Building Science Series

Sunpath Introduction

Prepared & Presented by Devang

Agenda

1. Importance of Building Science
2. How the Earth rotates around the Sun
3. How to read a Sunpath
4. Basic shading design
5. Current practice and other potential uses of Sunpath

http://telugnet.na1381756400.netdna-cdn.com/wp-content/uploads/2014/10/prabhas-baahubali-birthday-photos.jpg

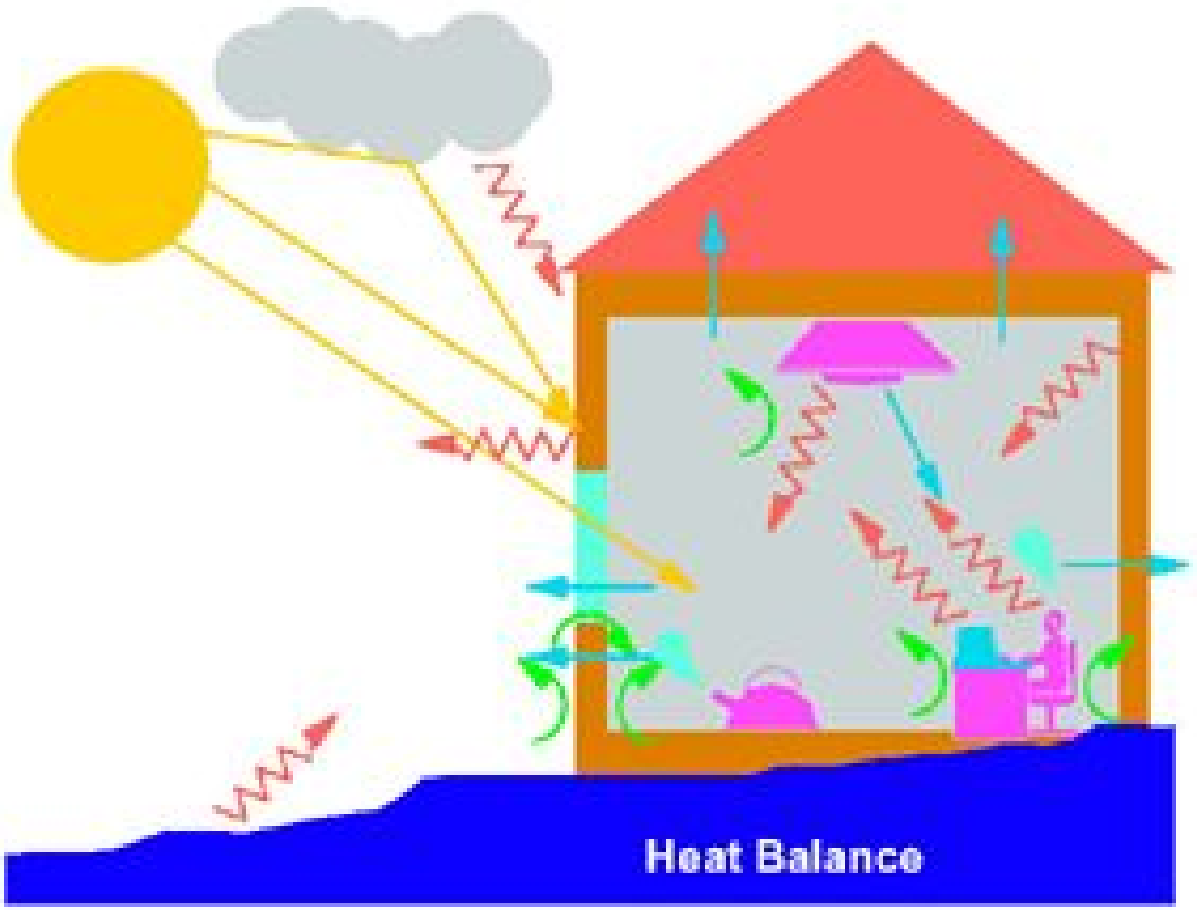
Why to be aware about the basic principles of **Building science**?

Traditional Practice

https://s-media-cache-ak0.pinimg.com/originals/a5/de/85/a5de85615b530ef43e50f72fdb17083b.gif

https://s-media-cache-ak0.pinimg.com/736x/4b/e2/9f/4be29f243f975486c73002c8f578aedc.jpg

Maximum Influence

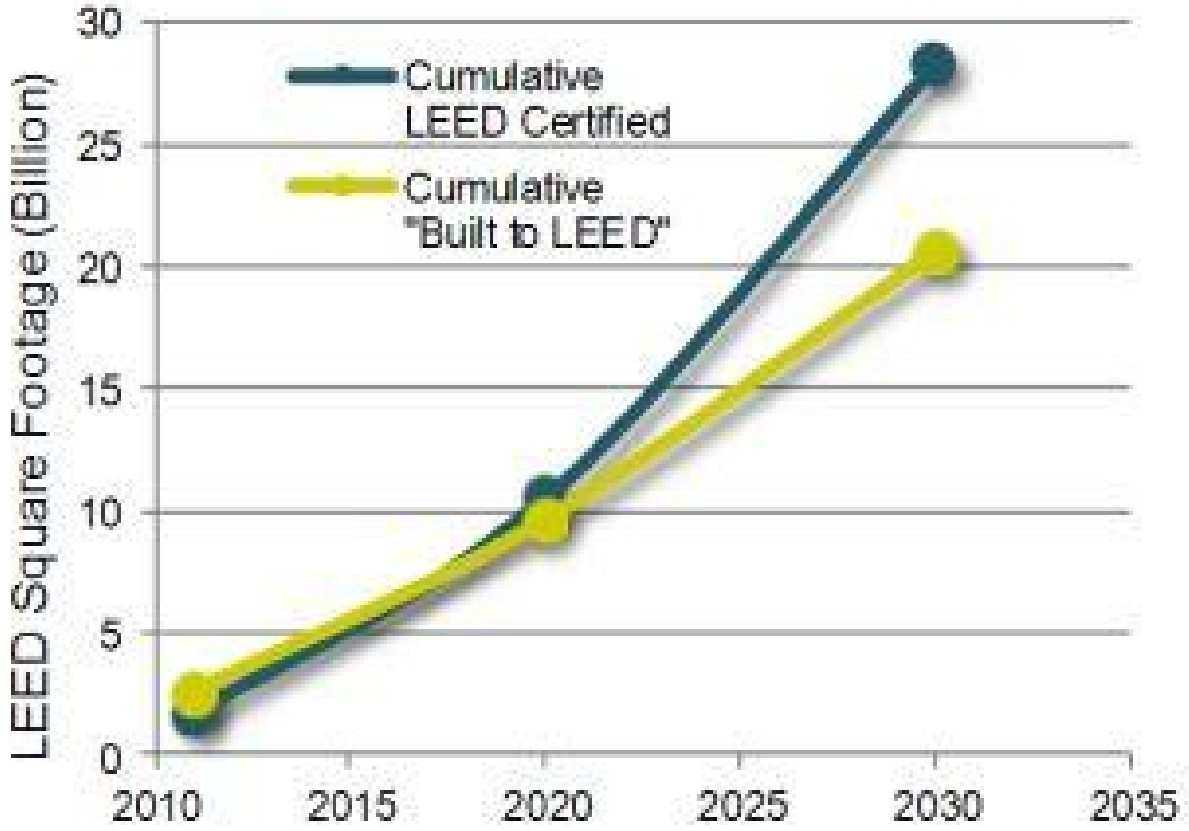


https://www.new-learn.info/packages/clear/thermal/buildings/building_fabric/heat_transfer/images/heatbalance.png

Better Occupant Satisfaction

http://www.gizmodo.jp/upload_files2/140311_applehq.jpg

Better Sale / Lease value



http://www3.cec.org/islandora-gb/islandora/object/islandora:1111/datastream/OBJ-EN/view

Greenwashing

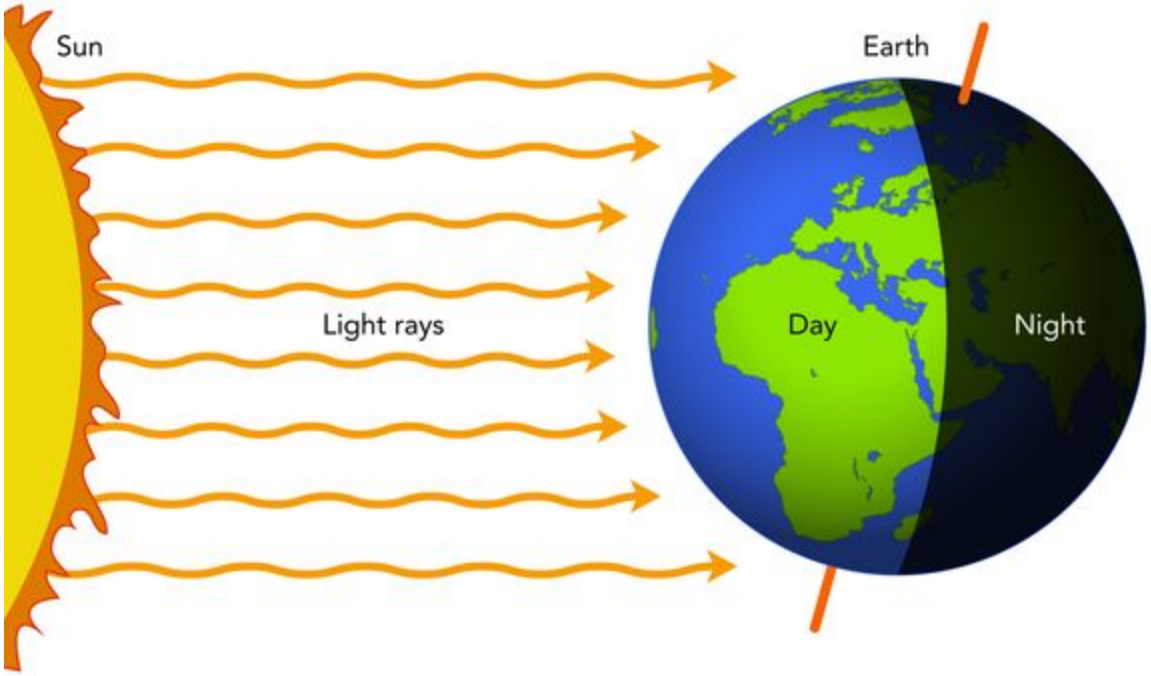
https://oneplanetsustainability.files.wordpress.com/2013/11/rio20-green-washing-capitalism.jpg

http://www.cbnme.com/wp-content/uploads/2015/10/img046.jpg

Green Building Consultants

https://sc01.alicdn.com/kf/HTB1cZMxKFXXXXX_XXXXq6xXFXXXm/Green-Building-Consultants-Indonesia.jpg_350x350.jpg

How the Earth moves around the Sun?



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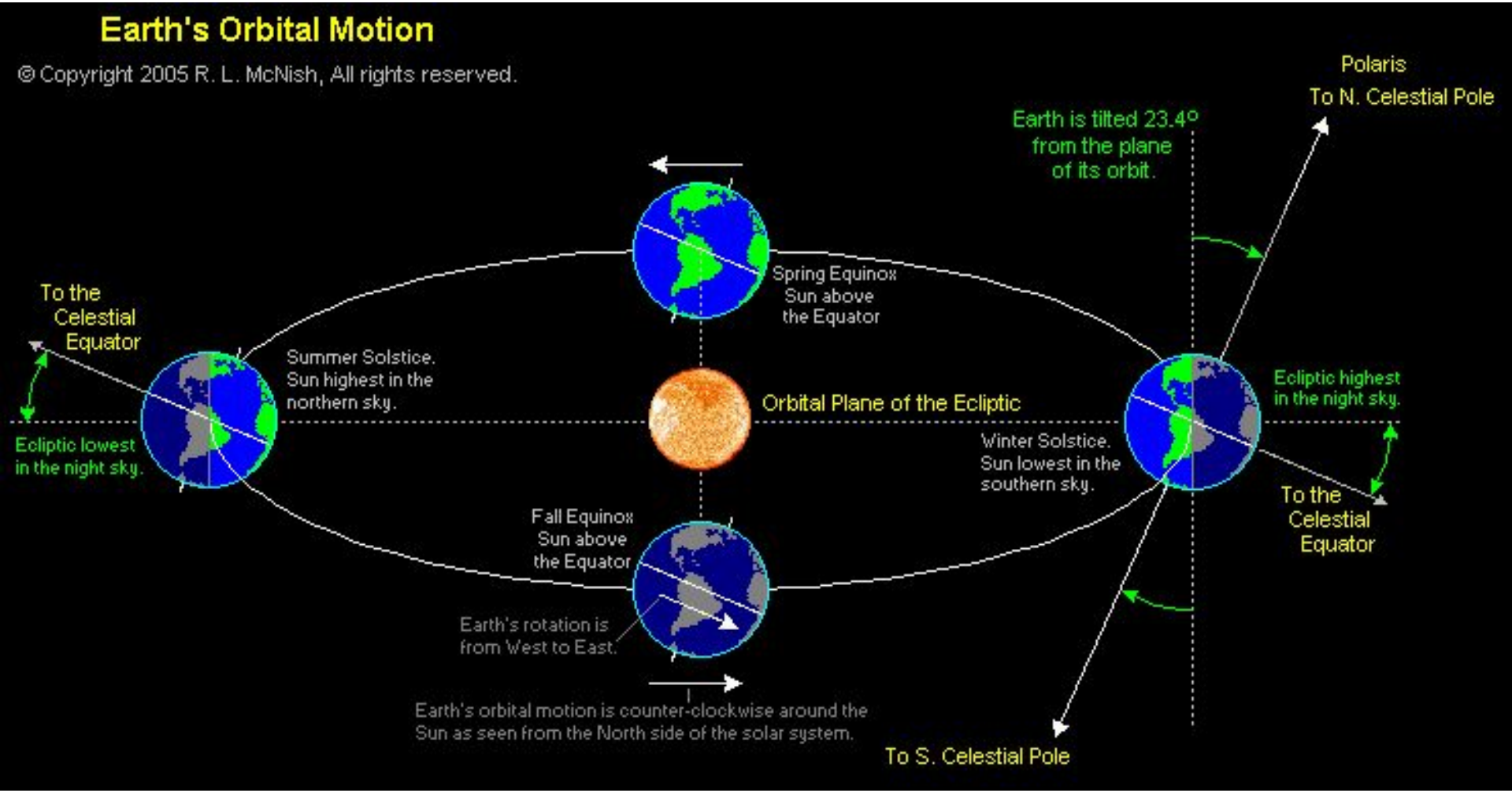
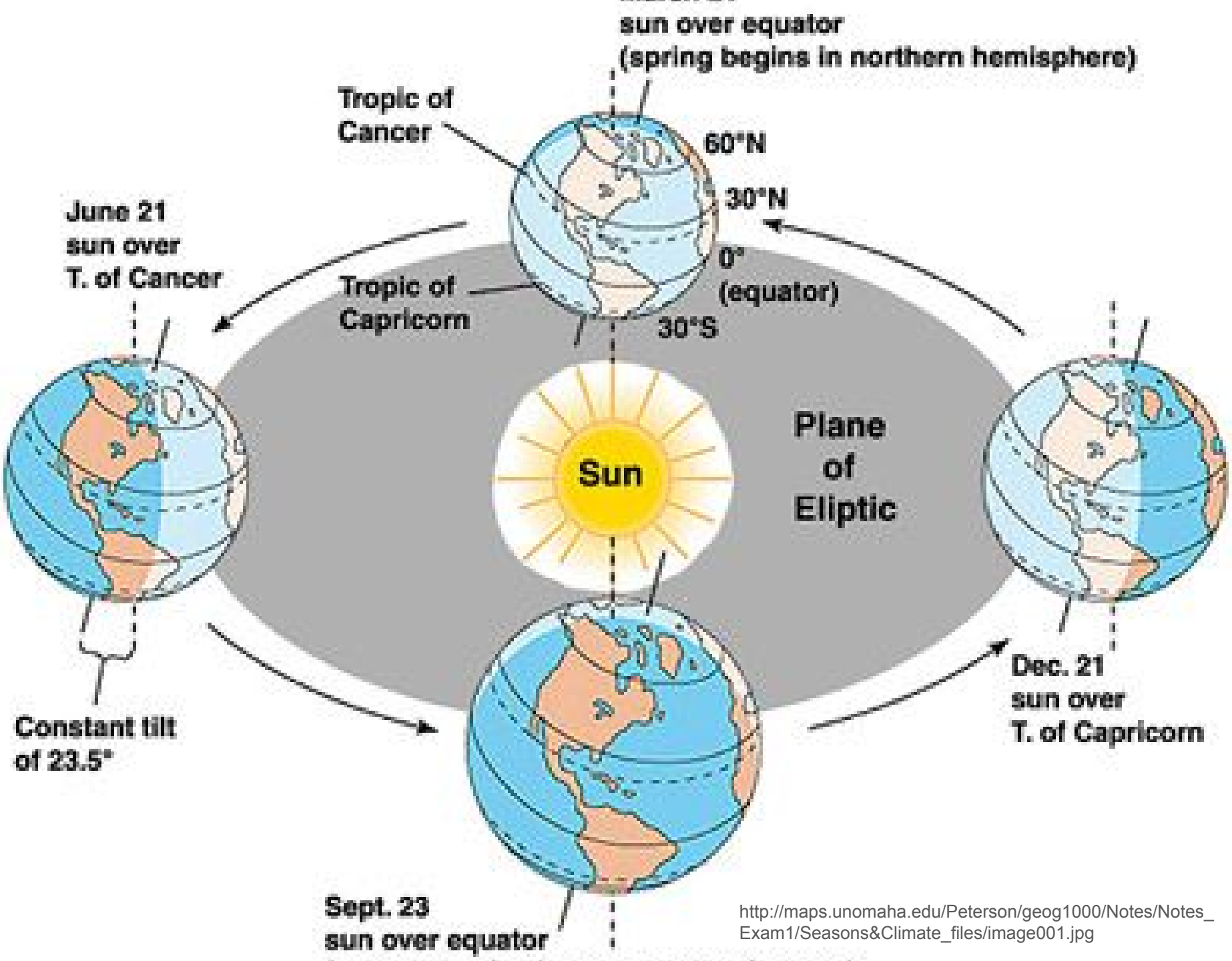


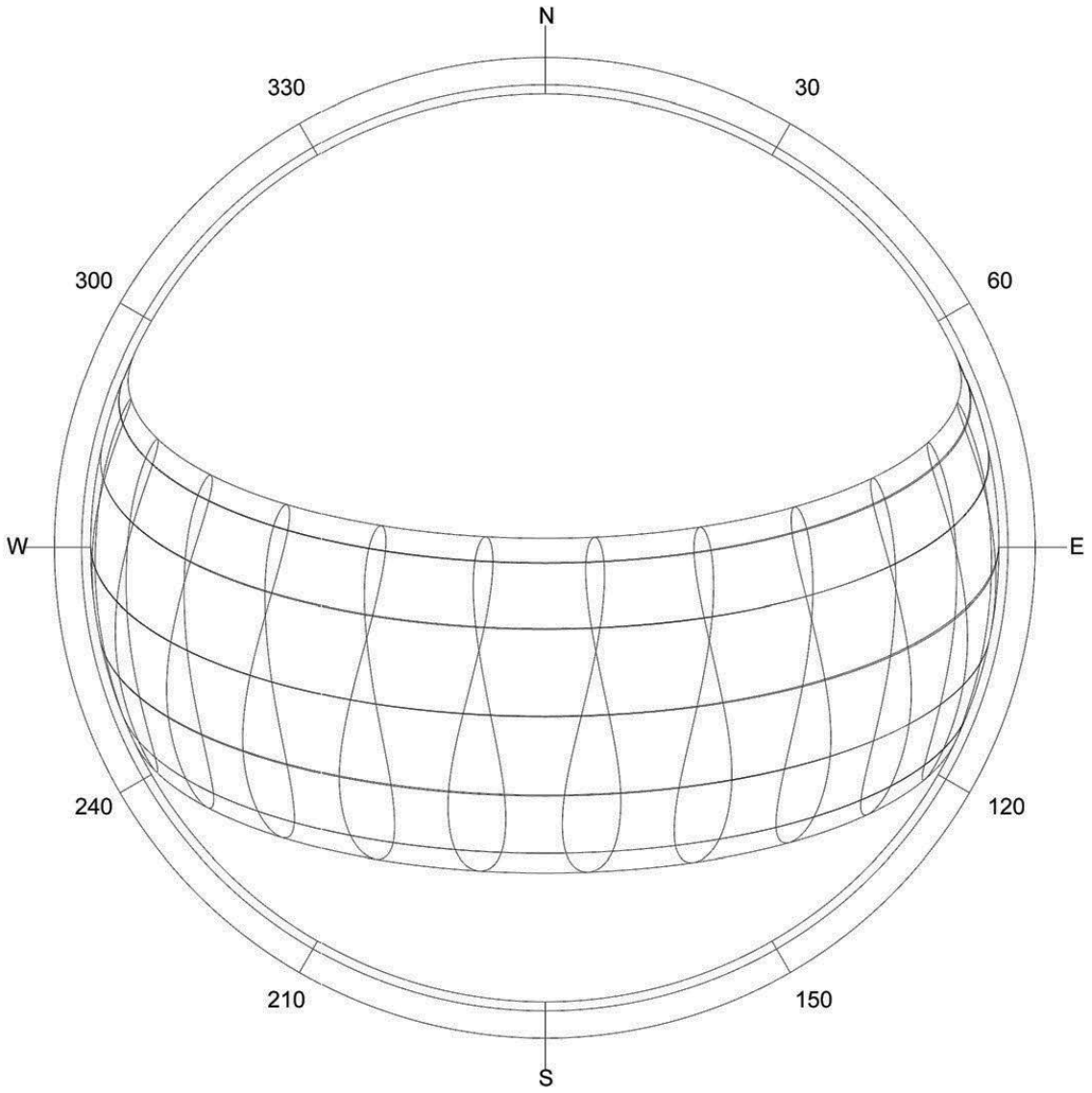
http://calgary.rasc.ca/images/radec_earth_orbit.gif



http://maps.unomaha.edu/Peterson/geog1000/Notes/Notes_Exam1/Seasons&Climate_files/image001.jpg

SunCalc

How to read Sunpath diagram?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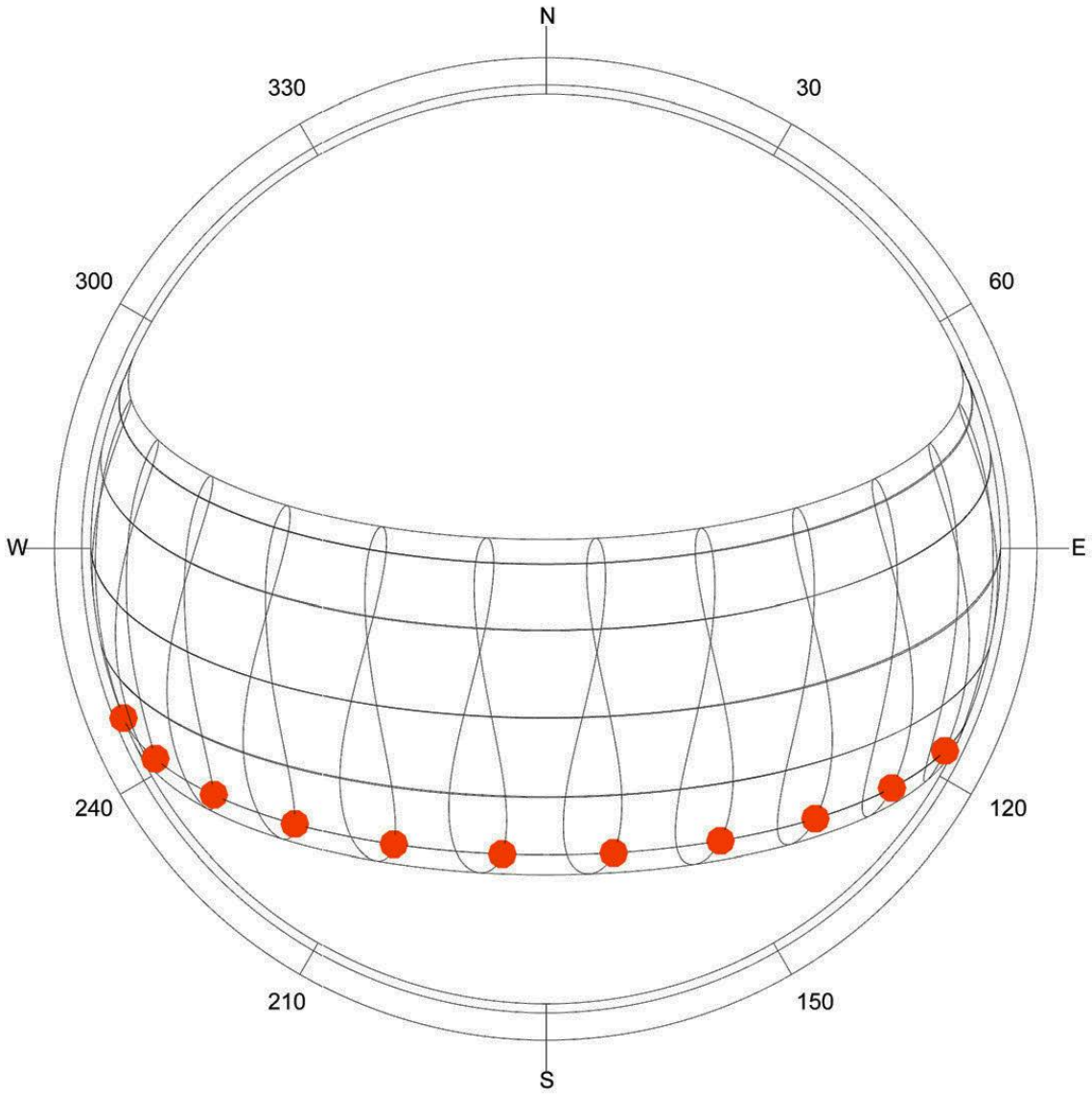
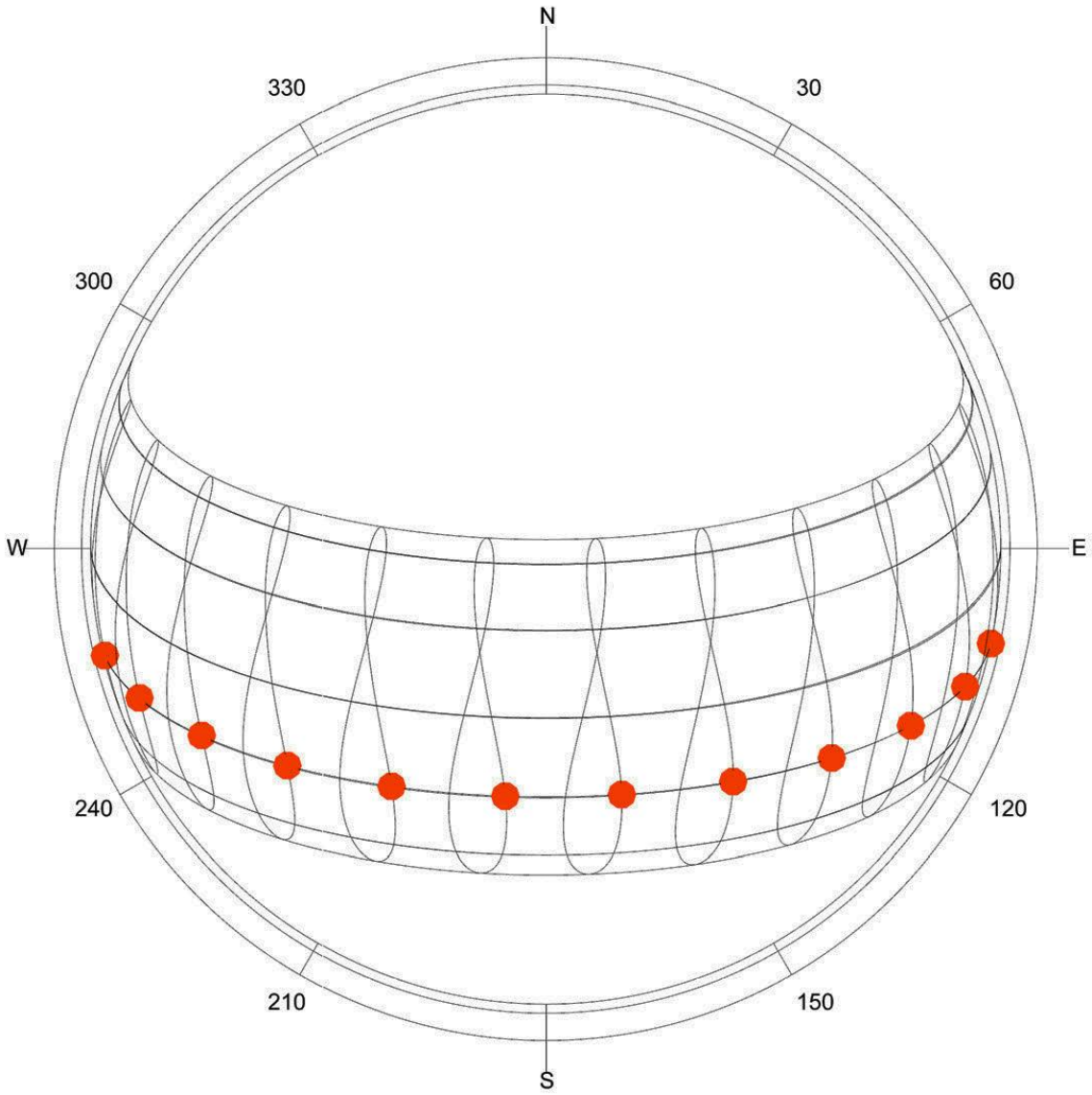
Months & Time



Sun-Path Diagram - Latitude: 22.3072
21 JAN



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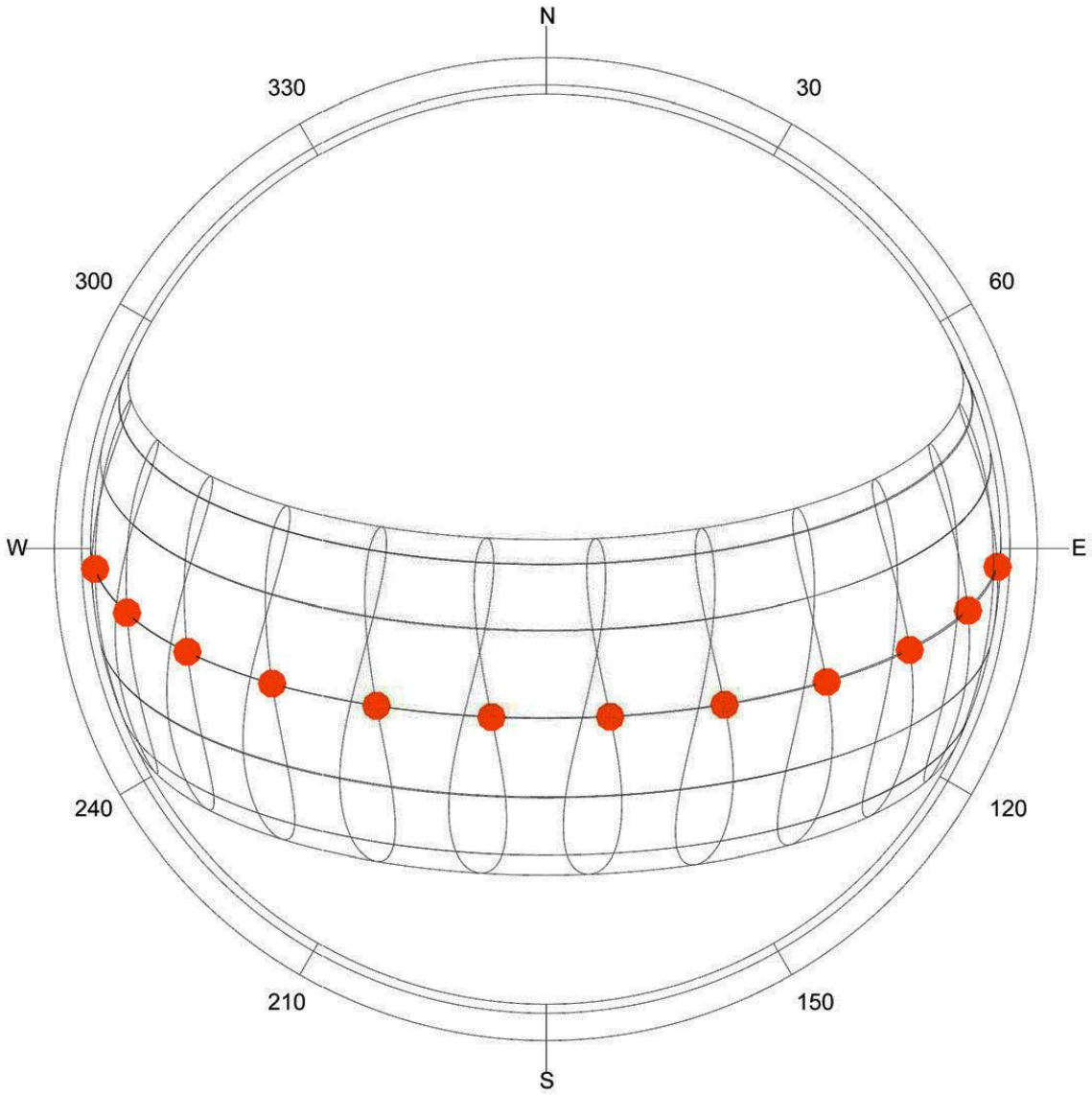

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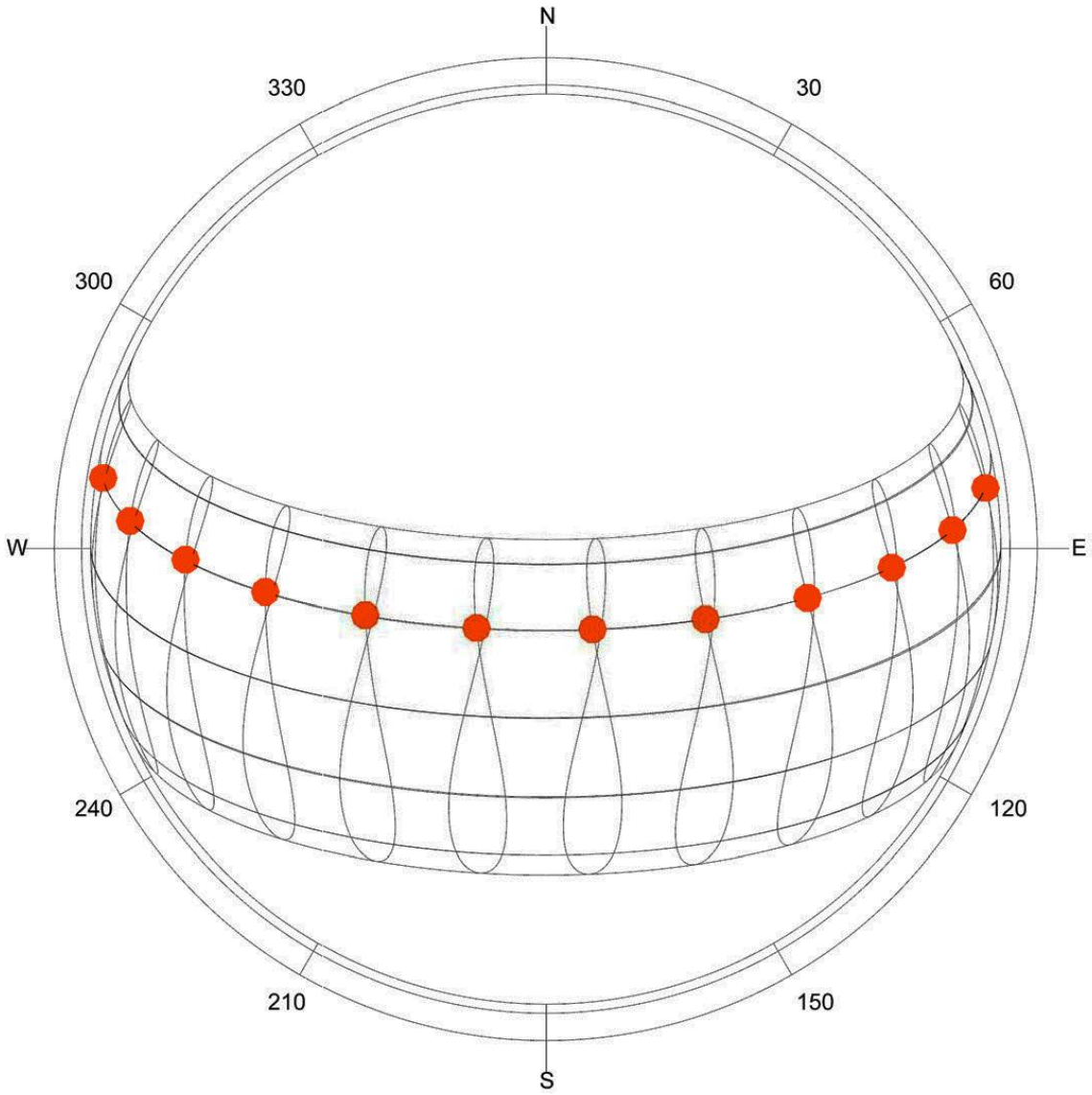

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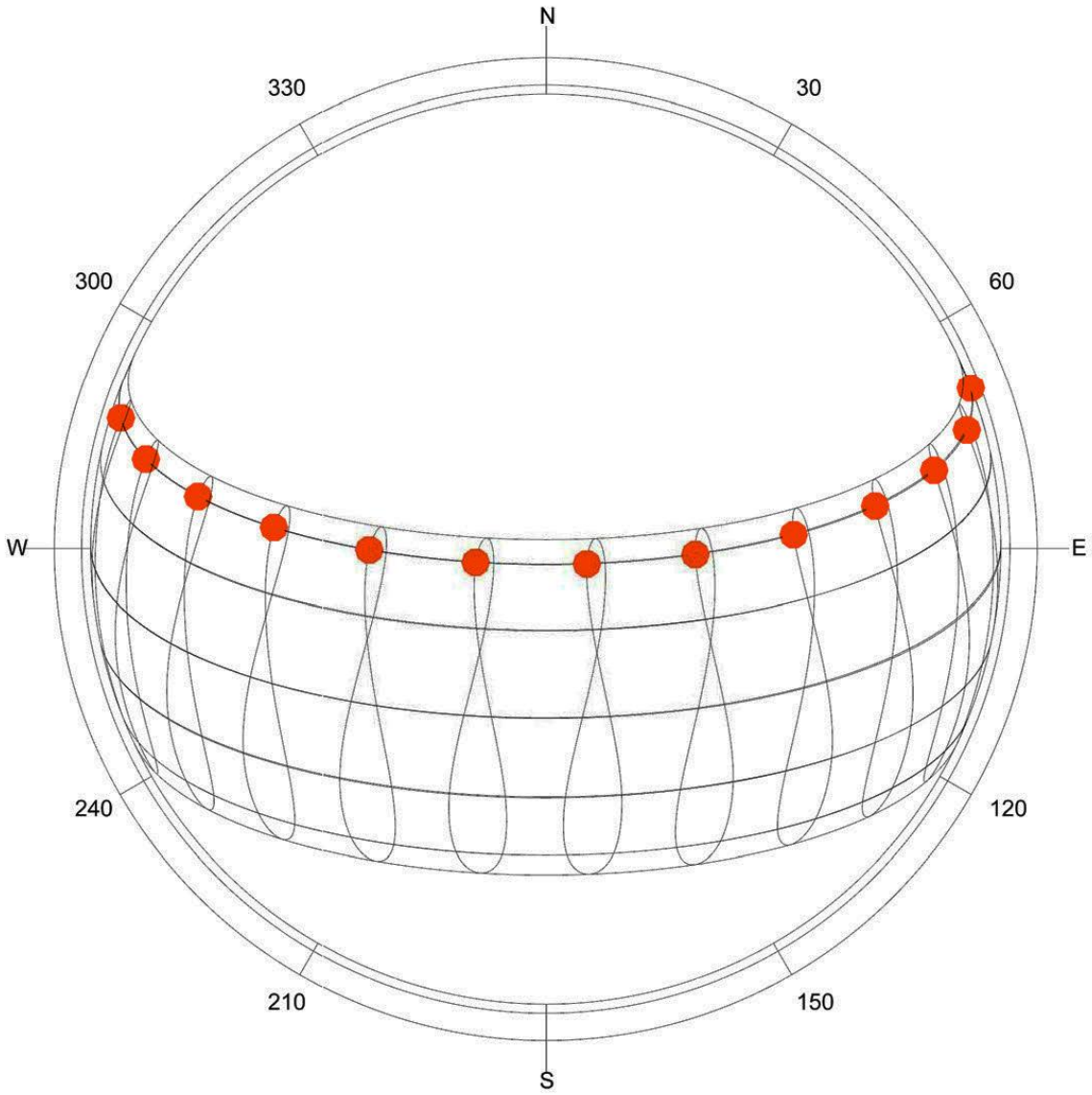

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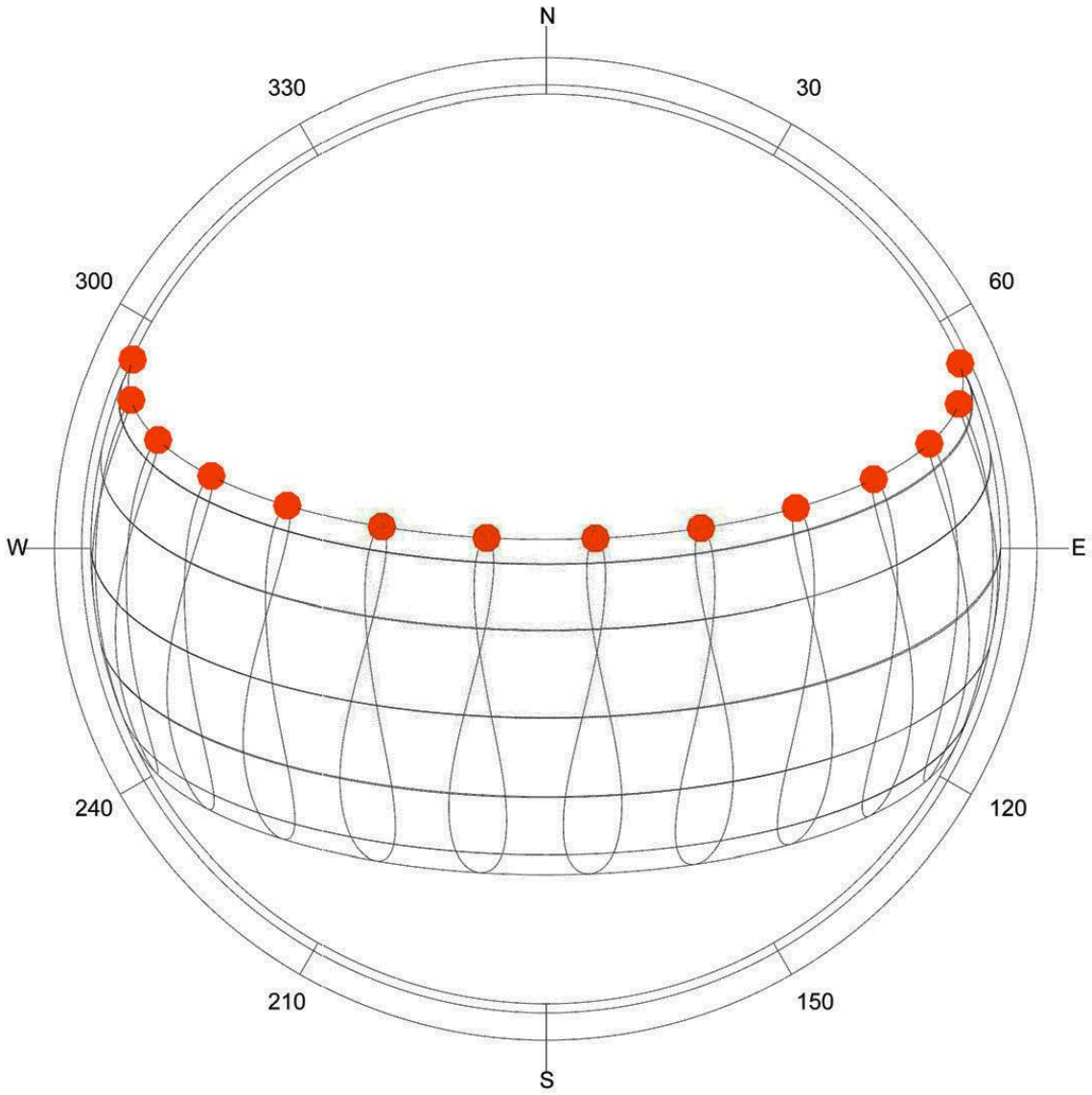

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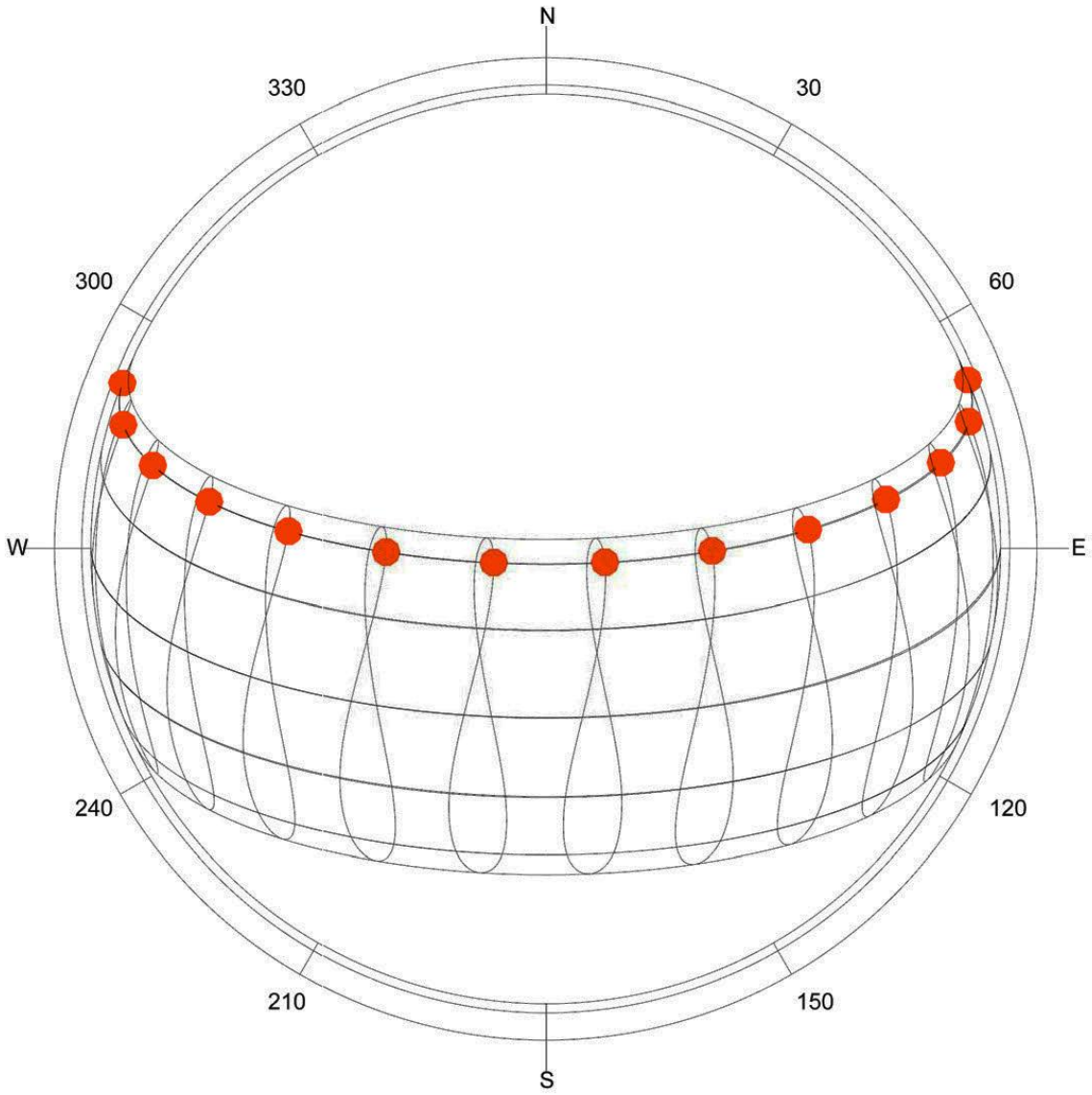

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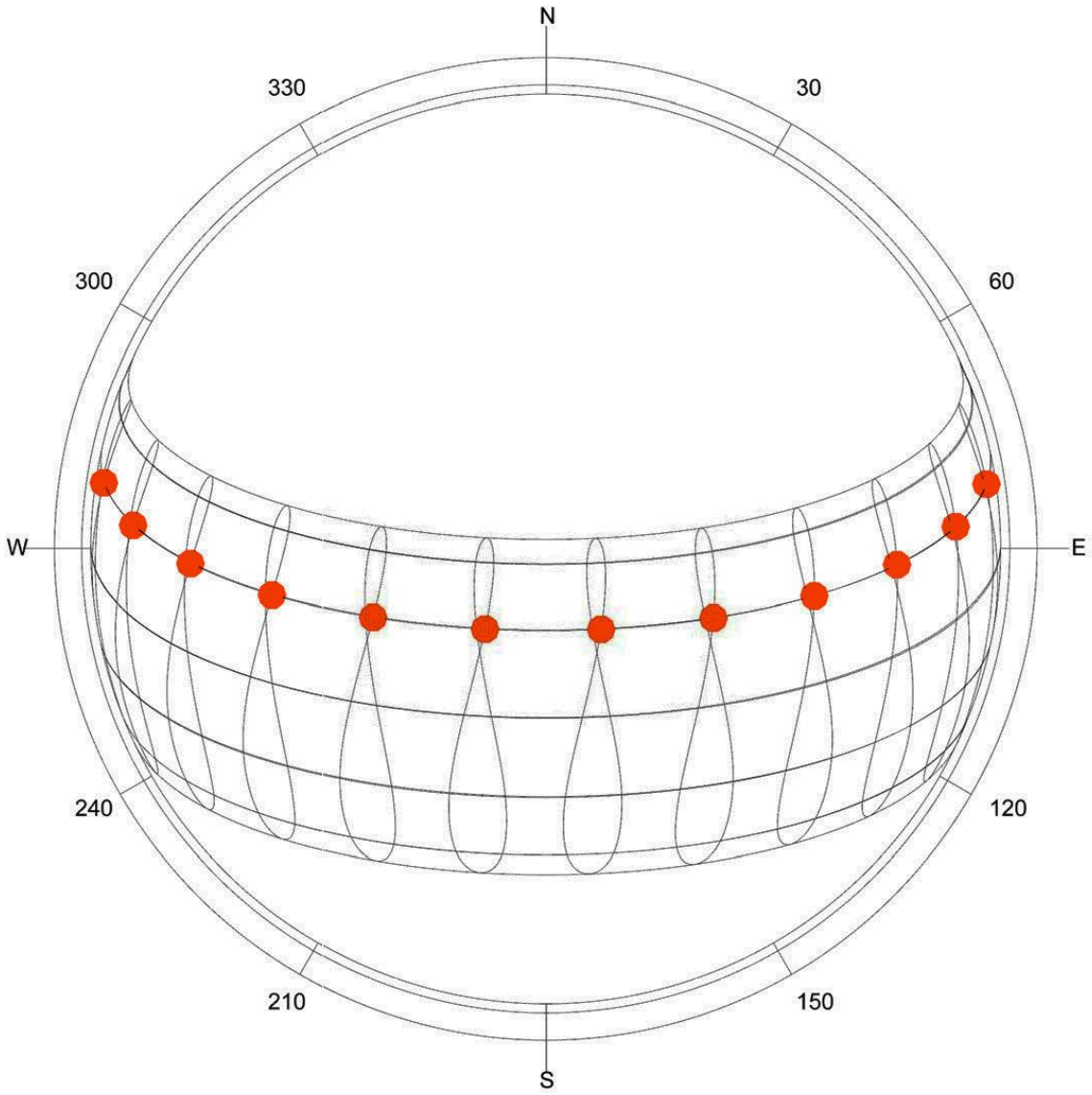

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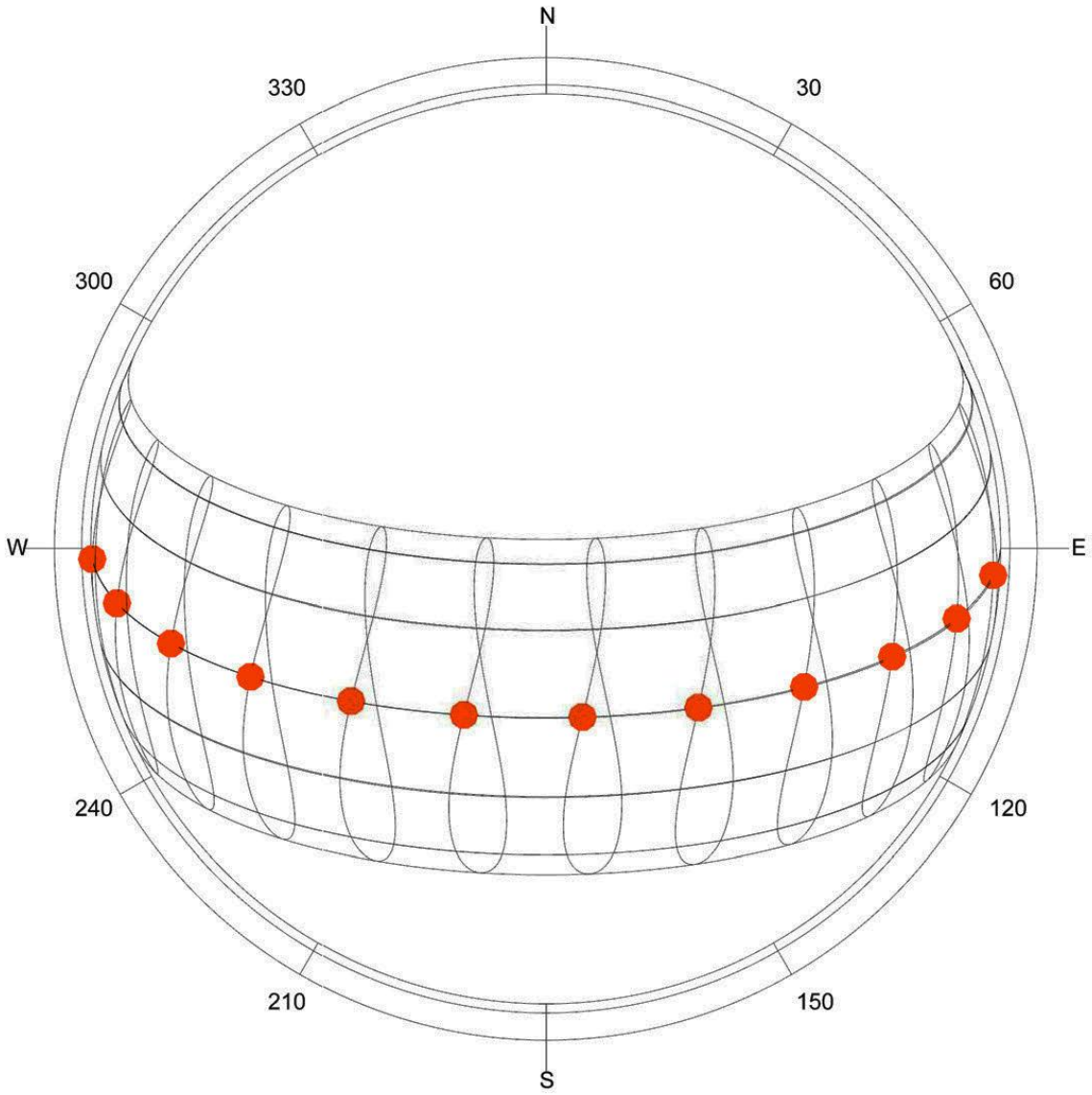
21 AUG



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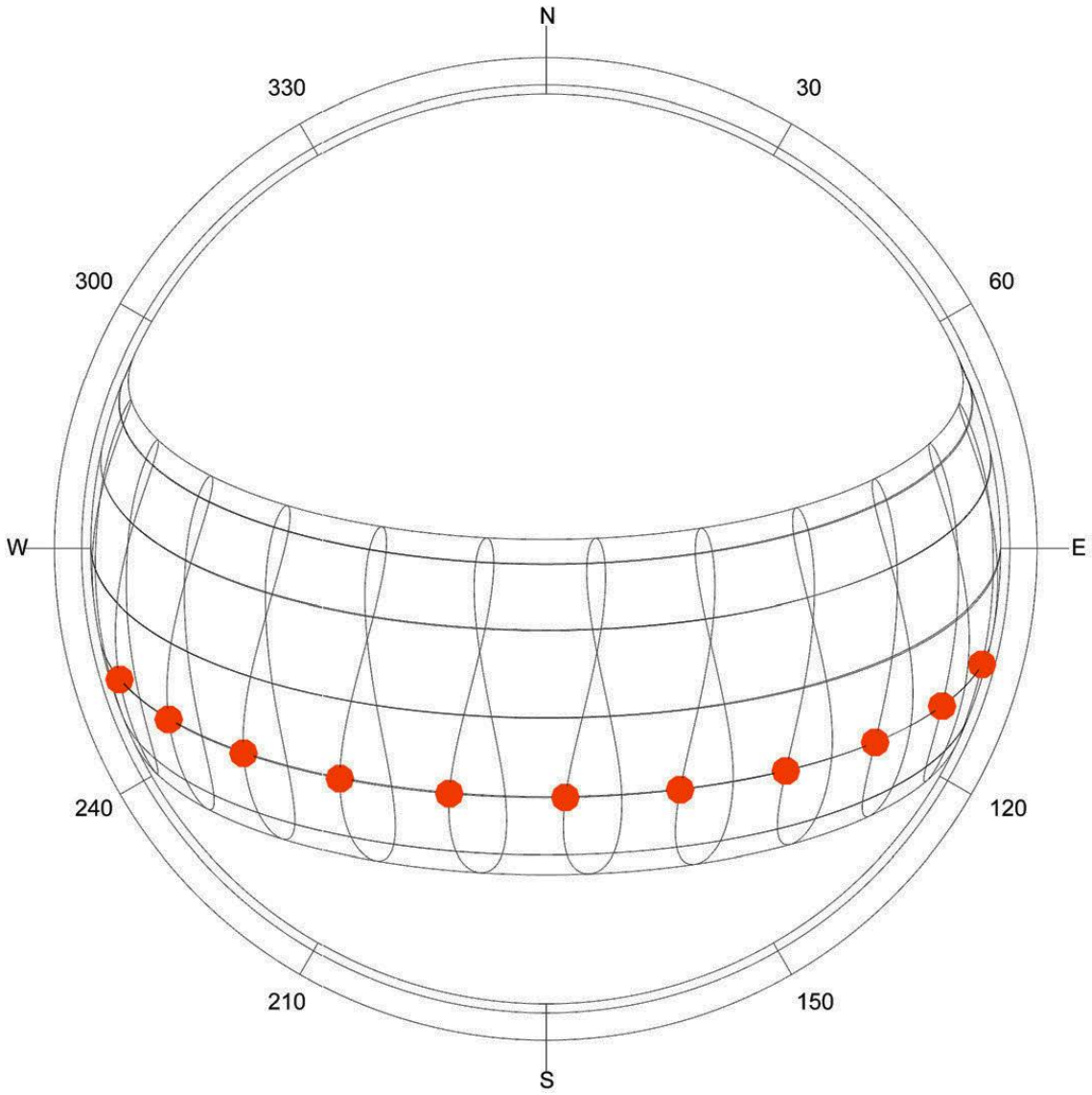
21 SEP



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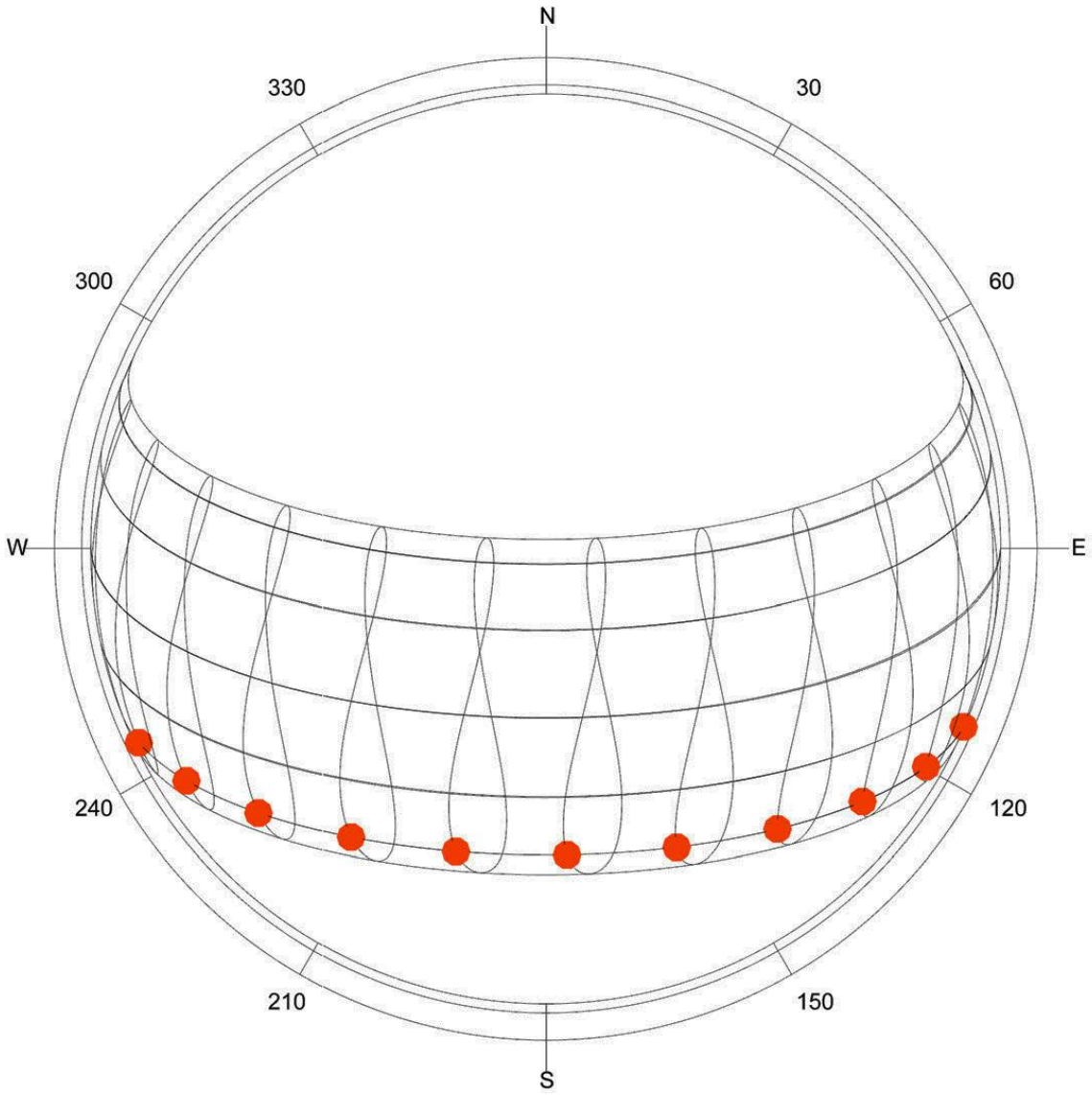

Sun-Path Diagram - Latitude: 22.3072
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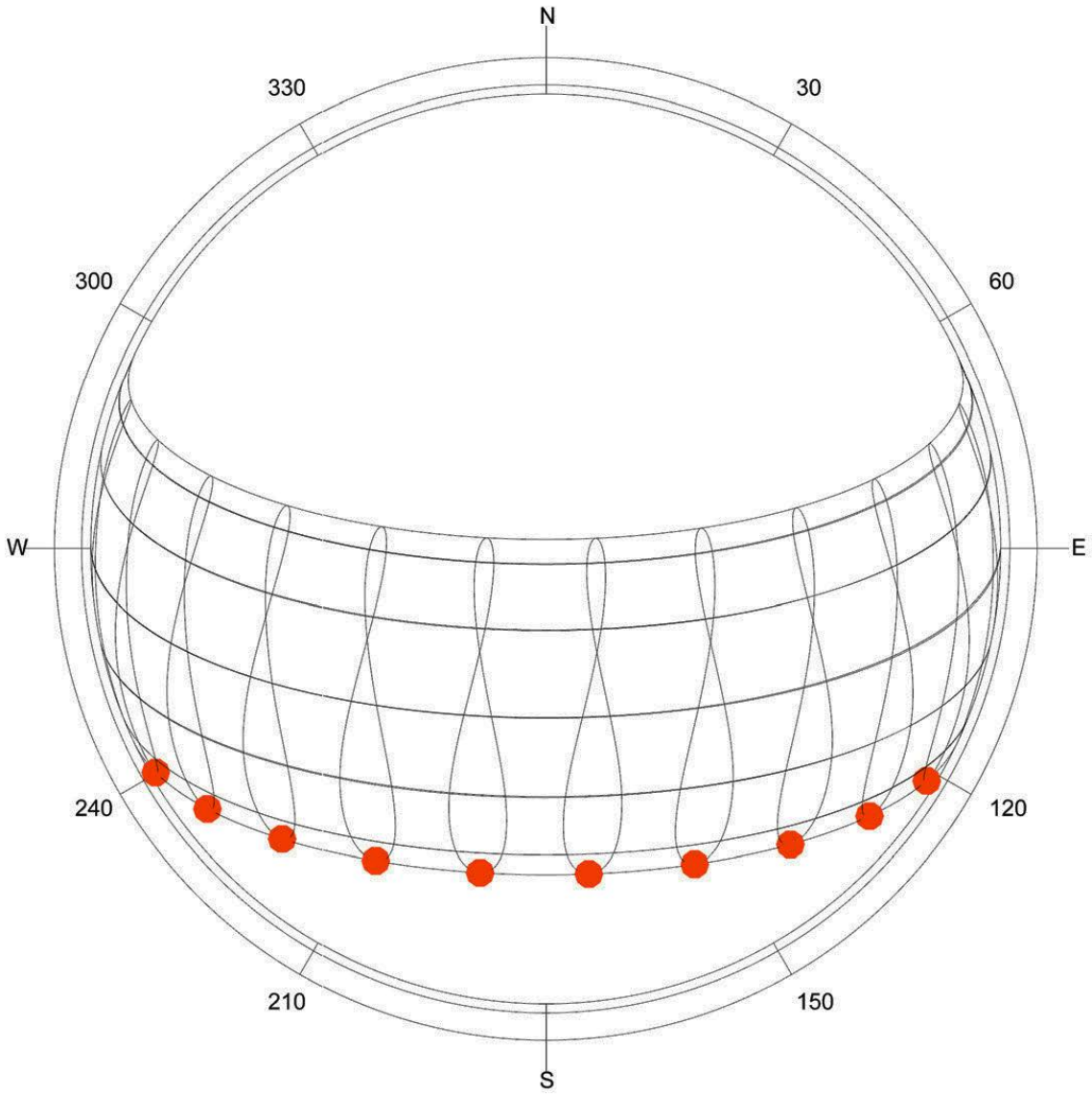
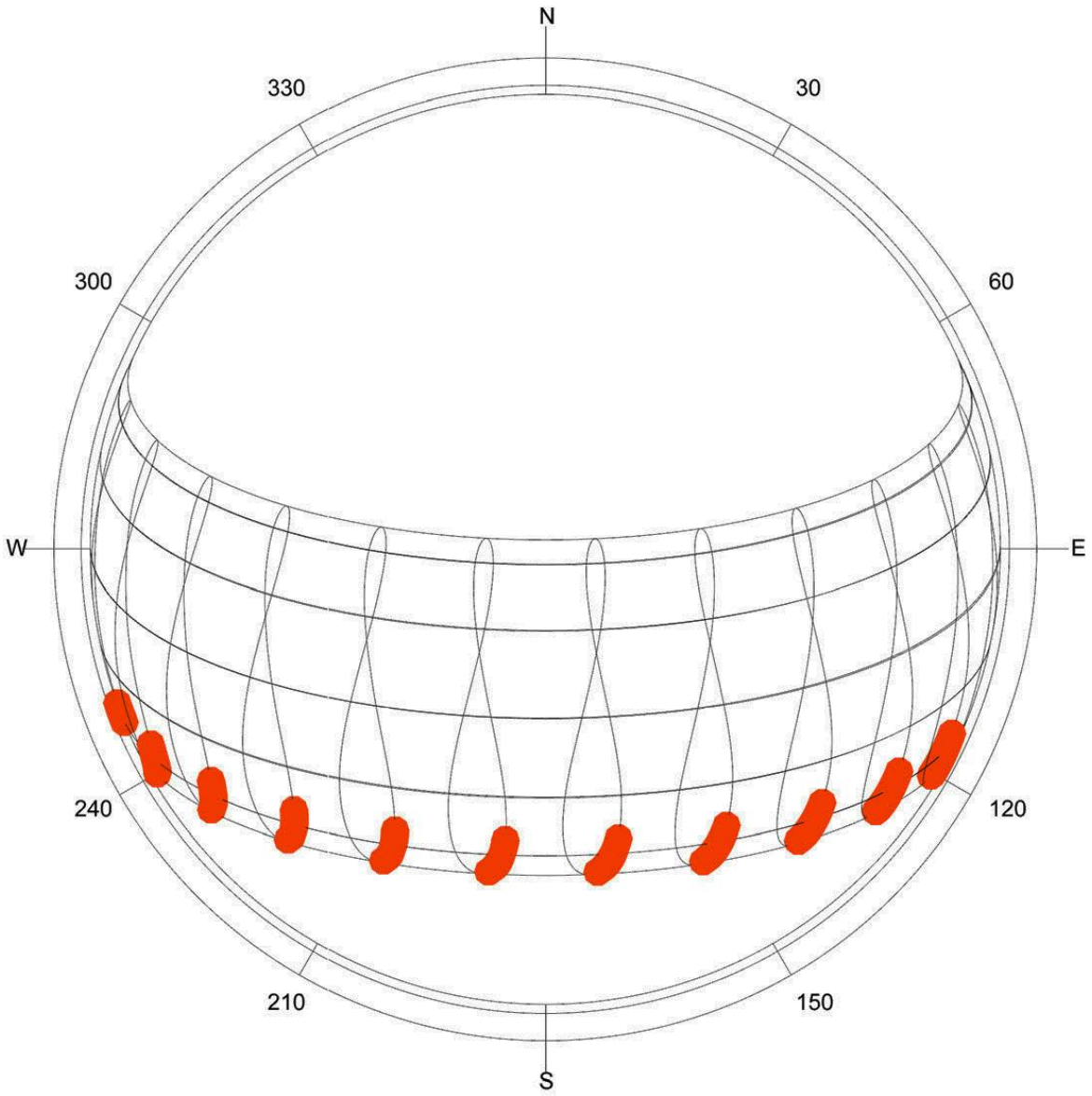


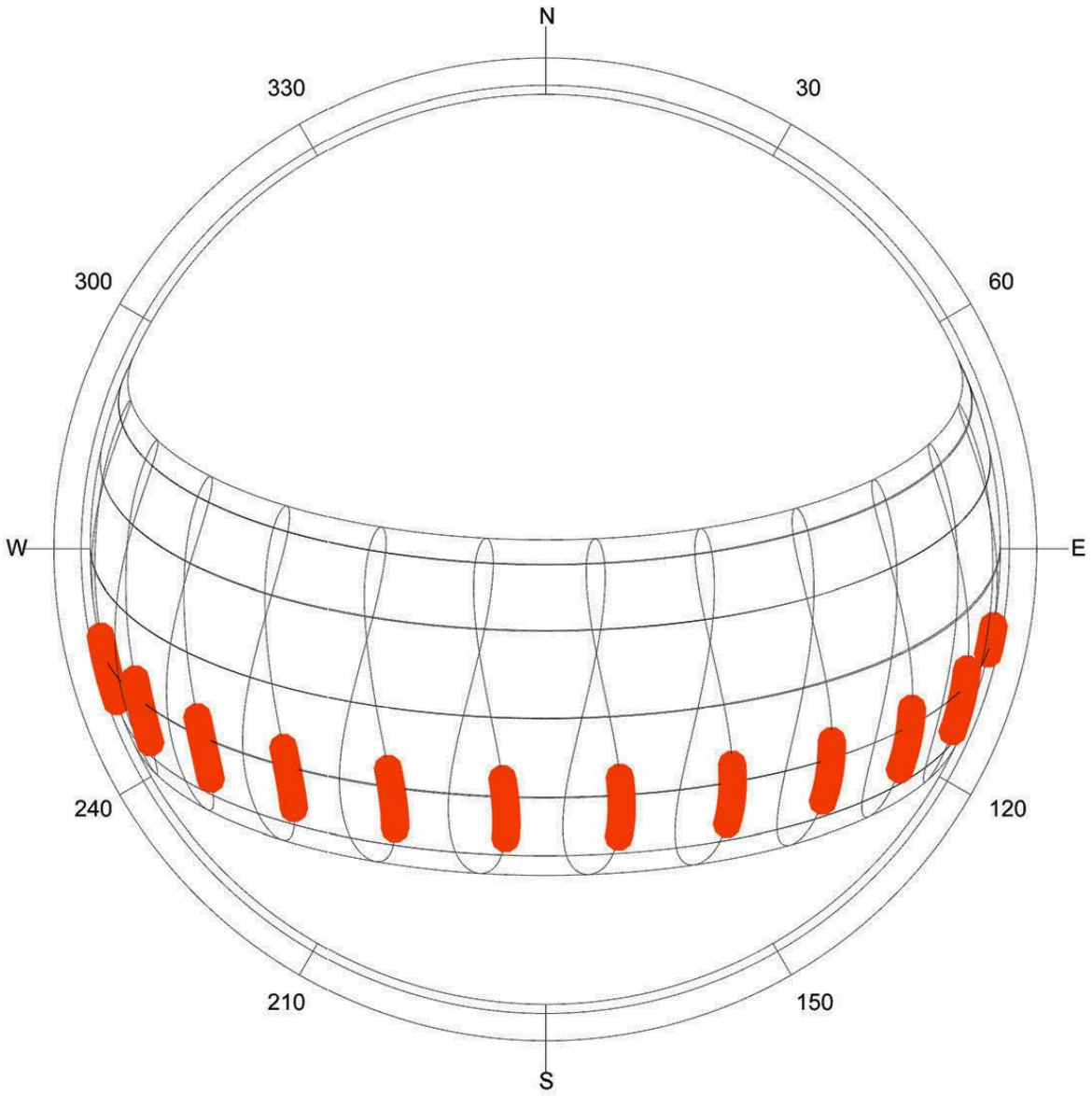
Sun-Path Diagram - Latitude: 22.3072
21 DEC

Days



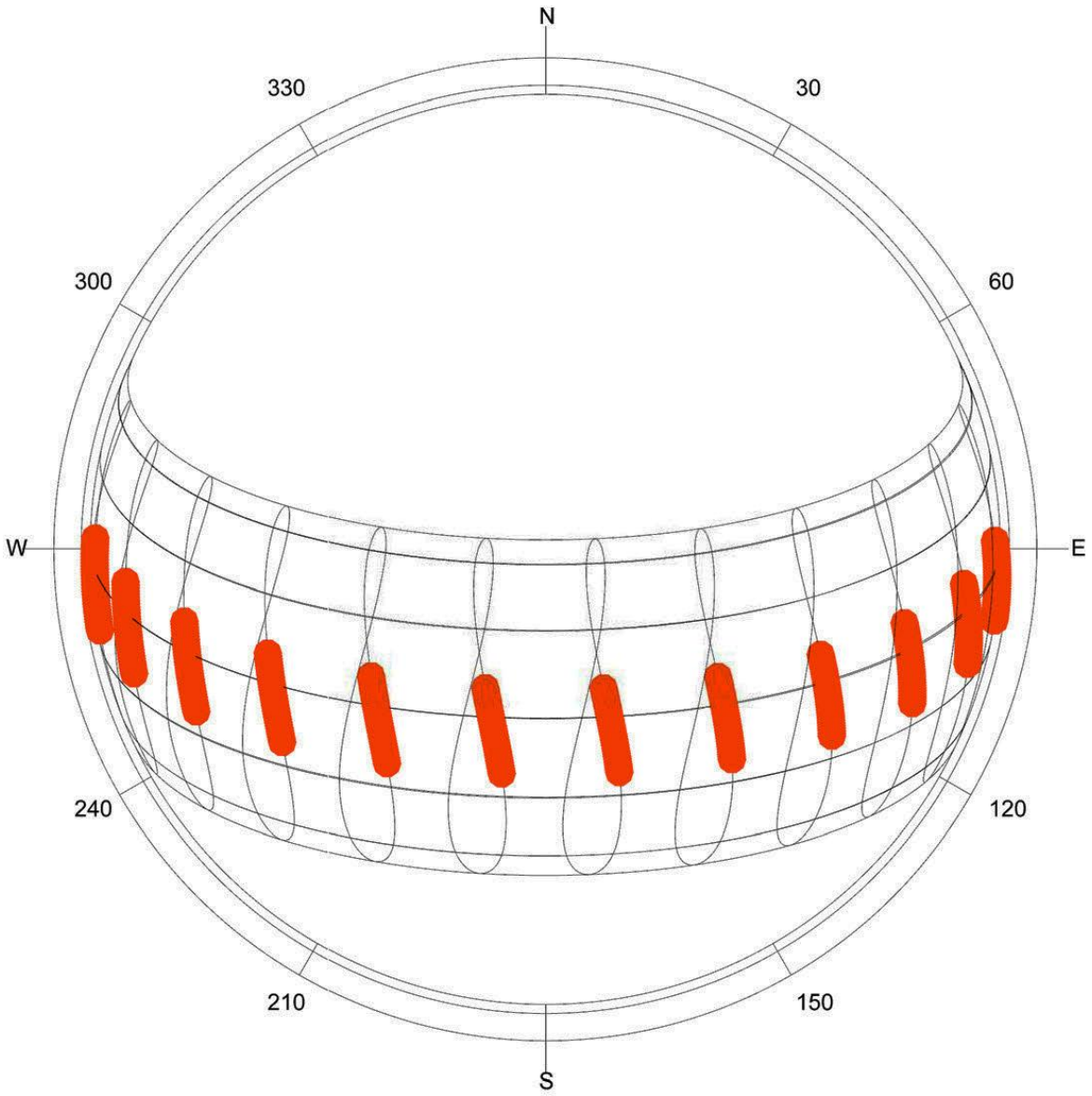
Sun-Path Diagram - Latitude: 22.3072

January



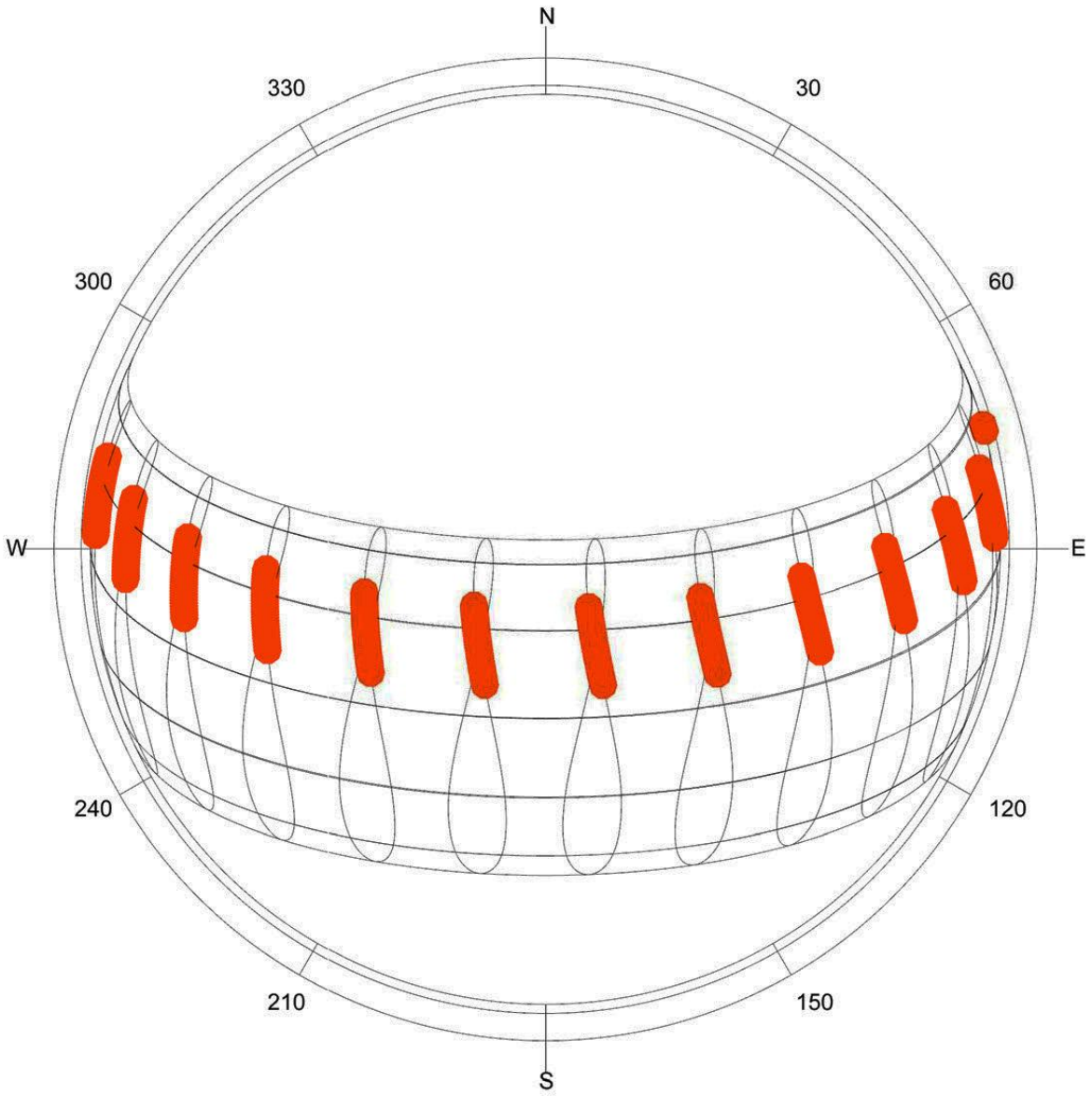
Sun-Path Diagram - Latitude: 22.3072

February



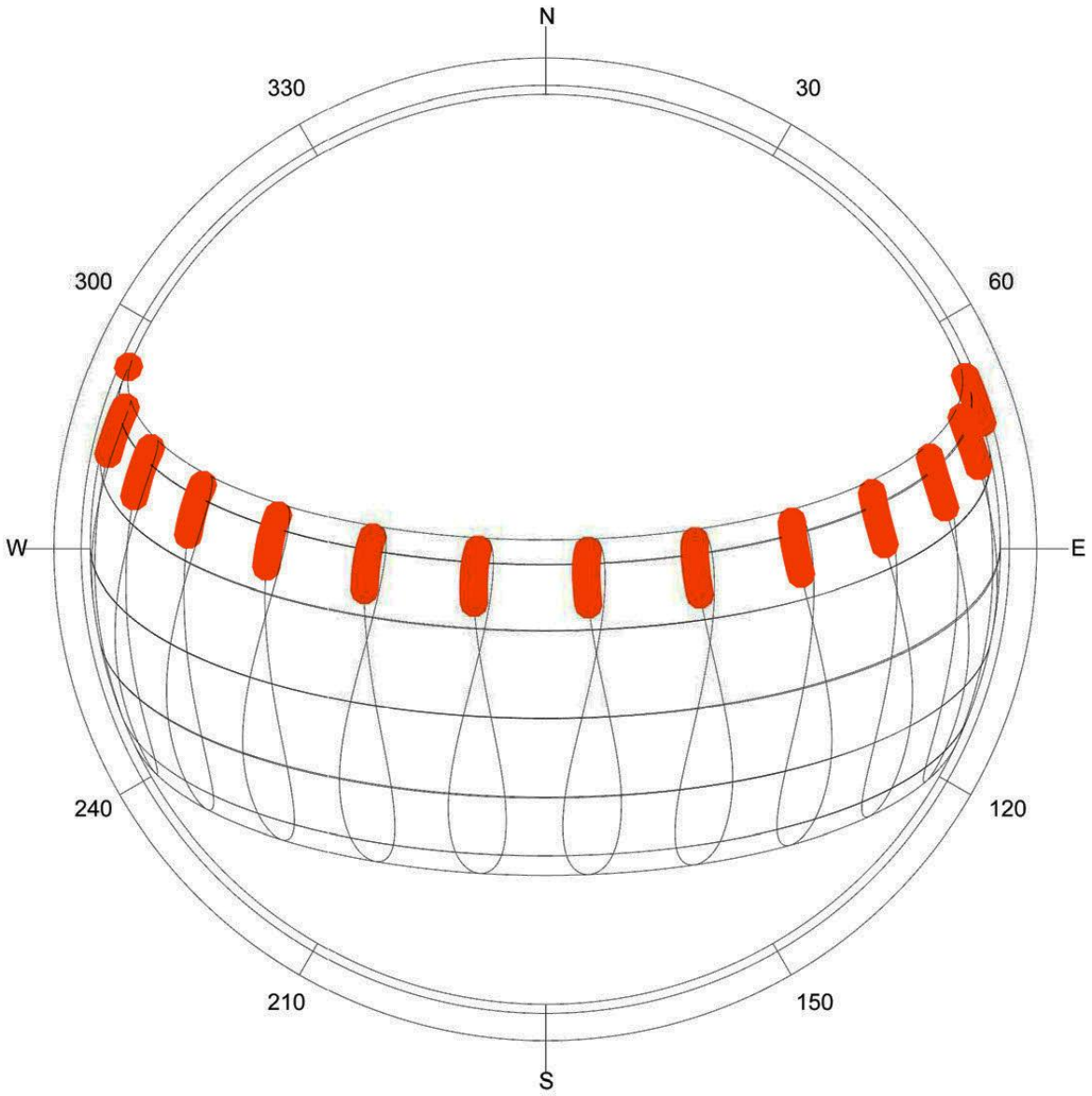
Sun-Path Diagram - Latitude: 22.3072

March



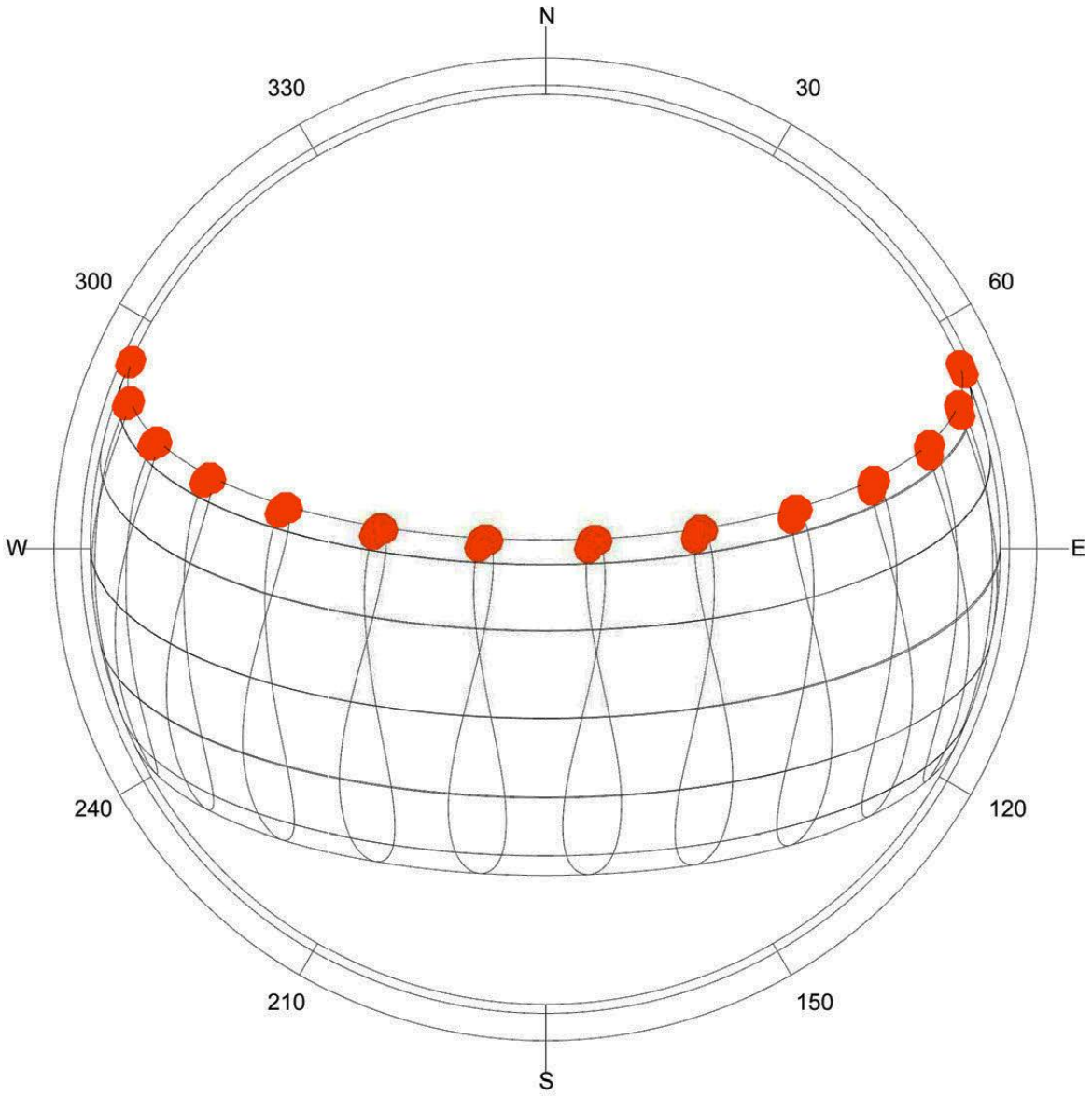
Sun-Path Diagram - Latitude: 22.3072

April



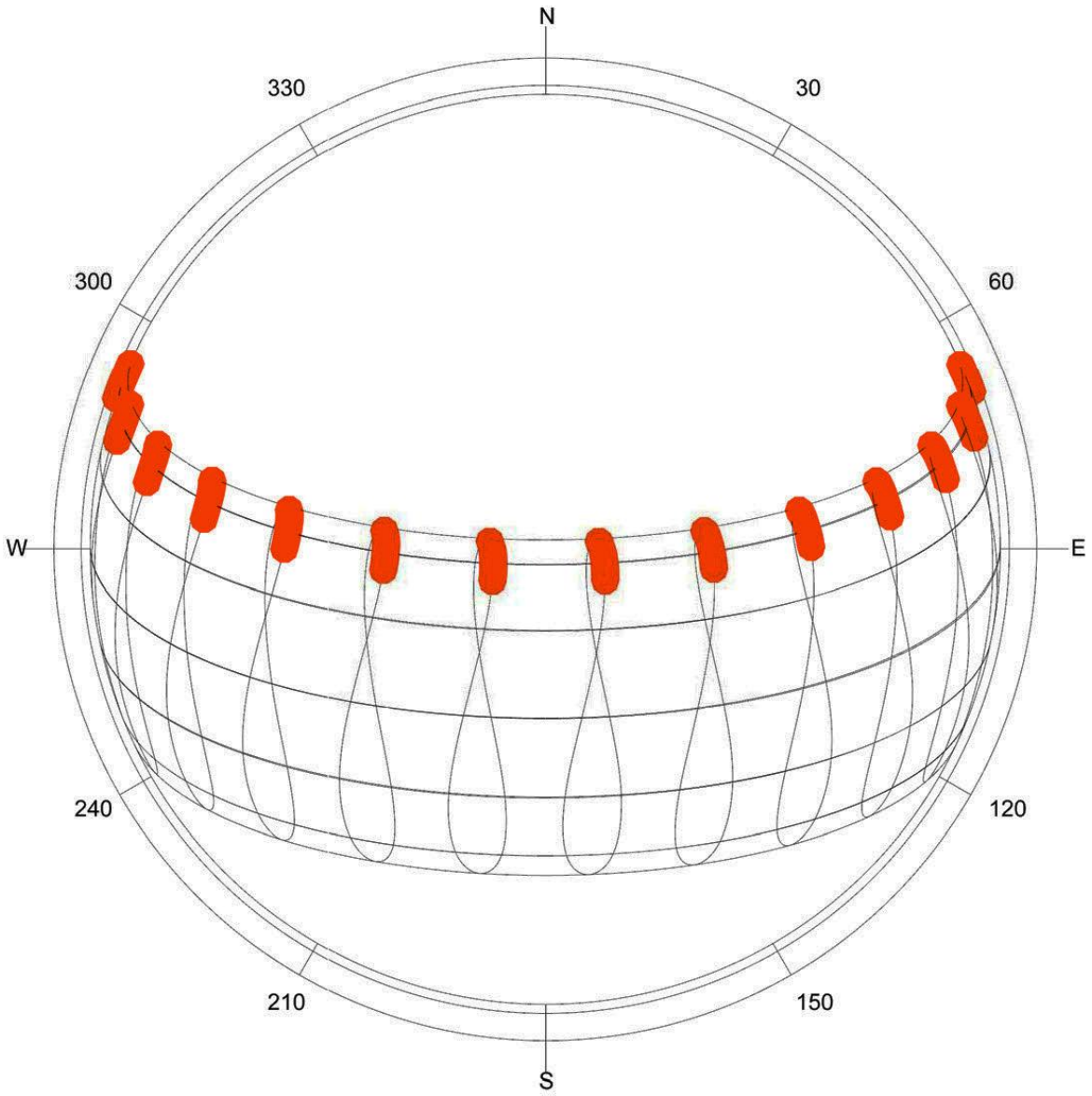
Sun-Path Diagram - Latitude: 22.3072

May



Sun-Path Diagram - Latitude: 22.3072

June



Sun-Path Diagram - Latitude: 22.3072

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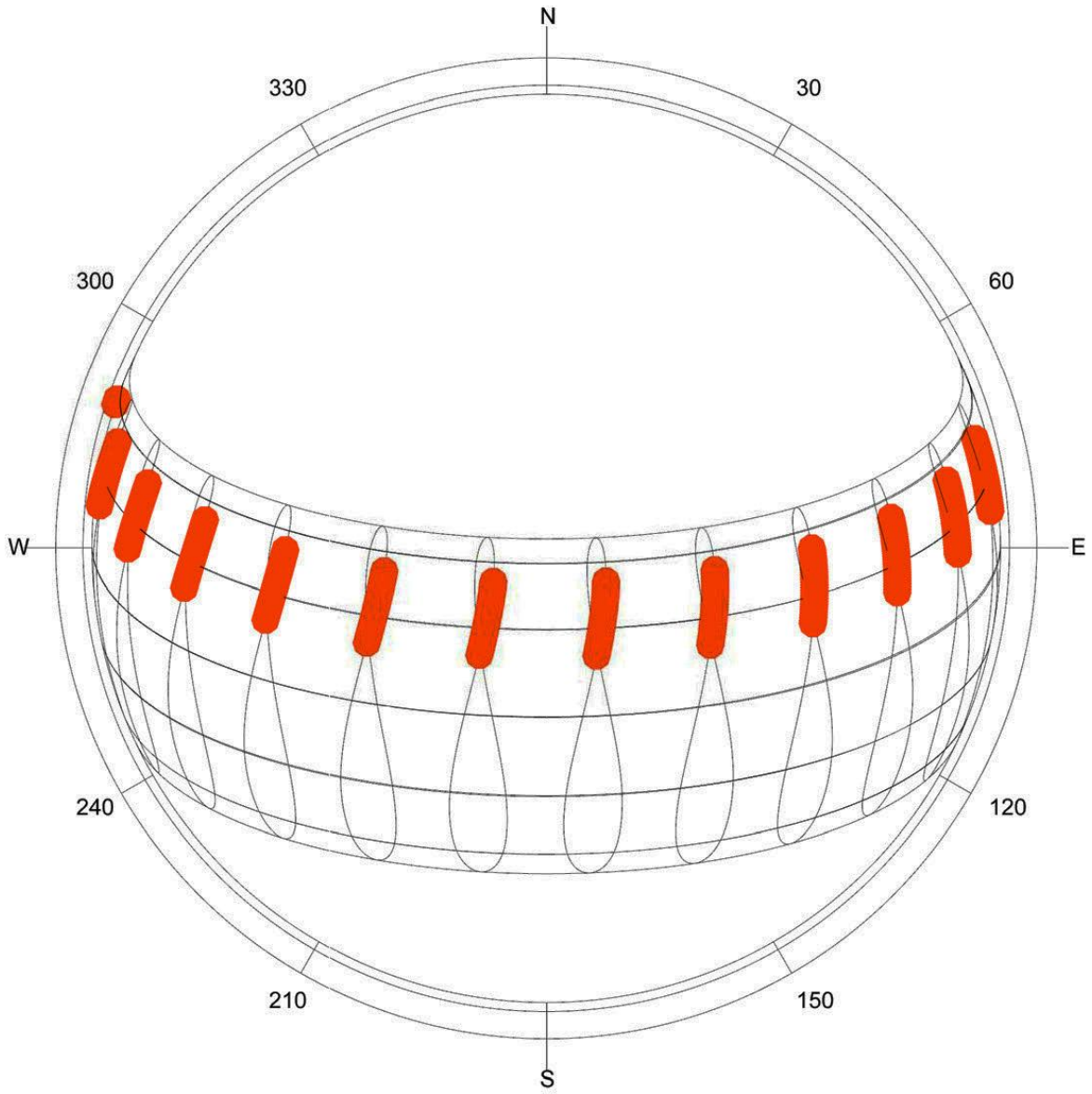
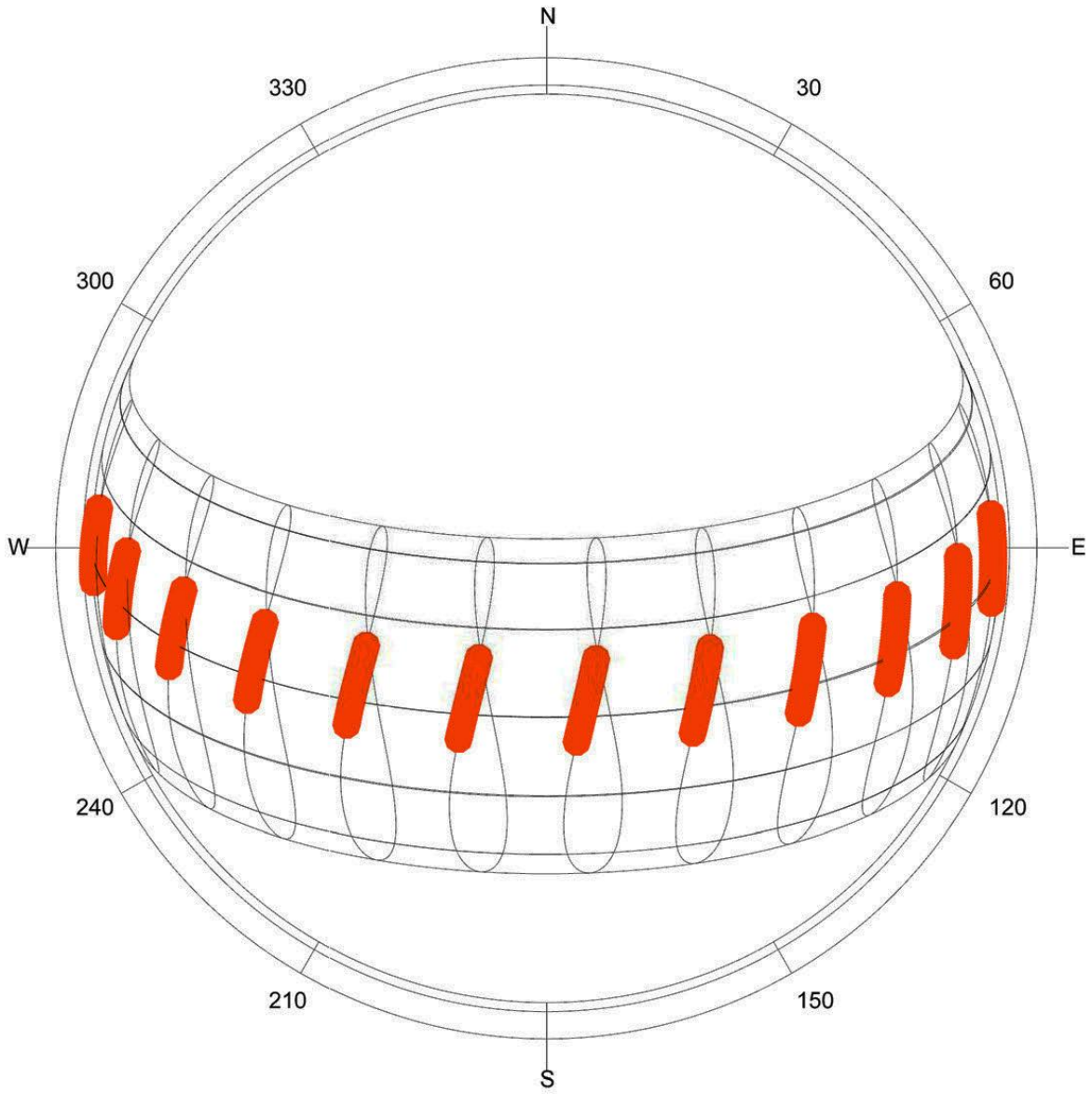


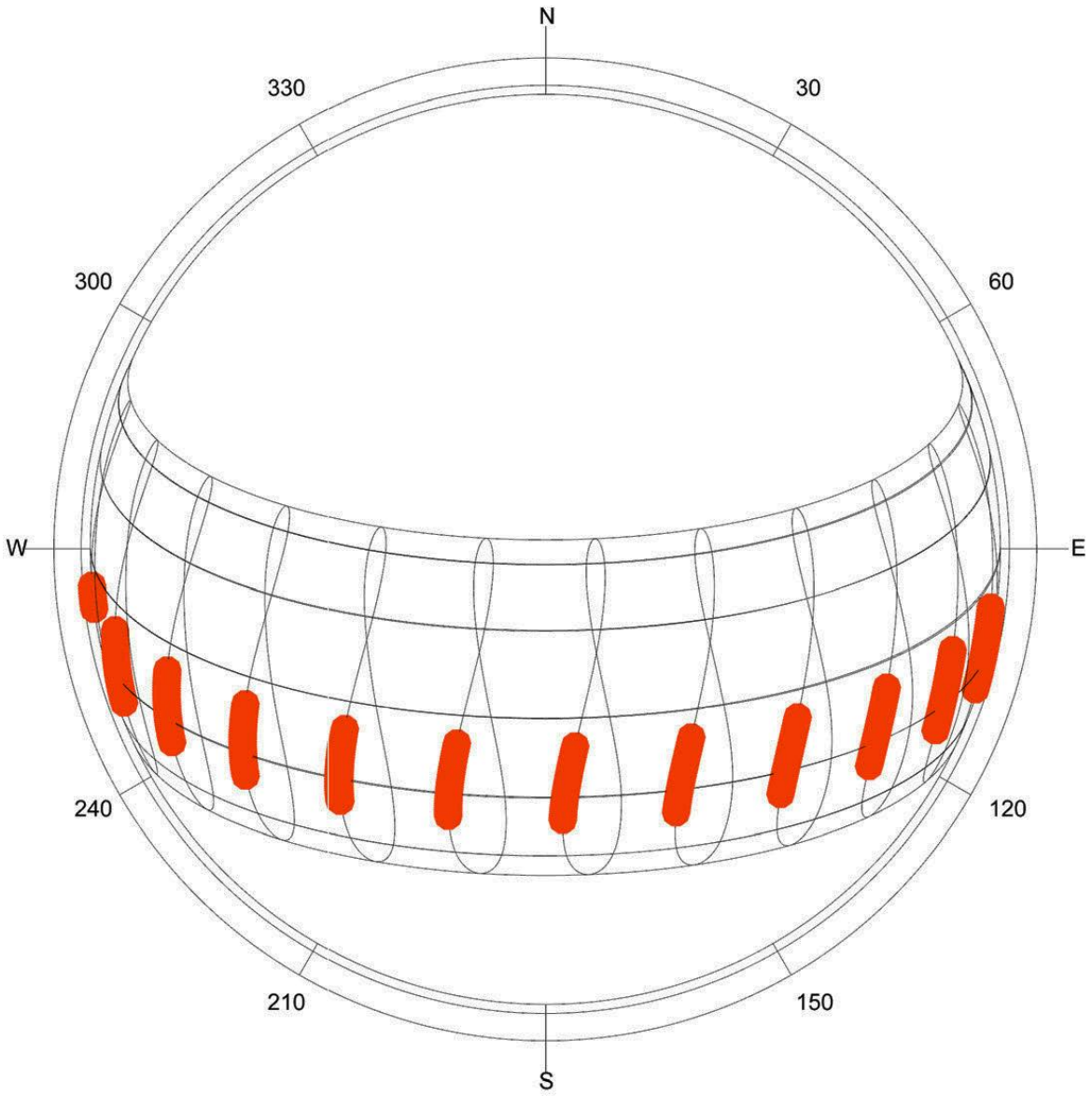
Sun-Path Diagram - Latitude: 22.3072

August



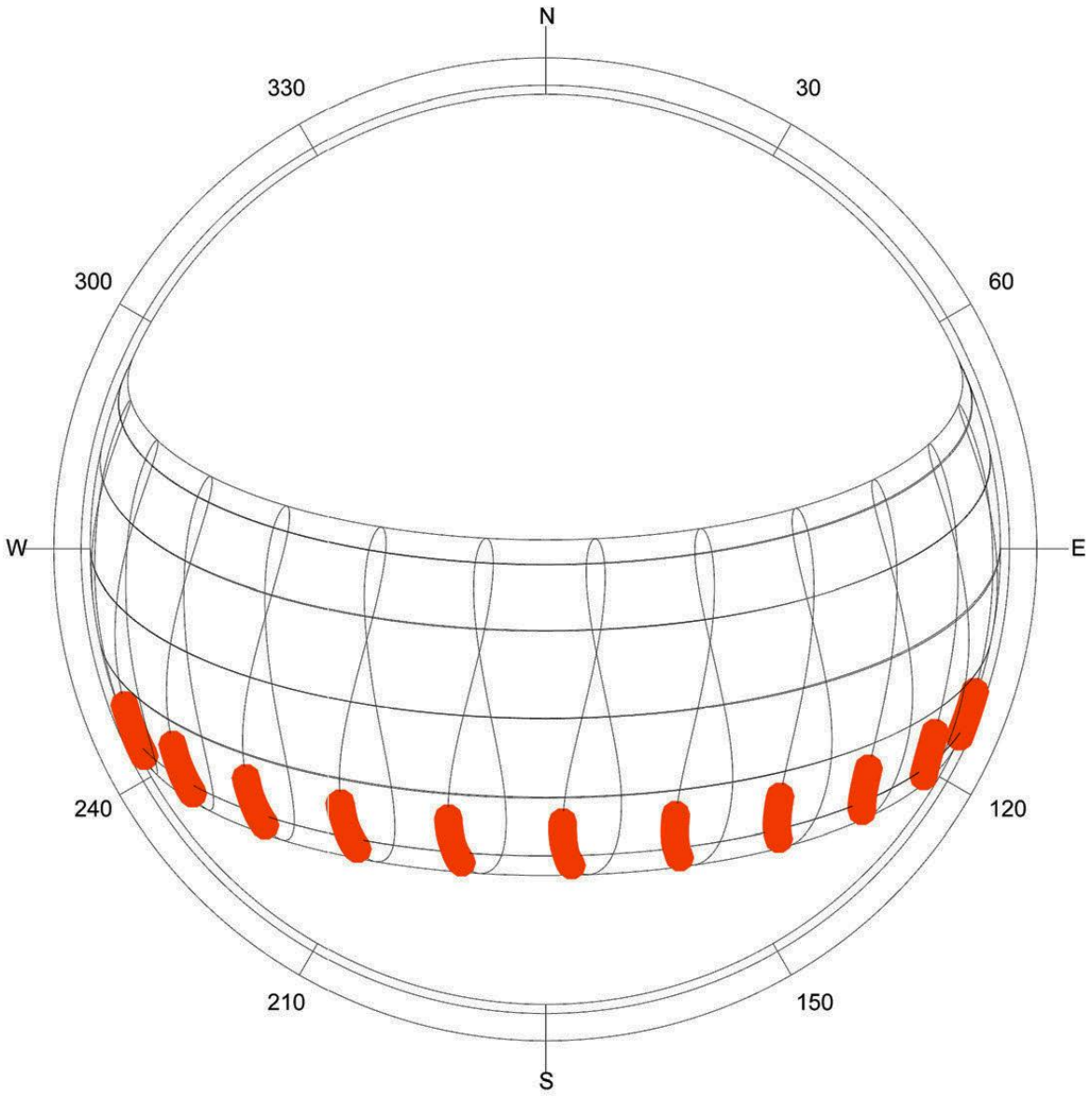
Sun-Path Diagram - Latitude: 22.3072

September



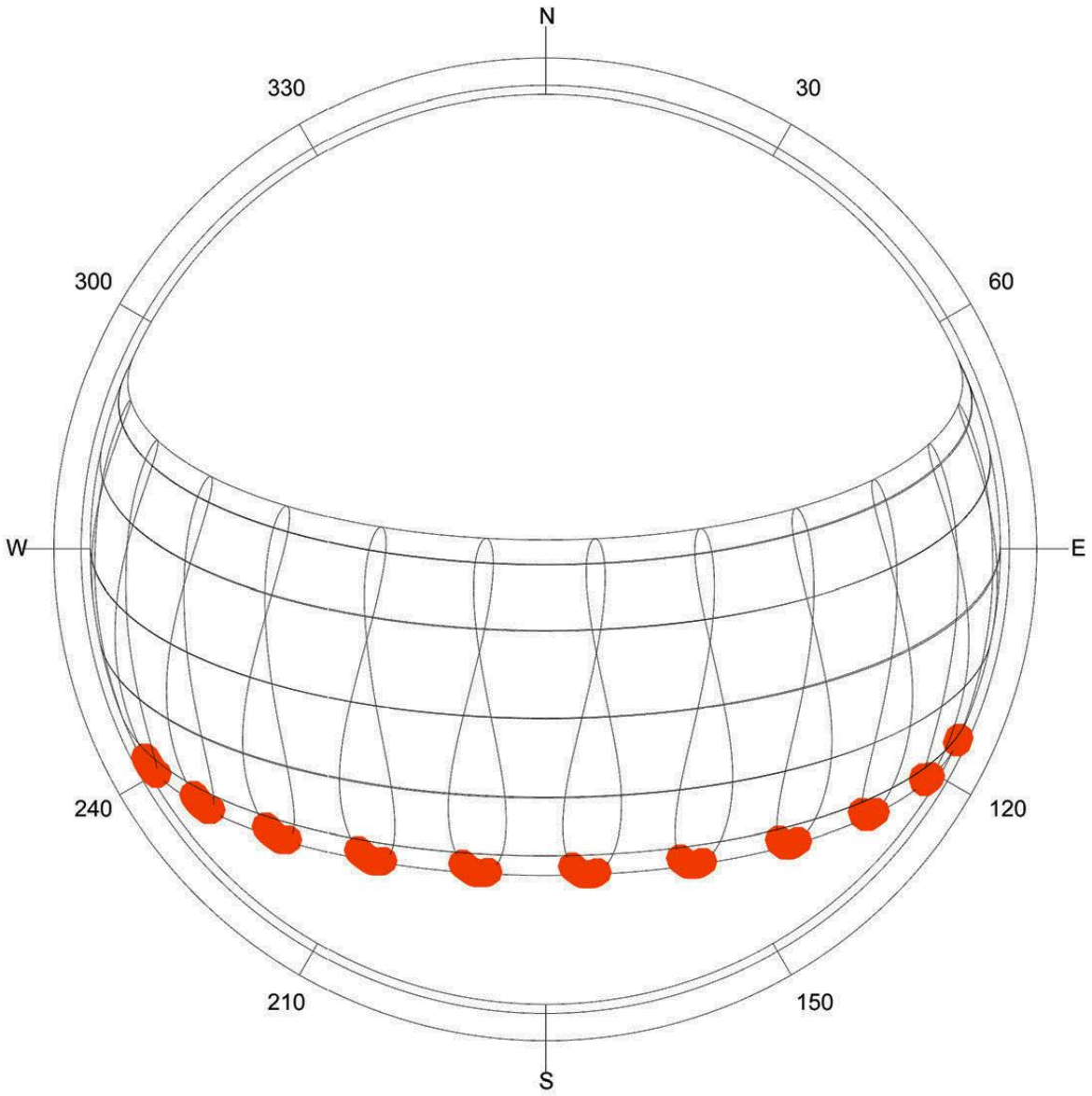
Sun-Path Diagram - Latitude: 22.3072

October



Sun-Path Diagram - Latitude: 22.3072

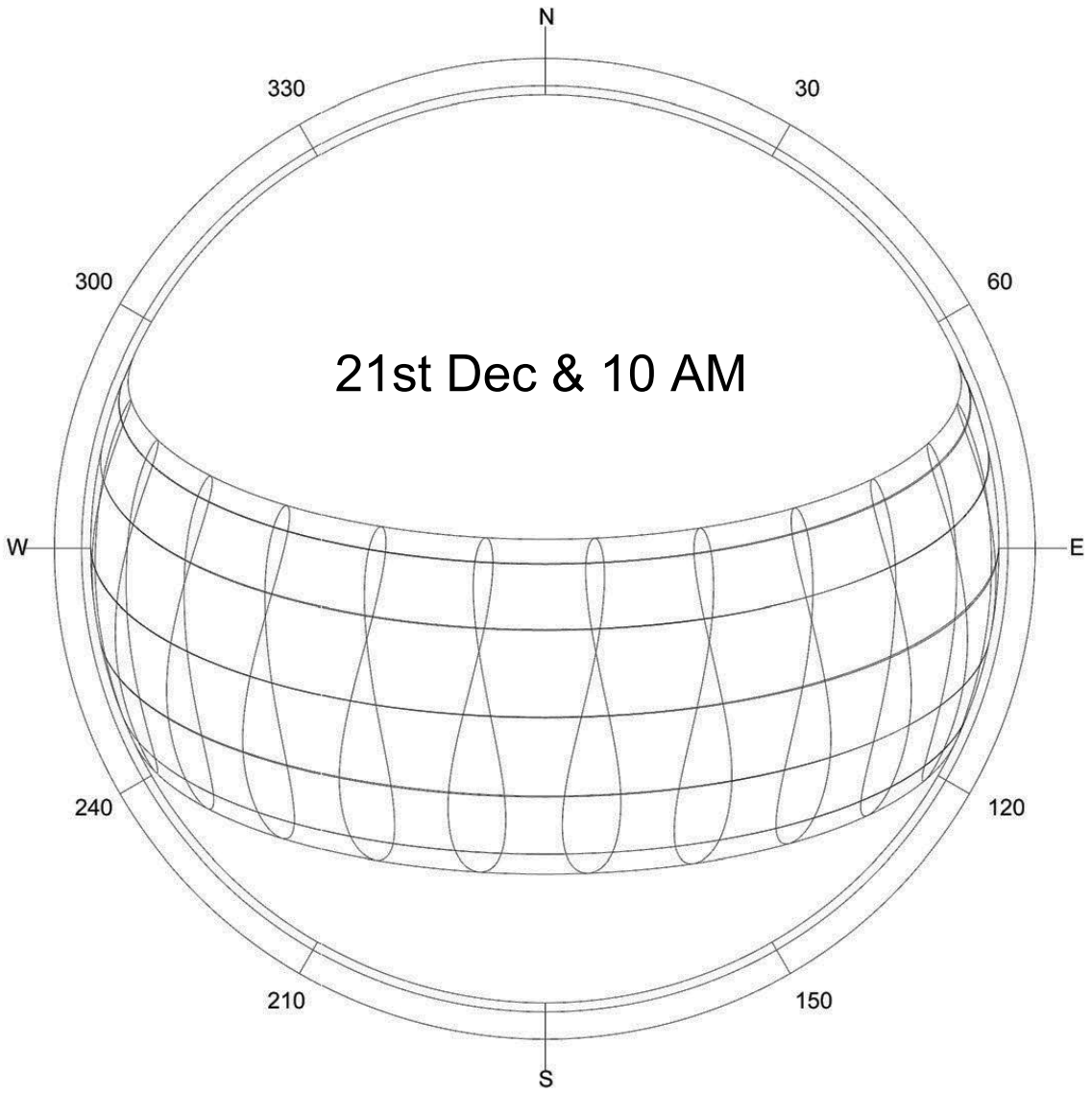
November



Sun-Path Diagram - Latitude: 22.3072

December

Examples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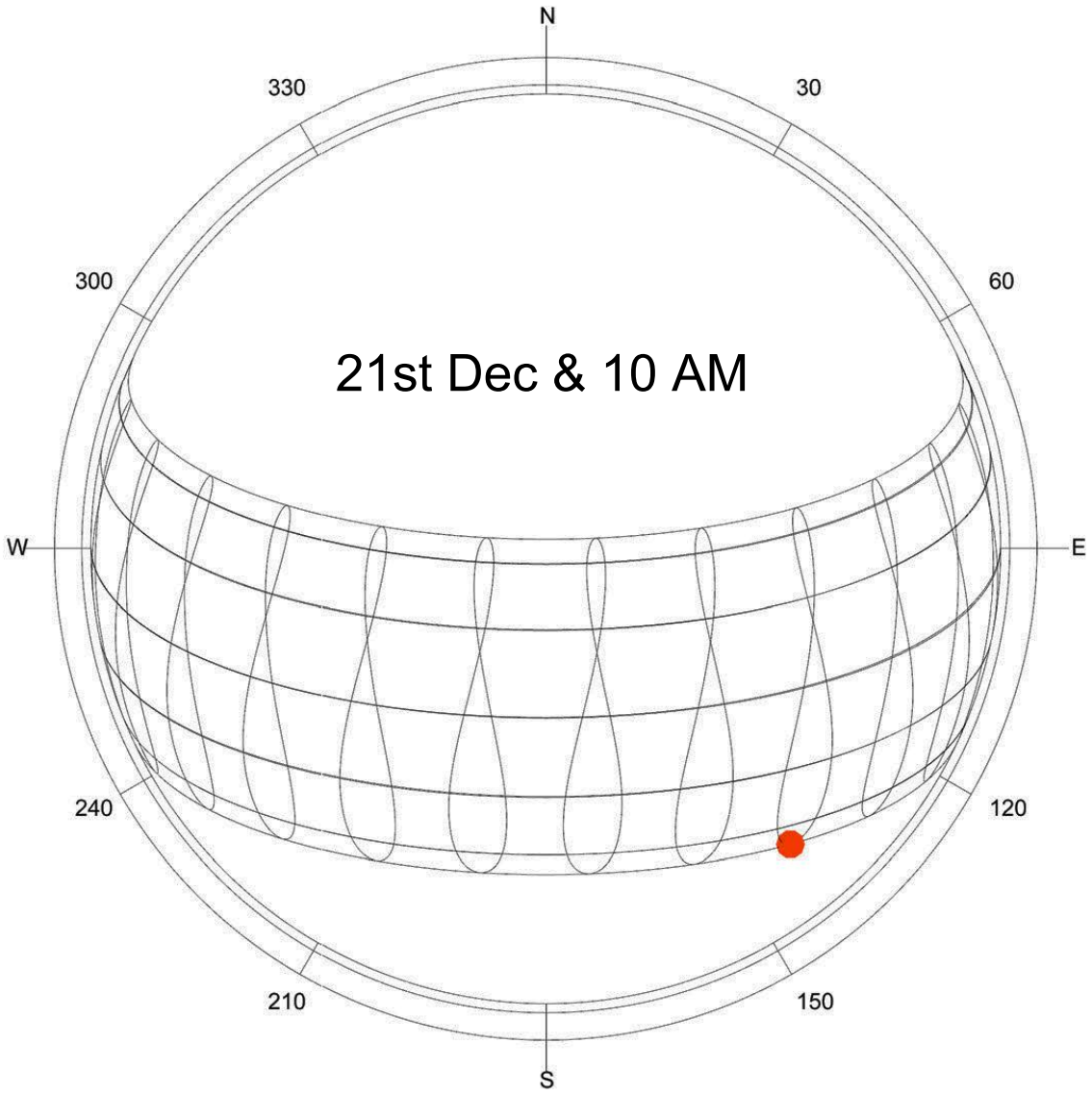
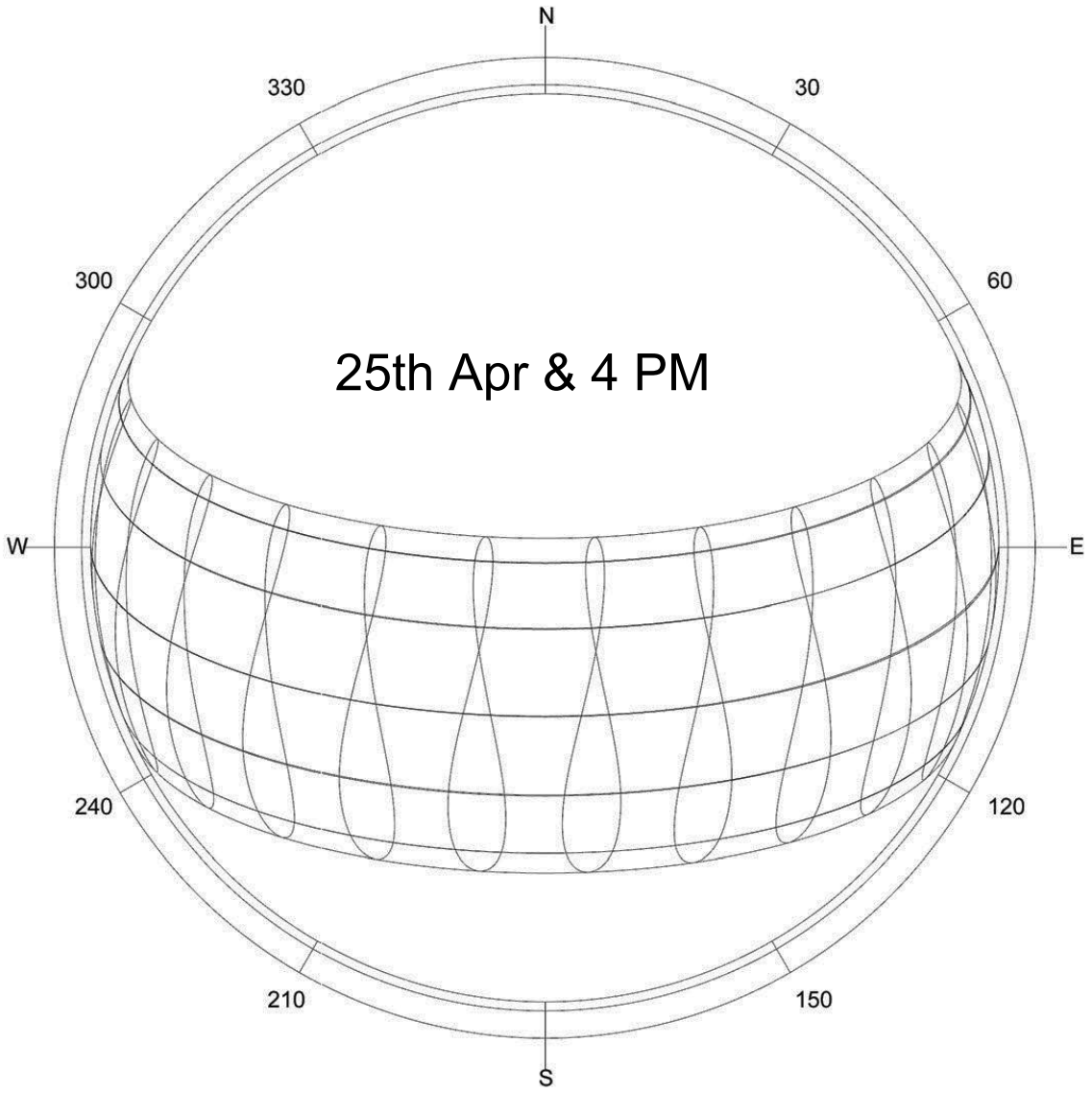


Sun-Path Diagram - Latitude: 22.3072
21 DEC 10:00, ALT = 32.48, AZM = 140.42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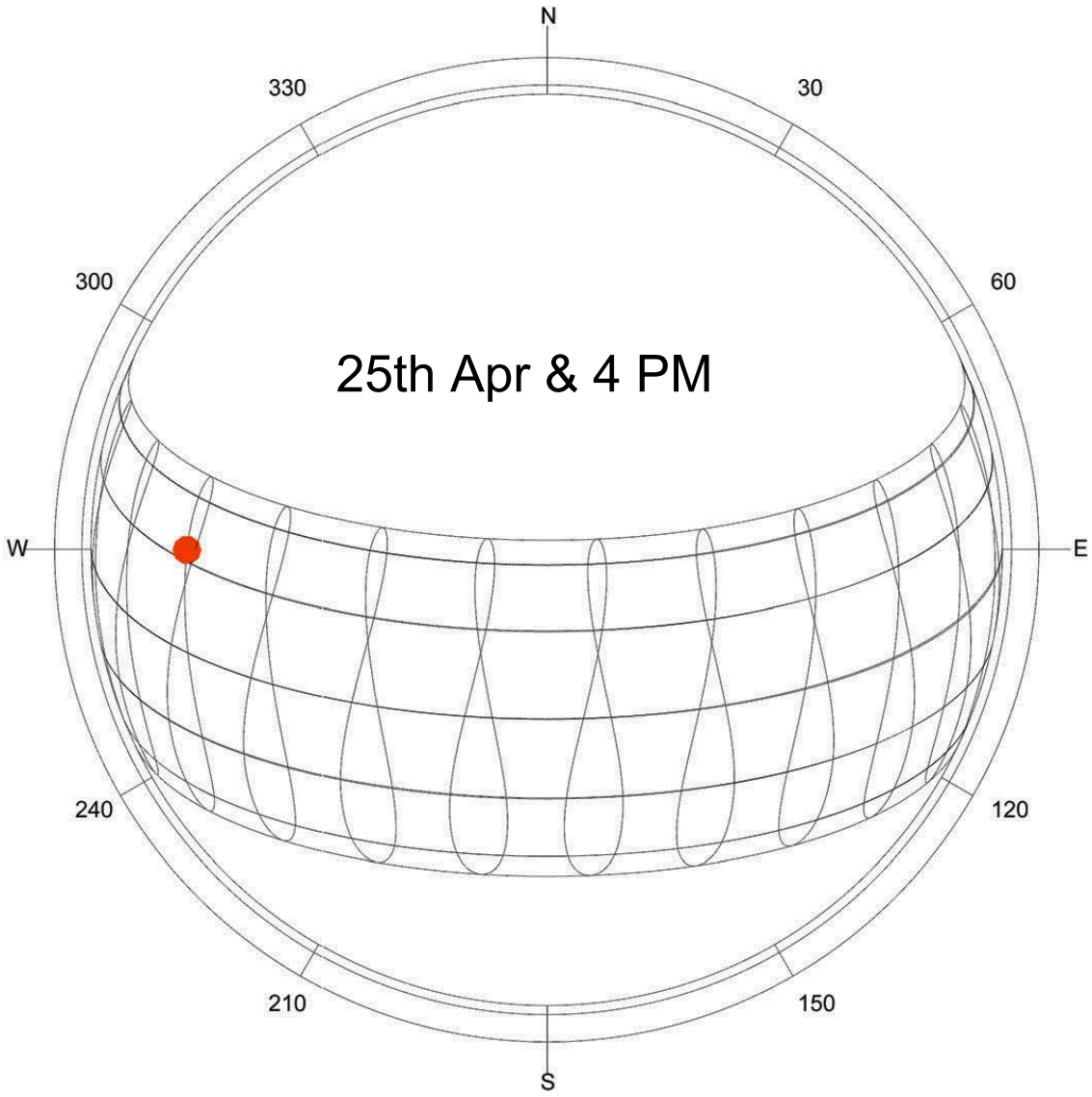

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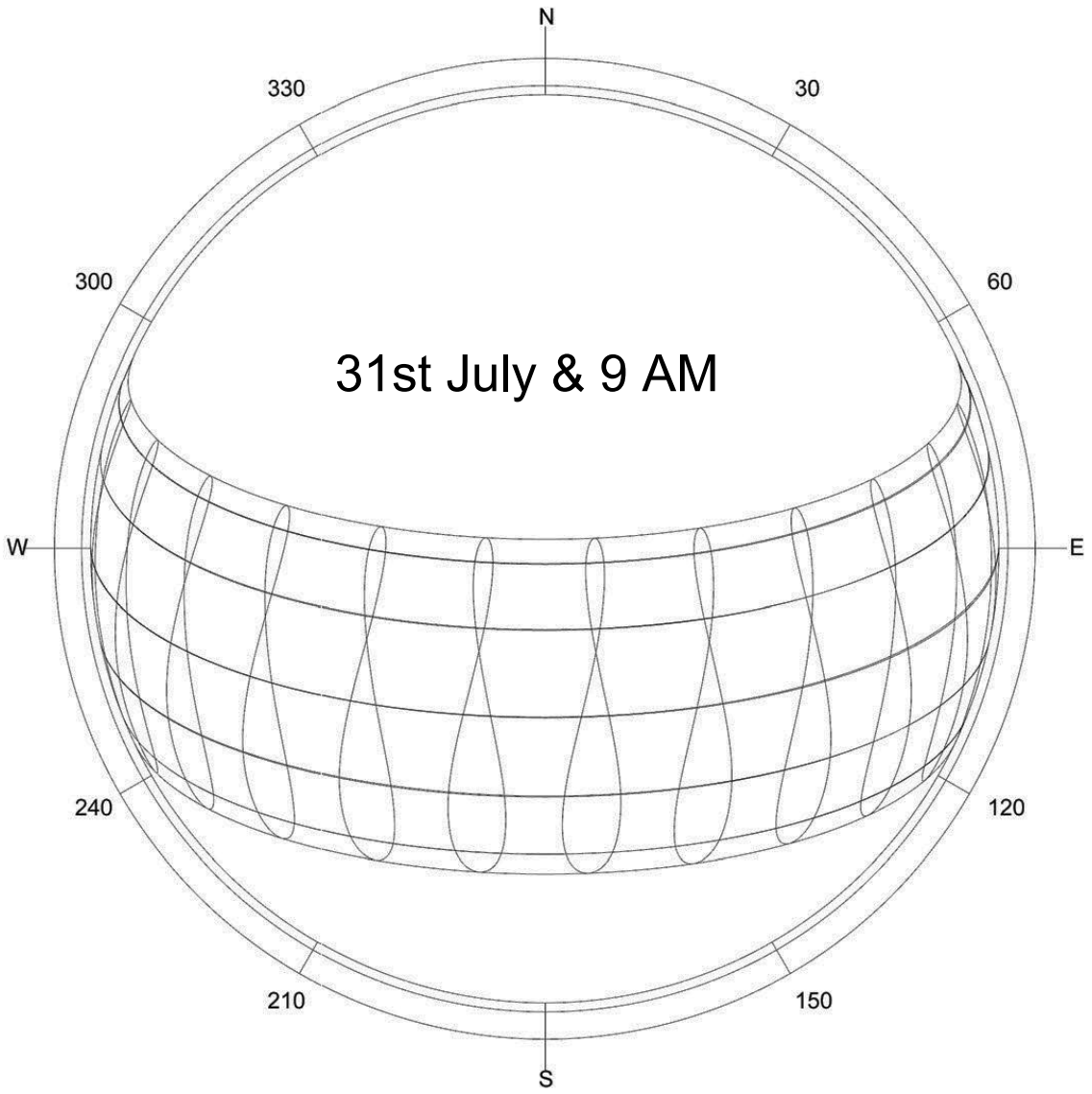
25 APR 16:00, ALT = 37.90, AZM = 269.89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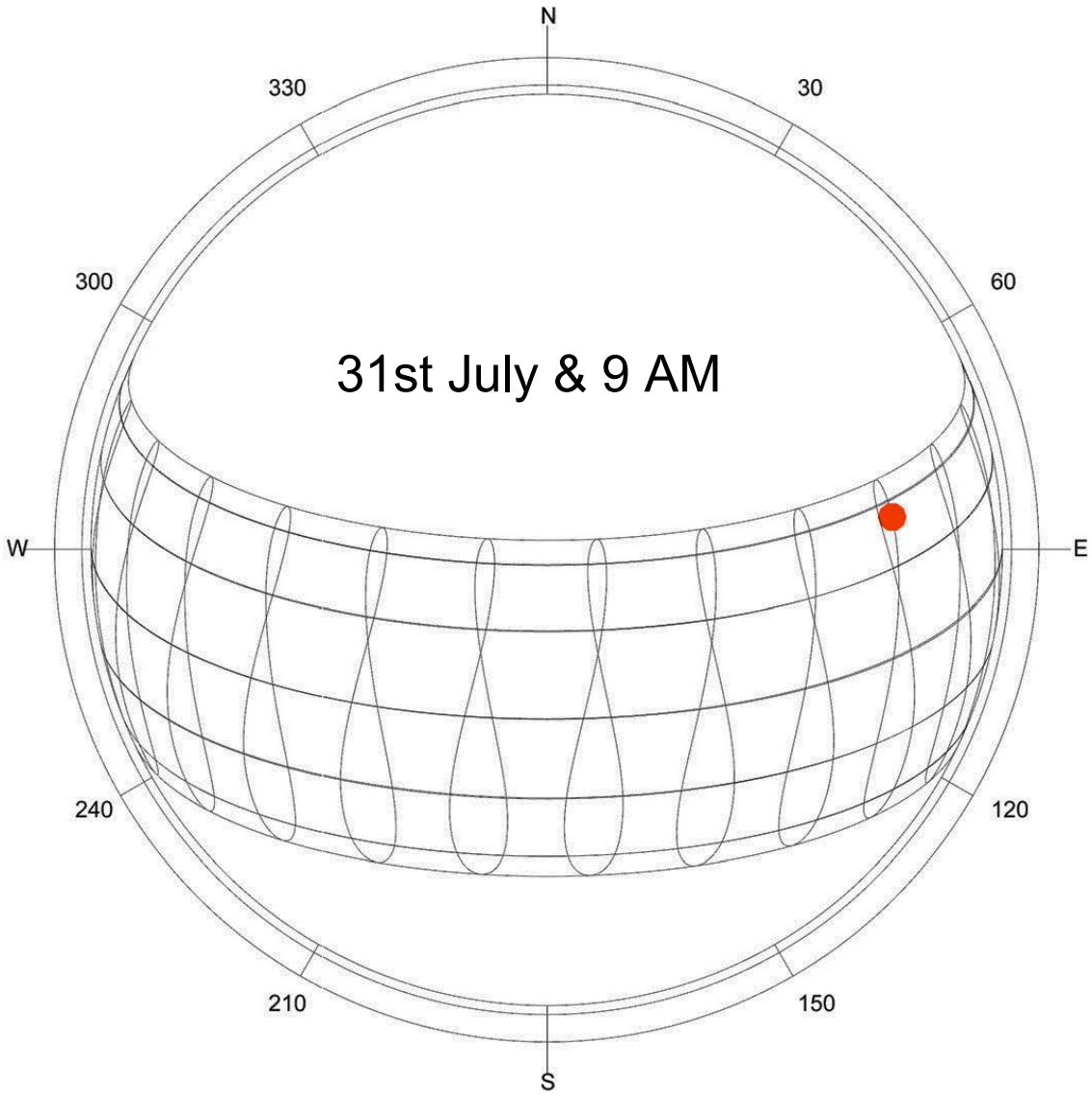
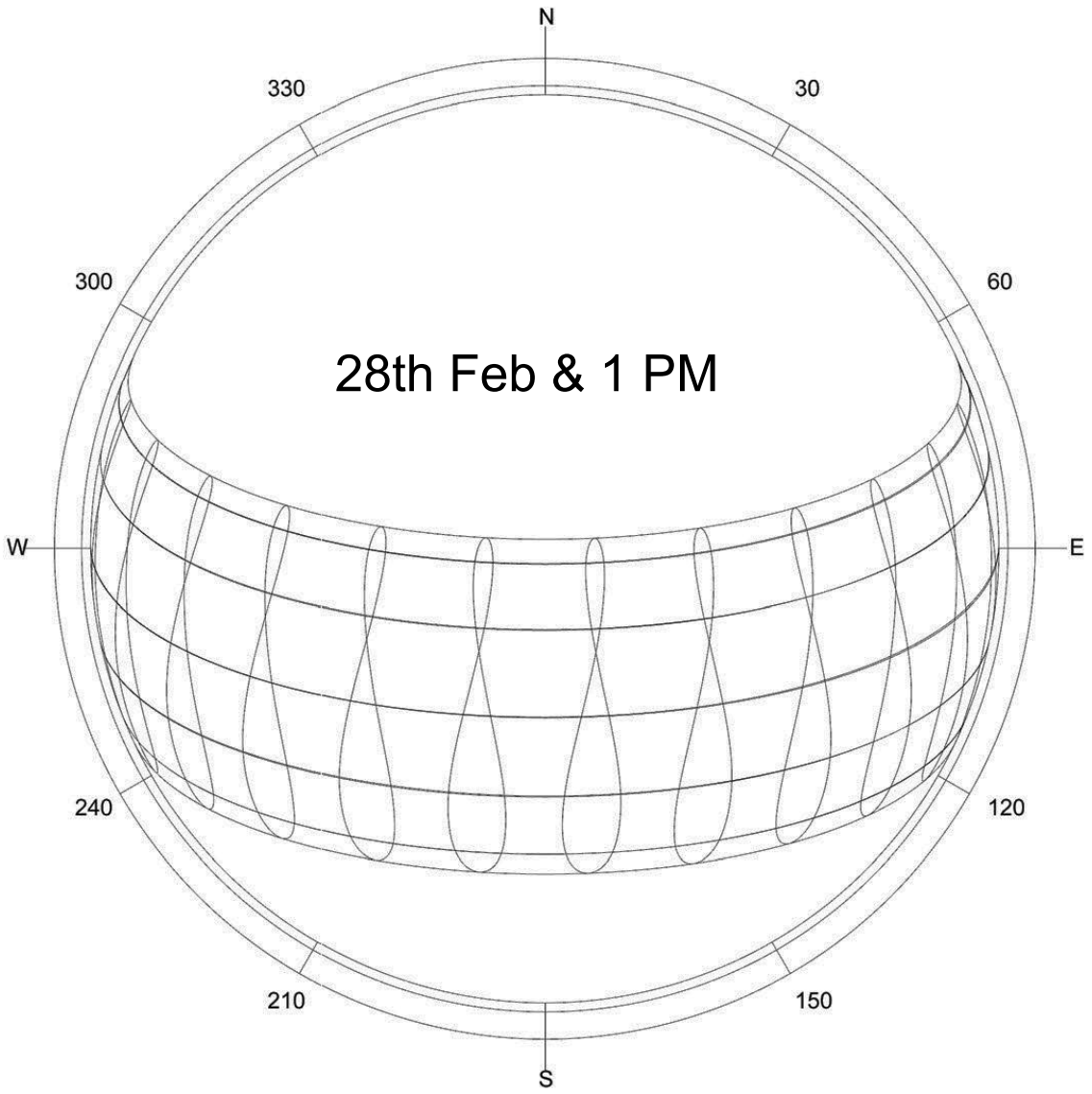


Sun-Path Diagram - Latitude: 22.3072
31 JUL 9:00, ALT = 40.42, AZM = 84.65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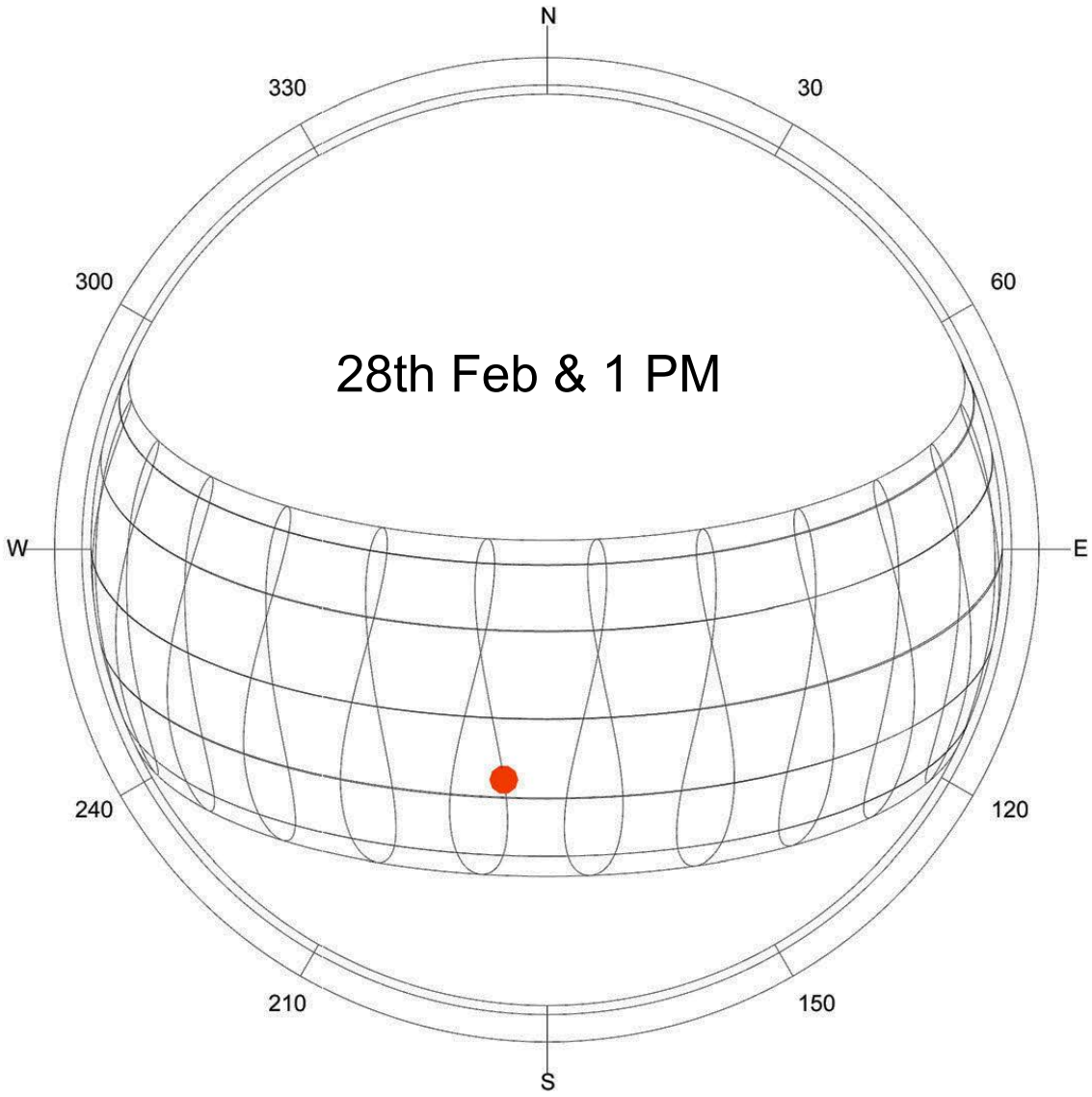
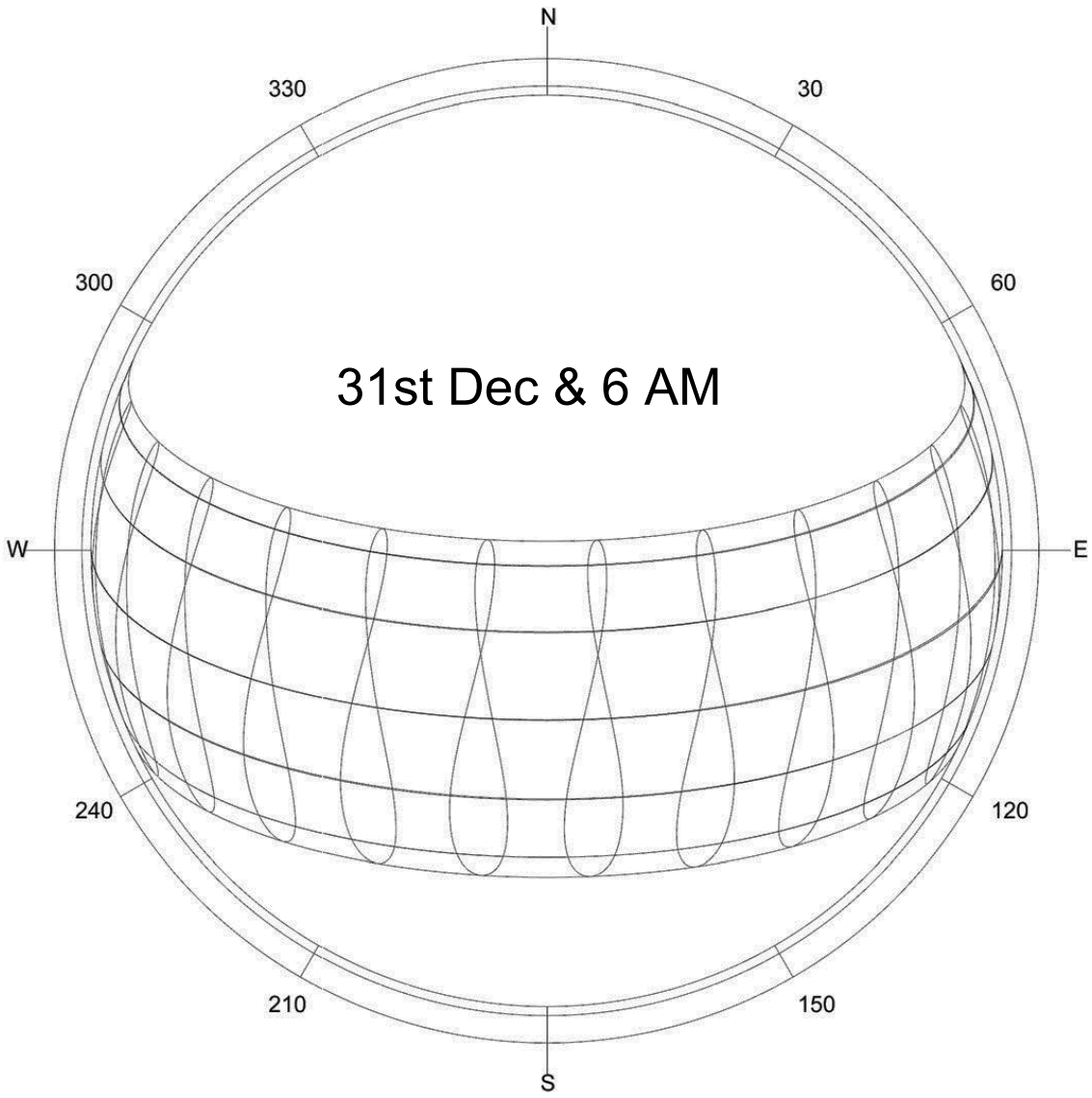


Sun-Path Diagram - Latitude: 22.3072
28 FEB 13:00, ALT = 59.08, AZM = 190.67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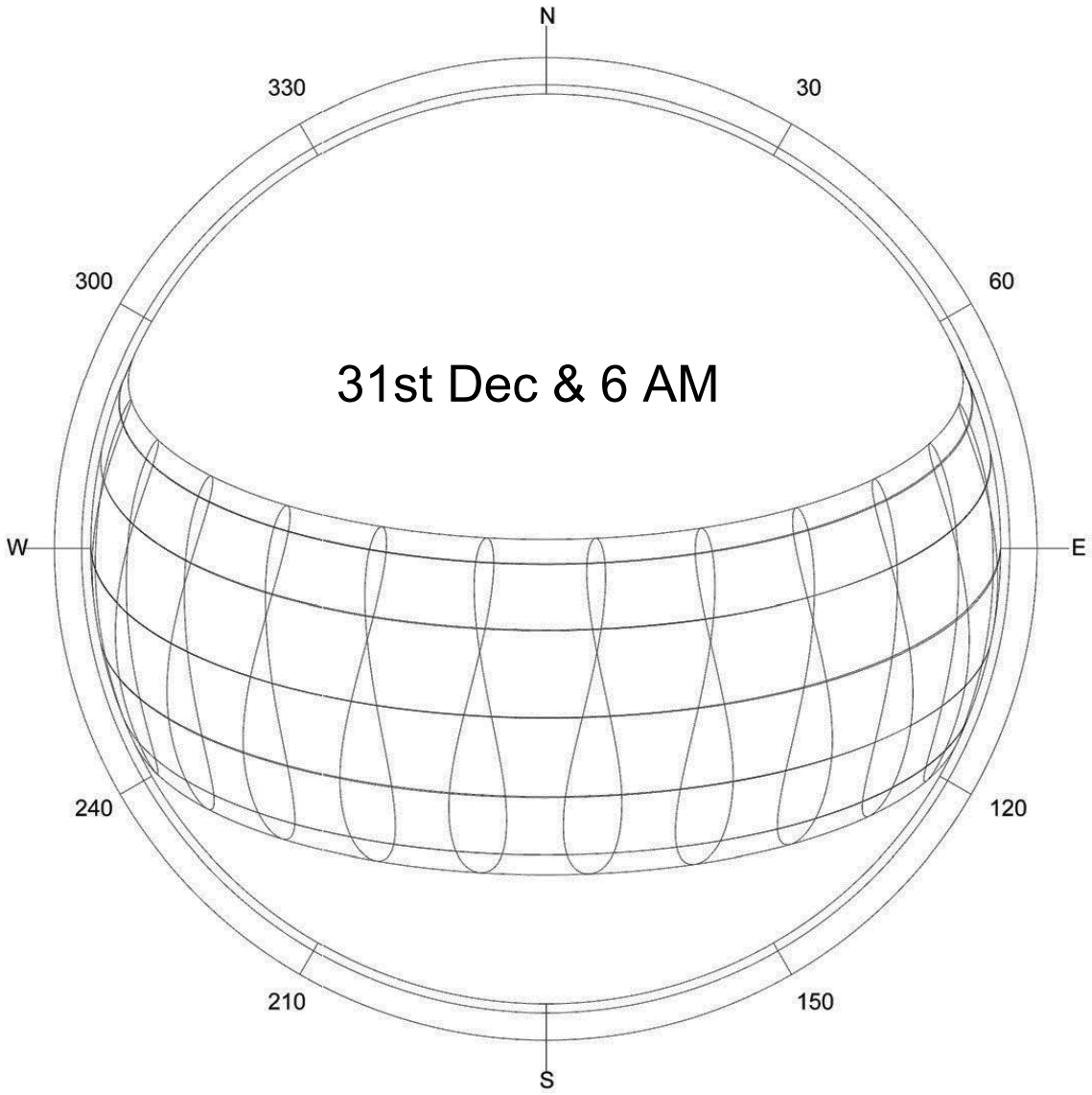
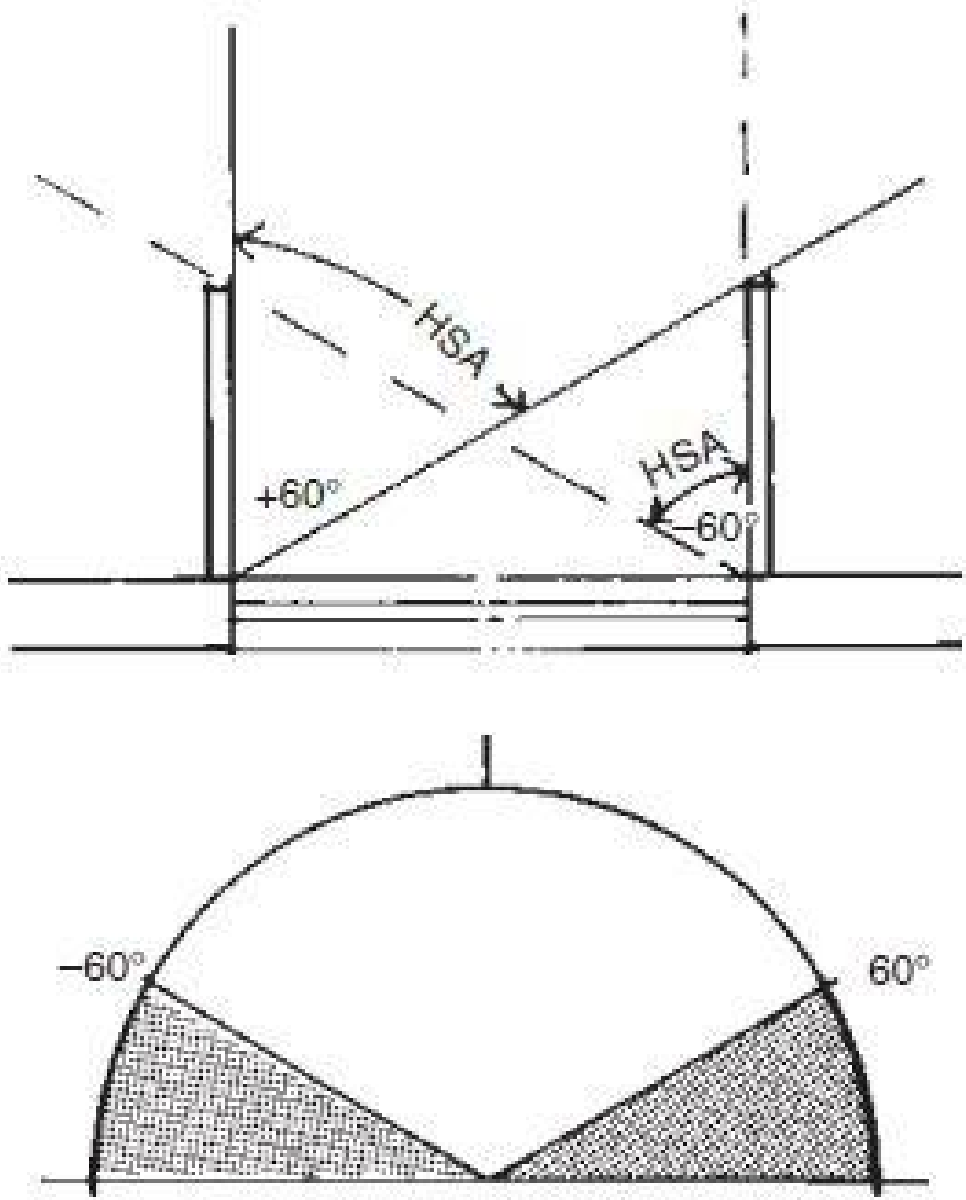


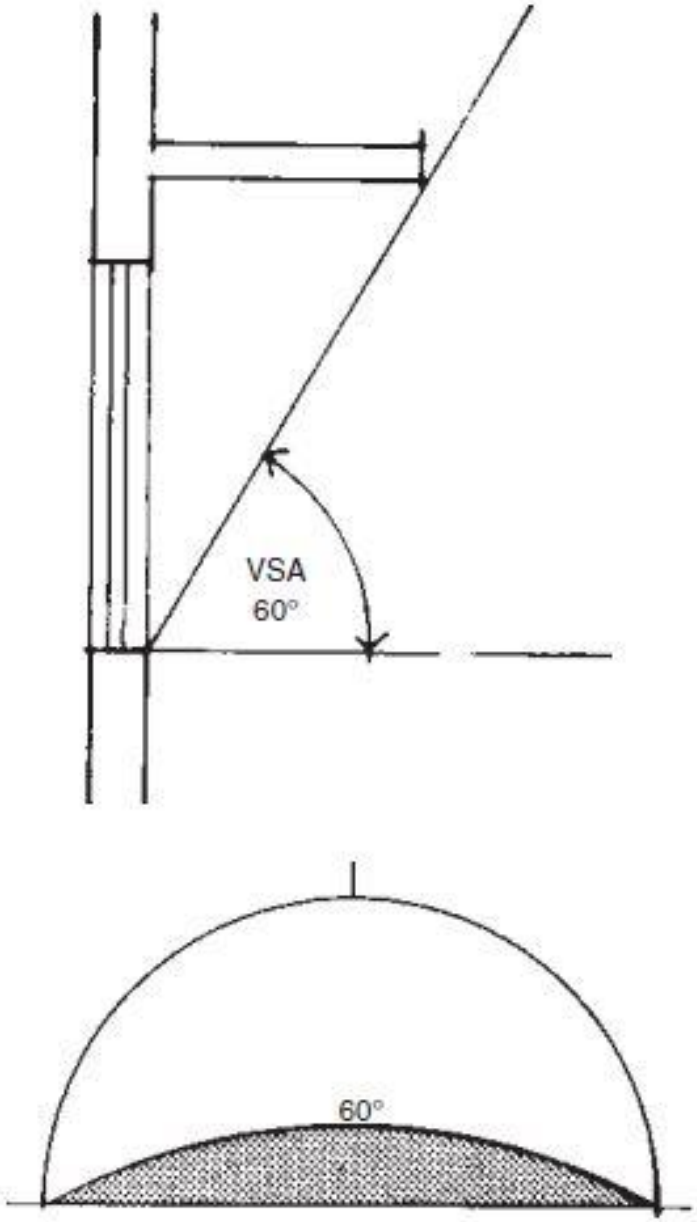
Sun-Path Diagram - Latitude: 22.3072
31 DEC

HSA & VSA



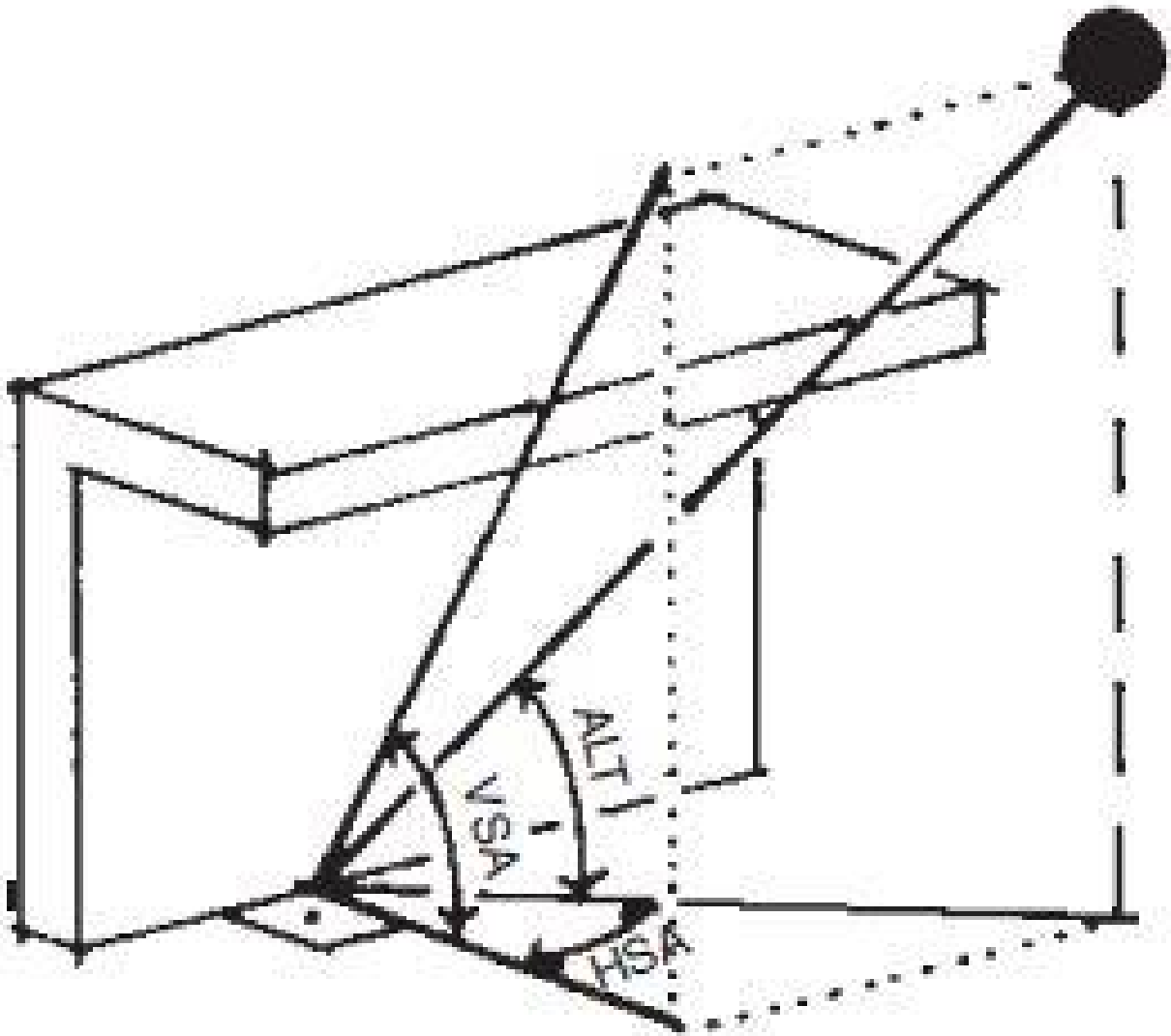
HSA = Horizontal Shading Angle

Credit:: Steveen Schozokolay



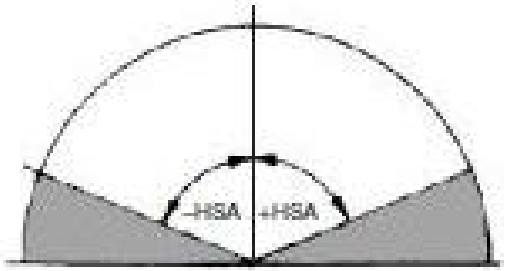
VSA = Vertical Shading Angle

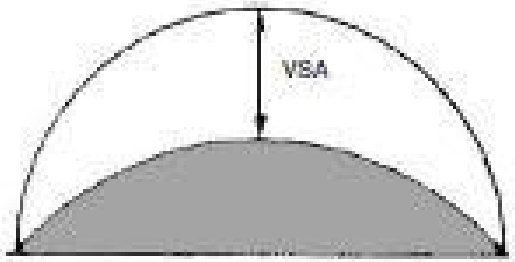
Credit:: Steveen Schozokolay

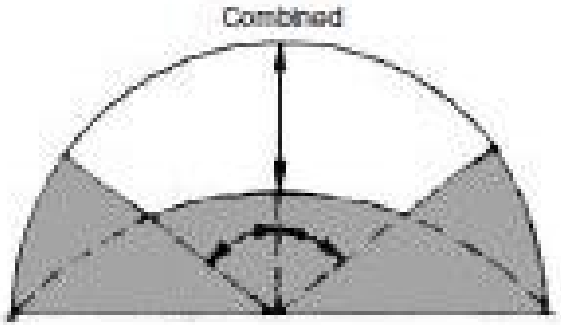


Projection of HSA and VSA on surface normal

Credit:: Steveen Schozokolay



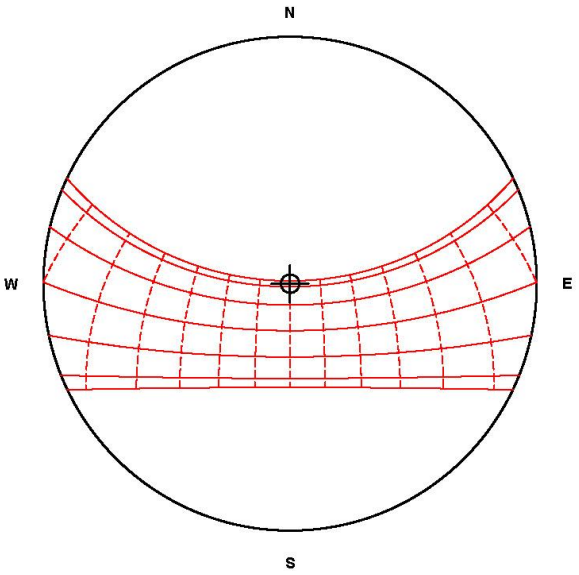




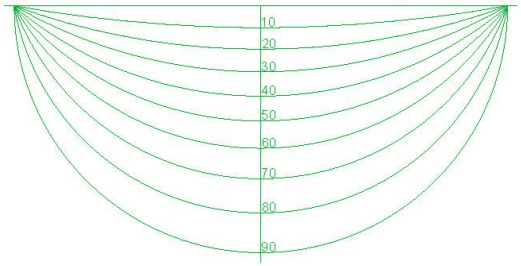
HSA & VSA Combined

Credit:: Steveen Schozokolay

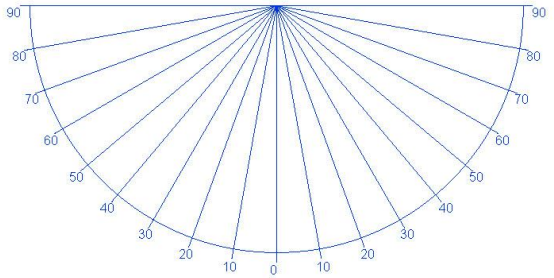
Examples



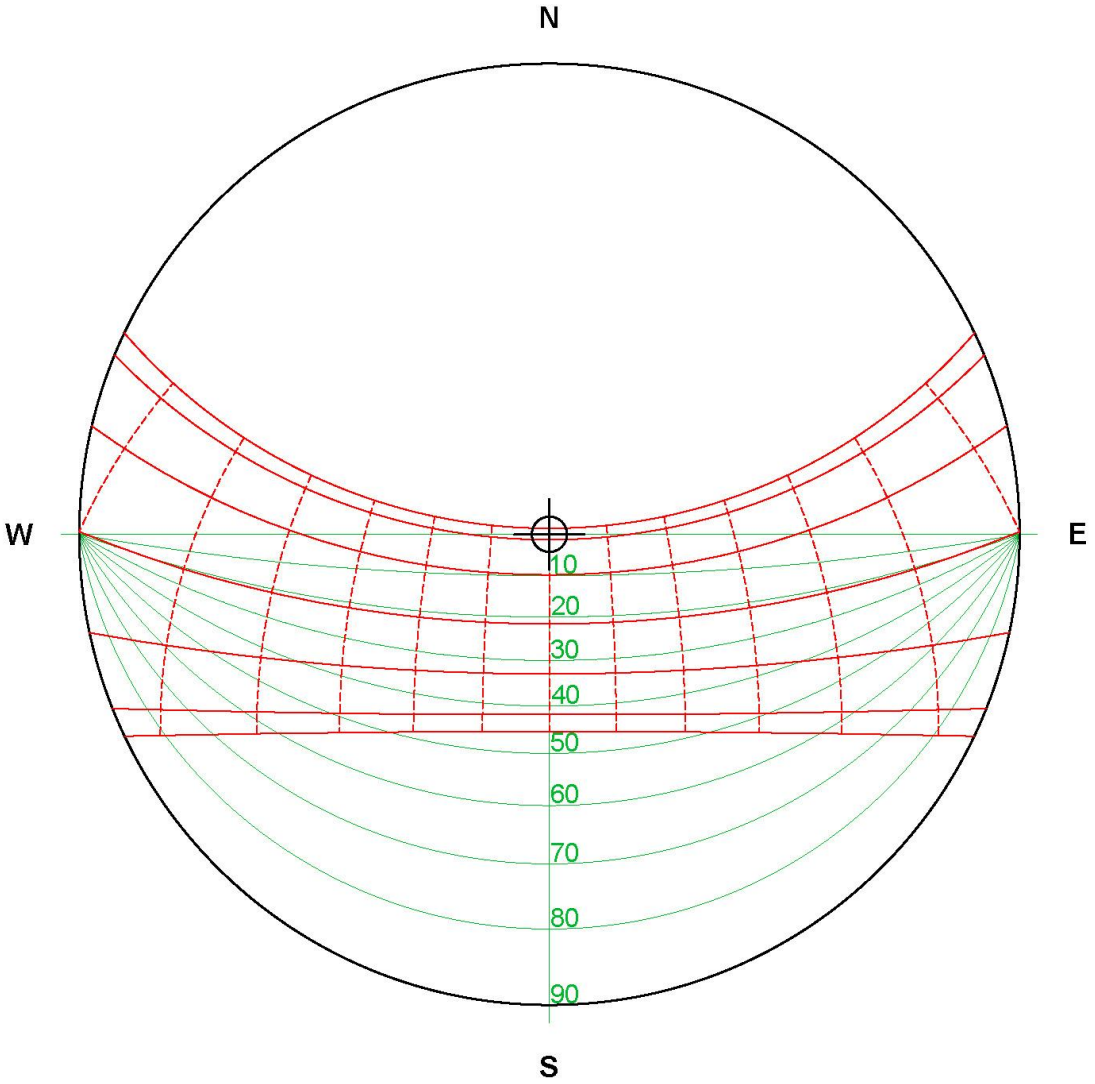
Sunpath



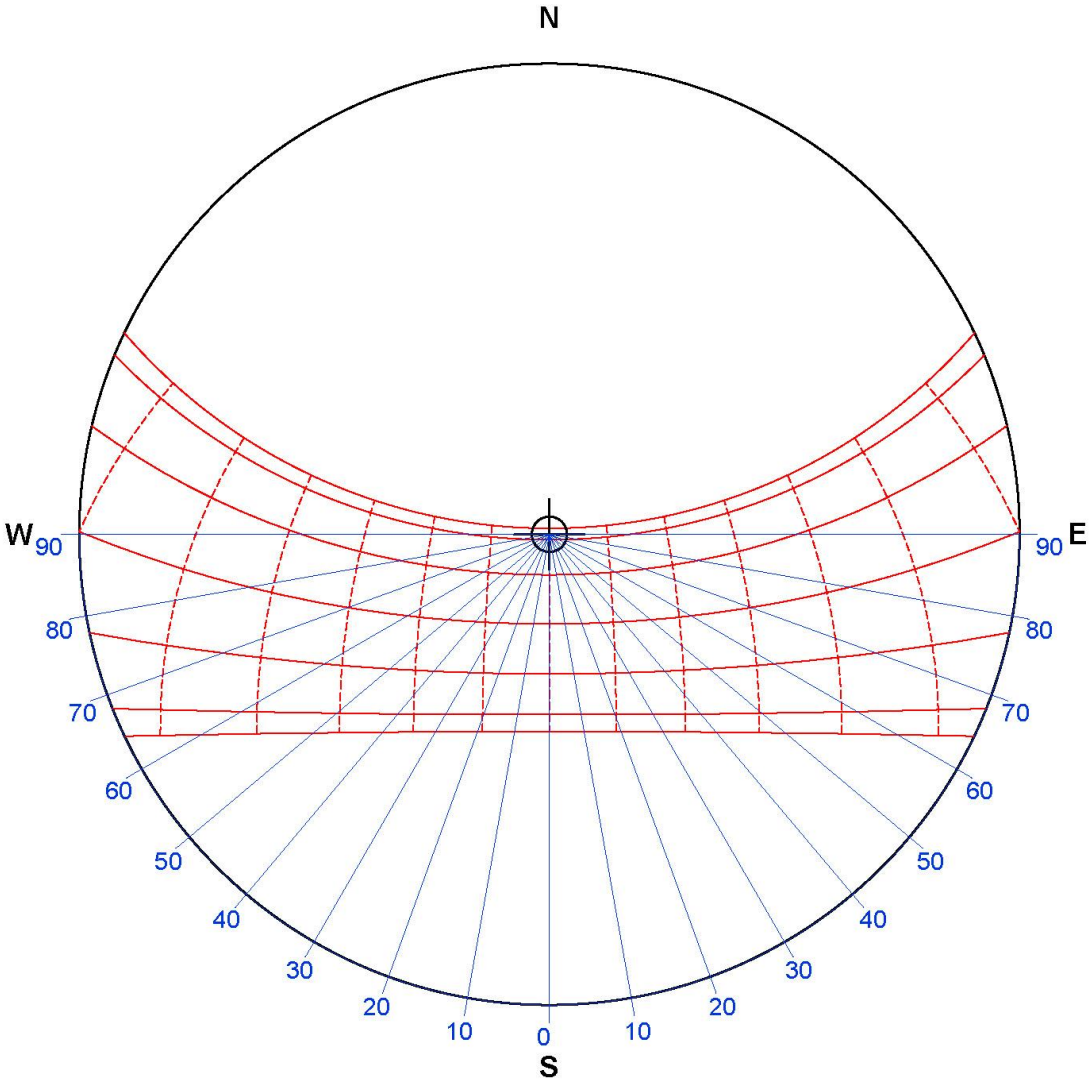
Vertical Shading Mask



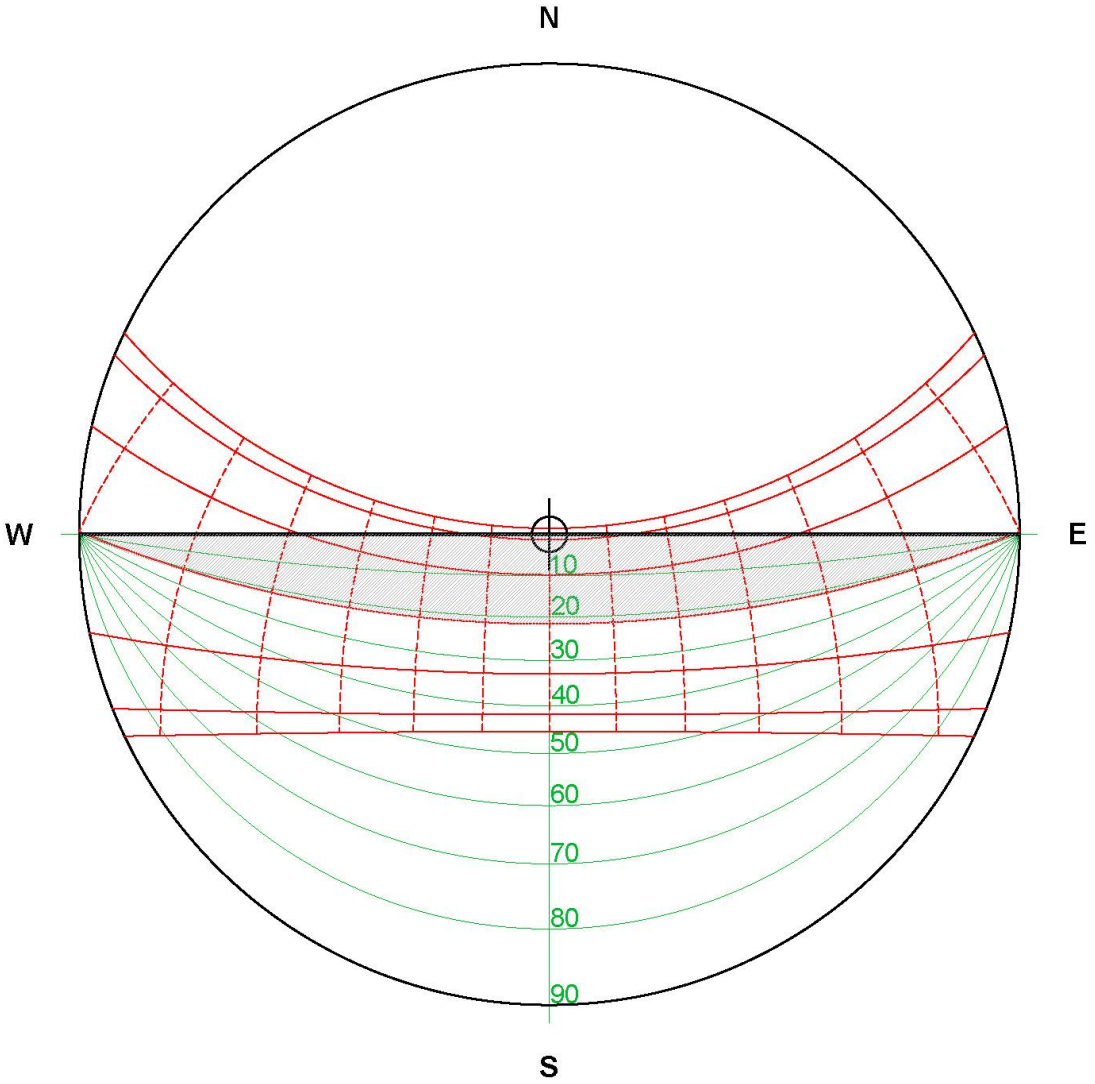
Horizontall Shading Mask



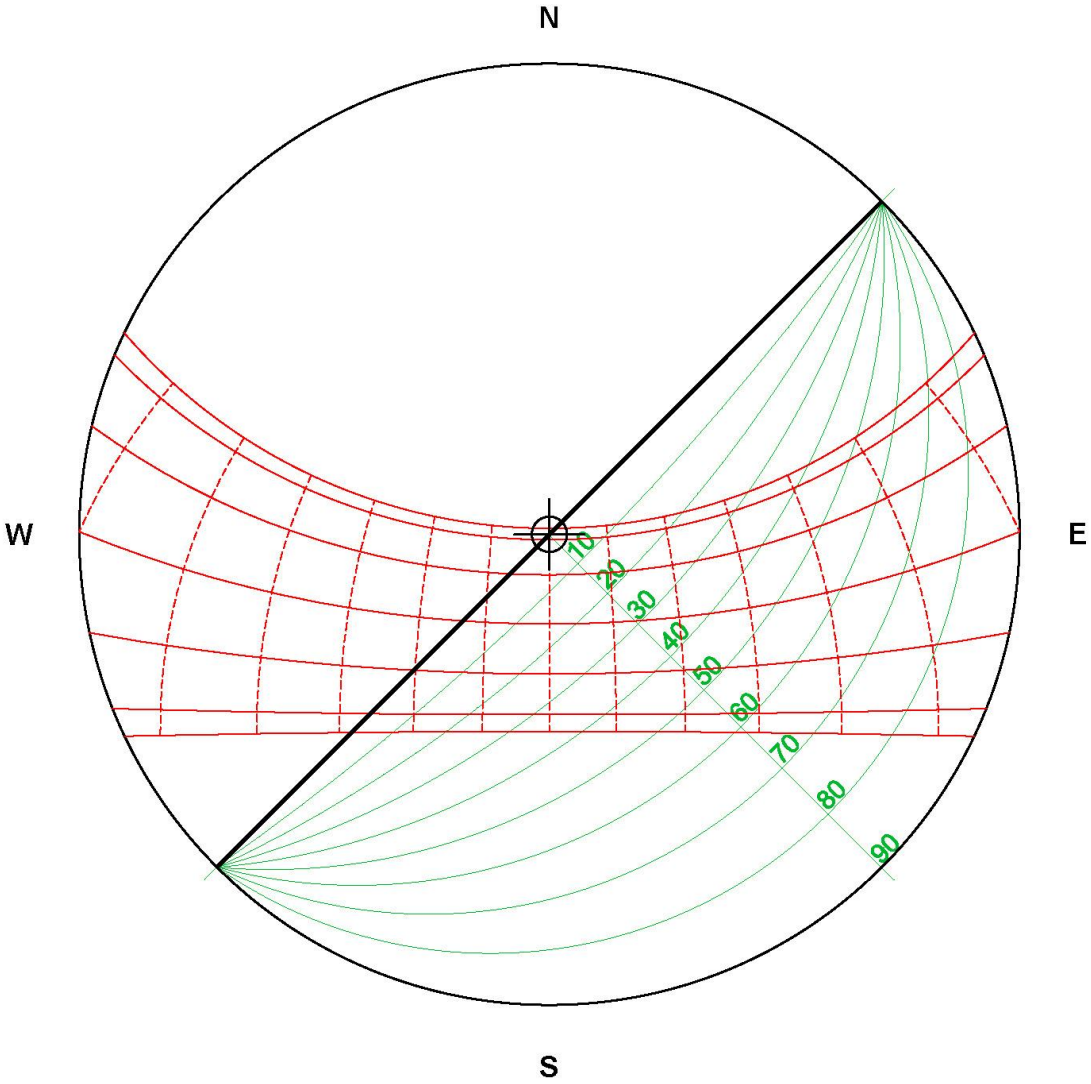
Sunpath + Vertical Shading Mask



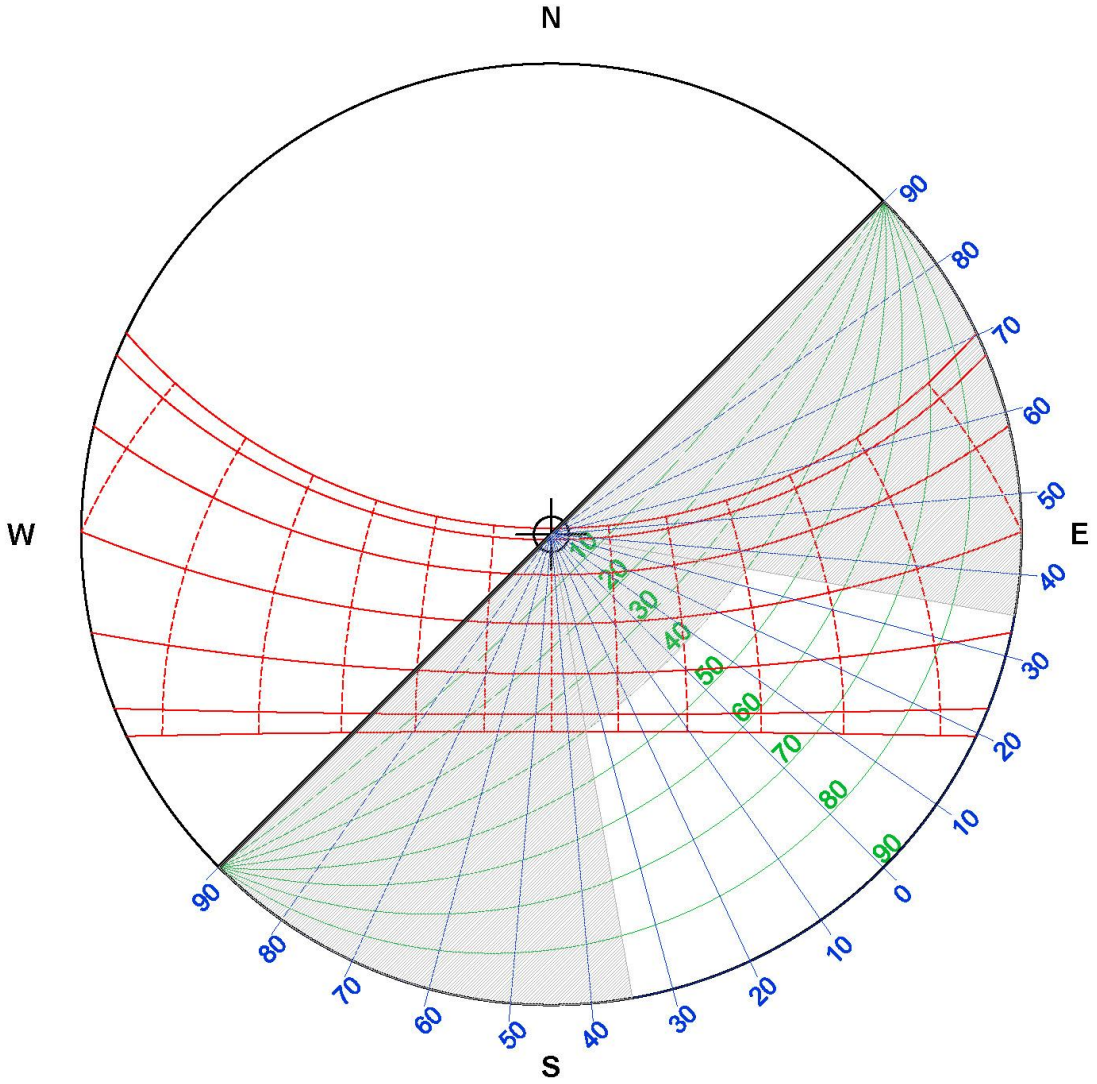
Sunpath + Hrizontal Shading Mask



Sunpath + Vertical Shading Mask + Shade Region

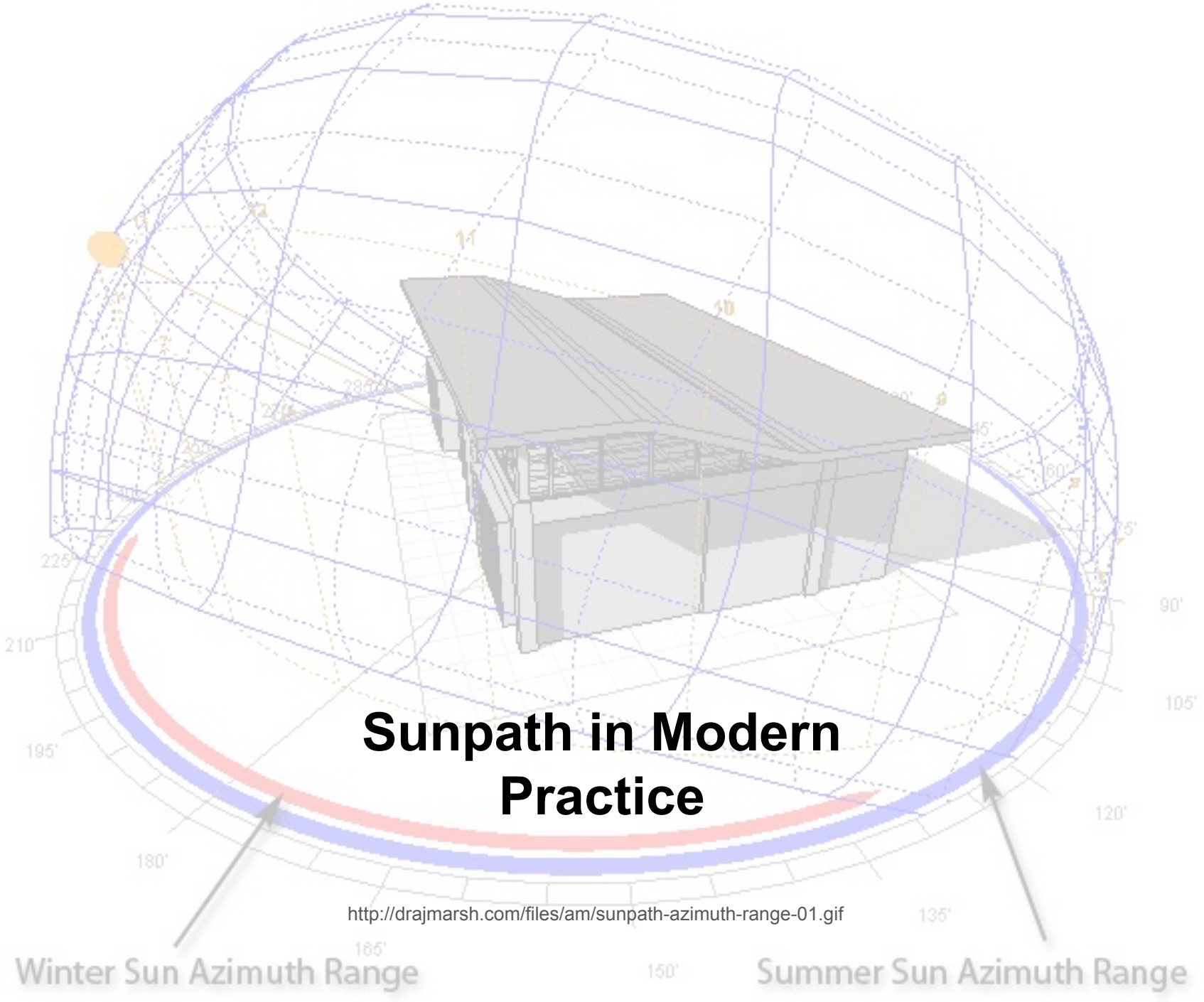


Sunpath + Vertical Shading Mask



Sunpath + Vertical Shading Mask + Horizontal Shading Mask + Shade Region

Sunpath in Modern Practice



http://drajmarsh.com/files/am/sunpath-azimuth-range-01.gif

East Hampton House - Overhang Analysis

5204 East Hampton House

Optimization of the facades that are exposed to the greatest solar loads can reduce conditioning costs and increase thermal and visual comfort. The most promising facade strategies for the East Hampton House are to use high-performance glazing and to use shading to decrease the amount of direct sunlight that is incident on glazing. This study analyzes the overhang range for the southeast and southwest facing facades for the East Hampton House.

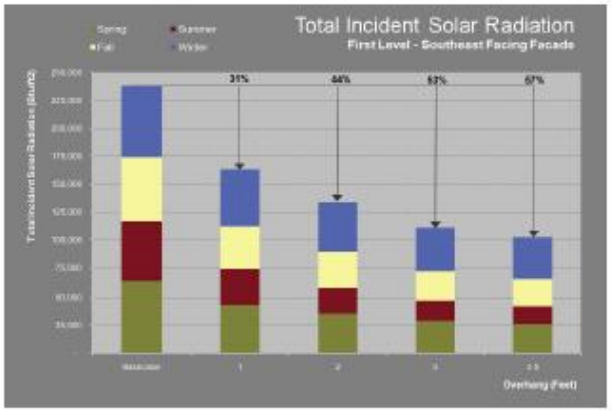
PROJECT DESIGN CRITERIA

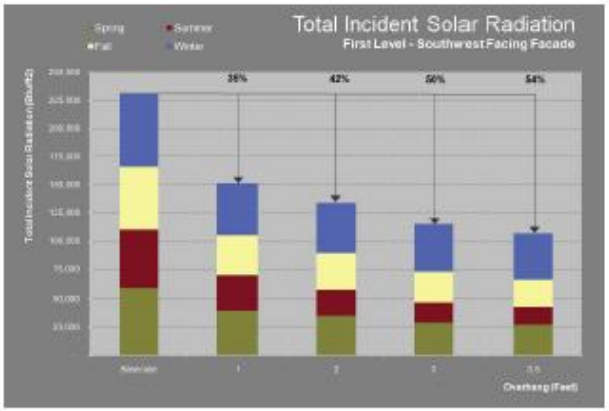
The current design overhang has a width of 3'-6". For a good passive design, the overhang should reduce the annual solar heat gain by 40%. In addition, the overhang should reduce solar heat gain in the summer, while promoting passive solar heating in the winter. There are four overhang widths tested in this study:

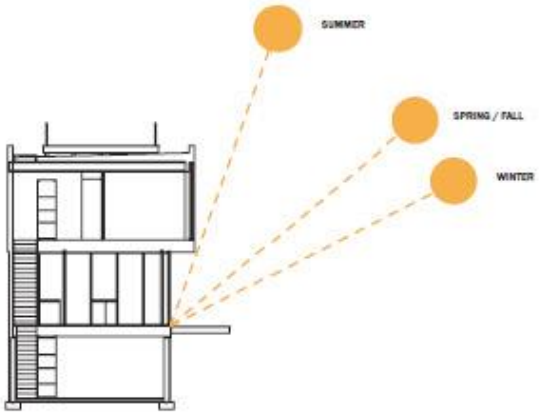
- Overhang Width of 1'-0"
- Overhang Width of 2'-0"
- Overhang Width of 3'-0"
- Overhang Width of 3'-6" (Current Design)

DESIGN RECOMMENDATION

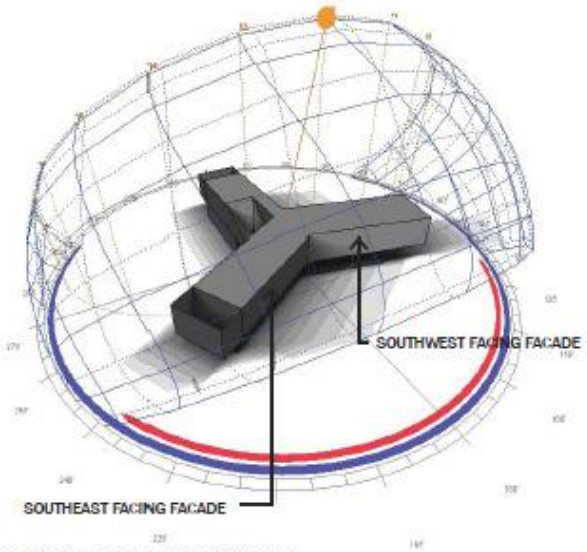
The current design effectively reduces annual incident solar radiation by 50%; however, it has undesirably low cumulative winter incident solar radiation. The overhang width of 2'-0" has an overall incident solar radiation reduction of over 40%, which meets our design goal. This option reduces the solar heat gain in summer by 50%, while still allowing sufficient passive heating capacity in winter. Based on this study, Atelier Ten recommends that the overhang width should be at a minimum 2'-0" and not to exceed 3'-6".



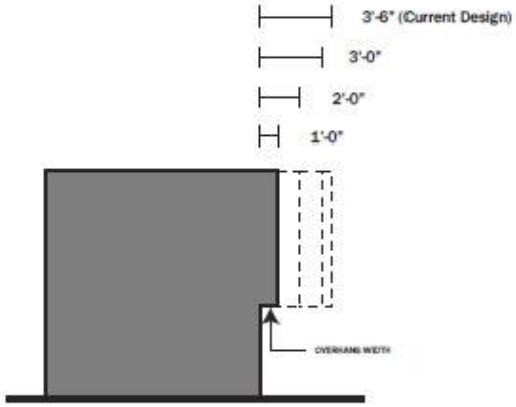




Seasonal Sun Angle at Noon



East Hampton House Model with Sun Path

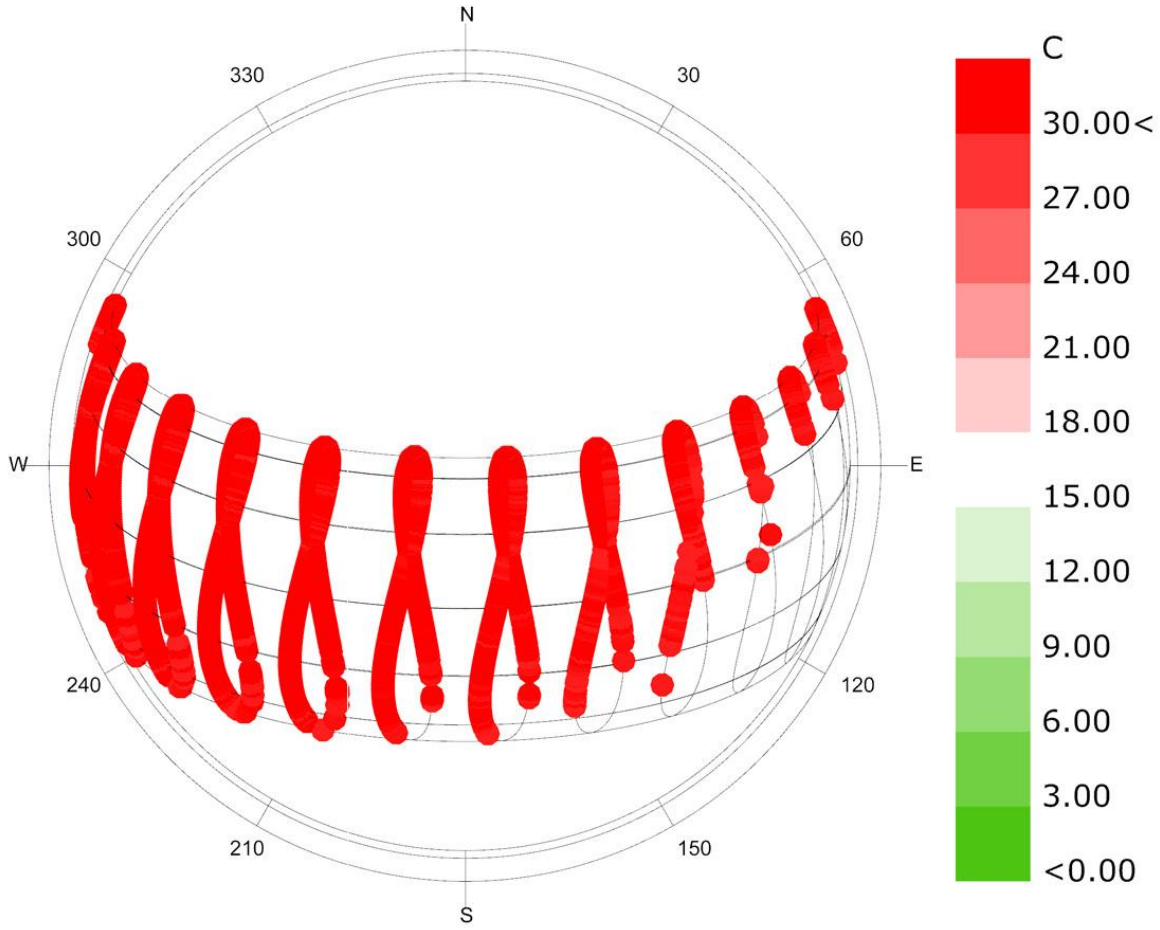


Overhang Width

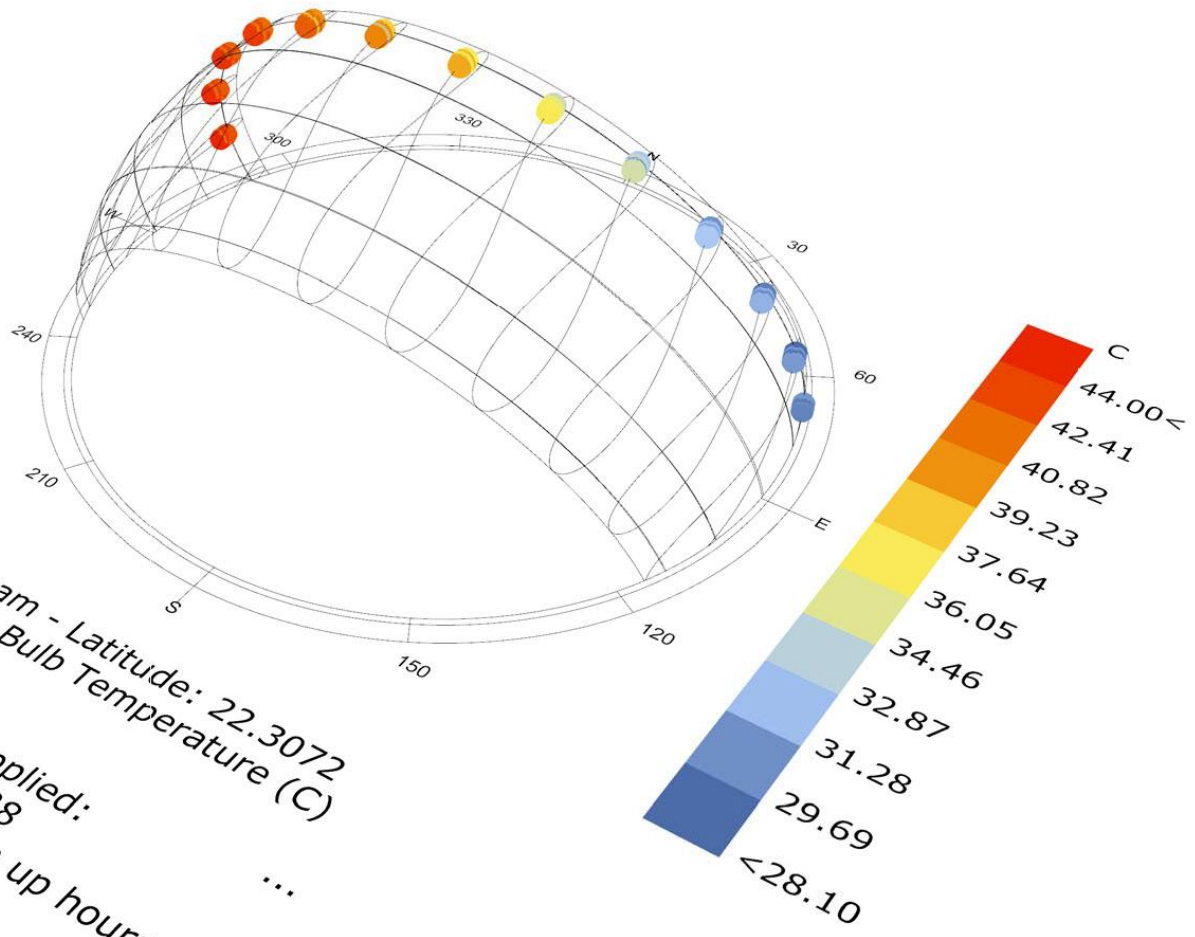
atelier ten
Environmental Design Consultants + Lighting Designers
45 East 20th Street, 4th Floor New York NY 10003 T +1 (212) 254 4500 www.atelierteh.com

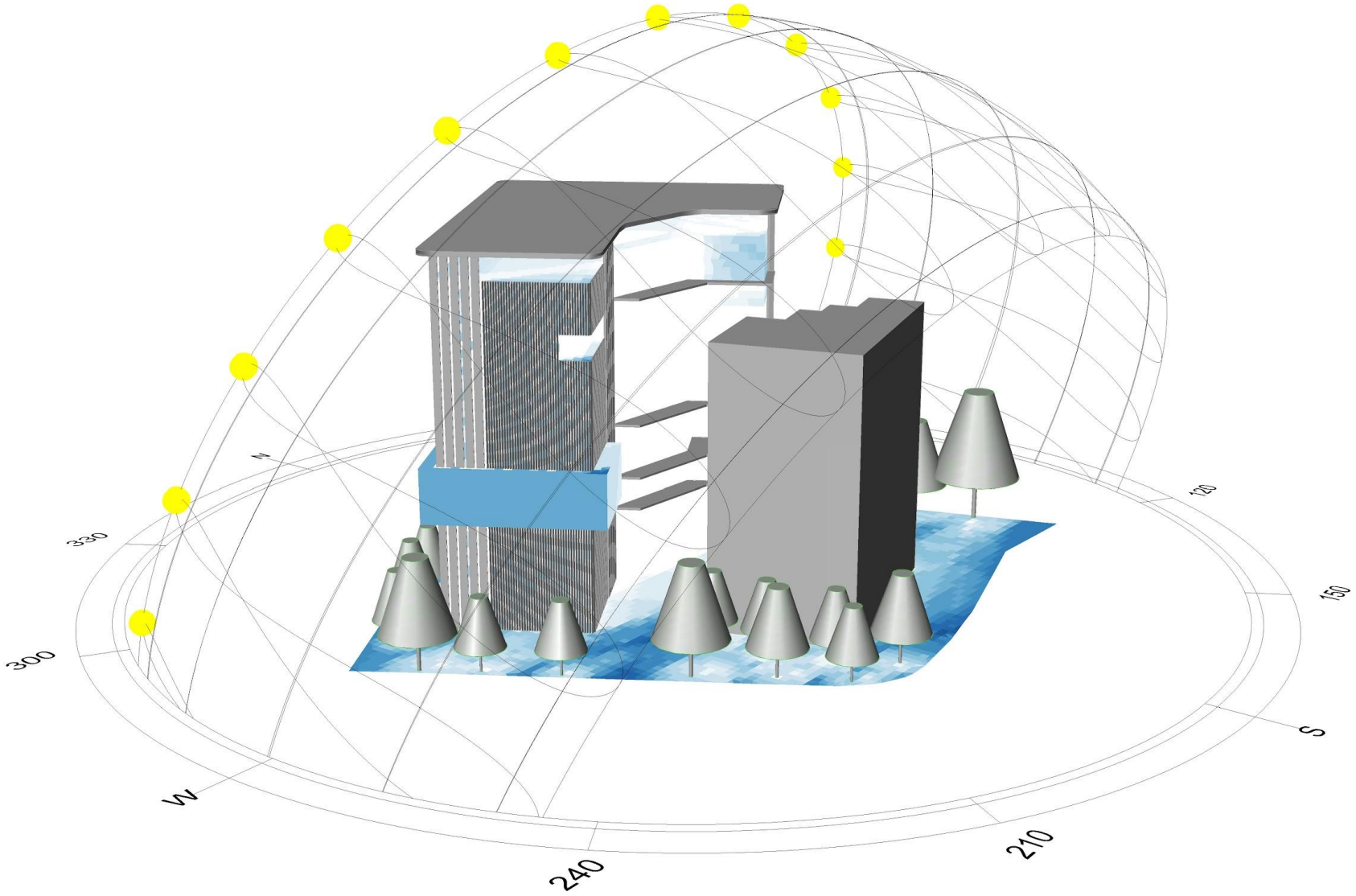
Credit: Jessica Zofchak

What’s next?

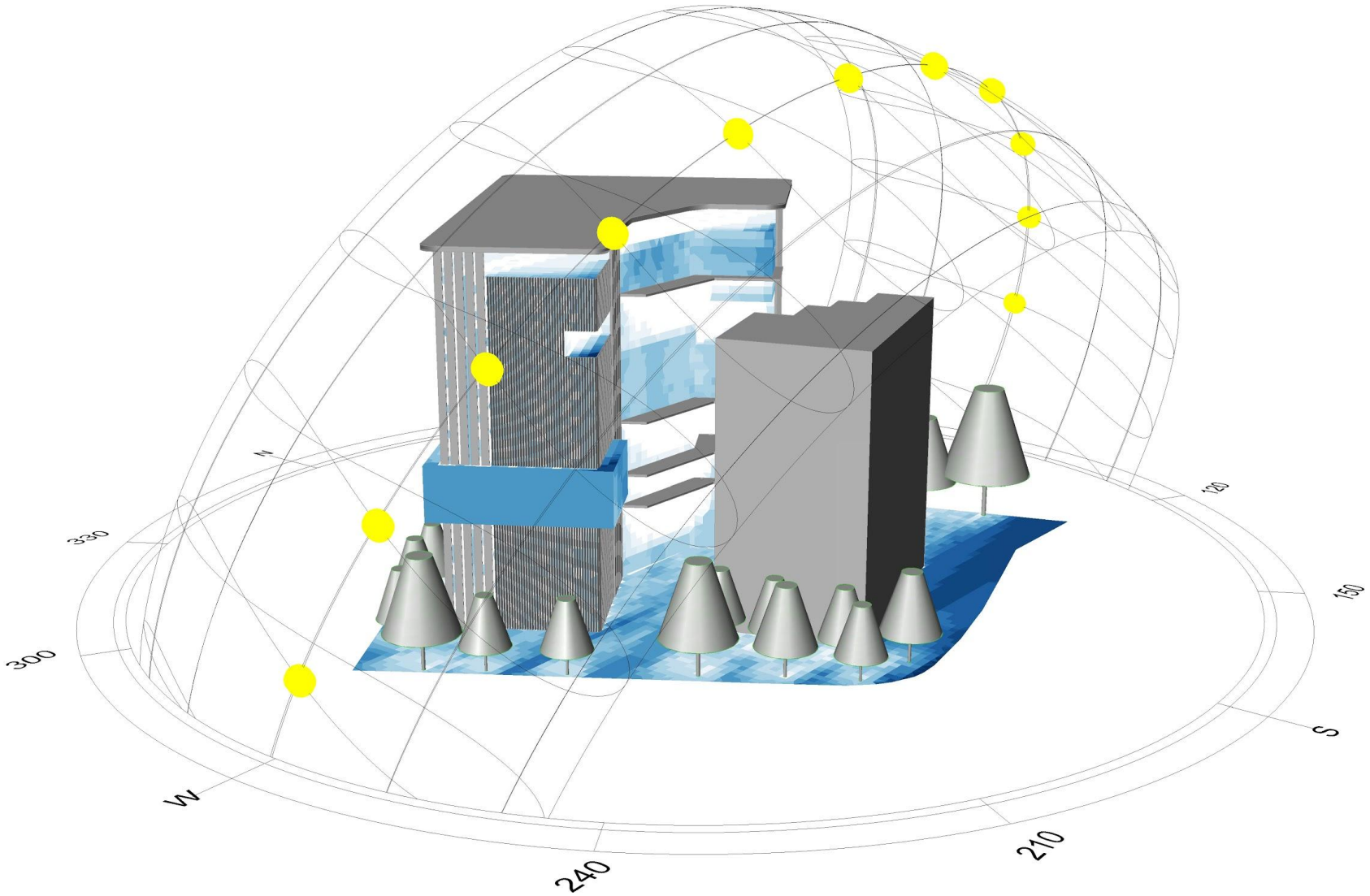


Sun-Path Diagram - Latitude: 22.3072
Hourly Data: Dry Bulb Temperature (C)
AHMEDABAD_IND
... ...
Conditional Selection Applied:
Dry Bulb Temperature>28
2637.0 hours of total 4378.0 sun up hours(60.23%).

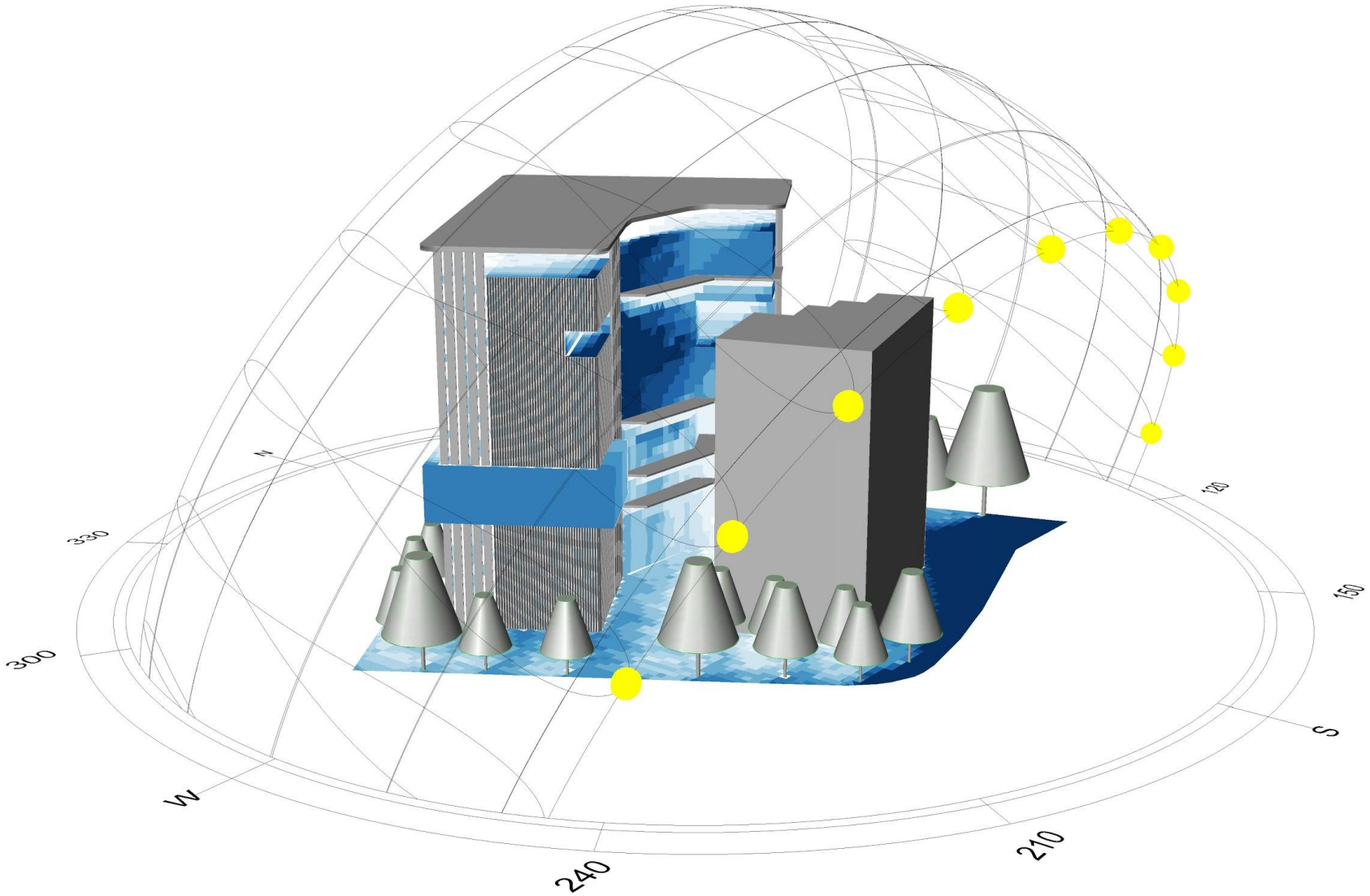

Sun-Path Diagram - Latitude: 22.3072
Hourly Data: Dry Bulb Temperature (C)
AHMEDABAD_IND
...
Conditional Selection Applied:
...
Dry Bulb Temperature>28
86.0 hours of total 91.0 sun up hours(94.51%).
...
C
44.00<
42.41
40.82
39.23
37.64
36.05
34.46
32.87
31.28
29.69
<28.10
N
E
S
W
30
60
120
150
210
240
300
330



Sunlght Hours Analysis - June 21st



Sunlght Hours Analysis - March 21st



Sunlght Hours Analysis - December 21st

Questions
Comments

Alright! You may stand up now!

https://qph.ec.quoracdn.net/main-qimg-8380b11d3d51db1d220f8d3f908141a7