SOLAR ACCESS AND SHADOW ANALYSIS

ILLUSTRATIONS OF HOW TO COMPLETE AN ANALYSIS

As required by SMC 19.56 and the Community Development Director

BACKGROUND

The City of Sunnyvale has a solar Access Ordinance which is intended to preserve the ability of residents to add functional solar panels to their roof. For this reason, each new second story addition needs to be analyzed to determine the extent of projected shadow on neighboring roofs.

The Sunnyvale Municipal Code (SMC) states that no new construction may shade more then 10% of the area of a neighboring roof on the shortest day of the year, December 21st, from 9 a.m. to 3 p.m. It also states that no new construction may shade any part of an existing solar collector. Please keep that in mind when designing your second story. The complete Solar Access Ordinance is located in Chapter 19.56 of the SMC, and can be obtained at the One-Stop counter or online at Sunnyvale, CA - Planning and Building

The following five pages provide step by step illustrations of how to complete the analysis. This method requires only a scale and a protractor. Please contact the Planning Division if you have any questions.

KEY TERMS

The sun's position is defined by two angles: the **altitude angle** and the **azimuth angle**.

Altitude Angle - the angle measured from the horizon up to the sun. For example, when the sun is on the horizon, the altitude angle is 0˚. When the sun is directly overhead, the angle is 90˚.

Azimuth Angle -The angle measured from the position of the city to the "true" or geographic north.

Shortest Day of the Year = On December 21St
The azimuth angle of Sunnyvale, California at 9:00 a.m. is 137˚ east from north. At 3:00 p.m., Sunnyvale's azimuth angle is 137˚ west from north.

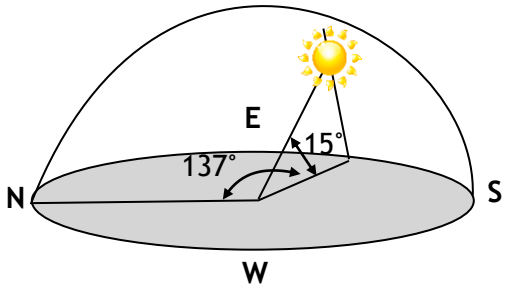
The altitude angle of Sunnyvale California at 9:00 a.m. and 3:00 p.m. is 15˚.

INSTRUCTIONS

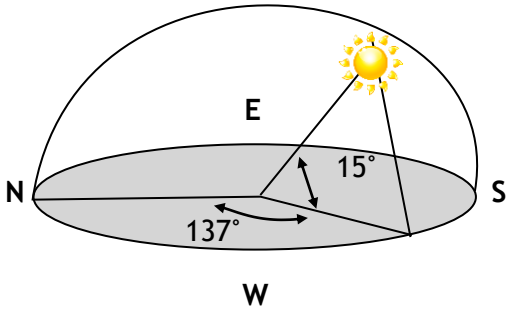
Refer to pages 2 through 7 for directions and illustrations.

SUN ANGLES:

DECEMBER 21ST
9:00 A.M.

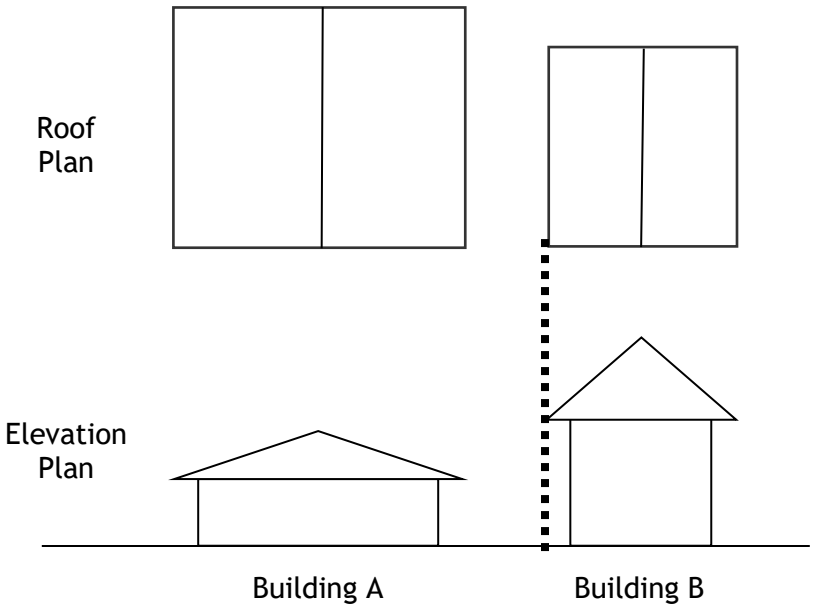


DECEMBER 21ST
3:00 P.M.



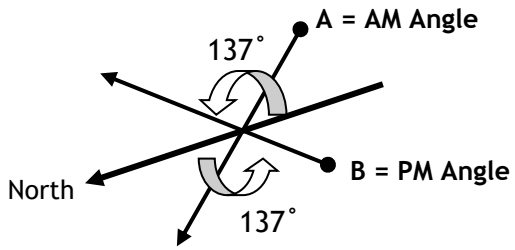
Instructions For Calculating The Maximum Shadow At 3:00 PM

Step 1



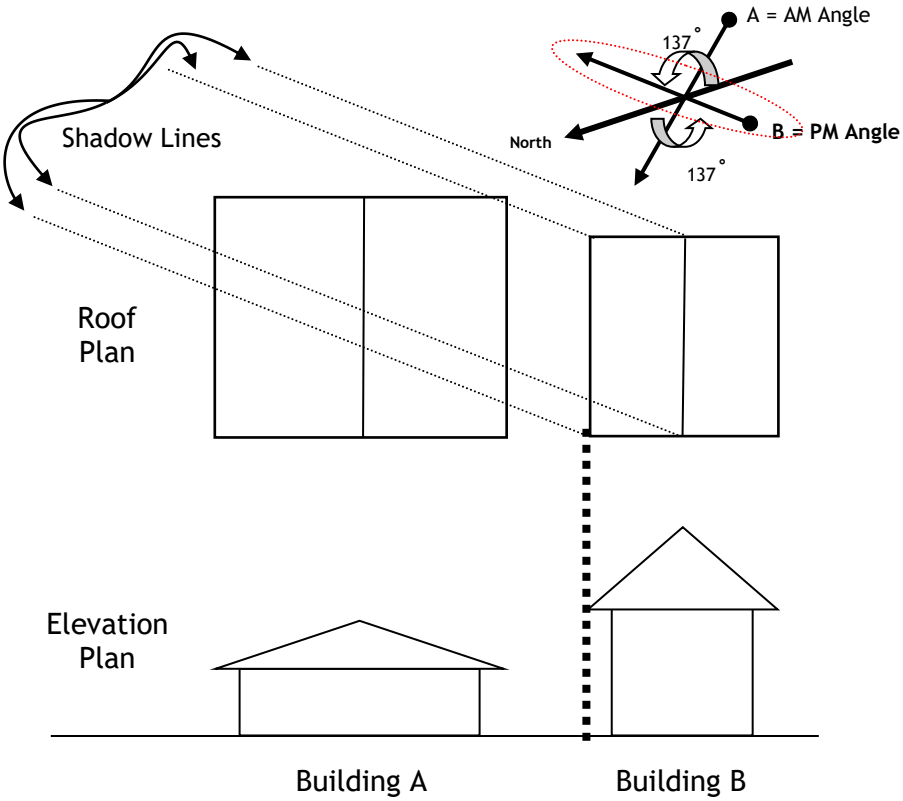
1. Draw elevations of the proposed structure and the affected building. Next draw a roof plan directly above the elevation making sure each roof plan aligns with the elevation. These drawings must be placed on the same plan and drawn to the same scale (min. 1:1/8). The roof plans must line up with the elevation drawings (see dotted line lining up the roofs on Building B).

Step 2



2. Identify the north direction and draw two 137˚ angles from the north direction (see points A and B). These lines demonstrate the sun angles at 9 a.m. and 3 p.m. on December 21st, (the shortest day of the year).

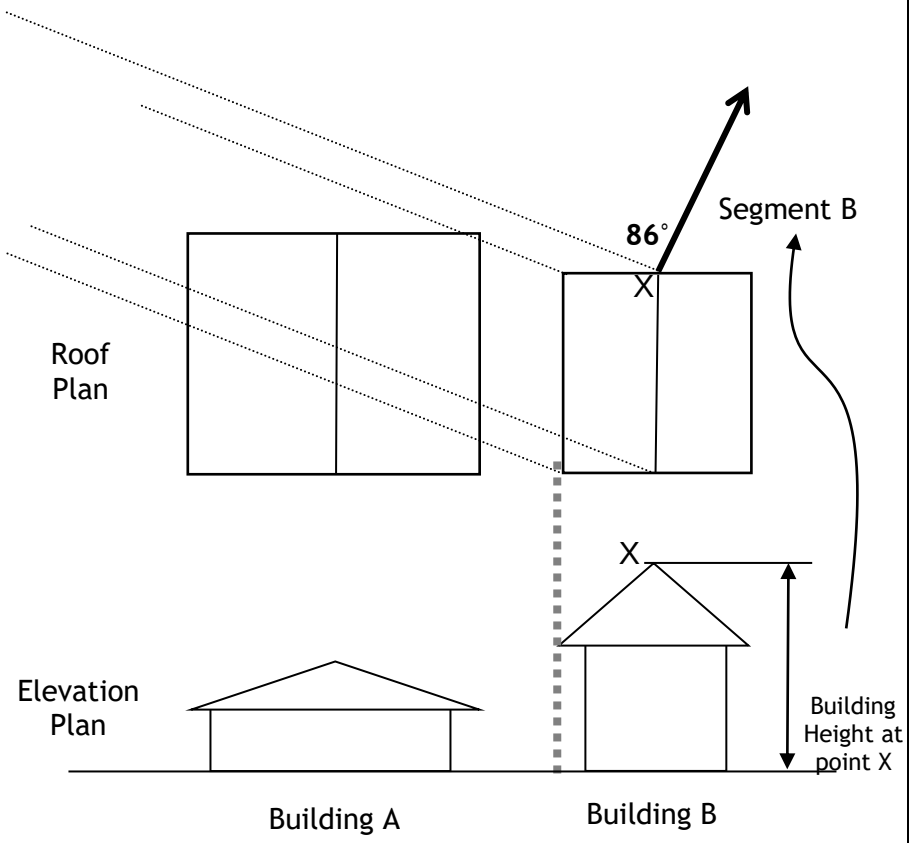
Step 3



3. Draw **shadow lines** parallel to the PM angle from each edge of the roof plan. These lines show how the sun will be angled across the roofs.

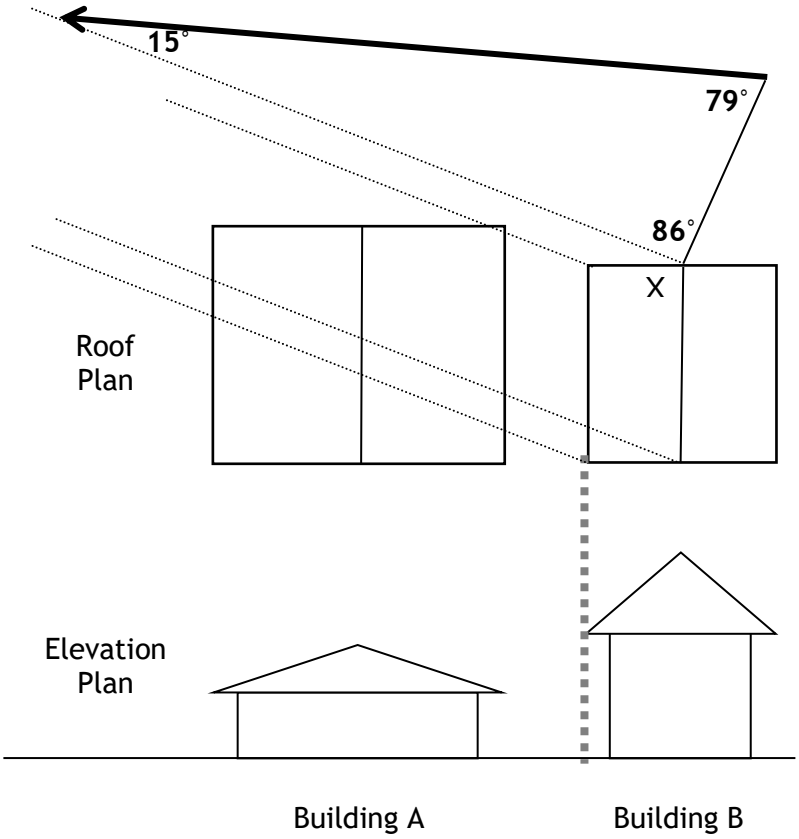
   Note: If the shadow lines do not cross a building, Steps 4-12 are not necessary (because the proposed building will not shade a neighboring roof).

Step 4



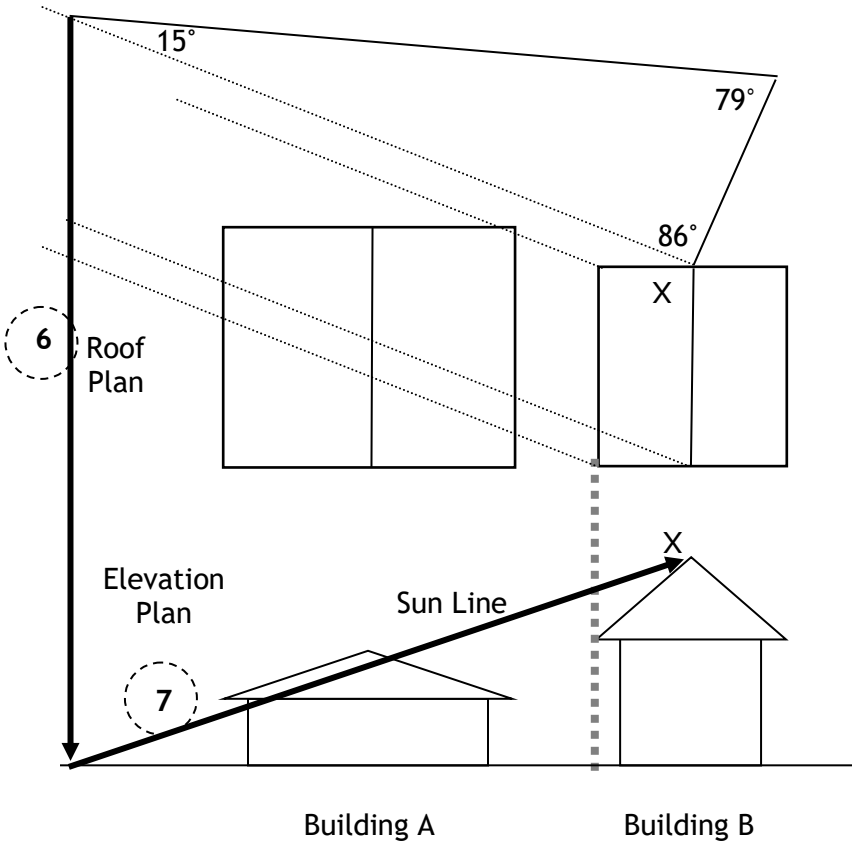
4. Choose one edge on the roof plan of Building B to draw the altitude angle. For this illustration, point X was used, but any roof edge may be used successfully. Draw a line segment (**"Segment B"**) at an 86° angle to the shadow line at Point X (this will be parallel to the AM angle). The length of Segment B should be equal to the building height at point X, where Segment B is drawn.

Step 5



5. Draw a 79° angle from the end of Segment B. Find the point at which this new line intersects the shadow line. This creates a 15° angle – the altitude angle of the sun.

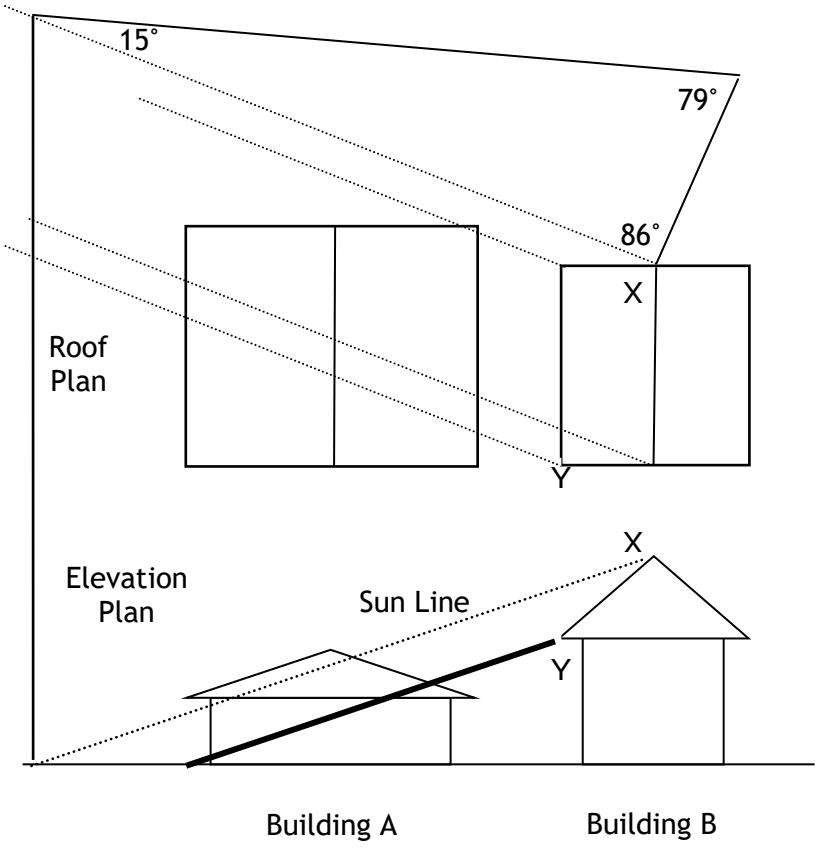
Steps 6 and 7



6. Draw a line from this point straight down to the grade on the elevation plan.

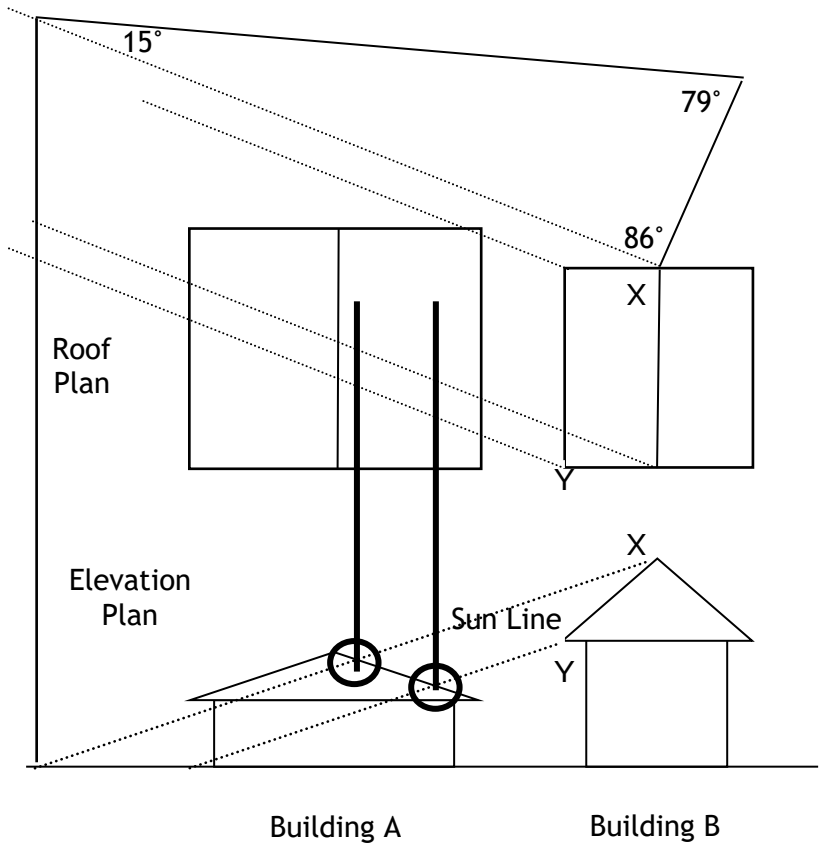
7. Connect the corresponding roof point on your elevation (Point X) with this new point on the ground. This line shows the angle of the sun across the roofs. This will be referred to as the "**Sun Line**."

Step 8



8. Draw lines from other major roof points, such as Y, on Building B that are parallel to the "Sun Line."

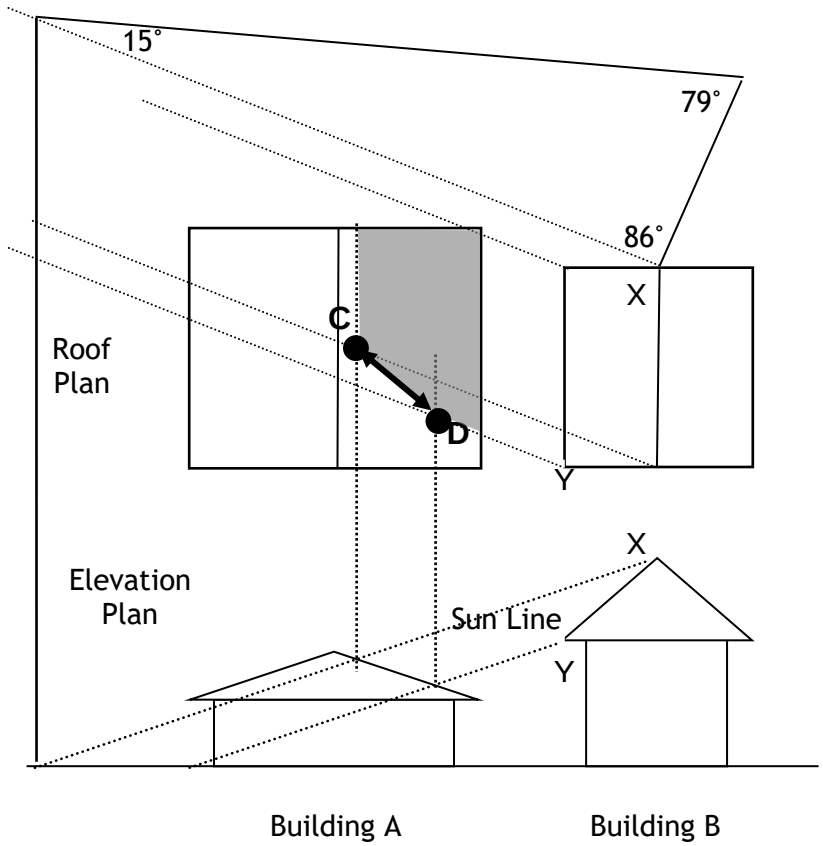
Steps 9 and 10



9. On the elevation drawing, find the points at which the shadow lines intersect with the roof on Building A. These are circled on the elevations.

10. Draw these lines straight up through the roof plan.

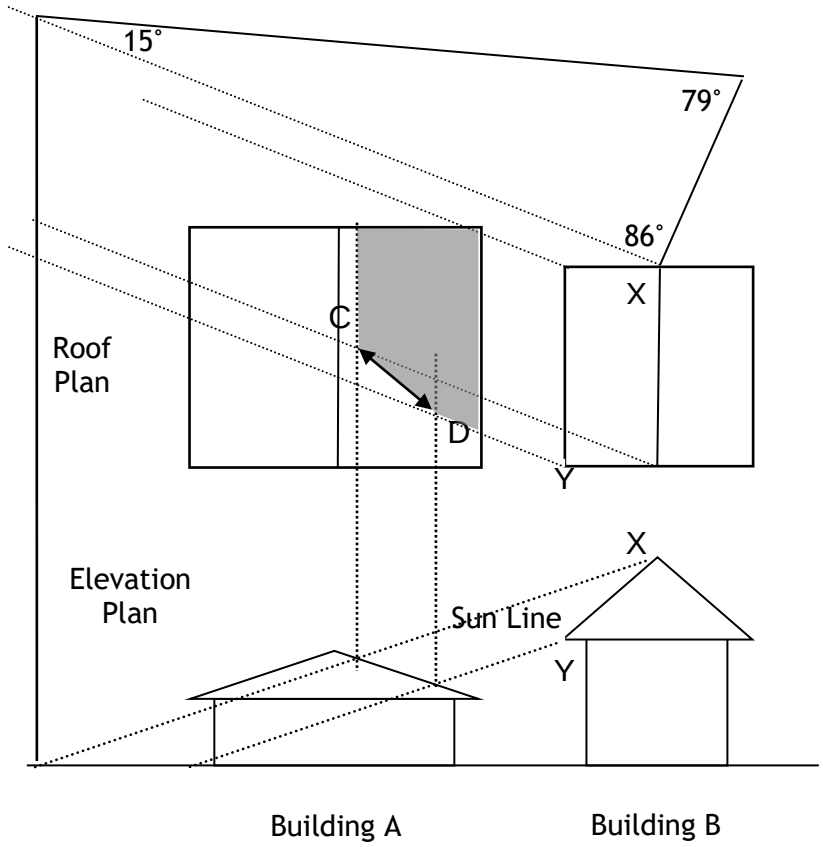
Step 11



11. Locate where the two sets of the lines intersect on the roof plan of Building A. Shade in the corresponding amount of shadow on the roof plan. The diagonal line was drawn between points C and D to reflect the shadow of the roof form between the top of the ridge and the lower edge of the roof.

    Calculate the area shaded as a percentage of the total roof area of Building A for the PM analysis.

Completed PM Solar Analysis



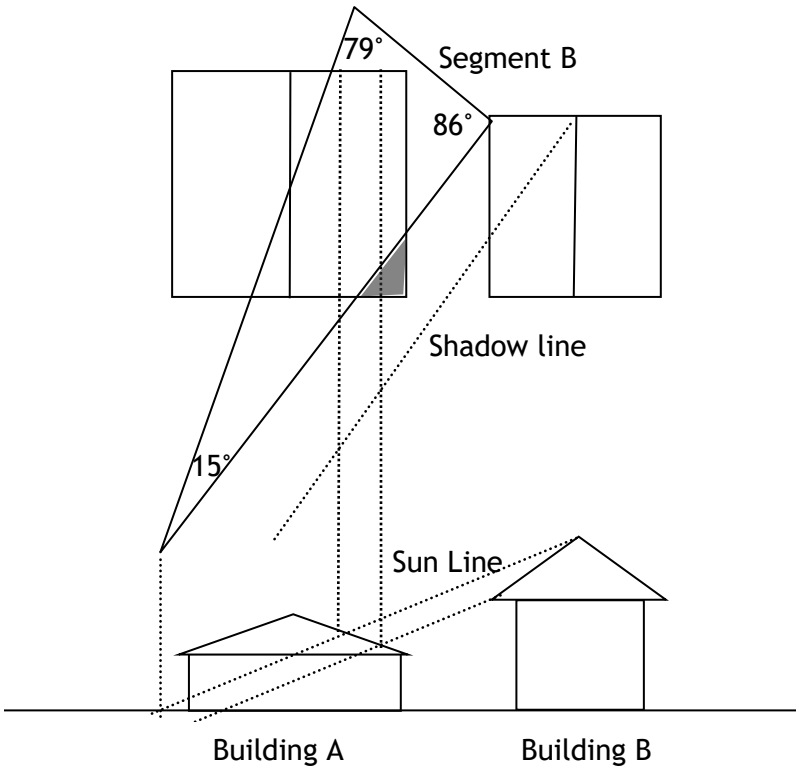
PM = Shaded Area ÷ by Roof Area

11. This is what a completed PM Solar Analysis looks like. It should include all the angles and line used to arrive at the shadow area.

12. Repeat steps 3-11 and refer to Example 1 below.

Submit the analysis for both the AM and PM to the Planning Division with your Planning Application.

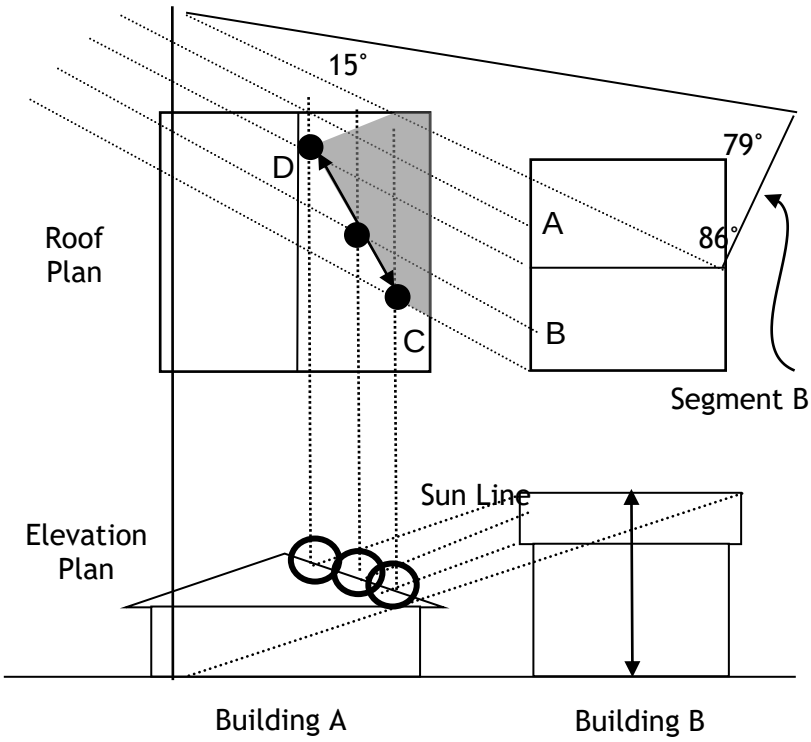
Example AM Solar Analysis



Example 1
AM Solar Analysis

Perform steps 3-11 for the AM analysis. Use the AM line for step 3 and the PM line in step 4 to determine the shadows for the AM Analysis.

Example PM Solar Analysis



Example 2
PM Solar Analysis with Different Roof Form

In this example the gable roof form of Building B is perpendicular to Building A. Note how a shadow line was drawn from the midpoint of each gable, points A and B. This helps determine how the angled roof affects the shadow lines. A diagonal line was drawn from point C to point D to reflect the changing roof height from the lower edge to the top ridge.