Ai-Alt

SEI STRUCTURAL ENGINEERING INSTITUTE ASCE | SE2050 COMMITTING TO NET ZERO

SE2050

EMBODIED CARBON ACTION PLAN

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Education

Ai-Alt is committed to promote the vision and principles of SE2050 by educating our staff about the impact of this movement. Through constant learning, we will incorporate sustainable design practices into our future projects. SE2050 library will be shared firm-wide to disseminate the knowledge about the movement.

Antonette Joyce Cortes, will serve as our ECAP Champion. A.J. Cortes is a structural engineer at Ai-Alt since 2020. She will attend the educational programs put on by SE2050 and present a summary to the rest of the staff.

ECAP Champion Contact Details:

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ajcortes@ai-alt.com
www.ai-alt.com

Reporting

The most essential step for structural engineers is to mindfully choose the right materials and use them as efficiently as possible. Calculation of embodied carbon will be done through widely accepted modeling tools.

The following Case Studies are just the start on our efforts to contribute in reducing embodied carbon by helping the design team to meet green building certifications requirements, and assisting building owners to better position for future code or policy changes geared toward lowering embodied carbon emissions.

Confidential Project

Case Studies

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Building Data

Gross Floor Area:	5,002 sq. ft.
Building Envelope Area:	3,987 sq. ft.
Fenestration Area:	1,461 sq. ft.

The use of glass block wall is a major component to the design in the renovation of an existing space for use as a boxing gym and as a major event center, allowing a visual connection from inside to out. The challenge was to ensure that the use of glass block which has light transmission nearly equal to that of flat glass does not increase the required cooling capacity of the renovated space. Utilizing efficient glass block with low thermal transmittance (U-value) ensures that heat energy is not lost during winter months. Incorporating canopies in the design provides solar shading during summer while strategically located to allow solar radiation to pass through the glass block during winter. With proper solar radiation and solar shading analyses, and daylighting studies, we enabled the design team to adhere to its desire on using glass block walls for the project.

Ai-Alt Scope of Work:

Energy analysis including Solar Radiation, Solar Shading, Daylighting analyses. Preparation of energy compliance drawings in accordance with the 2020 New York City Energy Conservation Code (“NYCECC”).

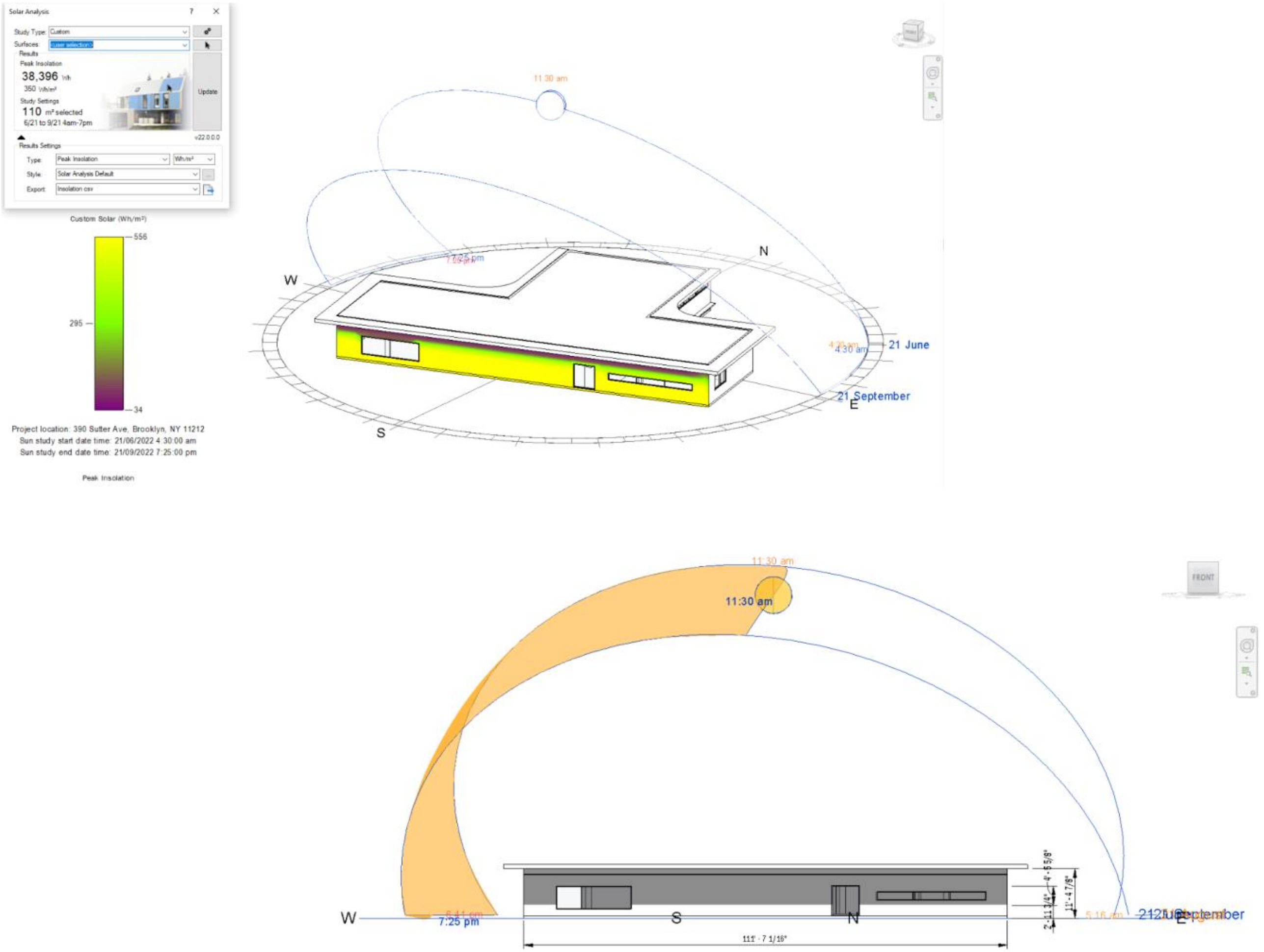

Figure 1.1. Peak Insolation & Solar Shading (Summer)

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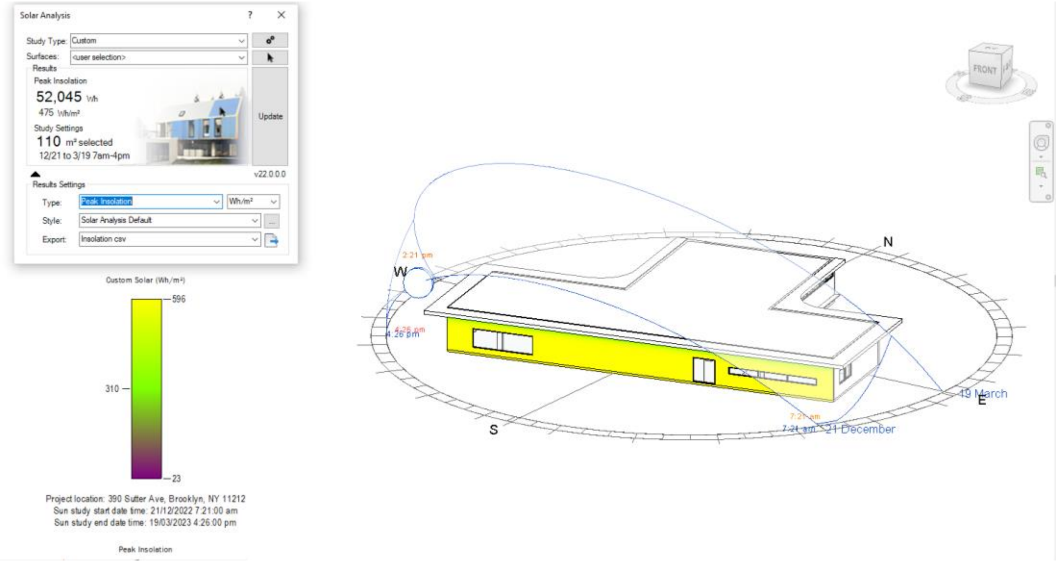

Figure 1.2. Peak Insolation (Winter)

Energy Analysis:

Through efficient design, the calculated amount of peak solar radiation passing through the glass block is only 30.7% of the maximum allowed by code due to the effects of external shading provided by the canopies, thus reducing the required cooling capacity for the renovated space during summer.

Whereas, during winter, the calculated peak amount of solar radiation passing through the glass block is 16.7% greater than mandated by code even with the external shading from the canopies, thus reducing the required heating capacity for the renovated space during winter.

Our efforts help the overall design team to meet the energy conservation requirements as mandated by the governing codes and standards.

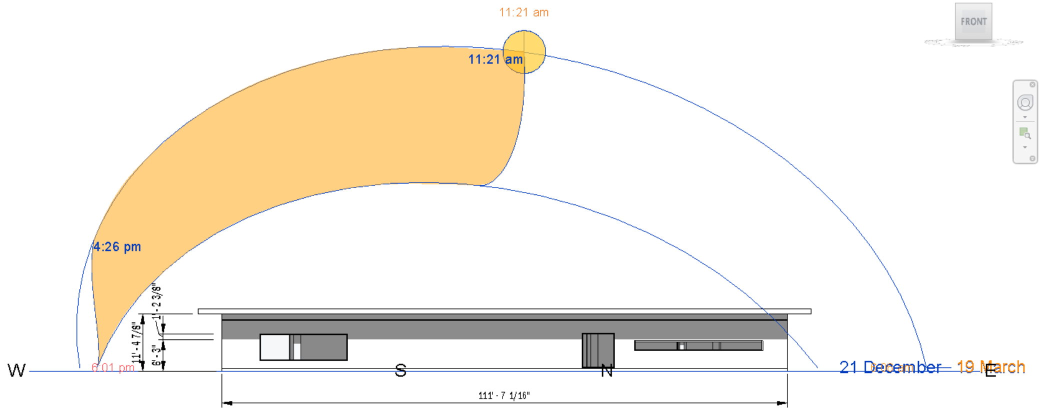

Figure 1.3. Solar Shading (Winter)

Town of East Hampton Facilities

Case Studies

Our challenge was to assist the Town of East Hampton in the determination on the suitability of the town's various facilities for the installation of new PV Array Systems for their current and future usage as part of its commitment to making climate mitigation and the elimination of greenhouse gas emissions a guiding principle and objective of all its operations. Ai-Alt was able to assist the various departments of the Town of East Hampton to meet the town's policy changes geared toward helping to lower the embodied carbon emissions.

Child Development Center of Hamptons

Building Data:

Gross Floor Area:	2,010 sqm
Roof Orientation:	Northeast & Southwest
Roof Slope:	Approx. 1.12° (min.) - 8.26° (max.)
Roof Elevation:	Approx. 11ft (min.) – 21ft (max.)

The existing building was previously used by the Child Development Center of Hamptons and is currently unoccupied. It was originally built in 2007 and comprised of steel rigid frame as main structural system with standing metal roof deck sitting directly on top of Z-purlins. The purlins are spanning between the steel rigid frame with typical spacing of 36 inches in the field and at 18± inches at roof edges. The purlins are also closely spaced at the bay adjacent to the change in roof elevations to support the expected snow drifts that could form during snowstorm event.

Figure 2.1. Existing Structure

Child Development Center of Hamptons

Shadow and Sun Path Study:

Using Solar Analysis, the PV energy generation and payback period were estimated. As shown in Figures 1 through 7, the ideal orientation to point the panels are due South at 19 degrees. However, this orientation creates aesthetic impact, so a proposed 10° tilt facing Northeast and Southwest were recommended for CDCH Building for practical reason with the following estimated energy production:

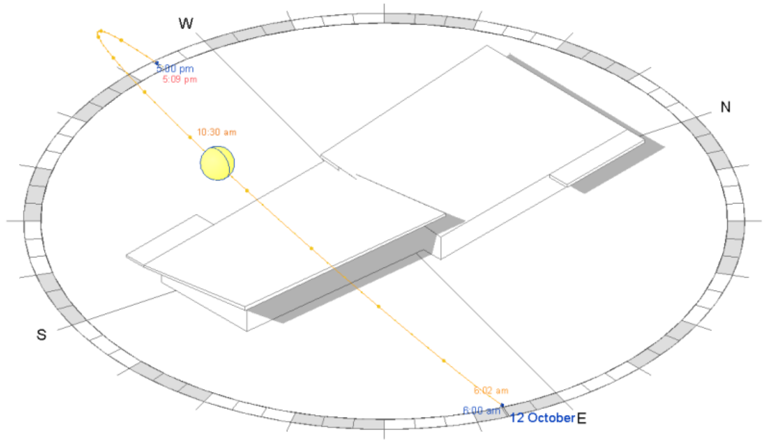

Figure 2.2. Building Conceptual Mass

Probable PV Energy Production

EUI	336 kWh/ m²/Year
Electricity Cost	$ 0.15/kWh
Cost Escalation	1.0%
PV Panel Area	924 m²
Insolation	183,687 kWh/Year
Energy Savings	$ 27,553.00
Building Energy Offset	27% of 675,360 kWh/Y
Payback Period	14 years

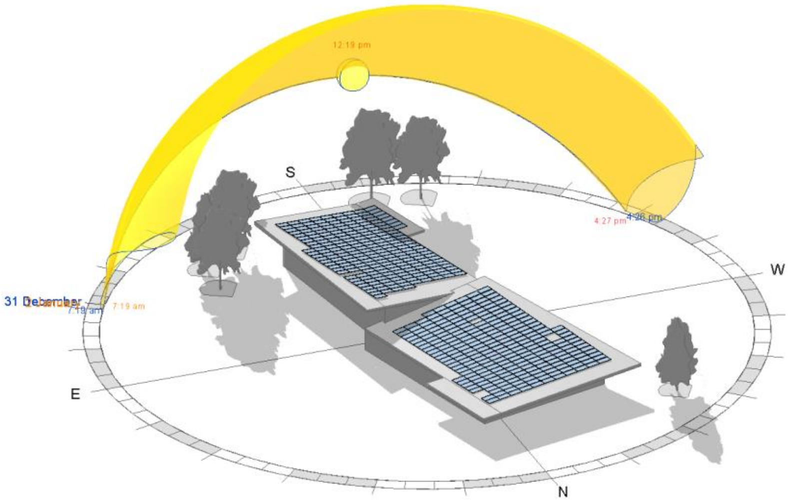

Figure 2.3. Annual Sun Path

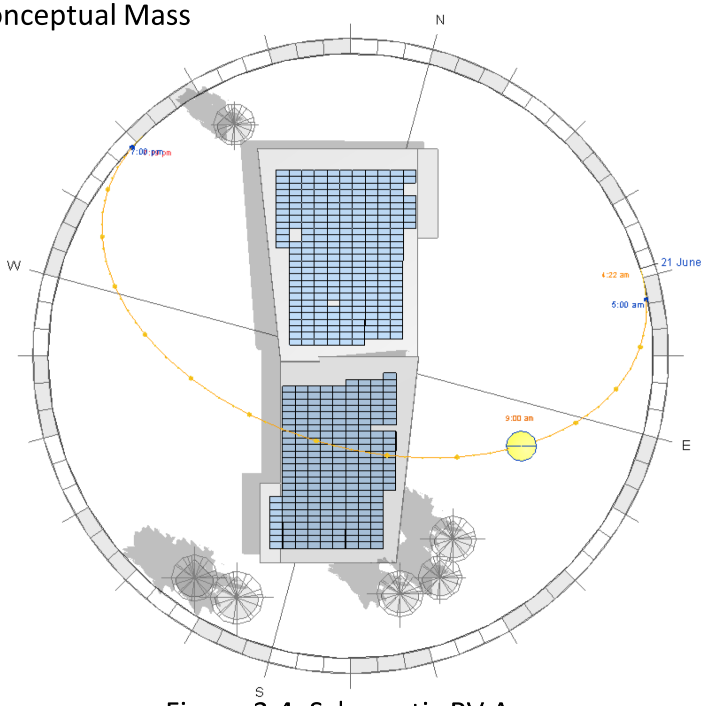

Figure 2.4. Schematic PV Array

Town of East Hampton Facilities

Case Studies - Child Development Center of Hamptons

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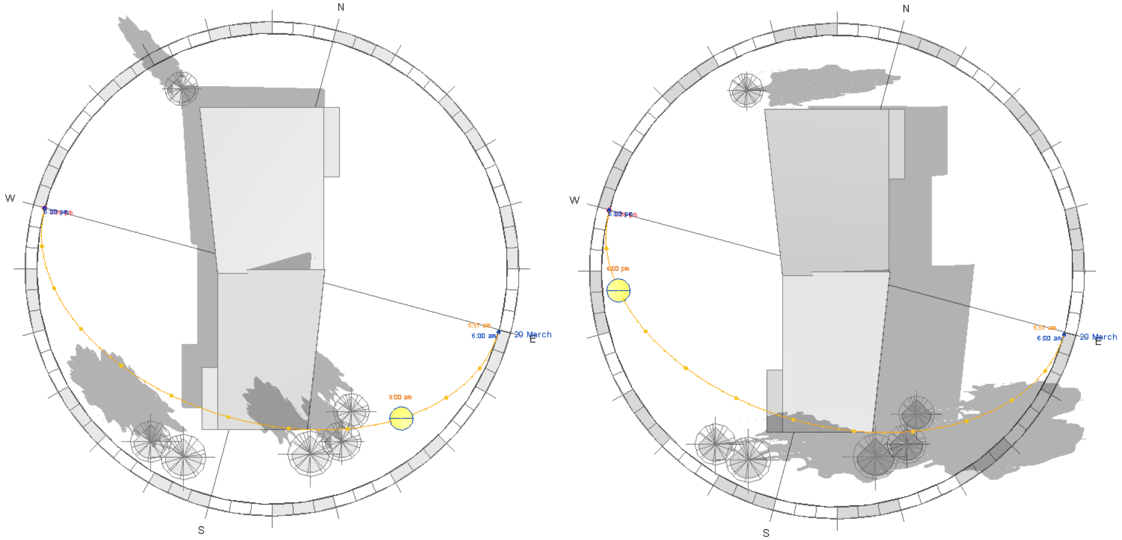

Figure 2.5. Spring Equinox

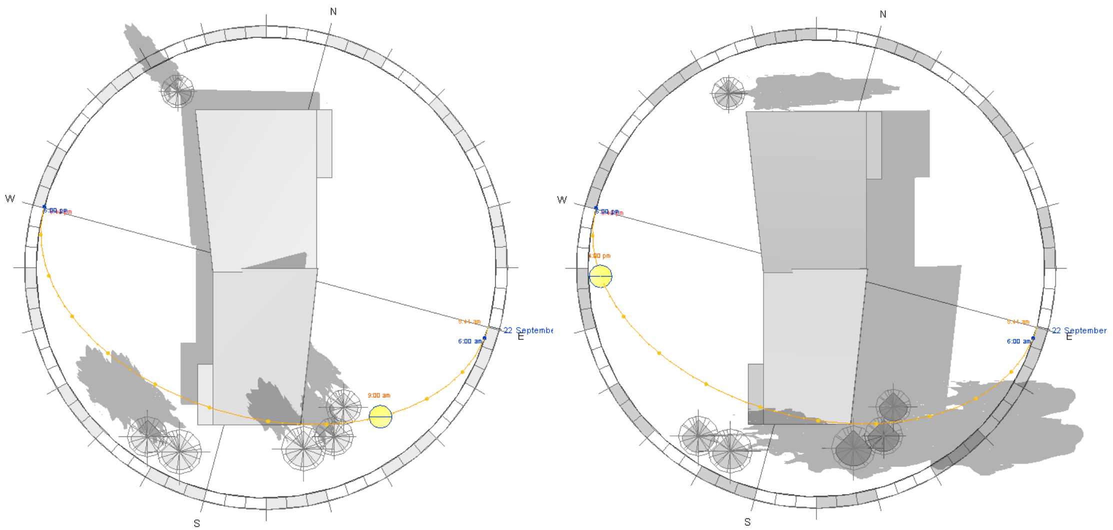

Figure 2.7. Fall Equinox

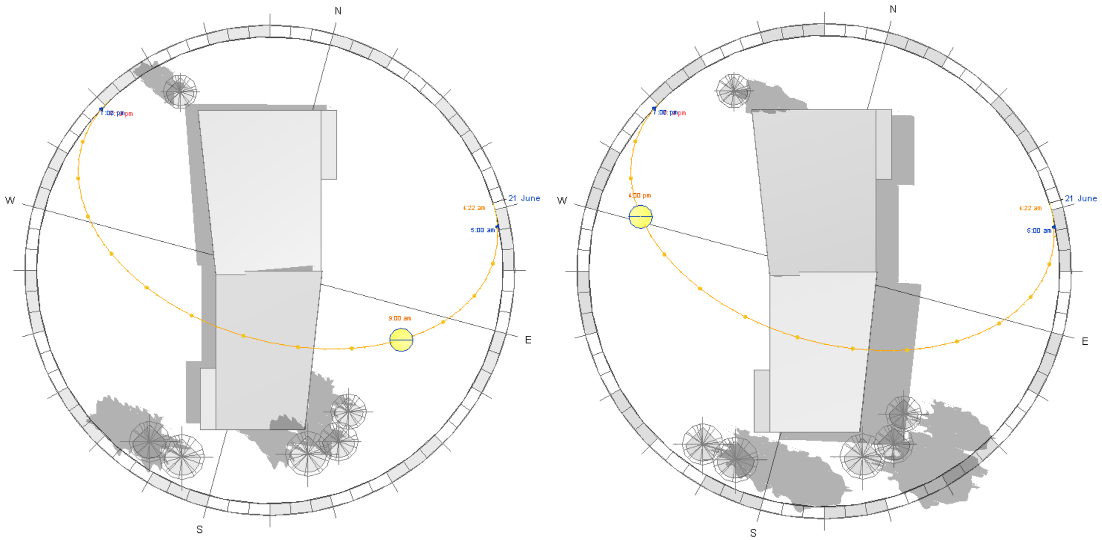

Figure 2.6. Summer Solstice

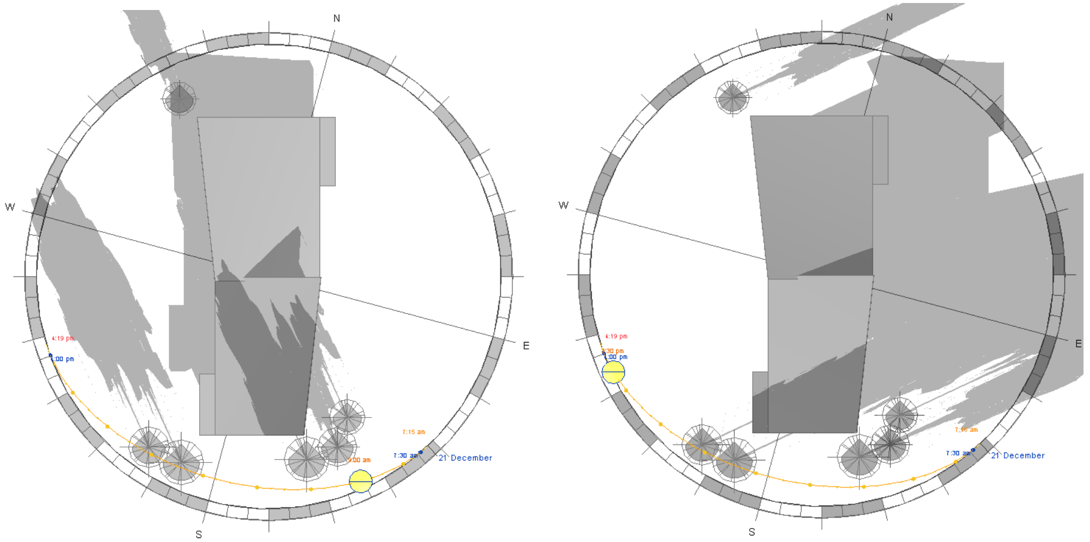

Figure 2.8. Winter Solstice

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Transfer Station Buildings

Building Data:

Gross Floor Area:	2,121 sqm
Roof Orientation:	Approx. 60° NW & SE
Roof Slope:	Approx. 4.60° & 4.80°
Roof Elevation:	Approx. 119ft (min.) – 125ft (max.)

The Transfer Station Building is comprised of Tipping Floor and Paper/Cardboard areas, constructed utilizing a series of steel rigid frames spanning at 45-ft with transverse wide-flange steel purlins supporting directly the uninsulated standing seam sheeting. The standing seam metal roof spans approximately 5-ft between purlins and has integrated skylights.

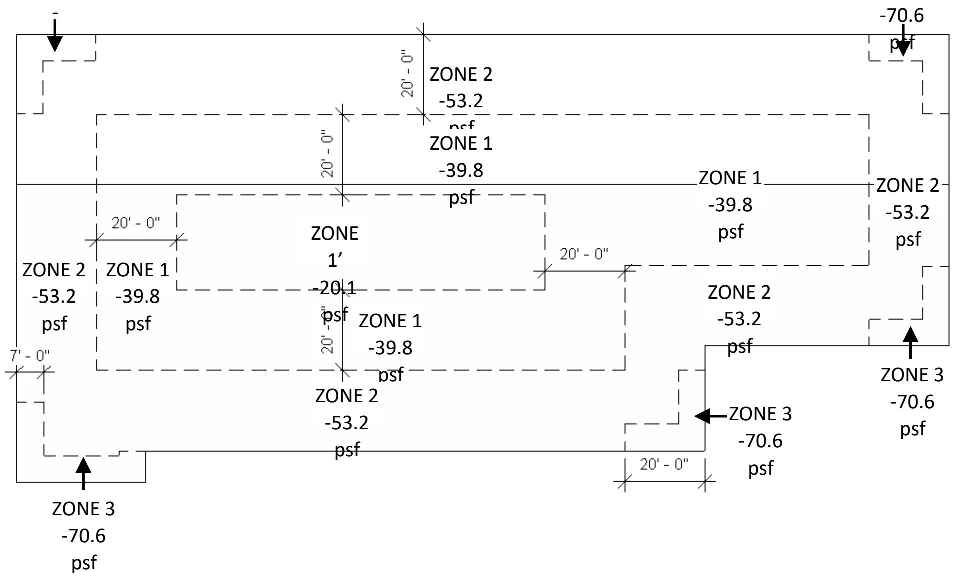

Figure 3.1: Design Wind Pressure imposed to PV Array

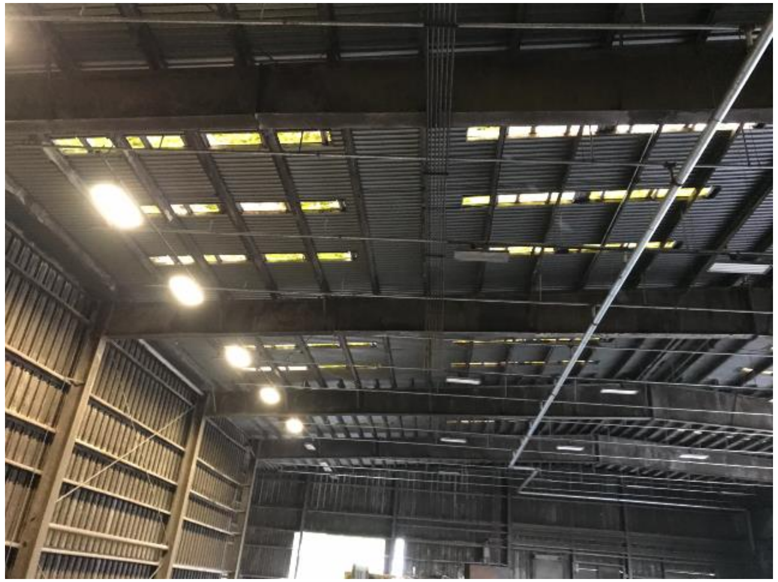

Figure 3.2: Existing Roof Structure

Town of East Hampton Facilities
Case Studies

Transfer Station Buildings

Shadow and Sun Path Study:

For a total of 549 PV modules installed parallel to roof surface and assuming a conservative 1% annual escalation cost, the payback period for the PV Array System for the Transfer Station Building is calculated to be 14 years.

<u>Probable PV Energy Production</u>

EUI	180 kWh/ m²/Year
Electricity Cost	$ 0.15/kWh
Cost Escalation	1.0%
PV Panel Area	1.090 m²
Insolation	222,085 kWh/Year
Energy Savings	$ 33,313.00
Building Energy Offset	58% of 381,780 kWh/Year
Payback Period	14 years

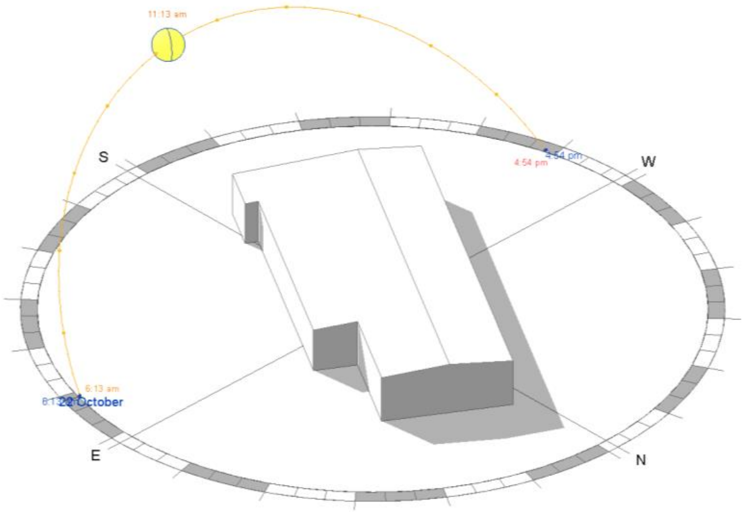

Figure 3.3. Building Conceptual Mass

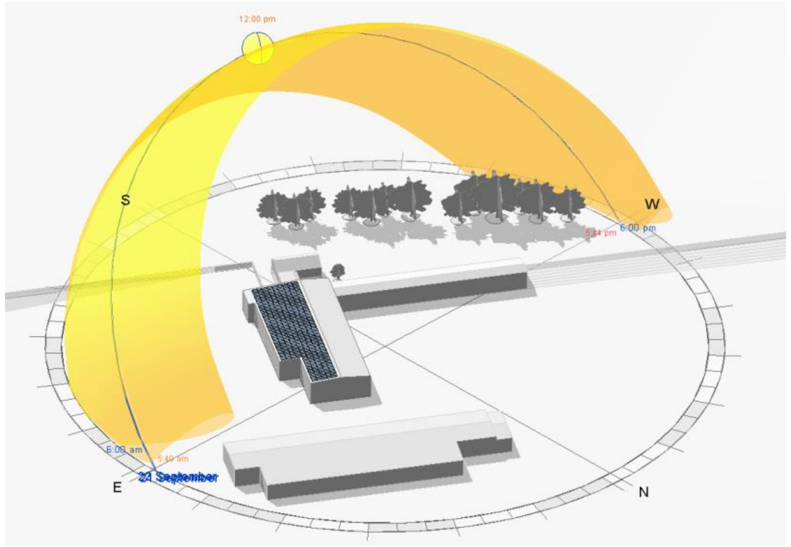

Figure 3.4. Annual Sun Path

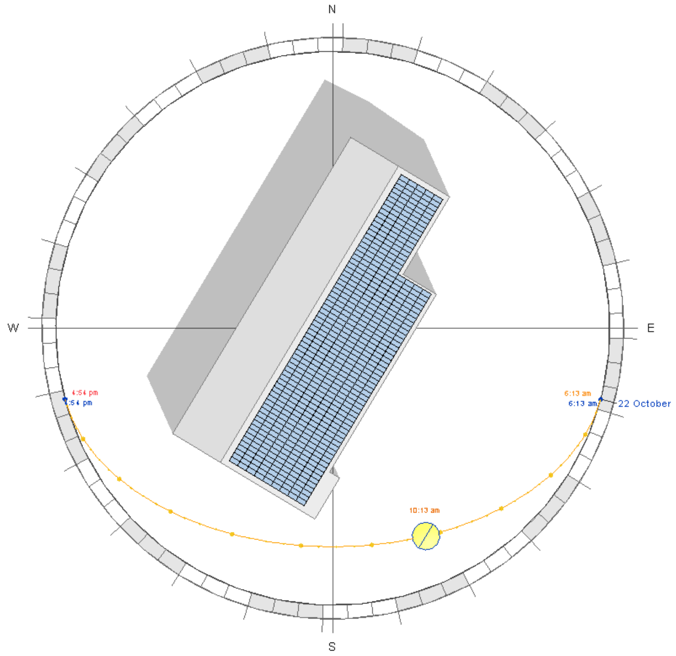

Figure 3.5. Schematic PV Array

Town of East Hampton Facilities

Case Studies - Transfer Station Buildings

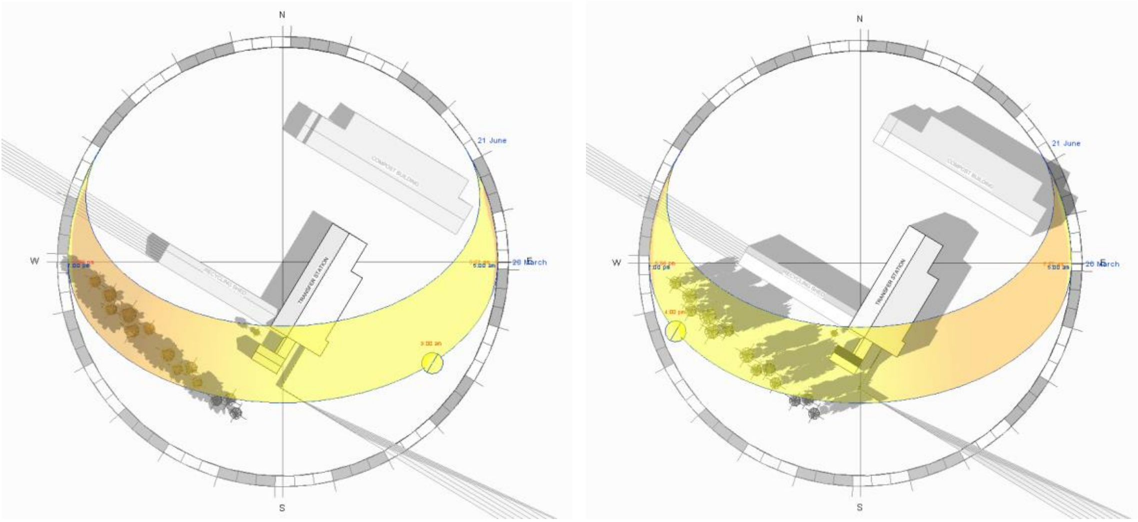

Figure 3.6. Spring Equinox

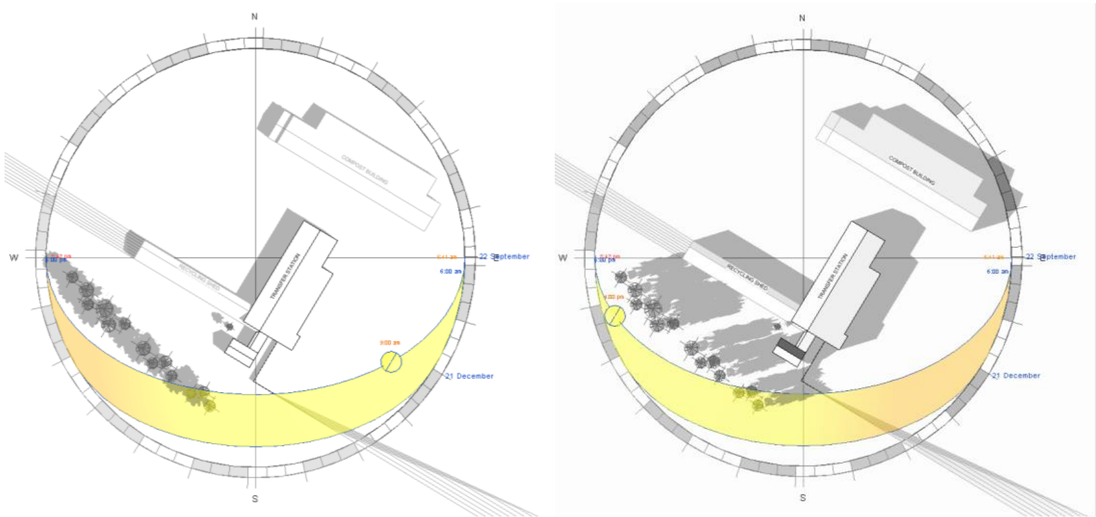

Figure 3.7. Fall Equinox

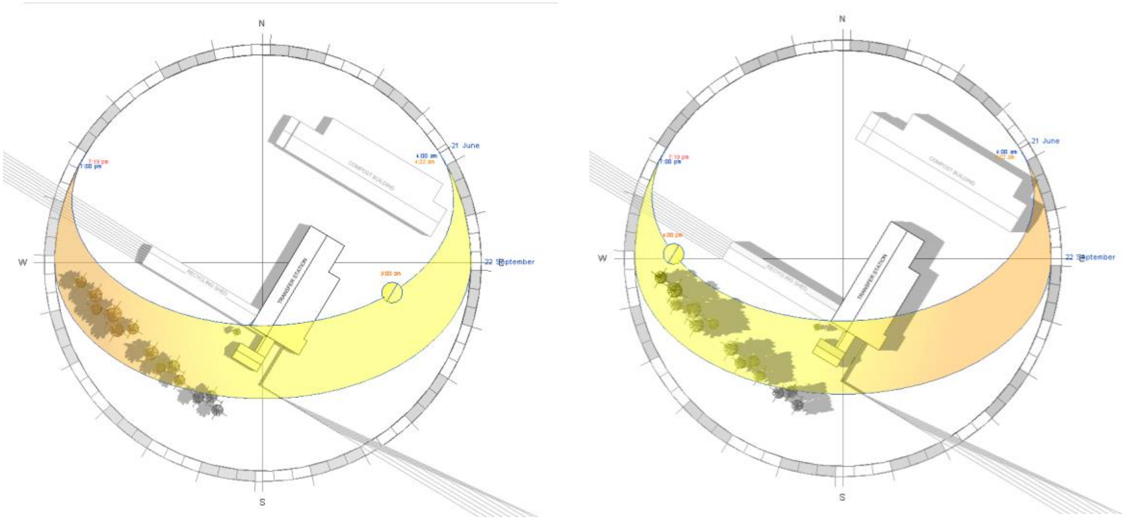

Figure 3.8. Summer Solstice

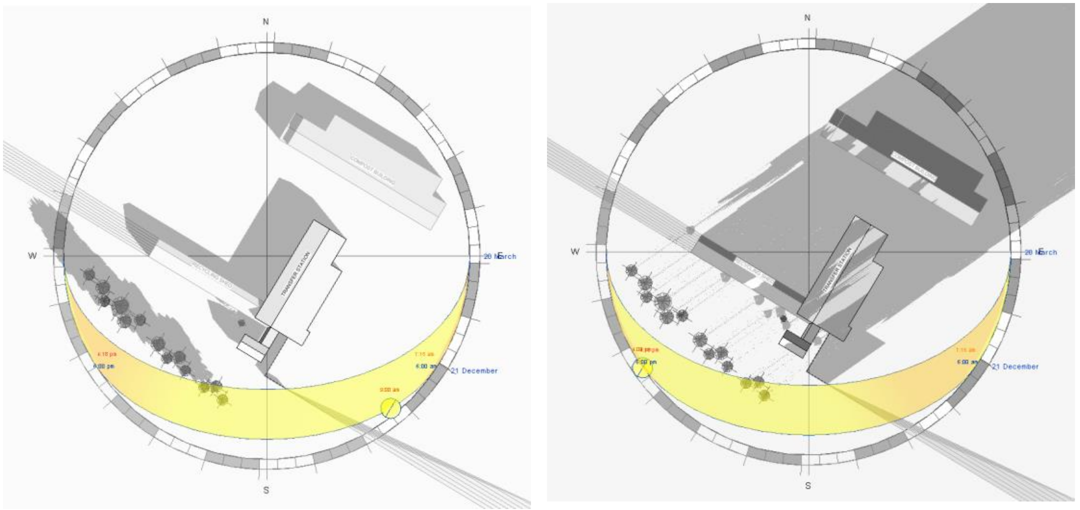

Figure 3.9. Winter Solstice

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Compost Building

Figure 4.1: Existing Roof Structure

Building Data:

Gross Floor Area: 3,0471 sqm
Roof Orientation: Approx. 30° NE & SW
Roof Slope: Approx. 4.60°
Roof Elevation: Approx. 106ft (min.) – 112ft (max.)

The second building from the Sanitation Department is the Compost Building, which is comprised of steel rigid main frame with standing metal roof supported by a series of Z-purlins spaced at approximately 5.5-ft and a bay distance of 25-ft.

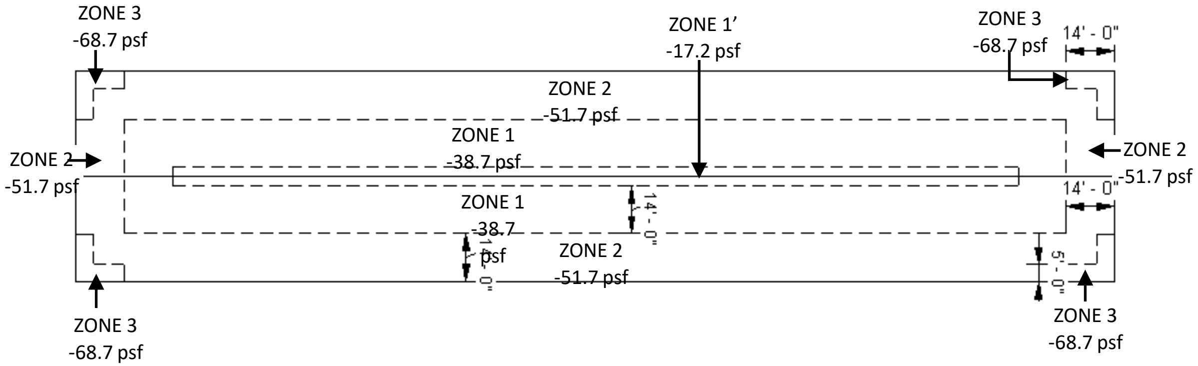

Figure 4.2: Design Wind Pressure imposed to PV Array

Town of East Hampton Facilities
Case Studies

Compost Building

Shadow and Sun Path Study:

Solar Panels will either be installed parallel to the existing roof structure's slope (Option 1) or with tilt angle of 41 degrees facing 60 degrees Southeast (option 2). Option 2 produces significantly more electricity but for aesthetic reasons and additional installation cost, Option 1 is likely to be implemented. Results of the probable energy production are based on Option 1.

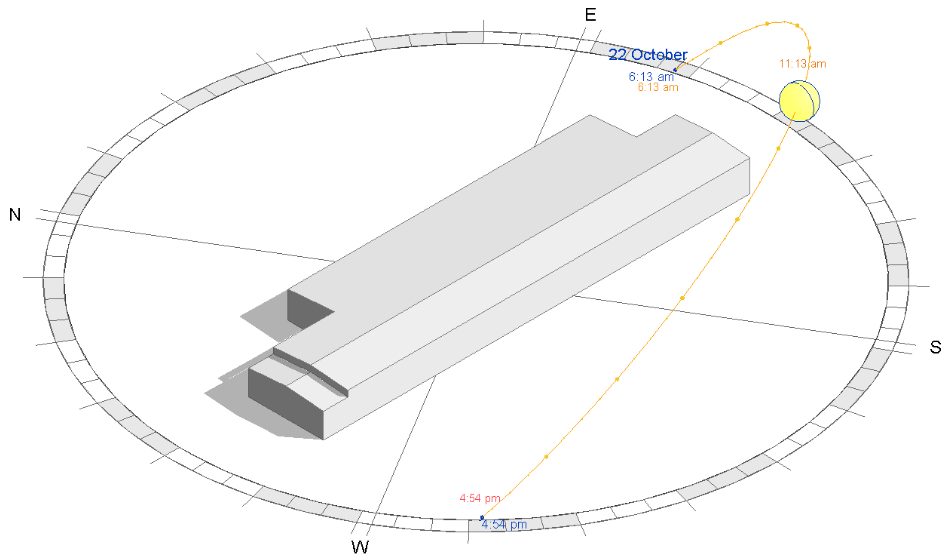

Figure 4.3. Building Conceptual Mass

<u>Probable PV Energy Production</u>

EUI	195 kWh/ m²/Year
Electricity Cost	$ 0.15/kWh
Cost Escalation	1.0%
PV Panel Area	983 m²
Insolation	188,78 kWh/Year
Energy Savings	$ 28,371.00
Building Energy Offset	32% of 594,165 kWh/Year
Payback Period	16.5 years

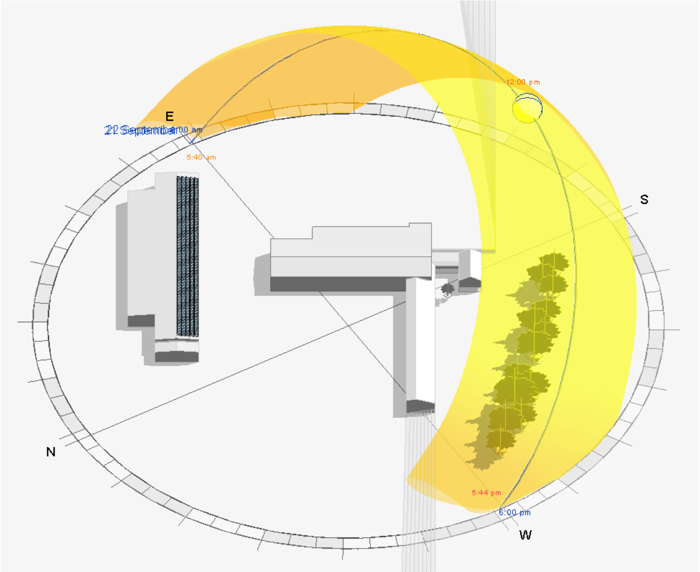

Figure 4.4. Annual Sun Path

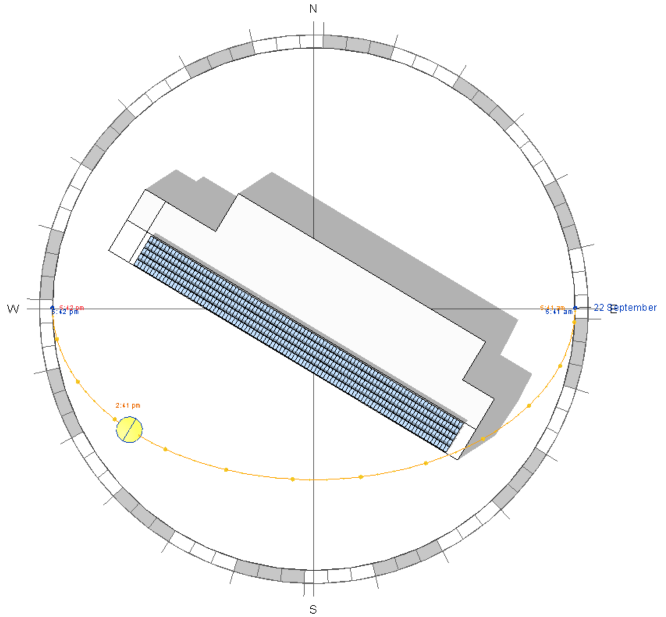

Figure 4.5. Schematic PV Array

Town of East Hampton Facilities

Case Studies - Compost Building

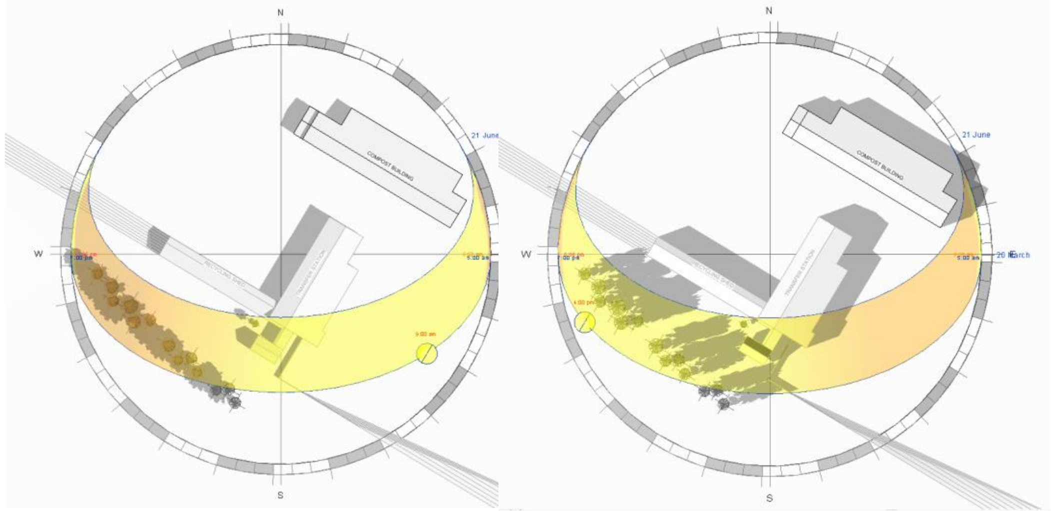

Figure 4.6. Spring Equinox

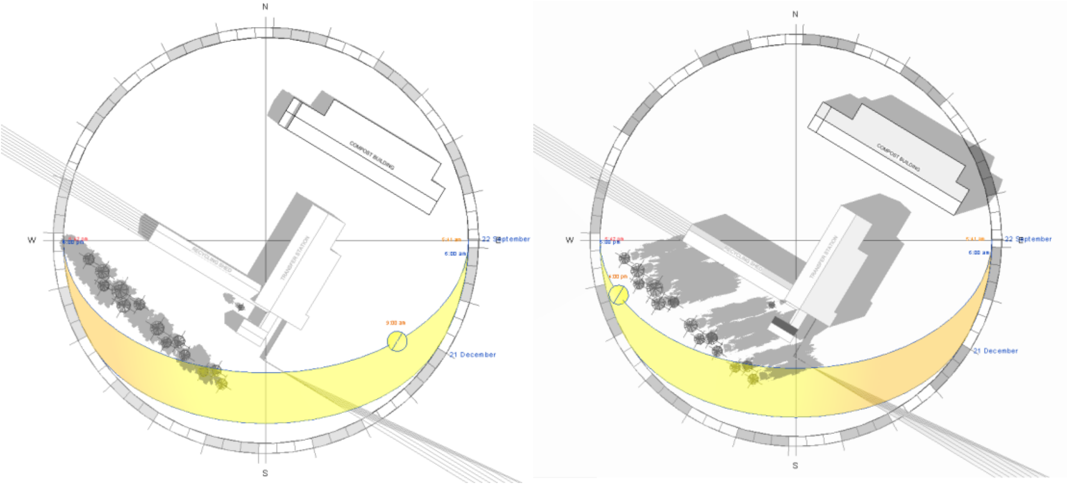

Figure 4.7. Fall Equinox

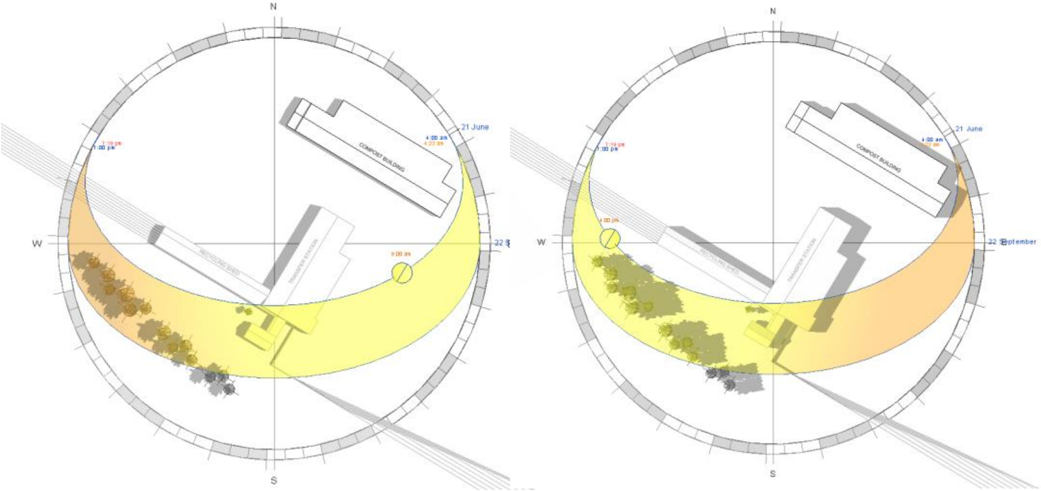

Figure 4.8. Summer Solstice

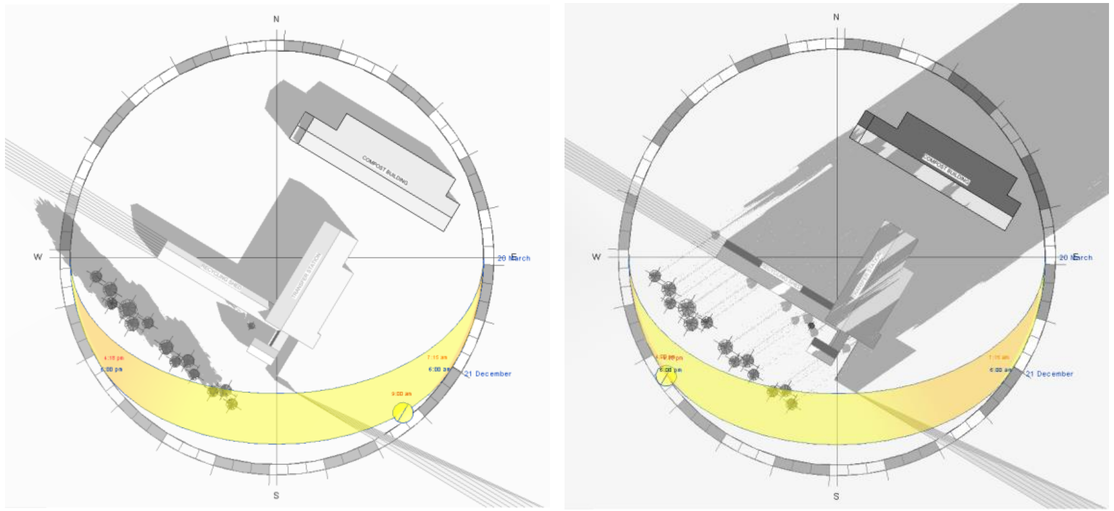

Figure 4.9. Winter Solstice

Town of East Hampton Facilities

Case Studies

Recycling Building

Figure 5.1: Existing Roof Structure

Building Data:

Gross Floor Area:	986 sqm
Roof Orientation:	Approx. 30° NE & SW
Roof Slope:	Approx. 12.00° & 17.32°
Roof Elevation:	Approx. 108ft (min.) – 119ft (max.)

Lastly, the Recycle Building. A 30-ft steel rigid frame which has a standing seam roof supported by Z-purlins spaced at 4-ft. Rod cross-bracings are also utilized to disseminate the lateral loads between steel rigid frame without subjecting the seam metal roof with in-plane forces due to lateral wind and seismic forces.

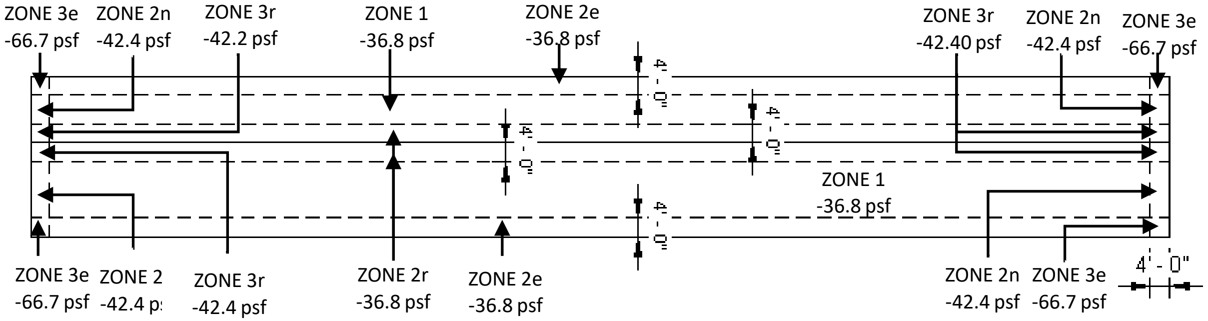

Figure 5.2: Design Wind Pressure imposed to PV Array

Recycling Building

Shadow and Sun Path Study:

Solar Panels will either be installed parallel to the existing roof structure's slope (Option 1) or with tilt angle of 41 degrees facing 60 degrees Southeast (option 2). Option 2 produces significantly more electricity but for aesthetic reasons and additional installation cost, Option 1 is likely to be implemented. Results of the probable energy production are based on Option 1.

<u>Probable PV Energy Production</u>

EUI	195 kWh/ m²/Year
Electricity Cost	$ 0.15/kWh
Cost Escalation	1.0%
PV Panel Area	983 m²
Insolation	188,78 kWh/Year
Energy Savings	$ 28,371.00
Building Energy Offset	32% of 594,165 kWh/Year
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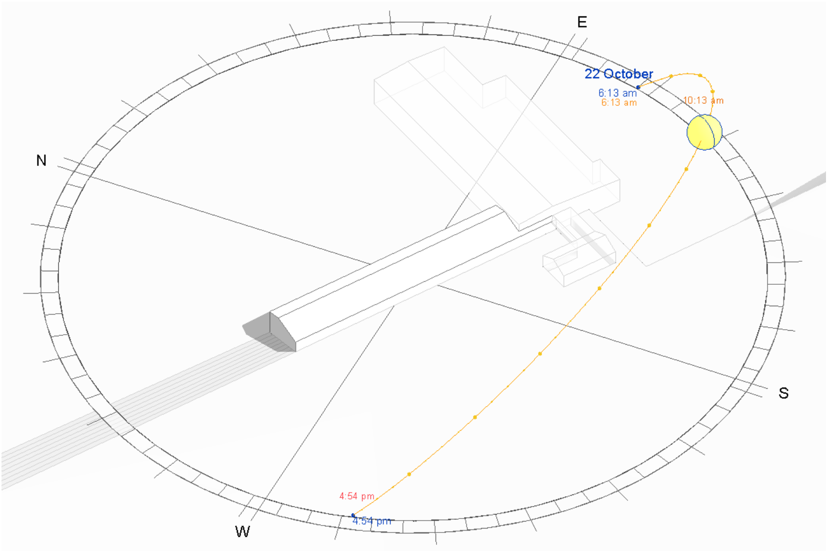

Figure 5.3. Building Conceptual Mass

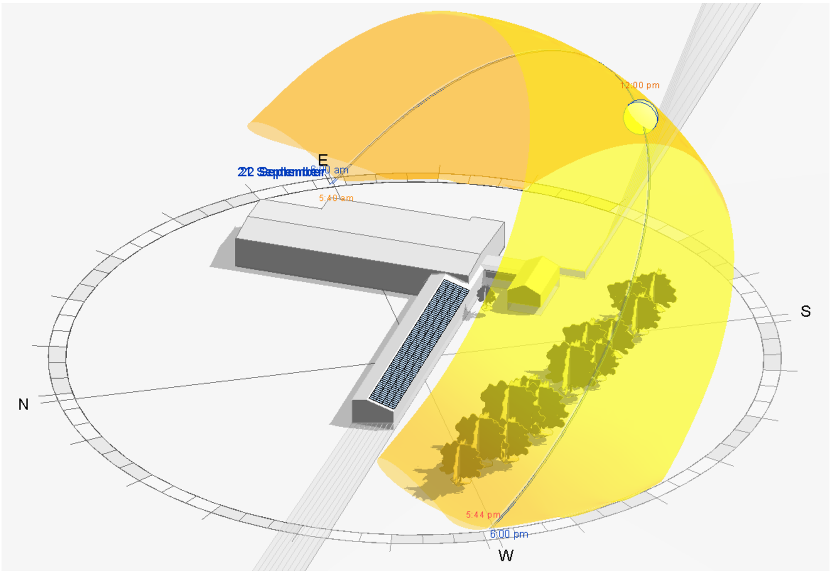

Figure 5.4. Annual Sun Path

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Town of East Hampton Facilities

Case Studies - Recycling Building

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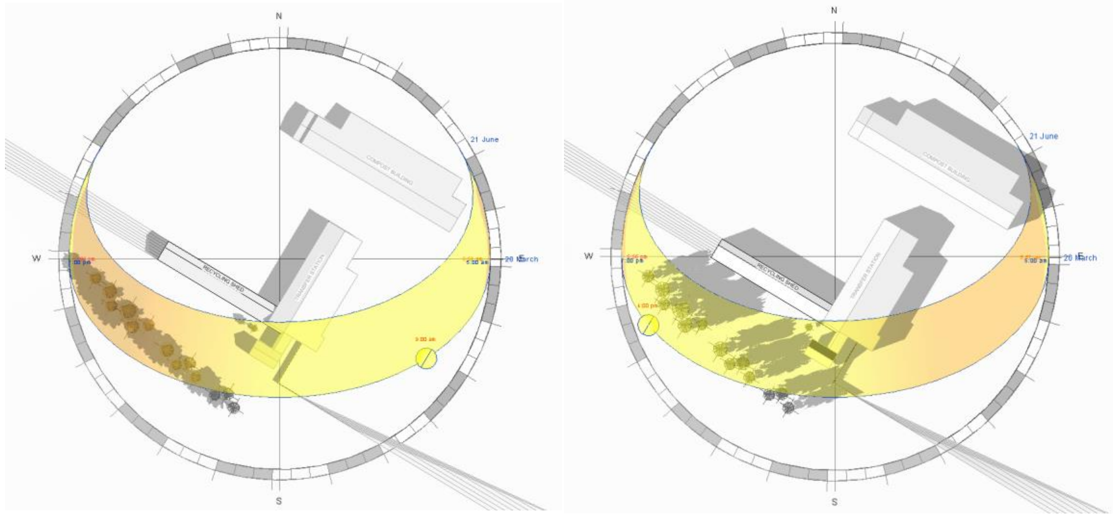

Figure 5.5. Spring Equinox

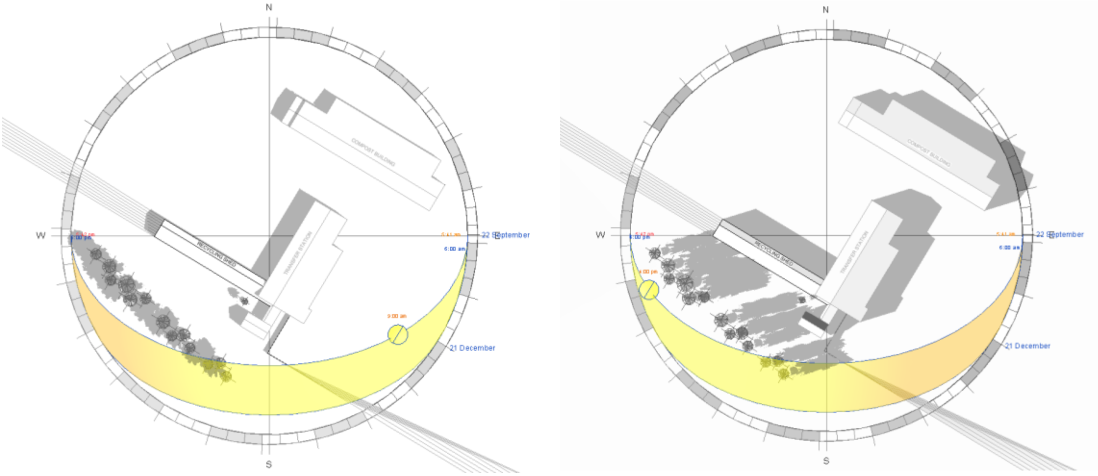

Figure 5.6. Fall Equinox

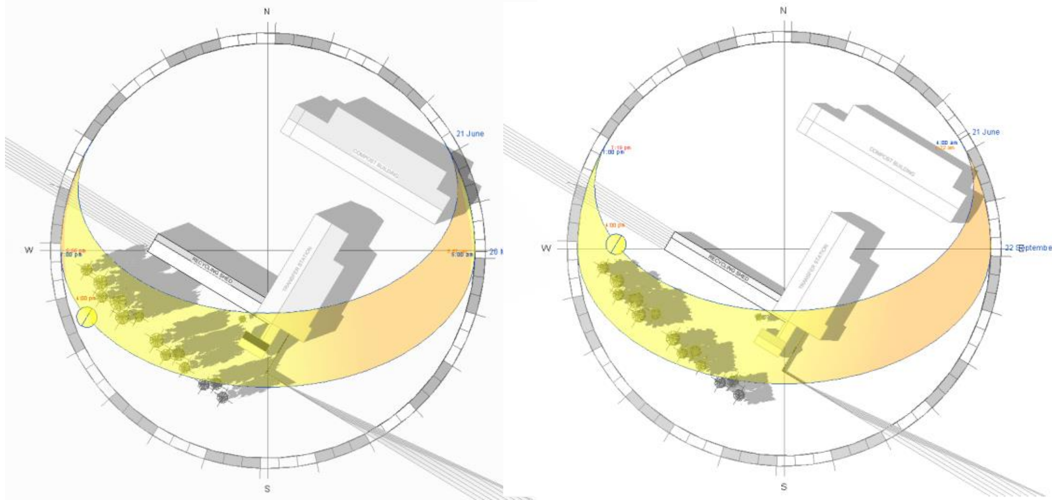

Figure 5.7. Summer Solstice

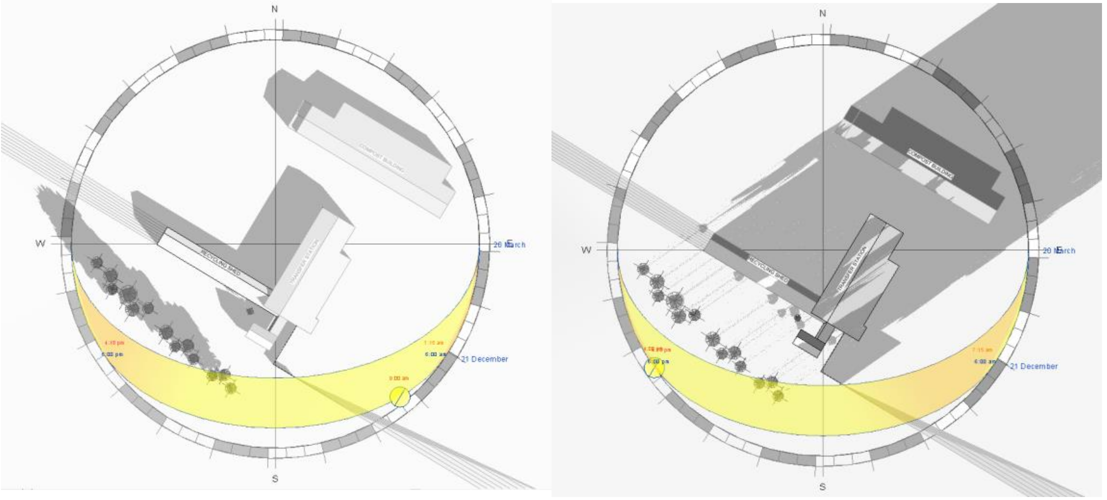

Figure 5.8. Winter Solstice

Ai-Alt

Strategies

Through Constant Learning

Education is the primary key in the promotion of sustainable designs. Ai-Alt's main goal is to educate all our staff about the methodologies on how we can integrate sustainability in our day to day structural engineering practice. We will all be active in knowledge sharing within our technical group to accelerate our advancement in the implementation of sustainable design in every project that we work.

Through Documentation

Collating data from our future projects' performance will play an important role in our decision-making. Collating the data will allow us to plan better and verify the effectiveness and efficiency of our designs. Ai-Alt is committed to submit our data to the SE2050 database, within one year of joining and then annually.

Through BIM Implementation

The most important decisions regarding a building's sustainable features are made during the concept design and preconstruction phase. BIM based sustainability analyses will allow us to make better prediction of building performance, construction cost, and MEP systems. We will utilize a wide range of products for coordination designs, energy analysis, and documentation.

Biogenic Construction Materials

To shift towards building with low embodied carbon, incorporating biogenic materials into the design is a great approach to reduce climate change impacts of the building sector. The efficiency of these materials will be evaluated through a BIM-based life-cycle assessment (LCA). Performing a life cycle assessment will help us make decisions early in the design phase of future projects.

Advocacy

We aim to promote sustainable design practices through education and marketing outreach. As part of our marketing outreach, Ai-Alt will be announcing its pledge for SE2050 within the company website. By educating the clients and future collaborators about the impacts of green building, they may be more inclined to support this movement. In addition, Ai-Alt plans to recap our action plans after one year and identify adversities and successes of our projects.