



Township Archives
Township of Brick, NJ
401 Chambers Bridge Rd, Brick, NJ 08723

***This File Contains Personal Identifiable
Information of Private Citizen(s).***

Certain information contained in this file is ***Exempt from Release*** under the Open Public Records Act (OPRA) (Public Law 2001, CHAPTER 404 (N.J.S.A. 47:1A-1 et seq.)) and Executive Orders issued by the Governor of New Jersey. The following information ***MUST*** be redacted prior to release:

- Social Security Numbers
- Drivers' License Numbers
- Unlisted Phone Numbers
- Credit Card Numbers
- Bank Account Numbers and Balances

For further information, consult with the Township Clerk, Township Archivist or Township Attorney prior to release.

A handwritten signature in black ink, appearing to read "Bryan J. Dickerson", is written over a horizontal line.

Bryan J. Dickerson, CA, CMR
Township Archivist

Issued: 8 January 2020

BLOCK

723

LOT

1

QUALIFICATION CODE

ADDRESS (SITE)

340 Chambersbridge Rd., Brick Township, NJ 08723

PERMIT NO.

21-0723



CONSTRUCTION PERMIT APPLICATION

C21-003187

Applicant Completes: Sections I, II, III (optional), IV, VI, and VII

I. IDENTIFICATION

Transportation Building-340 Chambersbridge Rd., Brick Township, NJ 08723

1. Proposed Work Site at:

2. Name of Owner in Fee: Brick Township Board of Education

Tel. 732-735-3000

e-mail jedwards@brickschools.org

Address 101 Hendrickson Avenue, Brick, NJ 08724

street

municipality

zip code

3. Ownership in Fee: Public ☒ Private ☐

4. Principal Contractor: North Electric, Inc.

Tel. 973-454-1455

Address 403 Rifle Camp Road

e-mail rados@northelectricinc.com

Woodland Park, NJ 07424

License No. OR, if new home, Builder Reg. No. 34EB00803200

Exp. Date 03/31/24

Home Improvement Contractor Registration No. or Exemption Reason

Federal Emp. ID No. 22-3796567

FAX:

5. Architect or Engineer KMB Design Group

Contact Kyle Tress

Address 1800 Route 34

e-mail ktress@kmbdgc.com

Tel. 732-894-5866

FAX:

6. Responsible Person in Charge once Work has Begun Rados Milojkovic

Tel. 973-454-1455

FAX:

V. FEE SUMMARY (for office use only)

		Update	Update
1. Building	\$ 0.00		
2. Electrical	\$ 0.00		
3. Plumbing	\$ 0.00		
4. Fire Protection	\$ 0.00		
5. Elevator Devices	\$ 0.00		
6. Subtotal	\$ 0.00		
7. Less 20% for State Plan Review	\$ 0.00		
8. Subtotal	\$ 0.00		
9. State Permit Surcharge Fee	\$ 0.00		
10. Subtotal	\$ 0.00		
11. Cert. of Occupancy	\$ 0.00		
12. Other	\$ 0.00		
13. TOTAL	\$ 0.00		

VI. BUILDING/SITE CHARACTERISTICS

1. Number of Stories		(office use only)
2. Height of Structure		
3. Area — Largest Floor		
4. New Building Area		
5. Volume of New Structure		
6. Max. Live Load		
7. Max. Occupancy Load		
8. If Industrialized Building: State Approved		
9. Total Land Area Disturbed		
10. Flood Hazard Zone		
11. Base Flood Elevation		
12. Wetlands yes ☐ no ☐		

IIa. PROPOSED WORK

☐ Minor Work☐ Repair☐ Asbestos Abat. Subch. 8☐ New Building☒ Alteration☐ Lead Hazard Abatement☐ Addition☐ Renovation☐ Radon Remediation☐ Demolition☐ Reconstruction☐ Annual Permit

IIb. SUBCODES

(Check all that apply)

☒ Building☒ Electrical☐ Plumbing☒ Fire Protection☐ Elevator

FOR OFFICE USE ONLY (Optional)

Est. Cost	Plans Rec'd by	Date Rec'd	Rejection Date	Approval Date	Re-viewer	Resubmission Dates Approval	Rejection	Re-viewer
\$6,334.00	gma	8/25/21		09/22/21	KCK			
\$21,115.00				10/21/21	mc			
\$0.00				10/18/21	mc			
	Eng	Exempt		9/9/21	ECC			

TOTAL COST \$27,449.00

VII. DESCRIPTION OF BUILDING USE

A. RESIDENTIAL (primary use)

1. State Specific Use:

2. Use Group, Proposed:

3. Change in Use Group, Indicate Present:

4. No. of dwelling units: Total Units Income-restricted

Gained, Sale

Gained, Rental

Lost, Sale

Lost, Rental

B. NON-RESIDENTIAL (primary use)

1. State Specific Use: Municipal

2. Use Group, Proposed: Solar

3. Change in Use Group, Indicate Present:

C. MIXED USE -List secondary use(s):

D. Construct. Classification: Present

Proposed

III. PLAN REVIEW (optional)

DO YOU WANT:

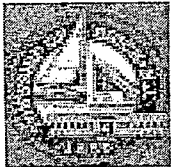
1. ☐ Partial Releases2. ☐ Prototype Processing

IV. DOES OR WILL YOUR BUILDING CONTAIN ANY OF THE FOLLOWING?

1. ☐ Elevators/Escalators/Lifts/

Dumbwaiters/Moving Walks

2. ☐ High Pressure Boilers3. ☐ Pressure Vessels4. ☐ Refrigeration Systems5. ☐ Cross-Connections/Backflow Preventers6. ☐ Hazardous Uses/Places of Assembly7. ☐ Sprinklers/Standpipes8. ☐ Smoke Control Systems in Open Wells9. ☐ Underground Storage Tanks10. ☐ Swimming Pools, Spas and Hot Tubs11. ☐ LPGas Tanks12. ☐ Fire Alarm



Brick Township
401 Chambersbridge Rd
Brick, NJ 08723

Date Issued 04/28/2022
Control Number C-21-003187
Permit Number 21-2723
Permit Issue Date 10/19/2021
Certificate Number 21-2723

Certificate

Construction Code Division
(Certificate of Approval)

Identification

Work Site Location: 340 CHAMBERS BRIDGE RD. Brick Township, NJ Block: 723 Lot: 1 Qual:
Owner in Fee: BRICK TOWNSHIP BOARD OF EDUCATION
Owner Address: 101 HENRICKSON AVE. BRICK NJ 08723
Telephone:
Contractor: NORTH ELECTRIC, INC
Address: 403 RIFLE CAMP ROAD WOODLAND PARK NJ 07424
Telephone: (973) 454-1455 Fax: Federal Emp. Number:
License Number or Builders Registration Number:

Home Warranty Number: Type of Warranty Plan: ☐ State ☐ Private

Use Group: E Construction Classification:

Maximum Live Load: 0 Maximum Occupancy Load: 0

Description of Work/Use: SOLAR PANELS - ...INSTALL 42.23 kw ROOF MOUNT PHOTOVOLTAIC SYSTEM

Certificate Comments:

☐ **Certificate of Occupancy**

This serves notice that said building or structure has been constructed in accordance with the New Jersey Uniform Construction Code and is approved for occupancy.

☒ **Certificate of Approval**

This serves notice that the work completed has been constructed or installed in accordance with the New Jersey Uniform Construction Code and is approved. If the permit was issued for minor work, this certificate was based upon what was visible at the time of inspection.

☐ **Certificate of Continued Occupancy**

This serves notice that based on a general inspection of the visible parts of the building there are no imminent hazards and the building is approved for continued occupancy.

☐ **Temporary Certificate of Compliance**

The following conditions must be met no later than or the owner will be subject to fine or order to vacate:
This certificate has an expiration date of:
Conditions to be met:

☐ **Certificate of Clearance - Lead Abatement 5:17**

This serves notice that based on written certification, lead abatement was performed as per NJACS:17 to the following extent.

- ☐ Total removal of lead-based paint hazards in scope of work
☐ Partial or limited time period (years); see file

☐ **Certificate of Clearance - Asbestos Abatement**

This serves notice that based on written certification, asbestos abatement was performed to the following extent.

- ☐ Total removal of asbestos hazards in scope of work
☐ Partial or limited time period (years); see file

☐ **Certificate of Compliance**

This serves notice that said potentially hazardous equipment has been installed and/or maintained in accordance with the New Jersey Uniform Construction Code and is approved for use until

☐ **Temporary Certificate of Occupancy**

The following conditions must be met no later than: or the owner will be subject to fine or order to vacate:
This certificate has an expiration date of:
Conditions to be met:

David Newman Jr

Construction Official

Date Printed: 04/28/2022

U.C.C. F260 (rev. 08/05)

Fee: \$0.00

Check Number:

Collected By:

Page 1

CERTIFICATION IN LIEU OF OATH

I. OWNER SECTION (to be completed if the applicant is the owner in fee)

I hereby certify that I am the owner in fee of the property listed on Page 1.

Mark the following applicable boxes:

- A. ☐ I further certify that a new home (private residence) will be constructed on this property for my own use and occupancy. This dwelling is to be occupied by myself and is not to be used for any purpose other than single family residential use. I attest that all construction, plumbing, or electrical work will be done, in whole or in part, by me or by subcontractors under my supervision, in accordance with all applicable laws; and, I further acknowledge that said new home is not covered under the New Home Warranty and Builders Registration Act (N.J.S.A. 46:3B-1 et seq.) and that such fact shall be disclosed to any person purchasing this property within ten years of the date of issuance of a certificate of occupancy.

I UNDERSTAND THAT IN MARKING BOX A, I ACKNOWLEDGE THAT I AM ASSUMING RESPONSIBILITY FOR THE WORK DONE ON SAID PROPERTY, THE CONDITION OF THE PROPERTY PRIOR TO, DURING, AND AFTER ANY WORK PERFORMED, AND FOR THE PERFORMANCE OF THE SUBCONTRACTORS I HIRE, EMPLOY, OR OTHERWISE CONTRACT OR WITH WHOM I MAKE AGREEMENTS TO PERFORM WORK. I AM VOLUNTARILY AND KNOWINGLY ASSUMING THIS RESPONSIBILITY.

- B. ☐ I further certify the following as required by the New Jersey Uniform Construction Code, N.J.A.C. 5:23-2.15(f)1.ix:

I personally prepared the plans submitted for: 1) the new home referred to in A.; or, 2) an addition, alteration, renovation, or repair to an existing single family residence owned and occupied by myself and located on the property listed on Page 1; or, 3) a new structure that will be physically separate from, but that will be deemed part of, an existing single family residence that is owned and occupied by myself and located on the property listed on Page 1.

- C. ☐ I further certify that I will perform or supervise the following work:

C.1. ☐ Building C.2. ☐ Fire Protection

I further certify that I will perform the following work:

C.3. ☐ Electrical C.4. ☐ Plumbing

- D. ☐ I agree to advise all contractors on this project that they are required to be registered with the New Jersey Division of Taxation and to comply with all New Jersey tax laws.

I further certify the following as required by the Uniform Construction Code, N.J.A.C. 5:23-2.15(a)5: All required State, county, and local prior approvals, including such certification as the construction official may require, have been given or will be given prior to permit issuance.

I understand that if any of the above statements are willfully false, I am subject to punishment.

Signature _____ Date _____

II. AGENT SECTION (to be completed if the applicant is not the owner in fee)

I hereby certify the following as required by the Uniform Construction Code, N.J.A.C. 5:23-2.15(d): the proposed work is authorized by the owner in fee; and I have been authorized by the owner in fee to make this application as his agent.

I further certify the following as required by the Uniform Construction Code, N.J.A.C. 5:23-2.15(a)5: All required State, county, and local prior approvals, including such certification as the construction official may require, have been given or will be given prior to permit issuance.

I agree to advise all contractors on this project that they are required to be registered with the New Jersey Division of Taxation and to comply with all New Jersey tax laws.

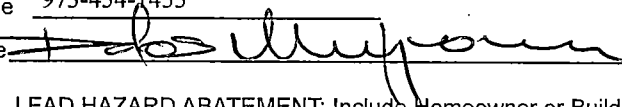
I understand that if any of the above statements are willfully false, I am subject to punishment.

☒ Check if contractor.

Agent Name North Electric, Inc.

Address 403 Rifle Camp Road, Woodland Park, NJ 07424

Telephone 973-454-1455

Signature 

- III. ☐ LEAD HAZARD ABATEMENT: Include Homeowner or Building Owner Affidavit as per N.J.A.C. 5:23-2.15(b)4.

- IV. ☐ HOME ELEVATION: Include Home Elevation Contractor Certification as per N.J.S.A. 52:27D-123.16.



ELECTRICAL SUBCODE TECHNICAL SECTION



IDENTIFICATION—APPLICANT: COMPLETE ALL APPLICABLE INFORMATION. WHEN CHANGING CONTRACTORS, NOTIFY THIS OFFICE. CALL UTILITY DIG NO: 1-800-272-1000.

Block 723 Lot 1 Qualification Code _____
Work Site Location Transportation Building-340 Chambersbridge Rd., Brick Township, NJ 08723

Owner in Fee: Brick Township Board of Education

Tel. (732) 735-3000 e-mail jedwards@brickschools.org

Address 101 Hendrickson Avenue, Brick, NJ 08724

Contractor: North Electric, Inc. Tel. (973) 454-1455

Address 403 Rifle Camp Road e-mail rados@northelectricinc.com

Woodland Park, NJ 07424

Contractor License No. 34EB00803200 Exp. Date 03/31/24

Home Improvement Contractor Registration No. or Exemption Reason (if applicable): _____

Federal Emp. ID No. 22-3796567 FAX: () _____

B. ELECTRICAL CHARACTERISTICS

Use Group Present Logistics Proposed Solar

[] Pole/Pad # _____ [] Temporary [] Other _____

Building Occupied as _____ Utility Co. _____

Est. Cost of Elec. Work \$ 21,115.00

JOB SUMMARY (Office Use Only)		INSPECTIONS		Dates (Month/Day)	
PLAN REVIEW		Type:	Failure	Failure	Approval
[] No Plans Required		Rough			
[] Partial Underslab Utilities Approved		Barrier-Free			
Date: _____	Approved by: _____	Trench			
[X] Electric Plans Approved		Temp. Serv.			
Date: <u>10-17-21</u>	Approved by: <u>MM</u>	Constr. Serv.			
Joint Plan Review Required:		TCO			
[] Bldg. [] Plumb. [] Fire. [] Elev.		Other			
SUBCODE APPROVAL for PERMIT		Service			
Date: <u>10-17-21</u>		Final	<u>4/25/22</u>	<u>4/26/22</u>	<u>MM</u>
Approved by: <u>MM</u>		Barrier-Free			
SUBCODE APPROVAL for CERTIFICATE		Temp. Cut-in-Card Date Issued			
[] CO. [] CCO. [] CA		Final Cut-in-Card Date Issued	<u>4-20-22</u>		
Date: <u>4-20-22</u>		Annual Pool Inspection			
Approved by: <u>MM</u>		Date of Grounding and Bonding Certification			

Date Received
Control #
Date Issued
Permit #

10/19/21
21-2723

C. CERTIFICATION IN LIEU OF OATH

I hereby certify that I am the owner of record and am authorized to make this application and that the work listed on this application.

Applicant Sign/Contractor sign and seal here: _____

Print name here: Rados Milojkovic

[X] Licensed Elec. Contractor [] Certified Landscape Irrigation Contr'r [] Exempt Applicant

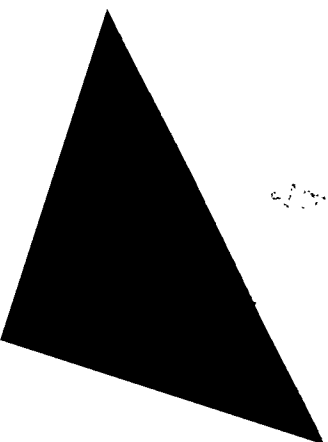
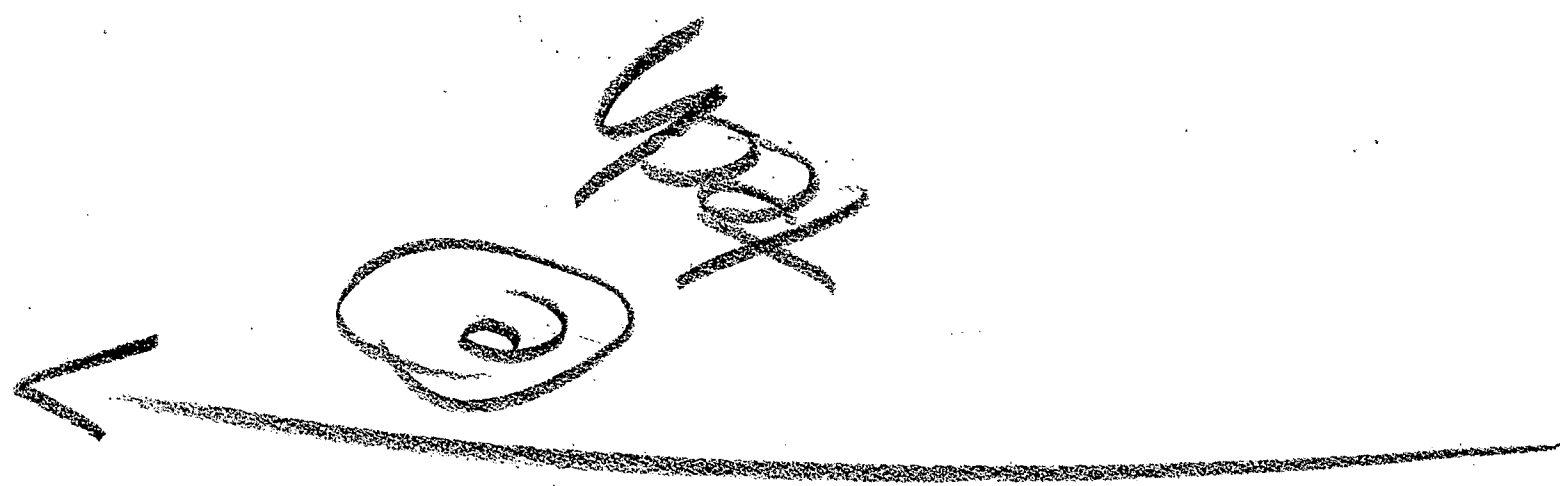
D. TECHNICAL SITE DATA

DESCRIPTION OF WORK: Commercial Rooftop Solar Project

QTY.	SIZE	ITEMS	FEE (Office Use Only)
_____	_____	Lighting Fixtures	_____
_____	_____	Receptacles	_____
_____	_____	Switches	_____
_____	_____	Detectors	_____
_____	_____	Light Poles	_____
_____	_____	Motors—Fract. HP	_____
_____	_____	Emergency & Exit Lights	_____
_____	_____	Communications Points	_____
_____	_____	Alarm Devices/F.A.O. Panel	_____
_____	_____	TOTAL NUMBERS	_____
_____	_____	Pool Permit/with UW Lights	_____
_____	_____	Storable Pool/Spa/Hot Tub	_____
_____	_____	KW Elec. Range/Receptacle	_____
_____	_____	KW Oven/Surface Unit	_____
_____	_____	KW Elec. Water Heater	_____
_____	_____	KW Elec. Dryer/Receptacle	_____
_____	_____	KW Dishwasher	_____
_____	_____	HP Garbage Disposal	_____
_____	_____	KW Central A/C Unit	_____
_____	_____	HP/KW Space Heater/Air Handler	_____
_____	_____	KW Baseboard Heat	_____
_____	_____	HP Motors 1/+ HP	_____
1	43	KW Transformer/Generator Inverter	_____
138		AMP Service Solar modules	_____
1	200	AMP Subpanels	_____
_____	_____	AMP Motor Control Center	_____
1	42.23	KW Elec. sign/outlet/light solar system	_____
_____	_____	<u>SBE ATTACHED</u>	_____

Administrative Surcharge \$ _____
Minimum Fee \$ _____
State Permit Surcharge Fee \$ _____
TOTAL FEE \$ _____

4-20-22
Secure can flex
install Bushings



CELE
BANK
FEDERAL
BANK
BANK

4-20-22
4-20-22
4-20-22

DR#351 109 477.



CUT-IN-CARD

MUNICIPALITY Brock

LOCATION 340 CHAMBERS BRIDGE RD UTILITY CO JCP41

BLK 723 LOT 1

DESCRIPTION

OWNER Brock

OCCUPANT Commercial/School

"Installation in the above premises has been inspected and is in accordance with N.E.C. and DCA requirements."

LIT METR

Interconnection p

- (1) Solar ACD-A
- (1) Solar ACD-B

☐ FINAL ☐ TEMPORARY This approval void after _____ days

DESCRIPTION OF SERVICE 400A 30 NH.

Inverters (1)
Solar Modules (13)

INSTALLED BY North Star Inc LICENSE NO 8032

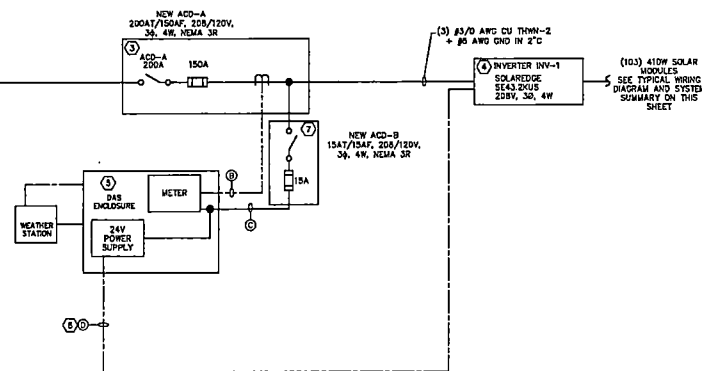
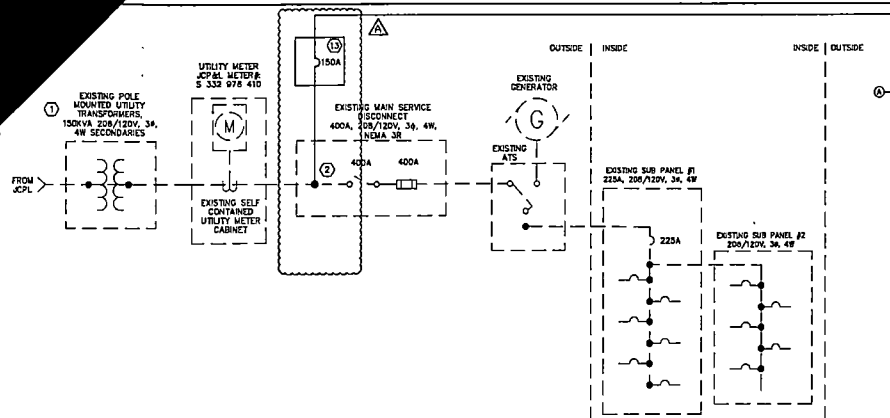
DATE 4/20/22 PERMIT # 21-2722 INSPECTOR (Signature)

☐ CALLED IN 4/20/22

Lic. No: 10035

U.C.C. Form F-350B 1 WHITE-UTILITY 2 CANARY-OFFICE/FILE 3 PINK-OFFICE/CONTRACTOR

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS AND TOLERANCES ARE THE PROPERTY OF THE DESIGNER. THE DESIGNER SHALL BE RESPONSIBLE FOR THE ACCURACY OF THE DIMENSIONS AND TOLERANCES. THE DESIGNER SHALL BE RESPONSIBLE FOR THE ACCURACY OF THE DIMENSIONS AND TOLERANCES. THE DESIGNER SHALL BE RESPONSIBLE FOR THE ACCURACY OF THE DIMENSIONS AND TOLERANCES.



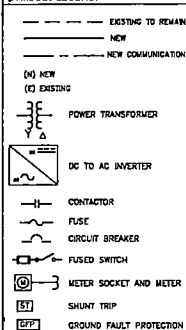
AC WIRE AND CONDUIT SCHEDULE:

AC WIRE AND CONDUIT SCHEDULE				
	MINIMUM VOLTAGE	WIRE SIZE & TYPE	MINIMUM CONDUIT LENGTH (FT)	VOLTAGE DROP
A	208V 3PH	(3) #10 AWG CU THWN-2 + #8 AWG N + #6 AWG GND	(1) 1-1/2"	1.44%
B	-	18 AWG SHIELDED TWISTED PAIR - CT EXTENSION CABLE	-	N/A
C	208V 3PH	(3) #12 THWN-2 + #12 AWG CU GROUND	3/4"	-
D	-	RS485 MODBUS COMMUNICATIONS CABLE	-	-

SYSTEM SUMMARY:

INVERTER NUMBER	INVERTER MODEL	INVERTER SIZE (KWAC)	INVERTER SECTION	STRING NUMBER	MODULE TYPE	TILT	AZIMUTH	MODULE SIZE (W)	NUMBER OF MODULES PER STRING	OPTIMIZER MODEL	NUMBER OF OPTIMIZERS	STRING SYSTEM SIZE (KWDC)	TOTAL SYSTEM SIZE (KWDC)	DC/AC
INV-1	SOLAREGE SE43.2KUS	43.20	1	STRING 1	CANADIAN SOLAR CS3W-410P	10°	146°	410	18	P860	9	7.38	42.23	0.98
				STRING 2	CANADIAN SOLAR CS3W-410P	10°	146°	410	18	P860	9	7.38		
				STRING 3	CANADIAN SOLAR CS3W-410P	10°	146°	410	18	P860	9	7.38		
			2	STRING 4	CANADIAN SOLAR CS3W-410P	10°	146°	410	17	P860	9	6.97		
				STRING 5	CANADIAN SOLAR CS3W-410P	10°	146°	410	16	P860	8	6.56		
				STRING 6	CANADIAN SOLAR CS3W-410P	10°	146°	410	16	P860	8	6.56		
TOTAL:		43.20							103	-	52	42.23		0.98

SYMBOLS LEGEND:



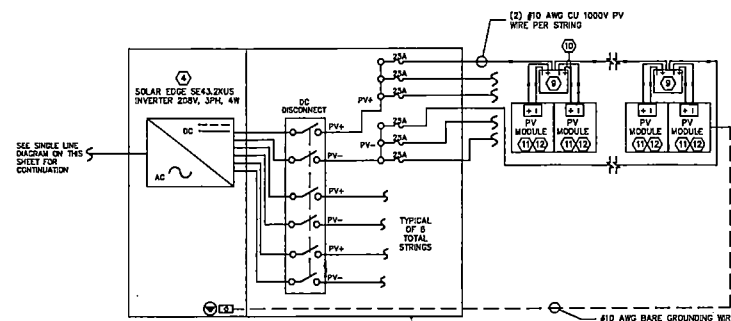
KEY NOTES:

- EXISTING 150 KVA UTILITY TRANSFORMERS, 208/120V, 3Ø, 4W SECONDARIES
- INTERCONNECTION FOR NEW PV SERVICE IN EXISTING MAIN SERVICE DISCONNECT, AHEAD OF THE DISCONNECT, ON THE LOAD SIDE OF THE UTILITY METER.
- NEW SERVICE ENTRANCE RATED 200A, 208/120V, 3Ø, 4W, NEMA 3R PV MAIN SERVICE AC FUSIBLE DISCONNECT SWITCH, FUSED AT 150A. SWITCH SHALL BE LOAD BREAK RATED, VISIBLE BREAK AND LOCKABLE IN THE OPEN POSITION.
- NEW SOLAREGE SE43.2KUS 208V, 3Ø INVERTER.
- NEW REVENUE GRADE SEC METER AND DAS IN NEMA 4 ENCLOSURE. COORDINATE EXACT REQUIREMENTS WITH DAS MANUFACTURER.
- COMMUNICATIONS CABLE BETWEEN INVERTERS AND DATA ACQUISITION SYSTEM.
- NEW 15A, 208/120V, 3Ø, 4W, NEMA 3R AC-2, AC FUSIBLE DISCONNECT SWITCH, FUSED AT 15A.
- PANEL MOUNTED 208/120V, 3Ø AC SURGE PROTECTIVE DEVICE
- SOLAREGE POWER OPTIMIZER, P860. ONE OPTIMIZER SHALL BE INSTALLED FOR EVERY 2 MODULES. SEE SYSTEM SUMMARY TABLE FOR OPTIMIZER CONFIGURATION PER STRING. POWER OPTIMIZER SHALL BE RATED TO THE RACKING SYSTEM USING THE STAR WASHERS INCLUDED WITH THE OPTIMIZER. THIS PROVIDES THE GROUNDING OF THE OPTIMIZER IN ACCORDANCE WITH THE NEC.
- JUMPER CABLE TO BE INSTALLED BETWEEN SOLAREGE POWER OPTIMIZERS WHERE NEEDED.
- CANADIAN SOLAR CS3W-410P 410W 100V SOLAR MODULES. SEE SYSTEM SUMMARY FOR FURTHER INFORMATION. EACH MODULE INCLUDES 1 #10 AWG OUTDOOR RATED QUICK CONNECTS FOR MODULE INTERCONNECTION. DO NOT REMOVE THE QUICK CONNECTS. OTHERWISE THE MODULE WARRANTY AND THE UL LISTING MAY BE INVALIDATED. QUICK CONNECTS SHALL COMPLY WITH NEC 690.33(C).
- INDIVIDUAL MODULES SHALL BE BONDED TO THE RACKING SYSTEM USING APPROVED RACKING GROUNDING LUG.
- NEW CIRCUIT BREAKER 150A, 208/120V, 3Ø, 4W, NEMA 3R PV CIRCUIT BREAKER TO BE LOCATED LESS THAN 10 FEET FROM THE POINT OF INTERCONNECTION.

INVERTER PROTECTIVE SETTING TABLE:

PROPOSED INVERTER GRID PROTECTION SETTINGS				
DEVICE SETTING	PICKUP	VALUE	TRIP TIME (SEC)	TRIP TIME (CYCLES)
27-1	45%	54.00 V	0.16	9.60
27-2	60%	72.00 V	1.00	60.00
27-3	86%	105.60 V	2.00	120.00
59-1	110%	132 V	1.00	60.00
59-2	120%	144 V	0.16	9.60
81U-2		59.5Hz	2.00	120.00
81U-1		57.0Hz	0.16	9.60
81O-1		60.5Hz	2.00	120.00
81O-2		62.0Hz	0.16	9.60

TYPICAL INVERTER SCHEMATIC:



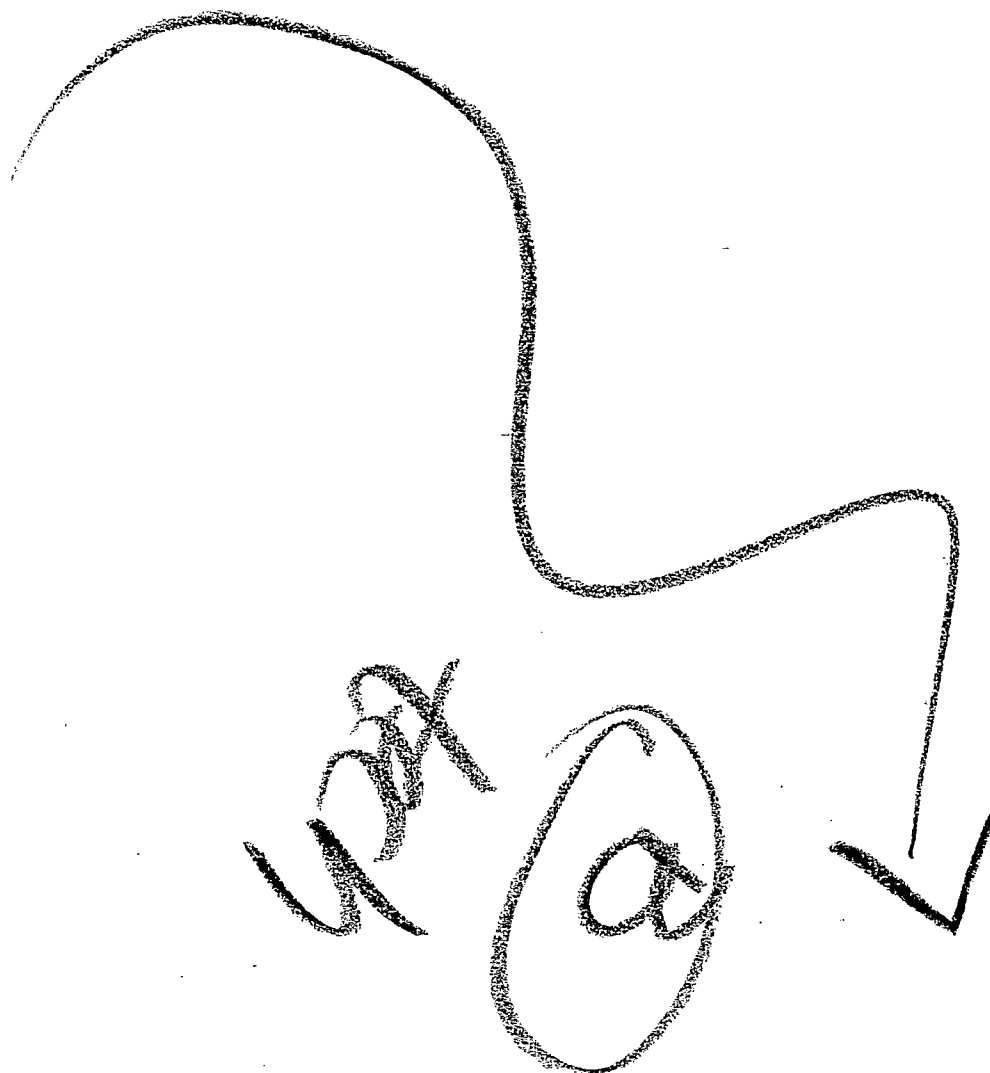
BRICK TRANSPORTATION BUILDING SOLAR
ROOF MOUNTED PHOTOVOLTAIC SYSTEM
42.23 KW DC / 43.20 KW AC
340 CHAMBERSBRIDGE ROAD
BRICK TOWNSHIP, NJ 08723

732.0753.007

PV ONE-LINE
DIAGRAM

REVISED
DATE
BY
CHK
APP

PV-200



845-874-
9-358

William

Frank

BRIGHT CORP.



FIRE PROTECTION SUBCODE TECHNICAL SECTION



A. IDENTIFICATION—APPLICANT: COMPLETE ALL APPLICABLE INFORMATION. WHEN CHANGING CONTRACTORS, NOTIFY THIS OFFICE. CALL UTILITY DIG NO: 1-800-272-1000.

Block 723 Lot 1 Qualification Code _____
Work Site Location Transportation Building-340 Chambersbridge Rd., Brick Township, NJ 08723

Owner in Fee: Brick Township Board of Education

Tel. (732) 735-3000 e-mail jedwards@brickschools.org

Address 101 Hendrickson Avenue, Brick, NJ 08724

Contractor: North Electric, Inc. Tel. (973) 454-1455

Address 403 Rifle Camp Road e-mail rados@northelectricinc.com
Woodland Park, NJ 07424

Fire Protection Equipment, NJ Div of Fire Safety Permit No. _____

Fire Protection Equipment, NJ Div of Fire Safety Installer No. _____

Fire Alarm Contractor No. _____ Exp. Date _____

Home Improvement Contractor Registration No. or Exemption Reason (if applicable): Licensed Electrical

Federal Emp. ID No. 22-3796567 FAX: (_____) Contractor

B. FIRE PROTECTION CHARACTERISTICS 34EB00803200 Exp. Date: 03/31/24

Use Group: Present Municipal Proposed Solar

Constr. Class: Present _____ Proposed _____

Heating System: ☐ New OR ☐ Modification to Existing
OR ☐ Conversion OR ☐ Replacement

Fuel Type: ☐ Gas ☐ Oil ☐ Electric ☐ Solar
Other _____

Location: _____

Total Cost of Fire Protection Work \$ 0

Fuel Storage Tank:

Fuel Type: ☐ Flammable OR ☐ Combustible
Capacity _____

Fire Alarm System: ☐ New OR ☐ Existing

Location of Panel: _____

Fire Suppression/Standpipe System:

☐ New OR ☐ Existing

Location of Main Control Valve: _____

JOB SUMMARY (Office Use Only)

PLAN REVIEW

☐ No Plans Required
☐ Partial - Underslab Utilities Approved

Date: _____ Approved by: _____

☐ Fire Protection Plans Approved

Date: _____ Approved by: _____

Joint Plan Review Required:

☐ Bldg. ☐ Elec. ☐ Plumb. ☐ Elev.

SUBCODE APPROVAL FOR PERMIT

Date: 10/18/24

Approved by: [Signature]

SUBCODE APPROVAL FOR CERTIFICATE

☐ CO ☐ CCO ☐ CA

Date: _____

Approved by: _____

INSPECTIONS

Type:	Failure	Failure	Approval	Initial
Alarm System				
Suppression Sys.				
Standpipe				
Fire Pump				
Pre-Eng. System				
Mechanical				
Smoke Control				
TCO				
Flam/Combust Tanks				
Fireplace Venting				
Final				
Other				

Dates (Month/Day)

C. CERTIFICATION IN LIEU OF OATH

I hereby certify that I am the (agent or) owner of record and am authorized to make this application.

Applicant/Contractor
sign here: _____

Print name here: Rados Milojkovic

D. TECHNICAL SITE DATA ☐ Certified Contractor ☒ Exempt Applicant

DESCRIPTION OF WORK:

Water Supply Source _____

Method of Alarm/Suppression System Supervision _____

	NUMBER	FEE (Office Use Only)
Flammable/Combustible Tanks	_____	\$ _____
Alarm Systems	_____	_____
☐ System	_____	_____
☐ 110v Interconnected	_____	_____
☐ CO Detectors/110v	_____	_____
Alarm Devices (i.e., smoke, heat, pulls, water/flow)	_____	_____
Supervisory Devices (i.e., tamper, low/high air)	_____	_____
Signaling Devices (i.e., horn/strobes, bells)	_____	_____
Other Devices	_____	_____
TOTAL	_____	_____
Suppression Systems	_____	_____
Fire Pump _____ GPM Type _____	_____	_____
Dry Pipe/Alarm Valves	_____	_____
Pre-action Valves	_____	_____
Sprinkler Heads (Dry and Wet)	_____	_____
Standpipes	_____	_____
Pre-engineered Systems	_____	_____
Wet Chemical	_____	_____
Dry Chemical	_____	_____
CO ₂ Suppression	_____	_____
Foam Suppression	_____	_____
FM200 Suppression	_____	_____
Other _____	_____	_____
Other Systems	_____	_____
Kitchen Hood Exhaust System	_____	_____
Smoke Control System	_____	_____
Fuel-Fired Appliances ☐ Gas ☐ Oil ☐ Solid	_____	_____
Fireplace Venting/Metal Chimney	_____	_____
Other <u>Solar</u>	_____	_____

Administrative Surcharge \$ _____

Minimum Fee \$ _____

State Permit Surcharge Fee \$ _____

TOTAL FEE \$ _____



CONSTRUCTION PERMIT

Date Issued 10/19/2021
Control # C-21-003187
Permit # 21-2723

IDENTIFICATION Block: 723 Lot: 1 Qualifier _____
Work Site Location: 340 CHAMBERS BRIDGE RD. Brick Township, NJ Contractor NORTH ELECTRIC, INC
Owner in Fee BRICK TOWNSHIP BOARD OF EDUCATION Address 403 RIFLE CAMP ROAD WOODLAND PARK NJ 07424
101 HENRICKSON AVE. BRICK NJ 08723 Telephone: (973) 454-1455
Telephone: _____ Lic. No. or Bids. Reg. No. 34EB00803200
Federal Employee No. _____

Is hereby granted permission to perform the following work:

- | | | |
|--|--|--|
| ☒ BUILDING | ☐ PLUMBING | ☐ LEAD HAZARD ABATEMENT |
| ☒ ELECTRICAL | ☒ FIRE PROTECTION | ☐ DEMOLITION |
| ☐ ELEVATOR DEVICES | ☐ ASBESTOS ABATEMENT
(Subchapter 8 only) | ☐ OTHER |

DESCRIPTION OF WORK:

SOLAR PANELS ...INSTALL 42.23 kw ROOF MOUNT PHOTOVOLTAIC SYSTEM

Note: If construction does not commence within one (1) year of date of issuance, or if construction ceases for a period of six (6) months, this permit is void.

Estimated Cost of Work \$27,449

D. Neuman
Construction Official

10/19/21
Date

U.C.C. F170
equiv (rev 1/04)

1 WHITE - INSPECTOR

2 CANARY - OFFICE

3 PINK - TAX ASSESSOR

4 GOLD - APPLICANT

PAYMENTS (Office Use Only)

Building	\$0
Electrical	\$0
Plumbing	\$0
Fire Protection	\$0
Elevator Devices	\$0
Other	\$0.00
DCA Training Fee	\$0
CO Fee	
Other	\$0
Total	\$0
Check No.	
Cash	\$0
Credit	\$0
Collected By	

REQUIRED INSPECTIONS

Construction work must be inspected in accordance with the State Uniform Construction Code Regulations N.J.A.C. 5:23-2.18. This agency will carry out such periodic inspections during the progress of work as are necessary to insure that the work installed conforms with the requirements of the Uniform Construction Code.

The owner or other responsible person in charge of work must notify this agency when work is ready for any required inspections specified below. Requests for inspections must be made at least 24 hours prior to the time the inspection is desired. Inspections will be performed within three business days of the time for which they are requested. The work must not proceed in a manner which will preclude the inspection until it has been made and approval granted.

☒ Required inspections for all subcodes for one- and two-family dwellings are as follows:

1. The bottom of footing trenches before placement of footings, except that in cases of pile foundations, inspections shall be made in accordance with the requirements of the building subcode.
2. Foundations and all walls up to grade level prior to back filling.
3. All structural framing, connections, wall and roof sheathing and insulation; electrical rough wiring, panel and service installation; rough plumbing. The framing inspection shall take place after the rough electrical and plumbing inspections and after the installation of the heating, ventilation and /or air conditioning duct system. The insulation inspection shall be performed after all other subcode rough inspections and prior to the installation of any interior finish material.
4. Installation of all finished materials, sealings of exterior joints, plumbing piping, trim and fixtures; electrical wiring, devices and fixtures; mechanical systems equipment.

Additional required inspections for all subcodes of construction, for other than one- and two-family dwellings, are fire suppression systems, heat producing devices and Barrier Free subcode accessibility, if applicable.

☐ Required special inspections. The applicant by accepting the permit will be deemed to have consented to these requirements:

☒ A final inspection is required for each applicable subcode area before a final Certificate of Occupancy or Approval may be issued. The final inspections include the installation of all interior and exterior finish materials, sealing of exterior joints, mechanical system and other required equipment; electrical wiring, devices and fixtures; plumbing pipes, trim and fixtures; tests required by any provision of the adopted subcodes, Barrier Free accessibility, if applicable; and verification of compliance with NJAC 5:23-3.5, "Posting structures".

☒ A complete copy of released plans must be kept on the job site.

If you do not understand any of this information, please ask.

RECEIVING CLERK _____
DATE REC'D _____

ZONING PERMIT APPLICATION

PERMIT # _____
DATE ISSUED _____

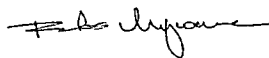
BLOCK: 723 LOT: 1 QUALIFIER: _____ SITE ADDRESS: _____

IDENTIFICATION:

1. NAME OF OWNER IN FEE: Brick Township Board of Education
COMPLETE ADDRESS: Transportation Building
340 Chambersbridge Rd., Brick Township, NJ 08723
PHONE # (732) 735-3000 EMAIL: jedwards@brickschools.org

2. NAME OF APPLICANT: North Electric, Inc.
APPLICANT ADDRESS: 403 Rifle Camp Road
Woodland Park, NJ 07424
PHONE # 973-454-1455 EMAIL: rados@northelectricinc.com

3. RESPONSIBLE PERSON FOR WORK: Rados Milojkovic
PHONE# 973-454-1455 FAX# _____

4. SIGNATURE OF APPLICANT: 

FOR OFFICE USE ONLY

FEE SUMMARY:

APPLICATION FEE: \$ _____
OTHER: \$ _____
TOTAL: \$ _____

REQUIRED BY APPLICANT

RESIDENTIAL: _____
COMMERCIAL: _____
EXISTING USE: _____
PROPOSED USE _____

BOARD APPROVAL: _____ PB _____ ZB _____
RESOLUTION#: _____
APPROVAL DATE: _____

PROJECT DESCRIPTION: (PLEASE CHECK APPLICABLE WORK & DESCRIBE)

*NEW BUILDING: _____ *ADDITION _____ *ALTERATION _____ *PORCH _____ *DECK _____

POOL: ABOVE GROUND _____ IN GROUND _____ FENCE: HEIGHT _____ TYPE _____

HEIGHT: _____ (*APPLICABLE)

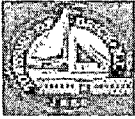
OTHER Solar

DESCRIPTION: Solar rooftop system

ZONING REVIEW:

DATE REVIEWED: 9-8-21 DATE DENIED: _____ DATE APPROVED: 9-8-21 INTLS: 

(SEE BACK PAGE)



Brick Township
401 Chambers Bridge Rd.
Brick, NJ 08723
(732) 262-1041

Date Issued: _____
Application Number: ZA-21-01396
Application Date: 9/8/2021
Project Number: 21-01461
Permit Number: 21-01461
Fee: \$0.00

Zoning Permit

Worksite **340 Chambers Bridge Rd.**
Location: **Brick Township, NJ 08723**

Owner: **BRICK TOWNSHIP BOARD OF EDUCATION**
Address: **101 HENRICKSON AVE.**
BRICK, NJ 08723

Applicant: **NORTH ELECTRIC, INC**
Address: **403 RIFLE CAMP ROAD**
WOODLAND PARK, NJ 07424

Block: 723 Lot: 1 Qualifier: _____ Zone: R-R-1

This Certifies that an application for the issuance of a Zoning Permit has been examined.

Present Use: Brick Board of Education Facility

☐ Non Conforming Use

☐ Non Conforming Structure

Proposed Use: Brick Board of Education Facility Transportation Building

Work Description:

Solar Energy System - Installation of a 42.23 KW solar panel system mounted on the roof of the building.

Additional Zoning Permit is required for additional work.

Application Approved Date: 9/8/2021

Upon review it was determined that the Zoning Permit:

☒ Permitted by Ordinance

☐ Permitted by Variance approved on: _____

☐ Approved with Conditions

☐ Valid Nonconforming Use/Structure is established by

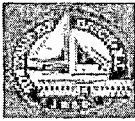
☐ Zoning Board of Adjustment

☐ Zoning Officer

Christopher J. Romano, Zoning Officer

9/8/2021

Date



Brick Township
401 Chambers Bridge Rd.
Brick, NJ 08723
(732) 262-1041

Date Issued: _____
Application Number: ZA-21-01396
Application Date: 9/8/2021
Project Number: _____
Permit Number: _____
Fee: \$0.00

Zoning Permit

Worksite **340 Chambers Bridge Rd.**
Location: **Brick Township, NJ 08723**

Owner: **BRICK TOWNSHIP BOARD OF EDUCATION**
Address: **101 HENRICKSON AVE.**
BRICK, NJ 08723

Applicant: **NORTH ELECTRIC, INC**
Address: **403 RIFLE CAMP ROAD**
WOODLAND PARK, NJ 07424

Block: 723 Lot: 1 Qualifier: _____ Zone: R-R-1

This Certifies that an application for the issuance of a Zoning Permit has been examined.

Present Use: Brick Board of Education Facility

☐ Non Conforming Use

☐ Non Conforming Structure

Proposed Use: Brick Board of Education Facility Transportation Building

Work Description:

Solar Energy System - Installation of a 42.23 KW solar panel system mounted on the roof of the building.

Additional Zoning Permit is required for additional work.

Application Approved Date: 9/8/2021

Upon review it was determined that the Zoning Permit:

☒ Permitted by Ordinance

☐ Permitted by Variance approved on: _____

☐ Approved with Conditions

☐ Valid Nonconforming Use/Structure is established by

☐ Zoning Board of Adjustment

☐ Zoning Officer

Christopher J. Romano, Zoning Officer

9/8/2021

Date

ENGINEERING PERMIT APPLICATION

BLOCK: 723 LOT: 1 ADDRESS: 40 Chambersbridge Rd., Brick Township, NJ 08723

RECEIVING CLERK: _____

PERMIT #: _____

IDENTIFICATION:

1. WORK SITE ADDRESS: Transportation Building
340 Chambersbridge Rd., Brick Township, NJ 08723

2. NAME OF OWNER IN FEE: Brick Township Board of Education

ADDRESS: 101 Hendrickson Avenue PHONE #: (732) 735-3000
Brick, NJ 08724 FAX #: ()

3. PRINCIPAL CONTRACTOR: North Electric, Inc.

ADDRESS: 403 Rifle Camp Road PHONE #: (973) 454-1455
Woodland Park, NJ 07424 FAX #: ()

4. ARCHITECT OR ENGINEER: KMB Design Group

ADDRESS: 1800 Route 34, Wall, NJ 07719 PHONE: # (732) 894-5866

5. RESPONSIBLE PERSON FOR WORK: Rados Milojkovic

ADDRESS: 403 Rifle Camp Road, Woodland Park, NJ 07424

PHONE #: (973) 454-1455 FAX #: () E-MAIL: rados@northelectricinc.com

PROJECT DESCRIPTION: ☐ GRADING/CLEARING ☐ ROAD OPENING
☐ SOIL REMOVAL/FILL ☐ RETAINING WALL ☐ POOL
☐ BULKHEAD/DOCK ☐ DWELLING ☐ TREE REMOVAL
☒ OTHER Solar

LENGTH: _____ WIDTH: _____ HEIGHT: _____

FEE SUMMARY:

APPLICATION FEE: \$ _____

REVIEW FEE: \$ _____

INSPECTION FEE: \$ _____

OTHER _____: \$ _____

BOND(S): \$ _____

TOTAL: \$ _____

SPECIAL CONDITIONS:

OCEAN COUNTY SOILS: _____

DRAINAGE EASEMENTS: _____

UTILITY EASEMENTS: _____

CONSERVATION EASEMENTS: _____

FEMA REQUIREMENTS: _____

D.E.P. PERMITS: _____

BOARD APPROVAL: ☐ PB ☐ ZB

APPLICATION NUMBER: _____

APPROVED DATE: _____

ENGINEERING REVIEW:

DATE RECEIVED: _____ DATE REJECTED: _____ DATE APPROVED: _____ INITIALS: _____

ENGINEERING REPORT

TO: Ecolibrium Solar, Inc.
507 Richland Avenue
Athens, Ohio 45701

DATE: June 29, 2021

ATTN: Mr. Chris Berg
Project Solutions Manager

NO: 24199D-1-0621-10

Re: Critical Review of Design Calculations and Roof Top Placement Drawings for the Ecofoot2+® Solar Panel Support System, BrightCore – (Brick Transportation Building) 300 Chambersbridge Road, Brick, New Jersey; CBC Report No. 24199D-1-0621-10

CBC Engineers and Associates, Ltd. (CBC) is pleased to submit our critical review of the ballast and attachment design calculations and placement shop drawings for the above referenced project. The Ecolibrium Solar, Inc. Ecofoot2+® solar panel support system will be used to support new solar panels on a building rooftop at 300 Chambersbridge Road, Brick, New Jersey. The structural analysis of the Ecofoot2+® system for this site has been performed in accordance with ASCE 7-16 using the design criteria shown in Table 1 below.

TABLE 1
DESIGN CRITERIA

DESCRIPTION	VALUE USED IN DESIGN
Basic Wind Speed – 3 Second Gust	130 mph
Occupancy Category	III
Exposure Category	B
Roof Height	20 ft
Solar Panel Module Weight	54.90 lbs
Solar Panel Module Length x Width	83.00 in x 41.30 in
Solar Panel Orientation	Landscape
Friction Coefficient	0.49
Existing Roof Type	EPDM Membrane
Pg = Ground Snow Load	20.0 psf
Seismic Design Category	B
Ss = 0.2s Response Mapped Acceleration Parameter	0.2020
Ballast Block Weight	32 lbs

Determinations have been made for the theoretical minimum combination of ballast and attachment capacity required to resist the applicable loading conditions, with the critical loading

scenario being used to determine the overall minimum capacity required. For this project, the necessary ballast and attachment to resist wind is the worst case loading scenario.

The wind pressure and force coefficients used in the determination of the required capacity to resist wind-induced uplift and sliding of the Ecofoot2+® ballasted and/or attached arrays are based on the results of the Ecofoot2® Racking System Wind Pressure Study performed for Ecolibrium Solar, Inc. by Rowan Williams Davies & Irwin, Inc. (RWDI) as presented in their report dated December 3, 2014 and subsequent update to that report dated April 18, 2017. Based on this study, the following two equations were provided to facilitate determination of the theoretical minimum capacity required to resist wind-induced uplift and sliding using the design criteria as shown in Table 1 above. The theoretical results for the minimum required ballast and attachments at each Ecofoot2+® location in the solar panel array are shown in the schematic attached in Appendix B. The placement shop drawing attached in Appendix C depicts the location of each Ecofoot2+® support and the actual suggested number of ballast blocks and attachments at each location as per the values shown in the Appendix B schematic. It is our understanding that the Attached Zones shown in Appendix B will be fastened to the roof using roof attachments with sufficient capacity to resist wind-induced uplift and sliding forces.

Ballast (lb) to Resist Uplift

$$\alpha_D \cdot Ballast_{uplift} = \alpha_W \cdot q_z \cdot |GC_p|_{uplift} \cdot A_{uplift} - \alpha_D \cdot M \quad (\text{lbs})$$

Ballast (lb) to Resist Sliding

$$\alpha_D \cdot Ballast_{drag} = \alpha_W \cdot q_z \cdot \left[(GC_p)_{drag}^* \cdot A_{drag} \cdot (1/f_n) + |GC_p|_{uplift}^* \cdot A_{uplift} \right] - \alpha_D \cdot M \quad (\text{lbs})$$

where:

- α_W = factor on wind load from ASCE 7-16
- α_D = factor on dead load from ASCE 7-16
- q_z = 3-second gust wind pressure (lbs/ft²) for site location from ASCE 7-16, including exposure factor (K_z) and directionality factor ($K_d = 0.85$) as per chapters 26 and 29 of ASCE 7-16.
- M = self-weight of assembled system (lbs) for appropriate averaging area
- f_n = frictional coefficient
- A_{uplift} = area (ft²) of panel(s) projected onto a horizontal plane
- A_{drag} = area (ft²) of panel(s) projected onto a vertical plane
- $|GC_p|_{uplift}$ = absolute value of uplift pressure coefficient for selected averaging area
- $(GC_p)_{drag}^*$ = highest drag pressure coefficient multiplied by the appropriate area reduction factor

$|GC_p|_{uplift}^*$ = absolute value of highest uplift pressure coefficient multiplied by the appropriate area reduction factor

Based on a critical review of the design calculations, it is the opinion of CBC that said calculations have been performed and prepared in accordance with the applicable provisions of the referenced standards and accepted industry practices. The calculations are included in Appendix A. It is also the opinion of CBC that the Ecofoot2+® placement shop drawings have also been performed and prepared in accordance with the applicable provisions of the referenced standards and accepted industry practices. The drawings are included in Appendix C. CBC has accordingly signed and sealed this report and the Ecofoot2+® placement shop drawings. As such, CBC is the Engineer of Record for the structural analysis of the Ecofoot2+® system for the above referenced project.

CBC has not evaluated the existing building structure for support of the proposed support system(s), and this is the responsibility of others than CBC. It is assumed others than CBC have evaluated the building structure for support of the proposed system(s). It is assumed the roofing system is installed according to the manufacturer's recommendations. If conditions for this project differ from those expressed herein, Ecolibrium Solar, Inc. and CBC Engineers & Associates, Ltd. should be notified immediately.

This critical review engineering report provides information regarding the Ecofoot2+® system by Ecolibrium Solar, Inc., which must be installed according to the instructions and requirements of Ecolibrium Solar, Inc.. The solar panels are supplied and designed by others, and are attached to the Ecofoot2+® supports, with provided Ecofoot2+® hardware, according to the instructions and requirements of Ecolibrium Solar, Inc.. It is assumed that the ballast blocks will be installed in accordance with the recommendations of Ecolibrium Solar, Inc., and in such a manner so that the required ballast will be permanently available for the life of the system. The specific construction techniques and methods chosen to install the Ecofoot2+® system as per the requirements of Ecolibrium Solar, Inc. and as detailed in this report are the responsibility of the installation contractor. Independent conclusions, opinions or recommendations made by others than CBC based on the information provided herein are the responsibility of the independent party.

Our professional services have been performed and our findings obtained in accordance with generally accepted engineering principles and practices. No other warranty, expressed or implied is

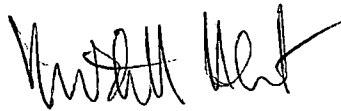
made. This report is not a bidding document and shall not be used for that purpose. This report has been prepared for the exclusive use of Ecolibrium Solar, Inc. for specific application to the project herein described. The report shall be used in its entirety.

Thank you for the opportunity to provide this report. If you have any questions, or require any further assistance, please contact us.

CBC Engineers & Associates, Ltd.
New Jersey Certificate of Authorization
24GA28237500

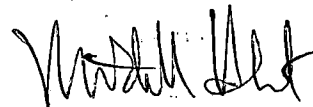


Rick L. Teachey, Jr., E.I.T.
Project Engineer



Mitchell T. Hardert, P.E.
Chief Engineer
N.J. Professional Engineer, No. GE 50879

RLT/MTH/leh
cc: Client (cberg@ecolibrumsolar.com)
1-File



6/29/21

Uplift, Sliding and Seismic Calculations

Explanation of EcoFoot System Calculations and Design Procedure

Installer Name:	BrightCore
Project Name:	Brick Transportation Building
Project Address:	300 Chambersbridge Rd Brick, NJ 08723
Date Prepared:	6/29/2021

Calculation Explanation Key Sections:

Introduction, Site Specifics and Variable Definition.....	Page 2
Wind Tunnel Testing, Uplift and Drag Force Calculations.....	Page 3
Ballast Application to Sheet S-1.0.....	Page 5
Detailed Calculations From Table 4.....	Page 7
ASCE 7-16 - Section 13.3: Attached Arrays.....	Page 8

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3rd Party Engineering Resources

Rowan, Williams, Davies, & Irwin Inc (RWDI) -- Wind Tunnel Testing Per ASCE 7 / IBC
Maffei Structural Engineering -- Peer Review of Wind Tunnel Testing
Testing Engineers, Inc. -- Friction Testing per ASTM G115
CBC Engineers -- Professional Engineering Review and Certification

Introduction, Site Specifics and Variable Definition

In order to efficiently design EcoFoot2+ and EcoFoot5D ballasted photovoltaic systems, Ecolibrium Solar makes use of a proprietary solar array design aid called "EcoCalcs". Starting with a set of design criteria, shown here in Table 1 below, EcoCalcs utilizes methodologies laid out in the ASCE7 and SEAOC PV1/PV2 documents, and derivative building codes. Actual calculations for this project are included herein, and are accompanied by a step-by-step explanation of Ecolibrium Solar's design process.

The output of EcoCalcs is a comprehensive set of ballast prescriptions, including Image 3 found on Page 5. Ballast prescriptions are applied to a proposed system layout by the Ecolibrium Solar engineering team. CBC Engineers, Ecolibrium Solar's professional engineering partner, has reviewed and verified EcoCalcs and reviews system designs to ensure that calculations and ballast prescriptions were correctly applied. Upon successful review, CBC Engineers provides a stamped design review including relevant supporting documentation (this explanation included) and a stamped, approved ballast plan.

Please note: Ecolibrium Solar and CBC engineers are not conducting a structural review of the proposed site.

Below, Table 1 and Table 2 list the design criteria and project details for a proposed system in Brick, NJ. These values will be used throughout the remainder of this explanation.

Table 1: System Design Criteria

Product Line	EcoFoot 2+
ASCE7 Version	2016
Ground Elevation (ft)	16.33
Roof Type	EPDM Membrane
Roof Height (ft.)	20
Roof Slope (deg)	1.20
Min Edge Setback (in)	48
Parapet Height (in.)	0
3 Sec. Gust (mph)	130
Occupancy Category	III
Wind Exposure	B
Snow Load (psf)	20.0
Seismic Data (S_s)	0.2020
Soil Site Class	D-Default
Coeff. Of Friction (f_n)*	0.49

**req's slip sheets*

Table 2: PV Module Specifics

Module Manufacturer	Canadian Solar
Module Model	CS3W-410P
Module Orientation	Landscape
Module Power (w)	410
Module Length (in)	83.00
Module Width (in)	41.30
Module Weight (lbs.)	54.90

Utilizing the inputs from Tables 1 and 2, the factors in Table 3 are generated for the site. This list of factors is used in various ways to fully define a proposed system according to calculations laid out in the SEAOC and ASCE documents. In the scope of this explanation, factors are used to calculate velocity pressure, q_h as defined in ASCE7-05, Section 6.5.10; ASCE7-10, Section 30.3.2; or ASCE7-16, Section 26.10.2, and ultimately the amount of ballast required to offset uplift and drag forces.

Table 3: Calculation Inputs, Constants, and Variables

Racking Component Weight per Module	14.59	lbs.
Ballast Block Weight	32	lbs.
Asymmetric lift load Ratio (North Row)	1.4	
Asymmetric lift load Ratio (South Row)	1.6	
Ala= Effective Lift Area of PV Module	23.505	ft ²
Ada= Effective Drag Area of PV Module	3.76	ft ²
dLF1= Dead Load of Module and Attributed Racking	69.491	lbs.
Roof Setback Minimum	48	in.
Load Combination Factor for Wind	0.6	
Load Combination Factor for Seismic	0.7	
α (from ASCE7 Table 6-2 or 26.9.1)=	7	
zg (from ASCE7 Table 6-2 or 26.9.1)=	1200	ft.
zmin (from ASCE7 Table 6-2)=	30	ft.
z selected (from zmin & inputs)=	30	ft.
Kz= Adjustment Factor for Building Height and Exposure	0.70	
Kzt= Topographic Factor	1	
Kd= Directionality Factor	0.85	
Ke= Ground Elevation Factor	0.999	
I= Importance Factor	1	
Wind design load factor	0.6	
Dead Load design load factor	0.6	
qh= Velocity Pressure ($0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \cdot I$)	25.75	

An explanation of variables:

Asymmetric Lift Load Ratio: This is a ratio describing the leverage created by EcoFoot base dimensions, module attachment location and location of center of ballast mass. Assessed as a multiplier on top of ballast distribution scheme in Image 4.

dLF1= Dead Load of Module and Attributed Racking: the weight of one module and hardware attributed to that module, not including ballast.

Ala= Effective Lift Area of PV Module: The surface area of a module projected onto the horizontal plane for lift calculations.

Ada= Effective Drag Area of PV Module: The surface area of a module projected onto the horizontal plane for drag calculations.

qh= Velocity Pressure at height "h": Calculation prescribed by ASCE7-05, eq. 6-15, and ASCE7-10, eq. 30.3-1, or ASCE7-16, eq. 26.10-1 (subscript "h" used here for clarity, ASCE7 utilizes subscript "z").

Wind Tunnel Testing, Uplift and Drag Force Calculations

Wind tunnel testing of the EcoFoot product line to determine GCn values has been conducted by Rowan Williams Davies & Irwin Inc. (RWDI), a nationally recognized boundary-layer wind tunnel test firm. Testing was conducted in accordance with ASCE7-05, section 6.6; and ASCE7-10 or 16, section 31.2. Module-specific GCn data allows for precise application of ballast to prevent uplift. Deviation from prescriptive wind GCn values has been addressed according to SEAOC PV2 via a peer review of the wind tunnel testing and results by Maffei Structural Engineering.

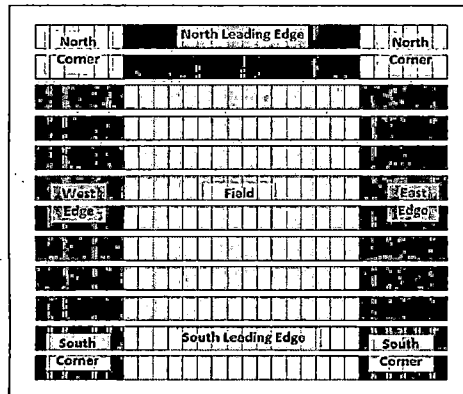
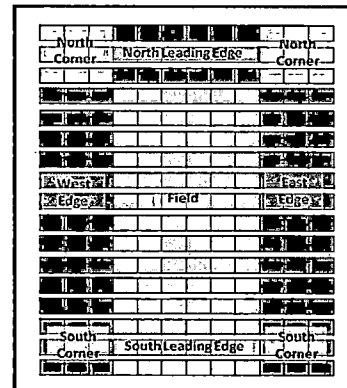
GCn and qh are used to calculate the pressure exerted on each module via the design wind pressure equations (ASCE7-05 – section 6.5.12.4, ASCE7-10 – section 30.4.2, ASCE7-16 – section 30.5.1). Ballast required to offset uplift and drag forces (BWUz) is calculated with load combination calculations from ASCE7-05/10 section 2.3.2, or ASCE7-16 section 2.3.1. Detailed calculations for this project are found in Table 4. Resulting required ballast BWUz is displayed graphically in Image 3.

Table 4: Ballast to Resist Uplift Calculations for Project Proposed in Brick, NJ 08723

		Load Sharing Area						Down (1x1)
	#col x #rows	2x2	2x3	3x2	3x3	3x2	3x3	
North Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.7	-5.9	-5.4	-4.9	-5.4	16.7
	WLFUz=Uplift wind force =pUz*Ala	lbs.	-157.4	-139.2	-127.1	-115.0	-127.1	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*1.0	lbs	-52.7	-41.8	-34.6	-27.3	-34.6	
	BWuz=ballast required = -DLFUz/0.6	lbs	87.9	69.7	57.6	45.5	57.6	
North Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.2	-5.4	-5.1	-4.4	-5.1	12.9
	WLFUz=Uplift wind force =pUz*Ala	lbs	-145.3	-127.1	-121.0	-102.9	-121.0	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*1.0	lbs	-45.5	-34.6	-30.9	-20.0	-30.9	
	BWuz=ballast required = -DLFUz/0.6	lbs	75.8	57.6	51.6	33.4	51.6	
E/W Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.7	-5.7	-5.4	-4.9	-5.4	16.7
	WLFUz=Uplift wind force =pUz*Ala	lbs	-157.4	-133.2	-127.1	-115.0	-127.1	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*1.0	lbs	-52.7	-38.2	-34.6	-27.3	-34.6	
	BWuz=ballast required = -DLFUz/0.6	lbs	87.9	63.7	57.6	45.5	57.6	
Field	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.2	-5.4	-5.1	-4.4	-5.1	12.9
	WLFUz=Uplift wind force =pUz*Ala	lbs	-145.3	-127.1	-121.0	-102.9	-121.0	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*1.0	lbs	-45.5	-34.6	-30.9	-20.0	-30.9	
	BWuz=ballast required = -DLFUz/0.6	lbs	75.8	57.6	51.6	33.4	51.6	
South Corner	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.7	-5.7	-5.4	-4.9	-5.4	16.7
	WLFUz=Uplift wind force =pUz*Ala	lbs	-157.4	-133.2	-127.1	-115.0	-127.1	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*1.0	lbs	-52.7	-38.2	-34.6	-27.3	-34.6	
	BWuz=ballast required = -DLFUz/0.6	lbs	87.9	63.7	57.6	45.5	57.6	
South Edge	pUz=Uplift design wind pressure =qh*GCnUz	psf	-6.2	-5.4	-5.1	-4.4	-5.1	12.9
	WLFUz=Uplift wind force =pUz*Ala	lbs	-145.3	-127.1	-121.0	-102.9	-121.0	
	DLFUz=Net ASD uplift = dLF1*0.6 + WLFUz*1.0	lbs	-45.5	-34.6	-30.9	-20.0	-30.9	
	BWuz=ballast required = -DLFUz/0.6	lbs	75.8	57.6	51.6	33.4	51.6	

The aerodynamic differences among different sub-sections of a large array are handled by various calculation sections (North Corner, North Edge, E/W Edge...) and apply according to the excerpt from the RWDI report shown below in Image 1. The highlighted sections of Table 4 correspond to specific module locations, also shown in Image 4: green - the north corners, purple - the east or west edge, orange - the deep interior. See Page 7 for expanded calculations pertaining to the highlighted sections.

Image 1: Aerodynamic Zones from RWDI Report

Aerodynamic Zone Key Plan for Table 2
(Portrait Orientation)Aerodynamic Zone Key Plan for Table 3
(Landscape Orientation)

To check the amount of drag a given sub-array will experience, the equation in Image 2 is utilized - an excerpt from RWDI's test report. Each sub-array is checked for sliding, proceeding from the smallest to largest or until drag no longer governs total required ballast.

Table 5 lists the calculations used to identify the total required ballast to counteract drag forces and prevent sliding. Friction values have been identified by Testing Engineers (IAS accredited) according to ASTM G115 - Standard Guide for Measuring and Reporting Friction Coefficients. Unless detailed information is available pertaining to the location of the sub-array, the roof's worst case uplift GCp are utilized in calculating drag and required ballast.

Image 2: Ballast to Resist Sliding Equation

Ballast (lb) to Resist Sliding

$$\alpha_D \cdot \text{Ballast}_{drag} = \alpha_W \cdot q_z \cdot \left[(GC_p)_{drag}^* \cdot A_{drag} \cdot \left(\frac{1}{f_n} \right) + |GC_p|_{uplift}^* \cdot A_{uplift} \right] - \alpha_D \cdot M \quad (lb) \quad (1b)$$

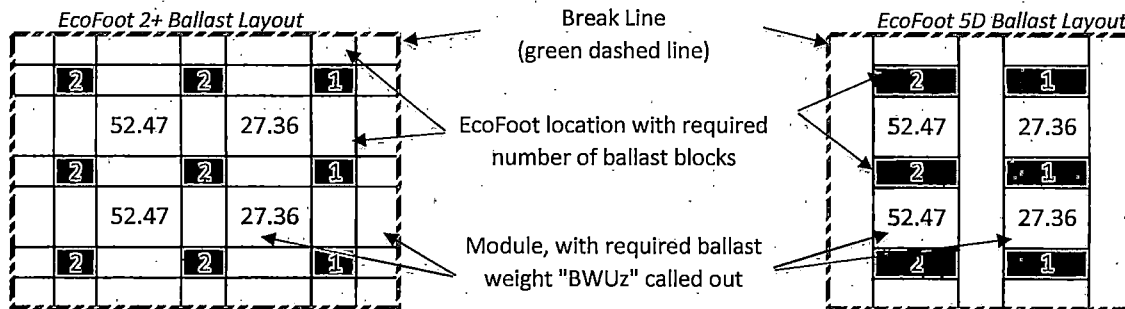
Table 5: Ballast to Resist Sliding Calculation

Sub-Array Module Count Total:	16
aw = Wind Load Combination Factor =	0.6
ad = Dead Load Combination Factor =	0.6
qz (qh in Table 3)=	25.75
M = dLF1 from Table 3 =	69.49
fn (also see Table 1) =	0.49
Auplift = Ala in Table 3 =	23.74
Adrag = Ada in Table 3 =	1.82
GCp-drag	1.49
GCp-uplift	-0.45
Area Reduction Factor =	0.40
(GCp) _{drag} =	0.60
GCp _{uplift} =	0.18
Total Required Ballast Weight (Per Image 2)=	1581.46
Wballastblock =	32
Total Required Ballast Blocks:	50

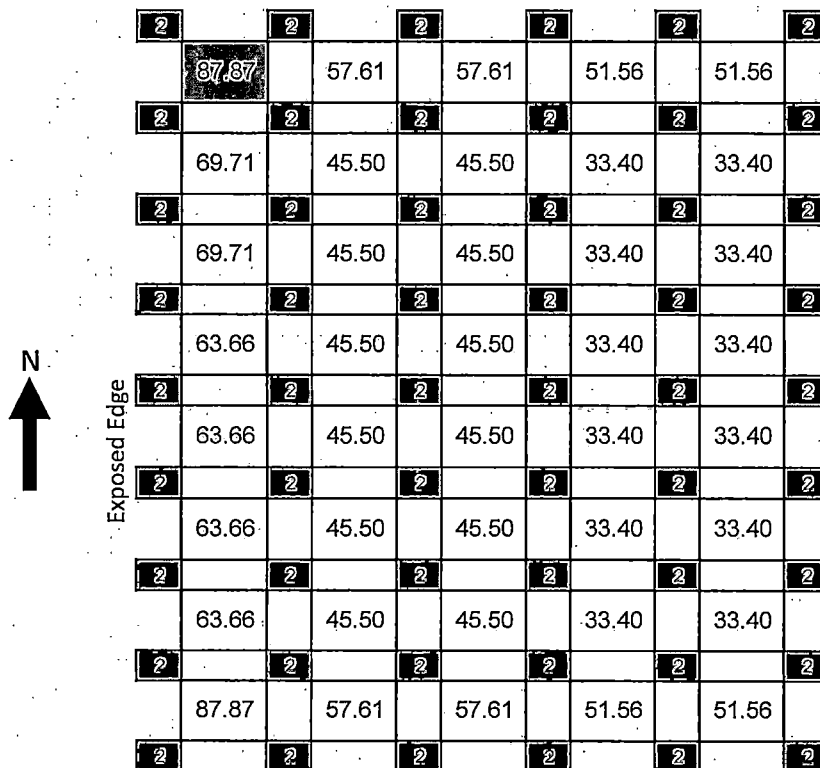
Ballast Application to Sheet S-1.0

For easier interpretation, the results calculated in Table 4 are laid out in graphical representations of a solar array, shown in Image 4. Ecolibrium Solar engineers and drafters make use of this graphical layout when applying ballast to a given system design.

As shown in Image 3, the ballast required to resist lift - BWUz from Table 4 - is listed for each module location in Image 4. A portion of each BWUz value is distributed to each of the connected EcoFoot Bases, also detailed in Image 3 and included in Image 4. The total ballast required at each EcoFoot location is then calculated and rounded up to the next ballast block increment.

Image 3: Example of Module and Ballast Graphical Representation

The ballast prescription array shown in Image 4 is one of many similar arrays created automatically through EcoCalcs in order to address all possible array configurations. The data calculated in Table 4 was ultimately used to assign ballast to the system design in Sheet S-1.0 by Ecolibrium Solar. EcoCalcs and the resulting ballast plan S-1.0 are reviewed by CBC Engineers for correctness and completeness. Once approved, an engineering report including Sheet S-1.0 and any supporting material (this explanation included) are stamped and sealed by a professional engineer registered in the state where the project is proposed.

Image 4: Ballast Prescriptions Produced by Table 4

NOTE: The colored module locations in Image 4 correspond to the same colored areas in Table 4: green - the north corners, purple - the east or west edge, orange - the deep interior. See Page 7 for more detailed calculations.

Detailed Calculations From Table 4

North Corner Module		
GCn Value from RWDI report:	-0.26	
qh value from Table 3:	25.75	
p_{Uz} = Uplift design wind pressure in Z direction = $qh \cdot GC_n$:	-6.69	psf
A_m = Surface Area of Module:	23.80	sqft
θ_m = Module Incline:	9.10	deg
A_{la} = PV Module Lift Area = $A_m \cdot \cos(\theta_m)$:	23.51	sqft
WLF_{Uz} = Uplift wind load force in Z direction = $p_{Uz} \cdot A_{la}$	-157.36	lbf
$dLF1$ = Dead load of one module and attributed hardware:	69.49	lbf
DLF_{Uz} = Uplift design load using ASD combo #7 = $dLF1 \cdot 0.6 + WLF_{Uz} \cdot 0.6$	-52.72	lbf
BW_{uz} = ballast weight required to resist wind uplift = $-DLF_{Uz} / 0.6$	87.87	lbf

East/West Edge Module		
GCn Value from RWDI report:	-0.22	
qh value from Table 3:	25.75	
p_{Uz} = Uplift design wind pressure in Z direction = $qh \cdot GC_n$:	-5.66	psf
A_m = Surface Area of Module:	23.80	sqft
θ_m = Module Incline:	9.10	deg
A_{la} = PV Module Lift Area = $A_m \cdot \cos(\theta_m)$:	23.51	sqft
WLF_{Uz} = Uplift wind load force in Z direction = $p_{Uz} \cdot A_{la}$	-133.15	lbf
$dLF1$ = Dead load of one module and attributed hardware:	69.49	lbf
DLF_{Uz} = Uplift design load using ASD combo #7 = $dLF1 \cdot 0.6 + WLF_{Uz} \cdot 0.6$	-38.20	lbf
BW_{uz} = ballast weight required to resist wind uplift = $-DLF_{Uz} / 0.6$	63.66	lbf

Interior Module		
GCn Value from RWDI report:	-0.17	
qh value from Table 3:	25.75	
p_{Uz} = Uplift design wind pressure in Z direction = $qh \cdot GC_n$:	-4.38	psf
A_m = Surface Area of Module:	23.80	sqft
θ_m = Module Incline:	9.10	deg
A_{la} = PV Module Lift Area = $A_m \cdot \cos(\theta_m)$:	23.51	sqft
WLF_{Uz} = Uplift wind load force in Z direction = $p_{Uz} \cdot A_{la}$	-102.89	lbf
$dLF1$ = Dead load of one module and attributed hardware:	69.49	lbf
DLF_{Uz} = Uplift design load using ASD combo #7 = $dLF1 \cdot 0.6 + WLF_{Uz} \cdot 0.6$	-20.04	lbf
BW_{uz} = ballast weight required to resist wind uplift = $-DLF_{Uz} / 0.6$	33.40	lbf

Redistributed General Matrix

		Column #										array continues to the right...	
		1	2	3	4	5							
Row # 1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		79	58	57	52	52							
2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		67	48	29	22	22							
3		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		67	48	29	22	21							
4		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		62	48	29	22	21							
5		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		62	48	29	22	21							
6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		62	48	29	22	21							
7		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		63	49	30	23	23							
8		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		82	60	60	55	55							

Redistributed Three-Row Matrix

		Column #										array continues to the right...	
		1	2	3	4	5							
Row # 1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		79	58	57	52	52							
2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		67	49	30	23	23							
3		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
		83	60	60	55	55							
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

Redistributed Two-Row Matrix

		Column #										array continues to the right...	
		1		2		3		4		5			
Row # 1		0.00		0.00		0.00		0.00		0.00		0.00	
		79		58		58		53		53			
		0.00		0.00		0.00		0.00		0.00		0.00	
2		82		60		60		55		55			
		0.00		0.00		0.00		0.00		0.00		0.00	

Redistributed Single Row Matrix

		Column #										array continues to the right...	
		1		2		3		4					
Row # 1		0.00		0.00		0.00		0.00		0.00		0.00	
		109		87		87		87					
		0.00		4.00		4.00		4.00		4.00		4.00	

Redistributed Three-Column Matrix

		Column #											
		1				2				3			
Row # 1		0.00		0.00		0.00		0.00		0.00		0.00	
		79				58				79			
		0.00		0.00		0.00		0.00		0.00		0.00	
2		67				49				67			
		0.00		0.00		0.00		0.00		0.00		0.00	
3		67				49				67			
		0.00		0.00		0.00		0.00		0.00		0.00	
4		62				49				62			
		0.00		0.00		0.00		0.00		0.00		0.00	
5		62				49				62			
		0.00		0.00		0.00		0.00		0.00		0.00	
6		62				49				62			
		0.00		0.00		0.00		0.00		0.00		0.00	
7		63				49				63			
		0.00		0.00		0.00		0.00		0.00		0.00	
8		82				60				82			
		0.00		0.00		0.00		0.00		0.00		0.00	

Redistributed Two-Column Matrix

		Column #		
		1	2	
Row # 1		0.00	2.00	0.00
		65	65	
2		0.00	0.00	0.00
		67	67	
3		0.00	0.00	0.00
		66	66	
4		0.00	0.00	0.00
		62	62	
5		0.00	0.00	0.00
		62	62	
6		0.00	0.00	0.00
		62	62	
7		0.00	0.00	0.00
		62	62	
8		0.00	0.00	0.00
		82	82	

Redistributed Single Column Matrix

		Column #		
		1		
Row # 1		0.00	0.00	
		145		
2		0.00	0.00	
		144		
3		0.00	0.00	
		145		
4		0.00	0.00	
		145		
5		0.00	0.00	
		144		
6		0.00	0.00	
		148		

Attached exposed

Rounded General Matrix

		Column #					array continues to the right...		
		1	2	3	4	5			
Row #	1	2	3	3	3	3	3	3	3
		North Corner	North Corner	North Corner	North Edge	North Edge			
2		3	3	2	2	2	2	2	2
		North Corner	North Corner	North Corner	North Edge	North Edge			
3		3	3	3	2	2	2	2	2
		North Corner	North Corner	North Corner	North Edge	North Edge			
4		3	3	3	2	2	2	2	2
		East/West Edge	East/West Edge	East/West Edge	Field	Field			
5		3	3	3	2	2	2	2	2
		East/West Edge	East/West Edge	East/West Edge	Field	Field			
6		3	3	3	2	2	2	2	2
		South Corner	South Corner	South Corner	South Edge	South Edge			
7		3	3	3	2	2	2	2	2
		South Corner	South Corner	South Corner	South Edge	South Edge			
8		3	3	3	2	2	2	2	2
		South Corner	South Corner	South Corner	South Edge	South Edge			
		3	3	3	3	3	3	3	3

Rounded Three-Row Matrix

		Column #					array continues to the right...		
		1	2	3	4	5			
Row #	1	2	3	3	3	3	3	3	3
		N/S Corner	N/S Corner	N/S Corner	N/S Edge	N/S Edge			
2		3	3	2	2	2	2	2	2
		N/S Corner	N/S Corner	N/S Corner	N/S Edge	N/S Edge			
3		3	3	3	2	2	2	2	2
		N/S Corner	N/S Corner	N/S Corner	N/S Edge	N/S Edge			
		3	3	3	3	3	3	3	3

Ballasted - exposed

Rounded Two-Row Matrix

		Column #											
		1		2		3		4		5			
Row #	1	2	N/S Corner	3	N/S Corner	4	N/S Corner	5	N/S Edge	6	N/S Edge	7	array continues to the right...
	2	3	N/S Corner	4	N/S Corner	5	N/S Corner	6	N/S Edge	7	N/S Edge	8	
	3	4	N/S Corner	5	N/S Corner	6	N/S Corner	7	N/S Edge	8	N/S Edge	9	

Rounded Single Row Matrix

		Column #									
		1		2		3		4			
1	1	3	Single Row	4	Single Row	5	Single Row	6	Single Row	7	array continues to the right...
	2	4	Single Row	5	Single Row	6	Single Row	7	Single Row	8	

Rounded Three-Column Matrix

		Column #													
		1			2			3							
Row #	1	2	North Corner	3	North Corner	4	North Corner	5	North Corner	6	North Corner	7	North Corner	8	
	2	3	North Corner	4	North Corner	5	North Corner	6	North Corner	7	North Corner	8	North Corner	9	
	3	4	North Corner	5	North Corner	6	North Corner	7	North Corner	8	North Corner	9	North Corner	10	
	4	5	East/West Edge	6	East/West Edge	7	East/West Edge	8	East/West Edge	9	East/West Edge	10	East/West Edge	11	
	5	6	East/West Edge	7	East/West Edge	8	East/West Edge	9	East/West Edge	10	East/West Edge	11	East/West Edge	12	
	6	7	South Corner	8	South Corner	9	South Corner	10	South Corner	11	South Corner	12	South Corner	13	
	7	8	South Corner	9	South Corner	10	South Corner	11	South Corner	12	South Corner	13	South Corner	14	
	8	9	South Corner	10	South Corner	11	South Corner	12	South Corner	13	South Corner	14	South Corner	15	
	9	10	South Corner	11	South Corner	12	South Corner	13	South Corner	14	South Corner	15	South Corner	16	
	10	11	South Corner	12	South Corner	13	South Corner	14	South Corner	15	South Corner	16	South Corner	17	
	11	12	South Corner	13	South Corner	14	South Corner	15	South Corner	16	South Corner	17	South Corner	18	
	12	13	South Corner	14	South Corner	15	South Corner	16	South Corner	17	South Corner	18	South Corner	19	
	13	14	South Corner	15	South Corner	16	South Corner	17	South Corner	18	South Corner	19	South Corner	20	
	14	15	South Corner	16	South Corner	17	South Corner	18	South Corner	19	South Corner	20	South Corner	21	

Ballasted - exposed

**Rounded Two-Column Matrix**

		Column #	
		1	2
Row # 1		2	2
		North Corner	North Corner
2		3	3
		North Corner	North Corner
3		3	3
		North Corner	North Corner
4		3	3
		East/West Edge	East/West Edge
5		3	3
		East/West Edge	East/West Edge
6		3	3
		South Corner	South Corner
7		3	3
		South Corner	South Corner
8		3	3
		South Corner	South Corner

Rounded Single Column Matrix

		Column #	
		1	
Row # 1		4	4
		North	
2		4	4
		Single Column	
3		4	4
		Single Column	
4		4	4
		Interior	
5		4	4
		Single Column	
6		4	4
		Single Column	
		5	5
		South	

Ballasted - exposed

Rounded General Matrix

		Column #					array continues to the right...				
		1		2		3		4		5	
Row #	1	2	North Corner	2	North Corner	2	North Corner	2	North Edge	2	North Edge
	2	2	North Corner	2	North Corner	2	North Corner	2	North Edge	2	North Edge
3	3	2	North Corner	2	North Corner	2	North Corner	2	North Edge	2	North Edge
	4	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	Field	2	Field
5	5	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	Field	2	Field
	6	2	South Corner	2	South Corner	2	South Corner	2	South Edge	2	South Edge
7	7	2	South Corner	2	South Corner	2	South Corner	2	South Edge	2	South Edge
	8	2	South Corner	2	South Corner	2	South Corner	2	South Edge	2	South Edge

Rounded Three-Row Matrix

		Column #					array continues to the right...				
		1		2		3		4		5	
Row #.	1	2	N/S Corner	2	N/S Corner	2	N/S Corner	2	N/S Edge	2	N/S Edge
	2	2	N/S Corner	2	N/S Corner	2	N/S Corner	2	N/S Edge	2	N/S Edge
	3	2	N/S Corner	2	N/S Corner	2	N/S Corner	2	N/S Edge	2	N/S Edge
		2		2		2		2		2	

Ballasted - unexposed

Rounded Two-Row Matrix

		Column #											
		1		2		3		4		5			
Row #	1	2	N/S Corner	2	N/S Corner	2	N/S Corner	2	N/S Edge	2	N/S Edge	2	
	2	2	N/S Corner	2	N/S Corner	2	N/S Corner	2	N/S Edge	2	N/S Edge	2	
		2		2		2		2		2		2	

array continues to the right...

Rounded Single Row Matrix

		Column #									
		1		2		3		4			
1		2	Single Row	4	Single Row	4	Single Row	4	Single Row	4	
		2		4		4		4		4	

array continues to the right...

Rounded Three-Column Matrix

		Column #													
		1				2				3					
Row #	1	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	
	2	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	
		2		2		2		2		2		2		2	
		2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	North Corner	2	
		2		2		2		2		2		2		2	
		2	East/West Edge	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	
		2		2		2		2		2		2		2	
		2	East/West Edge	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	East/West Edge	2	
		2		2		2		2		2		2		2	
		2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	
		2		2		2		2		2		2		2	
		2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	
		2		2		2		2		2		2		2	
		2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	South Corner	2	
		2		2		2		2		2		2		2	

Rounded Two-Column Matrix

		Column #	
		1	2
Row # 1		2	2
		North Corner	North Corner
2		2	2
		North Corner	North Corner
3		2	2
		North Corner	North Corner
4		2	2
		East/West Edge	East/West Edge
5		2	2
		East/West Edge	East/West Edge
6		2	2
		South Corner	South Corner
7		2	2
		South Corner	South Corner
8		2	2
		South Corner	South Corner

Rounded Single Column Matrix

		Column #	
		1	
Row # 1		3	3
		North	
2		3	3
		Single Column	
3		3	3
		Single Column	
4		3	3
		Interior	
5		3	3
		Single Column	
6		3	3
		Single Column	
7		3	3
		Single Column	
8		3	3
		Single Column	
		3	3
		South	

Ballasted - unexposed