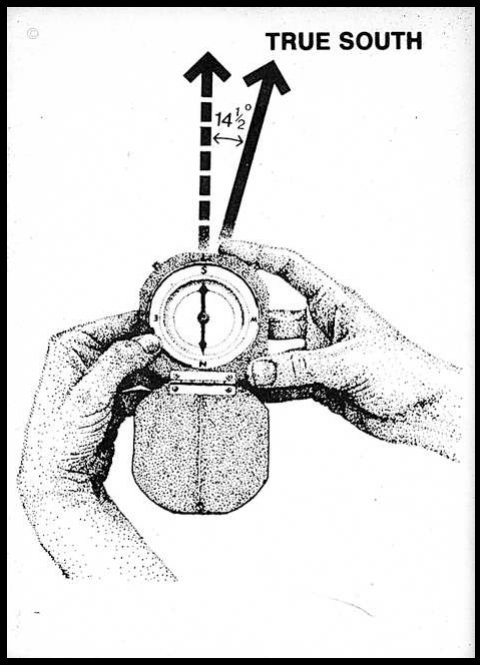


Fig. D.1 (continued)

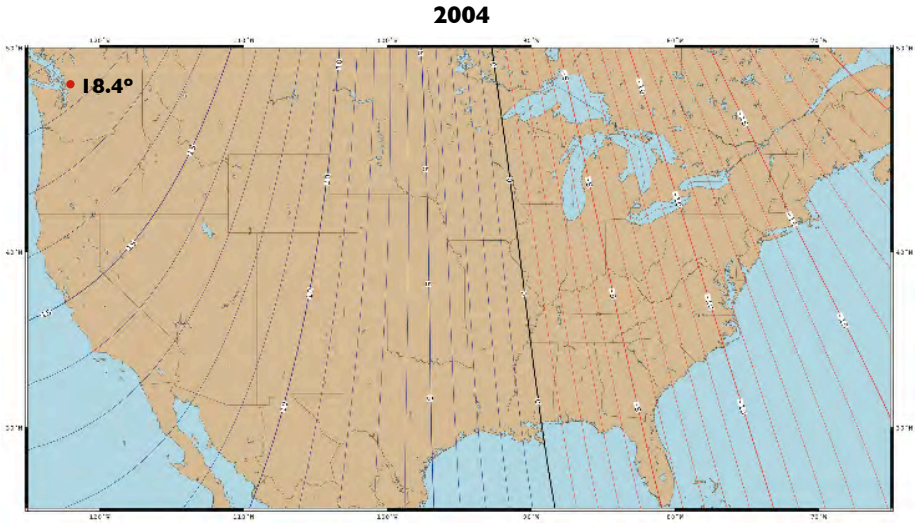
Sunpeg sundials can be found on pgs. 323-326 in *Sun, Wind, & Light.*

Sundial & Model Orientation

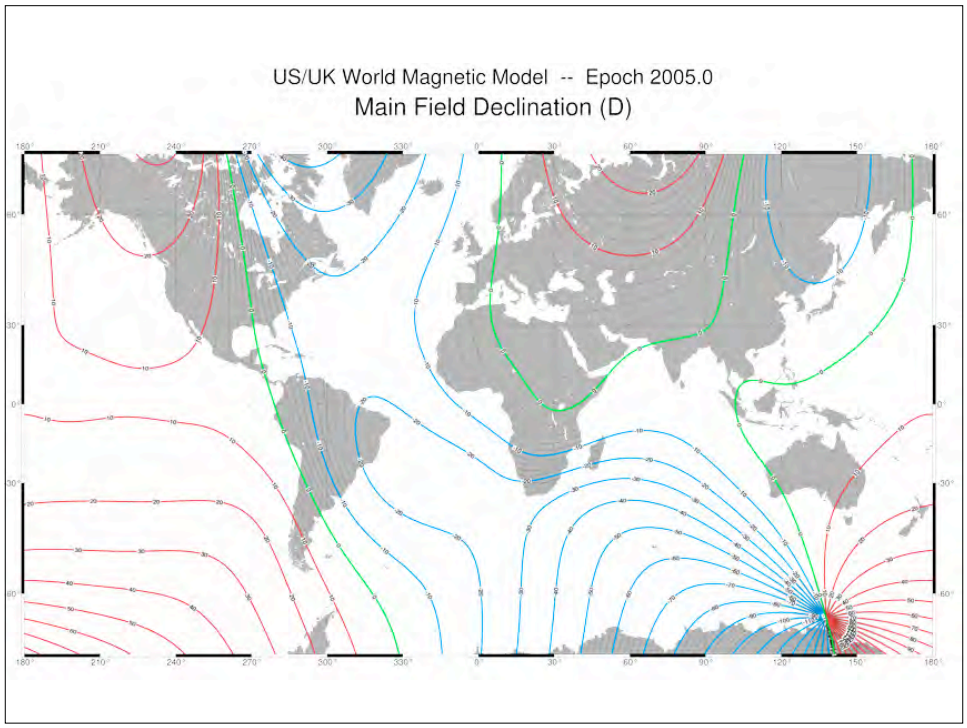


Magnetic Declination

(Magnetic Variation)



www.ngdc.noaa.gov/seg/geomag/declination.shtml



Clock time vs. solar time

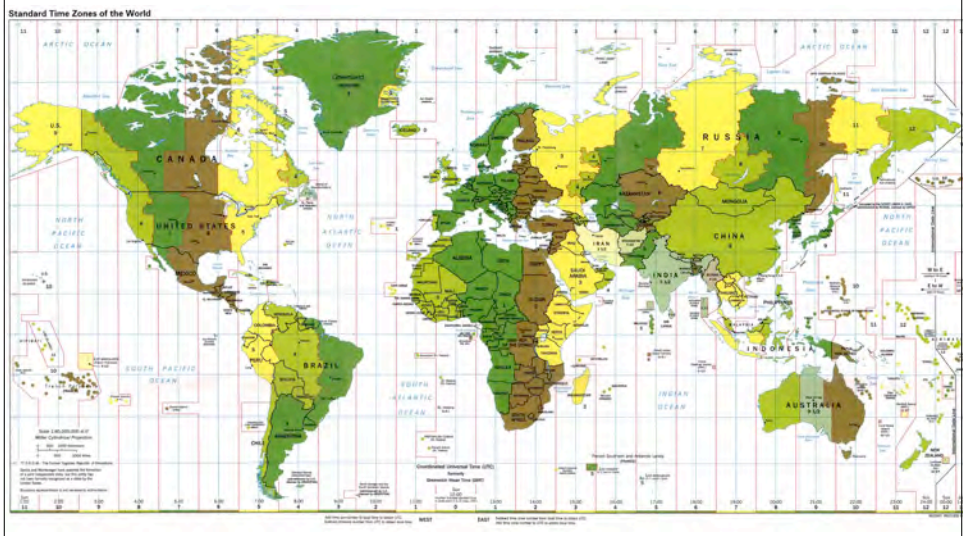
Solar time is unique for each location according to longitude and time of year, It is relatively straightforward to relate solar time to local standard time.

1. Standard Time vs. Daylight Savings Time
2. Longitude: distance from the standard meridian within a time zone (120°, 105°, 90°, 75°)
3. Equation of Time

2. Longitude: distance from the standard meridian within a time zone
(120º, 105º, 90º, 75º)

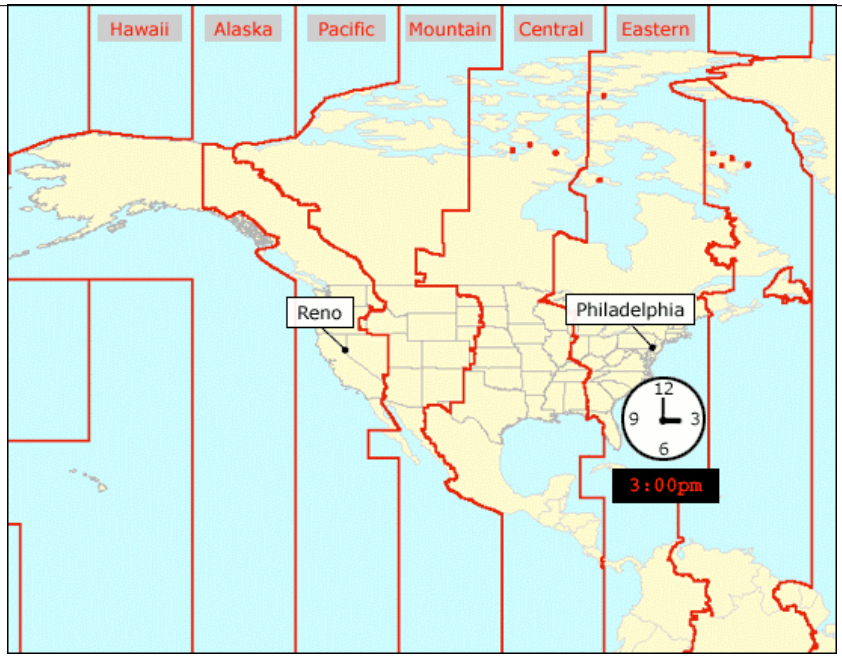
- Time zones = 1 hour segments

- 360° / 24 hours = 15 °/hour or
1 degree every 4 minutes



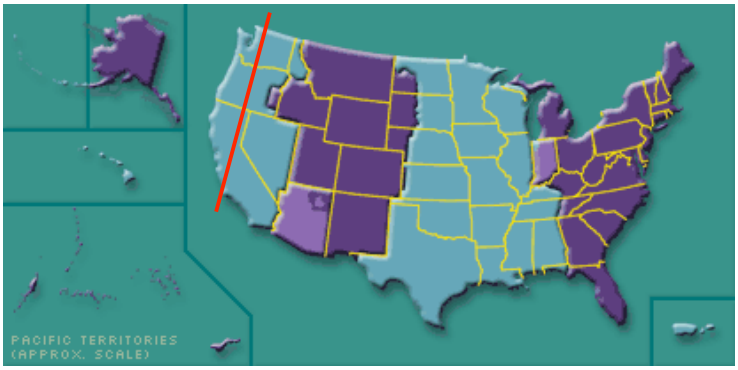
Time zones

Standard meridians run at roughly 15° intervals



Standard meridians run at roughly 15° intervals

Is the sun always at its highest altitude at clock noon?



Hint: The standard meridian is 120° for Pacific Standard Time.

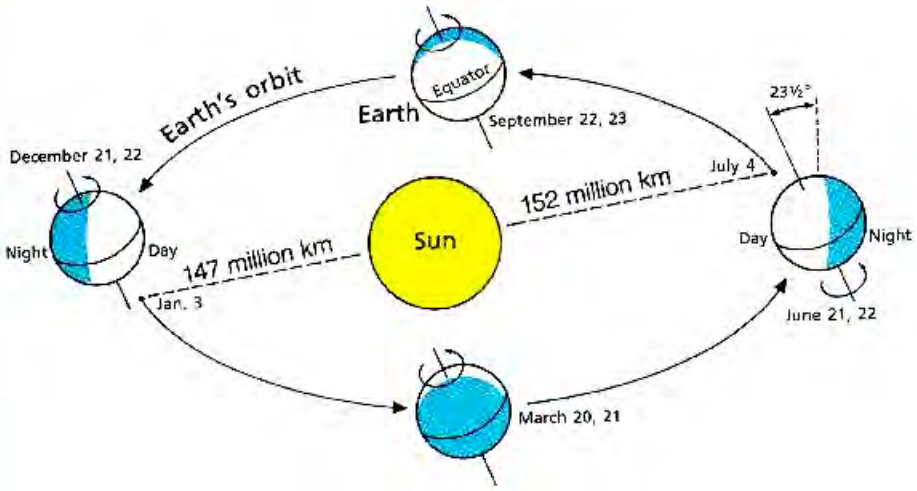
Pacific Standard Time datum (Standard Meridian):	120.00°
Seattle's Longitude:	122.33°
Our distance from the Standard Meridian:	2.33°

*The earth rotates **360° every 24 hours***
*360°/24 = 15°; the earth rotates **15° every 1 hour***
*60 minutes/15° results in **1°every 4 minutes***

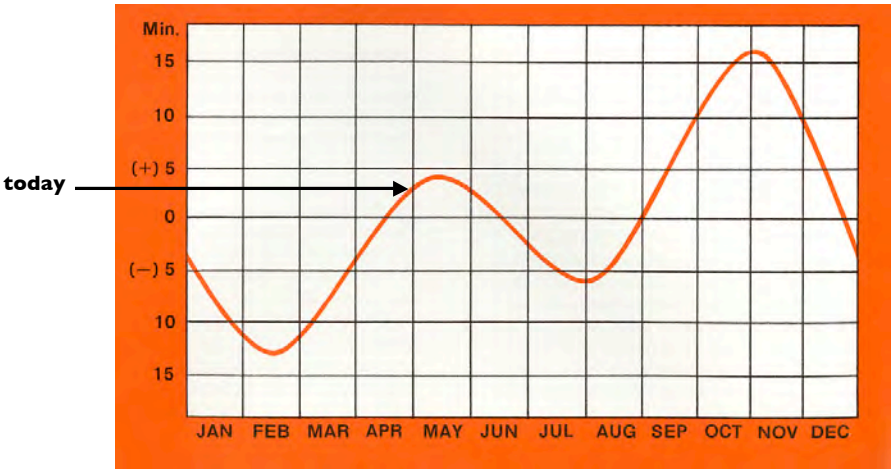
2.33° x 4 minutes = **9.33 minutes** (9 minutes 20 seconds)

The sun will reach "solar noon", the highest solar altitude for the day, at about 12:09 in Seattle (when it is noon, clock time, it is 11:51 solar time)

Equation of Time



Equation of Time



Converting Solar Time

Local solar time (**LSoT**) is the local clock time adjusted for these factors:

Step 1. Determine the local standard time, LST. This is clock time, adjusted for daylight savings time if necessary. If daylight savings is in effect, subtract one hour.

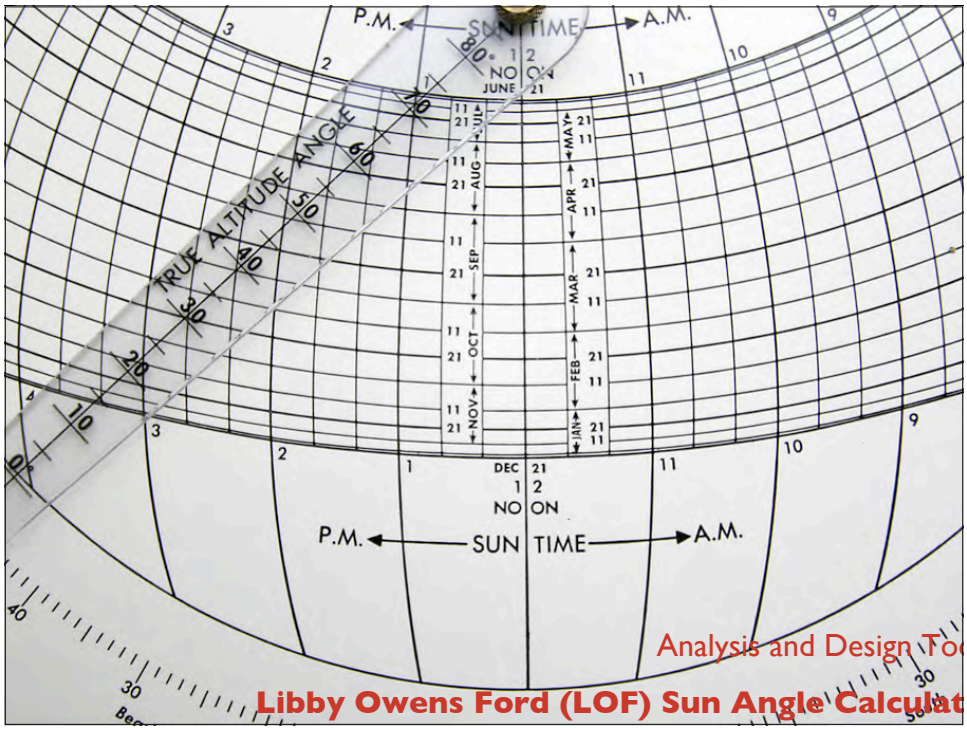
Step 2. Determine the local standard meridian (LSTM) and the local longitude (LL).

Step 3. Determine the equation of time, EoT , adjustment in minutes.

LSoT = LST + (4 minutes * (LSTM - LL)) + EoT
= 12:00 + (4 minutes * (120 - 122.33)) + (+4)
= 11:54

A4

Shading Model Studies



Analysis and Design To

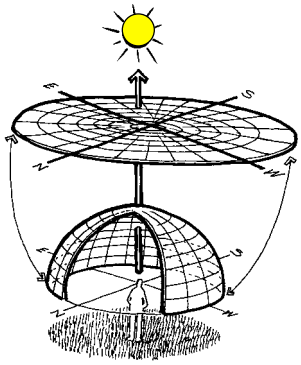
Libby Owens Ford (LOF) Sun Angle Calculat

Libbey-Owens Ford (LOF) Sun Angle Calculator

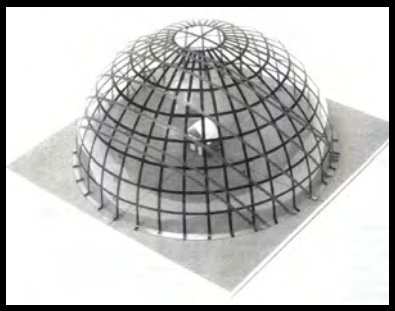
trusted by architects for generations

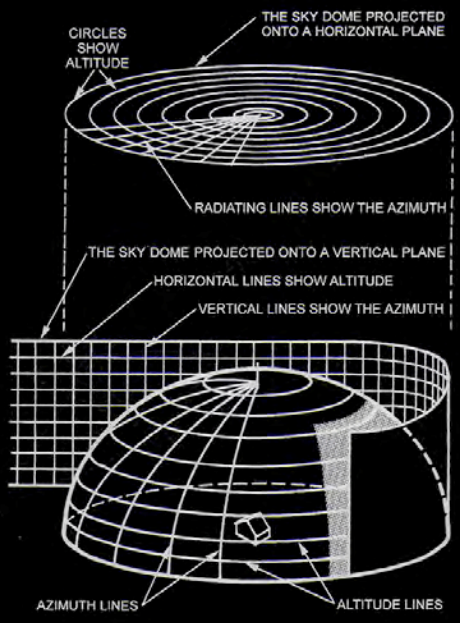
Visualizing Sun Paths:

Polar Plot of the Sun's Path



All Sun Path Diagrams represent the hemisphere of sky directly above and relative to the ground plane. Coordinates are altitude and azimuth.





A polar Sun Path Diagram

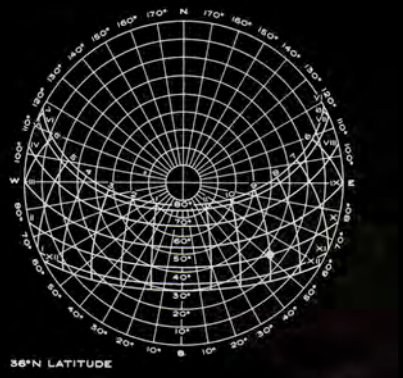
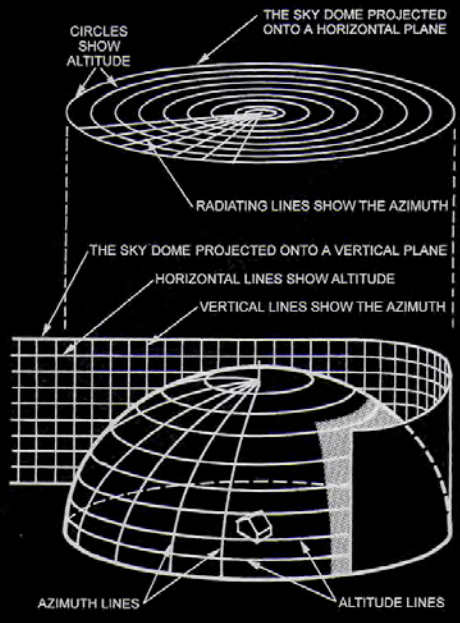


Figure 6.11c Horizontal sun path diagram. A complete set of these diagrams is found in Appendix A. (From *Architectural Graphic Standards*: Ramsey/Sleeper 8th ed. John R. Hoke, ed. copyright John Wiley, 1988.



Construction of Sun Path Diagrams:

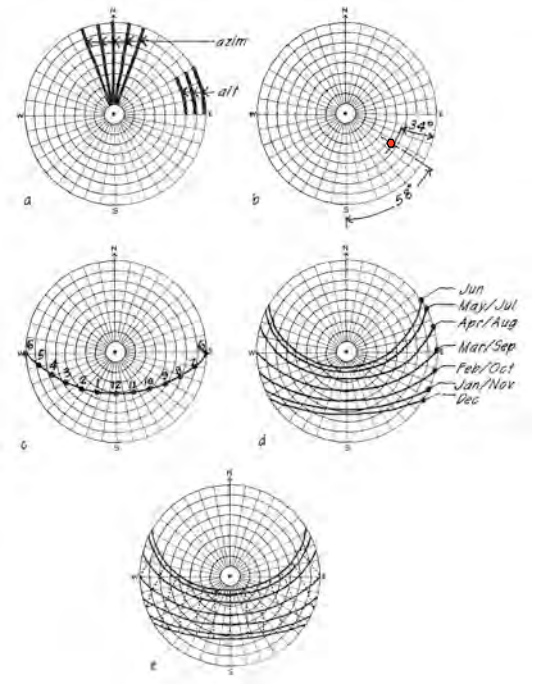
a. Altitude and Azimuth

b. 9 am March 21

c. Additional times on March 21

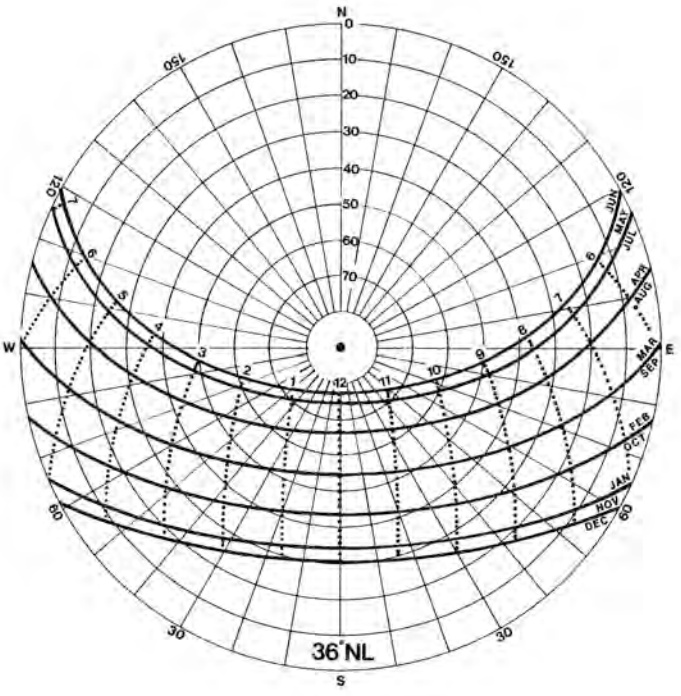
d. Plotting the sun for the 21st day of each month

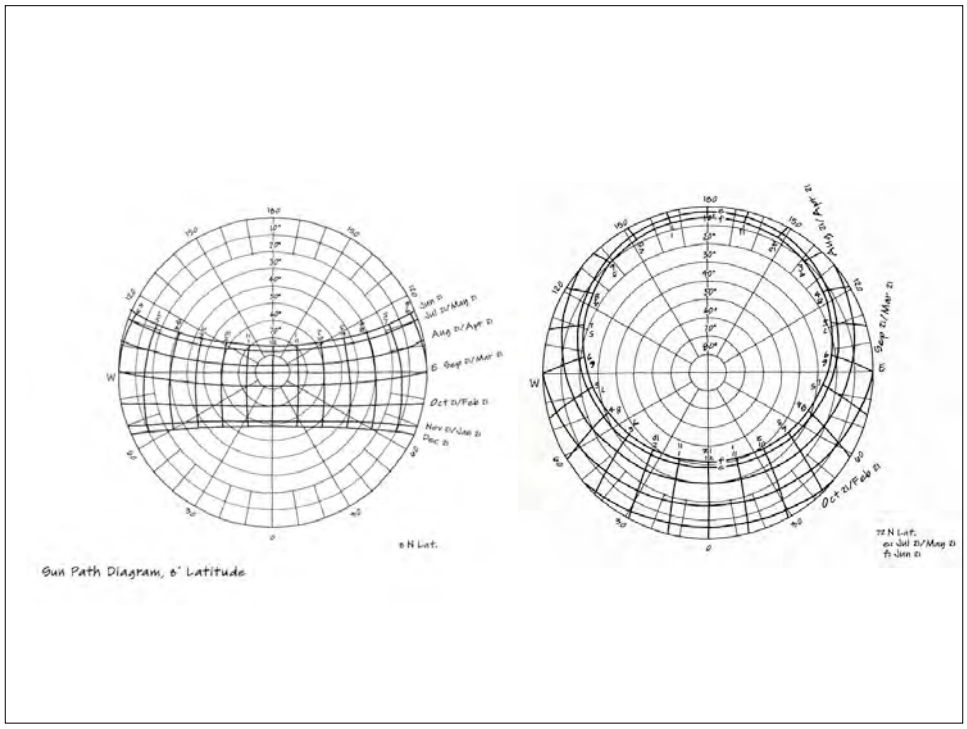
e. Hour lines (dotted) are added

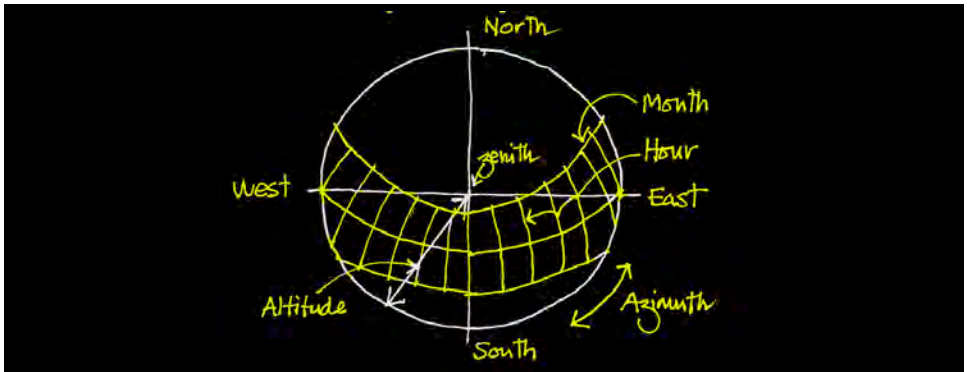


Sun, Wind & Light
pgs. 297 - 300

MEEB 10th Appendix D.3
pgs. 1539-1542







Sun path diagrams combine coordinates of **time and position** and allow analysis of:

1 Sun Position at any time of day and year
2 Site Shading (fisheye imagery)
3 Window Shading Devices

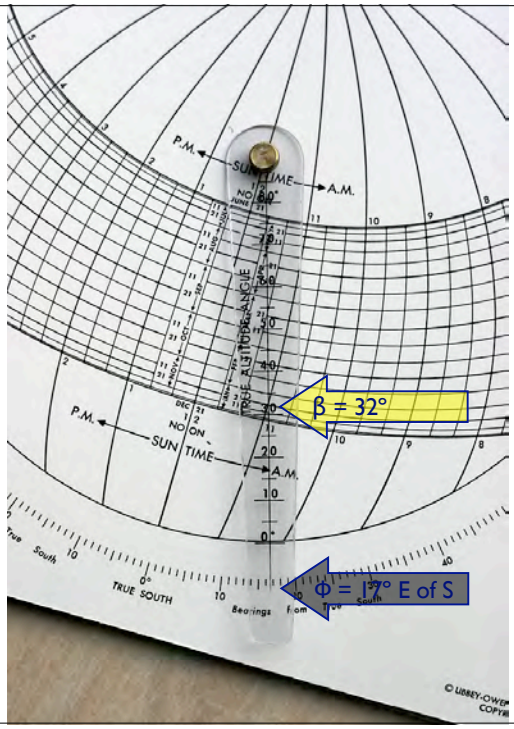
A LOF Sun Angle Calculator example:

Find the sun's position on **Jan. 21st** at **11 AM**

36° N. Latitude:

Altitude = **32°**

Azimuth = **17°**



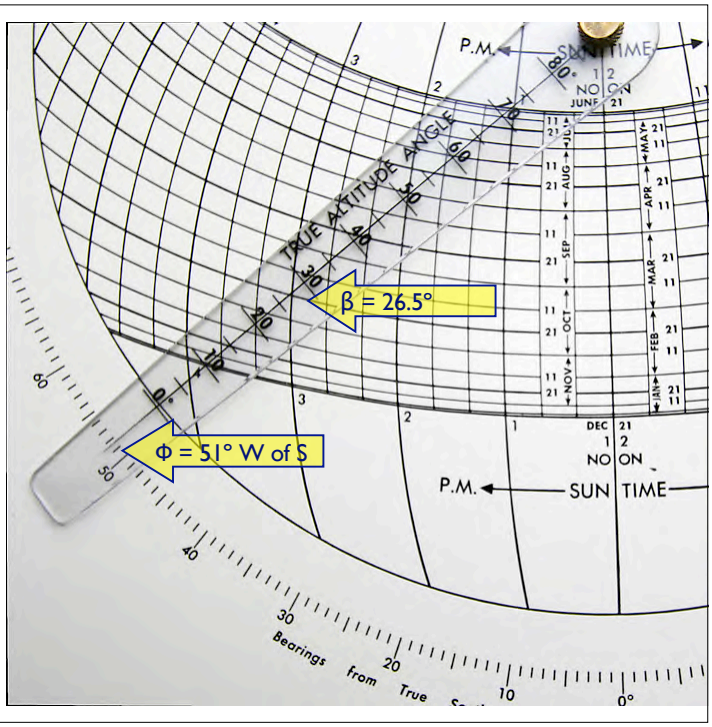
A LOF Sun Angle Calculator example:

Find the sun's position on **Oct. 21st** at **3 PM**

36° N. Latitude:

Altitude = **26.5°**

Azimuth = **51°**



A rectilinear Sun Path Diagram

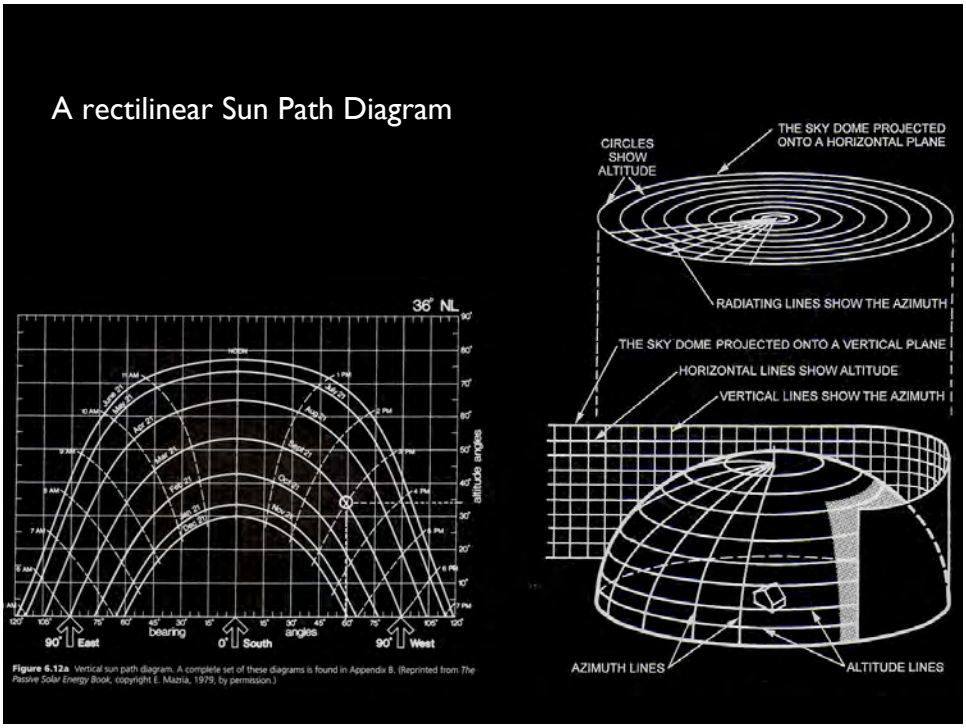
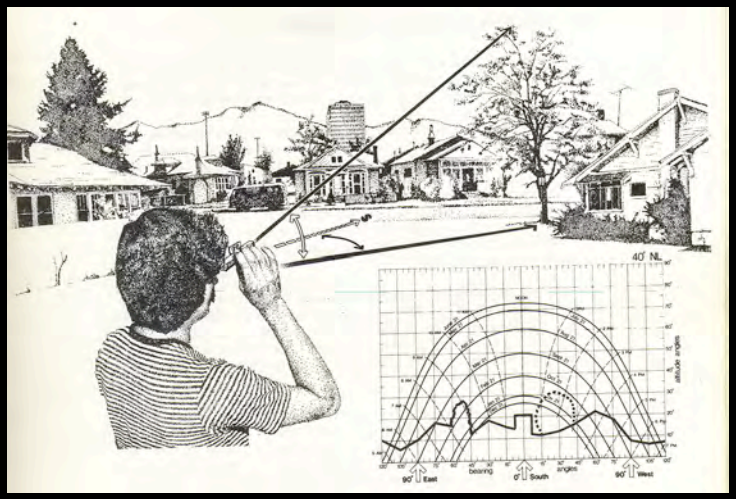


Figure 6.12a Vertical sun path diagram. A complete set of these diagrams is found in Appendix B. (Reprinted from *The Passive Solar Energy Book*, copyright E. Mazria, 1979, by permission.)



Site Shading Masks

Plotting a picture of the sun's path, and the landforms, buildings, trees and objects that block the sun.