P480 Project

Mark Boccelli, Yelnur Abilakim, Matthew Acates

Dr. Scoles

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Milestone 1

For this project, we will be developing a PV system for the residential home at 3009 Robin Lane, Havertown, PA. From figure 1 below, we have 4 possible surfaces for panels. In table 1, there are comments about the given surfaces which conclude that only surfaces 1, 3 and 4 will be used in our system. Surface location 2 has a poor slope which isn't recommended for panel placement. The other 3 surfaces do not have the most optimal azimuth but this is how the how was built and that is what we need to work with.

Figure 1. Roof with surfaces labeled

The measurements for length and width in table 1 were found using Google Earth. Note that these are the measurements for the surface, not the arrays that will be installed. The azimuth angle was found using a protractor addon for Chrome. Using the protractor, we set one line to North, 0 degrees, and the other line normal to the surface. Going clockwise from 0 degrees to the line normal to the surface, we attained the azimuth angle. Note that surface 1 has a 90 degree difference from surfaces 2, 3, and 4. This provides a little confirmation as it logically aligns with assumptions made from figure 1.

Table 1. Roof surface data

Surface	Length (ft)	Width (ft)	Area (ft. sq.)	Azimuth (deg)	Slope (deg)	Comments
1	12	13	156	116.8	32	Good AM sun, small
2	9	32	288	206.8	17	Don't recommend, a porch roof
3	17	32	544	206.8	26	Chimney causes AM shading, especially in winter
4	15	18	270	206.8	22	Distribution panel is directly below in basement

After attaining our roof measurements, we imported the data into SAM as a starting point and adjusted accordingly. Our measurements were close but ultimately we adjusted according to SAM's birdseye view seen in figure 2. Once the roof and chimney was in place, we created the active surfaces using the specifications from table 1. After importing the active surfaces, we adjusted the height of the roof so that the panel would lay flat against it. Finally, we imported the trees with height and diameter based on data from Google Maps and Google Earth. All specifications regarding the active surfaces and dimensions for the trees and chimney can be seen in tables 2 and 3.

Table 2. Active surface measurements after adjusting model in SAM

Active Surface	Length (ft)	Width (ft)	Area (ft. sq.)	Azimuth (deg)	Slope (deg)
1	13.01	13.55	176.29	116.8	32
2	9.86	29.74	293.24	206.8	26
3	12.70	17.61	223.65	206.8	22

Table 3. Chimney and trees object data

Object	Length (ft)	Height (ft)	Width (ft)	Diameter (ft)
Tree-left	|	32.81	|	49.21
Tree-right	|	22.97	|	29.53
Chimney	2.20	13.94	4.10	|

Figure 2. Model Birdseye view

The final representation of our model is seen in figure 3. The diurnal analysis model follows in figures 4, 5, and 6. This whole process took a lot of tweaking, but overtime we were satisfied with our model and diurnal analysis numbers. The analysis will also change over the course of this project as we add other factors such as snow loss.

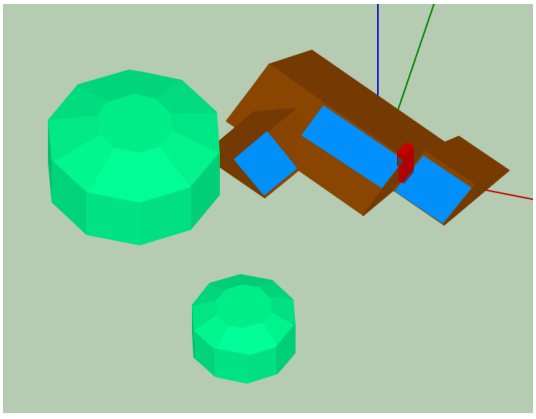

Figure 3. Model 3D view

	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Jan	100	100	100	100	100	100	100	0	0	0	0	0	0	0	6.80349	2.56792	0	100	100	100	100	100	100	100
Feb	100	100	100	100	100	100	100	0	0	0	0	0	0	0	3.12332	10.8694	0	0	100	100	100	100	100	100
Mar	100	100	100	100	100	100	19.2786	0	0	0	0	0	0	0	2.09353	13.1279	0	0	100	100	100	100	100	100
Apr	100	100	100	100	100	100	16.0278	0	0	0	0	0	0	0	1.20583	9.4928	0	0	0	100	100	100	100	100
May	100	100	100	100	100	51.8891	9.05573	0	0.507119	5.80219	0	0	0	0	0.257014	5.93095	0	0	0	100	100	100	100	100
Jun	100	100	100	100	100	35.0992	3.28825	0	5.25318	15.6062	0	0	0	0	0	3.5084	2.44209	0	0	100	100	100	100	100
Jul	100	100	100	100	100	47.1834	8.13275	0	0.899492	12.7699	0	0	0	0	0.000930918	3.58361	3.07808	0	0	100	100	100	100	100
Aug	100	100	100	100	100	94.019	19.1486	0	0	1.13962	0	0	0	0	0.510771	7.51675	0	0	0	100	100	100	100	100
Sep	100	100	100	100	100	100	5.15995	0	0	0	0	0	0	0	2.86703	10.9283	0	0	100	100	100	100	100	100
Oct	100	100	100	100	100	100	2.05004	0	0	0	0	0	0	0.0488144	9.55014	1.05948	0	100	100	100	100	100	100	100
Nov	100	100	100	100	100	100	100	0	0	0	0	0	0	0.0654594	13.5802	0	0	100	100	100	100	100	100	100
Dec	100	100	100	100	100	100	100	0	0	0	0	0	0	0	10.2737	0	0	100	100	100	100	100	100	100

Figure 4. Active surface 1 diurnal analysis

	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Jan	100	100	100	100	100	100	100	14.9048	3.0236	1.58689	1.07243	0.746272	0.527445	0.336769	0.266634	8.75472	79.2053	100	100	100	100	100	100	100
Feb	100	100	100	100	100	100	100	36.6055	6.37586	2.16949	1.19252	0.771424	0.513785	0.335654	0.294542	0.293457	61.7223	100	100	100	100	100	100	100
Mar	100	100	100	100	100	100	100	46.1636	9.12572	2.95779	1.30542	0.802099	0.488058	0.276412	0.276729	0.276803	11.23	100	100	100	100	100	100	100
Apr	100	100	100	100	100	100	100	30.4483	9.0677	3.44919	21.1514	18.6924	0.429406	0.29319	0.259753	0.284711	0.287412	15.5288	49.191	100	100	100	100	100
May	100	100	100	100	100	100	23.8426	23.5948	9.00909	3.68554	25.3151	56.6206	36.4089	8.06564	0.289382	0.275119	0.304167	0.569107	13.1273	100	100	100	100	100
Jun	100	100	100	100	100	100	20.9081	22.1129	9.69512	4.20777	14.547	60.5614	59.9201	25.0541	5.6643	0.270806	0.263888	0.265876	5.28467	100	100	100	100	100
Jul	100	100	100	100	100	100	23.6476	23.9728	10.5509	4.40557	14.7041	61.1483	53.8861	21.0195	3.05431	0.284091	0.263858	0.268083	5.64138	100	100	100	100	100
Aug	100	100	100	100	100	100	100	28.7462	10.1304	3.76387	24.2133	36.3764	16.9991	0.286659	0.29077	0.29475	0.282362	0.79117	20.9208	100	100	100	100	100
Sep	100	100	100	100	100	100	100	30.9467	7.54963	2.83219	7.04627	0.728147	0.410007	0.283233	0.274309	0.283006	2.69844	93.7263	100	100	100	100	100	100
Oct	100	100	100	100	100	100	100	23.697	4.39213	1.75681	1.02555	0.662638	0.432323	0.286275	0.28446	2.71408	99.5625	100	100	100	100	100	100	100
Nov	100	100	100	100	100	100	100	8.72919	2.50715	1.37691	0.920316	0.652016	0.41284	0.288294	0.275942	31.765	99.7441	100	100	100	100	100	100	100
Dec	100	100	100	100	100	100	100	6.26802	2.38074	1.37594	0.95737	0.66726	0.448643	0.322199	0.26517	31.3828	83.0711	100	100	100	100	100	100	100

Figure 5. Active surface 2 diurnal analysis

	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Jan	100	100	100	100	100	100	100	1.43149	0.616804	0.704233	0.672305	0.721859	0.754335	0.877574	4.15677	12.0585	29.488	100	100	100	100	100	100	100
Feb	100	100	100	100	100	100	100	0.50786	0.833836	0.703786	0.709567	0.745292	0.736127	1.06916	5.20896	13.7245	29.0731	100	100	100	100	100	100	100
Mar	100	100	100	100	100	100	100	0.823948	0.716223	0.764814	0.684888	0.725911	0.747095	2.02037	8.43096	18.3507	33.7727	100	100	100	100	100	100	100
Apr	100	100	100	100	100	100	0	0.698921	0.755879	0.67346	0.774831	0.692932	0.787094	5.37597	13.6417	25.005	42.668	83.7592	99.9048	100	100	100	100	100
May	100	100	100	100	100	100	1.01916	0.714067	0.666556	0.719364	0.640245	0.711519	0.872191	19.0726	34.3478	30.6672	49.1248	77.2033	99.2947	100	100	100	100	100
Jun	100	100	100	100	100	100	0.541742	0.676441	0.709836	0.713604	0.667071	0.685851	0.982897	27.0827	55.2741	47.134	47.9625	71.1778	92.3088	100	100	100	100	100
Jul	100	100	100	100	100	100	1.39923	0.652094	0.684296	0.689665	0.714216	0.705667	0.838496	20.7829	44.2294	40.2087	45.649	70.6864	94.0058	100	100	100	100	100
Aug	100	100	100	100	100	100	1.50709	0.661685	0.68217	0.622973	0.72862	0.714921	0.817721	8.85398	14.1921	25.8506	43.4117	73.9523	100	100	100	100	100	100
Sep	100	100	100	100	100	100	100	0.775599	0.723875	0.725867	0.624428	0.740498	0.795398	4.49328	12.169	23.2419	40.9904	99.9418	100	100	100	100	100	100
Oct	100	100	100	100	100	100	100	0.764112	0.719681	0.688663	0.706745	0.750267	0.835429	3.23199	9.69015	21.1077	69.0134	100	100	100	100	100	100	100
Nov	100	100	100	100	100	100	100	0.448447	0.759467	0.618298	0.719722	0.750302	0.854719	1.74354	6.98866	18.4738	43.0256	100	100	100	100	100	100	100
Dec	100	100	100	100	100	100	100	0.902828	0.745558	0.65623	0.751423	0.74422	0.783073	1.10604	4.82261	14.3835	35.7911	100	100	100	100	100	100	100

Figure 6. Active surface 3 diurnal analysis