Historic Preservation Services
Community Development & Neighborhood Services
281 N. College Ave.
Fort Collins, CO 80524

970.224.6078
preservation@fcgov.com
fcgov.com/historicpreservation

CERTIFICATE OF APPROPRIATENESS – Minor Alteration
ISSUED: August 15, 2025
EXPIRATION: August 15, 2026

City of Fort Collins
c/o Ian Skor, Sandbox Solar
112 Racquette Dr., Unit C
Fort Collins, CO 8054

Dear Property Owner:

This letter provides you with certification that proposed work to your designated Fort Collins landmark property, the Power Plant at 430 N. College Ave., has been approved by the City's Historic Preservation Division (HPD) because the proposed work appears to be routine in nature with minimal effects to the historic resource, and meets the requirements of Chapter 14, Article IV of the Fort Collins Municipal Code.

The alterations reviewed include:

- Rooftop solar installation, conforming to Historic Preservation solar policy (https://www.fcgov.com/historicpreservation/files/2024-4-17-rooftop-solar-policy-memo-hpc-final.pdf?1732227615)

Notice of the approved application has been provided to building and zoning staff to facilitate the processing of any permits that are needed for the work.

Please note that work beyond that indicated in your permit application/correspondence requires additional approval.

If the approved work is not completed prior to the expiration date noted above, you may apply for an extension by contacting staff at least 30 days prior to expiration. Extensions may be granted for up to 12 additional months, based on a satisfactory staff review of the extension request.

If you have any questions regarding this approval, or if I may be of any assistance, please do not hesitate to contact me. I can be reached at yjones@fcgov.com or at (970) 224-6045.

Sincerely,

Yani Jones
Historic Preservation Planner

City of Fort Collins

BUILDING PERMIT APPLICATION:

Solar PV

All information on the application must be filled out (as applicable).

Scope of work *(check one)*

New system installation ☐ Alterations to an existing system ☑ (new equipment or expansion) Reinstallation of an existing system ☐ (same equipment and same location)

USE / TYPE OF BUILDING *(check the correct uses below):*

Residential ☐ Commercial ☑

Single family detached ☐ Duplex/Two-Family ☐ Single Family Attached (Townhome) ☐ Multi-Family (Apartment/Condo) ☐

Garage ☐ Bank ☐ Bar ☐ Church ☐ Hotel/Motel ☐ Medical Office ☐ Retail ☐ Other ☑: University

JOB SITE ADDRESS: 430 N. College Ave. Fort Collins, CO 80524 **UNIT#:**

PROPERTY OWNER INFO: (All owner information is required – NOT optional)

Last Name Brown First Name BO Middle

Street Address 2537 Research Blvd SUITE 200 City Fort Collins State CO Zip 80526

Phone # Email Bo.Brown@colostate.edu

CONTRACTOR INFO:

Company Name Sandbox Solar LLC

License Holder Name Ian Skor LIC # S-3665 CERT # 4119-S

CONSTRUCTON INFO *(check any that apply)*:

PV (photovoltaic) ☑ Thermal Hydronic System ☐ Battery Storage ☐

Mounting: Ground ☐ Roof ☑

UTILITES INFO:

Electric Service Upgrade? Yes ☐ No ☑ Existing Amps New Amps

Electric Meter Relocation? Yes ☐ No ☑

Meter change out? Yes ☐ No ☑

Panel change out? Yes ☐ No ☑

VALUE OF CONSTRUCTION (*materials and labor*): $ 30000

DESCRIPTION OF WORK *(Include KWh and number of solar panels):*

10.36kW-dc, (19) x Solar Panels ballast roof mounted connected via breaker

JOBSITE SUPERVISOR CONTACT INFO: Name Ian Skor Phone 9705815799

SUBCONTRACTOR INFO:

Electrical Plumbing

Applicant: I hereby acknowledge that I have read this application and state that the above information is correct and agree to comply with all requirements contained herein and City of Fort Collins ordinances and state laws regulating building construction.

Applicant Signature Type or Print Name Ian Skor

Phone # 970-673-7733 Email engineering@sandboxsolar.com

THIS APPLICATION EXPIRES 180 DAYS FROM APPLICATION DATE

CONTRACTOR

SANDBOX SOLAR - (970) 673-7733

112 RACQUETTE DR UNIT C, FORT COLLINS, CO 80524

ijskor@sandboxsolar.com - OWNER/CEO

dannyweaver@sandboxsolar.com - PROJECT MANAGER

derekhettinger@sandboxsolar.com - PROJECT DESIGNER

INDEX

LOCATION

PROJECT DETAILS

PROPERTY OWNER	COLORADO STATE UNIVERSITY
PROPERTY ADDRESS	430 N COLLEGE AVE, FORT COLLINS, CO 80524
PARCEL NUMBER	9712219901
BUILDING RISK CLASSIFICATION	III
AHJ	FORT COLLINS
UTILITY	FORT COLLINS UTILITIES
ELECTRICAL CODE	2023 NEC
FIRE CODE	2021 IFC
BUILDING CODE	2021 IBC

SITE DETAILS

ASHRAE EXTREME LOW	-22.8°C (-9.04°F)
ASHRAE 2% HIGH	32°C (89.6°F)
CLIMATE DATA SOURCE	NORTHERN COLORADO
WIND SPEED	125 MPH (ASCE 7-16)
WIND EXPOSURE CAT.	C
GROUND SNOW LOAD	35 PSF
SEISMIC DESIGN CATEGORY	B

SYSTEM DETAILS

DESCRIPTION	NEW GRID-INTERACTIVE PV SYSTEM
DC RATING	10,360W
AC RATING	8,835W
AC CURRENT	32.55A
INVERTER(S)	(19) AP SYSTEMS QT2-480
MODULES	(19) LONGI LR5-72HBD-545
ARRAY WIRING	(1) STRING OF 10 & (1) STRING OF 9

INTERCONNECTION DETAILS

POINT OF INTERCONNECTION	LOAD SIDE OF SERVICE DISCONNECT
UTILITY SERVICE	277/480V, 3 PHASE, 4 WIRE
LOCATION	MAIN DISTRIBUTION PANEL

SCOPE OF WORK

THIS PROJECT INVOLVES THE INSTALLATION OF A GRID-INTERACTIVE PV SYSTEM. PV MODULES WILL BE MOUNTED USING A PRE-ENGINEERED MOUNTING SYSTEM. THE MODULES WILL BE ELECTRICALLY CONNECTED WITH A DC TO AC POWER INVERTER AND INTERCONNECTED TO THE LOCAL UTILITY USING MEANS AND METHODS CONSISTENT WITH THE RULES ENFORCED BY THE LOCAL UTILITY AND AHJ.

PHOTOVOLTAIC NOTES

1. MODULES AND SUPPORT STRUCTURES SHALL BE GROUNDED
2. SOLAR INVERTER SHALL HAVE MANUFACTURER INSTALLED DISCONNECTING MEANS THAT PREVENTS PARALLEL FEEDING UTILITY LINES DURING POWER OUTAGE.
3. REMOVAL OF AN INTERACTIVE INVERTER OR OTHER EQUIPMENT SHALL NOT DISCONNECT THE BONDING CONNECTION BETWEEN THE GROUNDING ELECTRODE CONDUCTOR.
4. ALL PV MODULES, ASSOICATED EQUIPMENT, AND WIRING SHALL BE PROTECTED FROM PHYSICAL DAMAGE
5. LIVE PARTS OF PV OUTPUT CIRCUITS SHALL NOT BE ACCESSIBLE TO OTHER THAN QUALIFIED PERSONS
6. ALL CONDUCTORS SHALL BE COPPER AND 90°C RATED
7. ALL ELECTRICAL EQUIPMENT SHALL BE LISTED
8. ALL WORK SHALL BE IN ACCORDANCE WITH THE 2021 IBC AND 2023 NEC
9. A SINGLE CONDUCTOR SHALL BE PERMITTED TO BE USED TO PERFORM THE MULTIPLE FUNCTIONS OF DC GROUNDING, AC GROUNDING, AND BONDING BETWEEN AC AND DC SYSTEM PER NEC 690.47(C) AND SIZED PER NEC 250.166
10. PER NEC 250.92 NON-CURRENT CARRYING METAL PARTS OF EQUIPMENT SHALL BE EFFECTIVELY BONDED TOGETHER

1029

SANDBOX SOLAR

(970) 673-7733

CSU POWERHOUSE

430 N COLLEGE AVE
FORT COLLINS, CO 80524

COLORADO LICENSED
ARASH ZANDIEH
53832
PROFESSIONAL ENGINEER

Exp. 10/31/2025

PROJECT SUMMARY

PROJECT ID:	1029
DATE:	7/9/25
CREATED BY:	DEREK H.
REVIEWED BY:	

REVISIONS

PV-1

INVERTERS									
REF.	QTY.	MAKE AND MODEL	AC VOLTAGE	GROUND	RATED POWER	MAX OUTPUT CURRENT	MAX INPUT CURRENT	MAX INPUT VOLTAGE	FAULT CURRENT	WEIGHTED EFFICIENCY
I1	5	AP SYSTEMS QT2	480V 3P	NOT SOLIDLY GROUNDED	1,800W	2.17A, 3-PHASE	80A	60V	35.1Apk, 13.9MS DURATION	95.50%

MODULES									
REF.	QTY.	MAKE AND MODEL	PMAX	ISC	IMP	VOC	VMP	TEMP. COEFF. OF VOC	FUSE RATING
M1-19	19	LONGI LR5-72HBD	545W	13.92A	13.04A	49.65V	41.8V	-0.265%/°C	30A

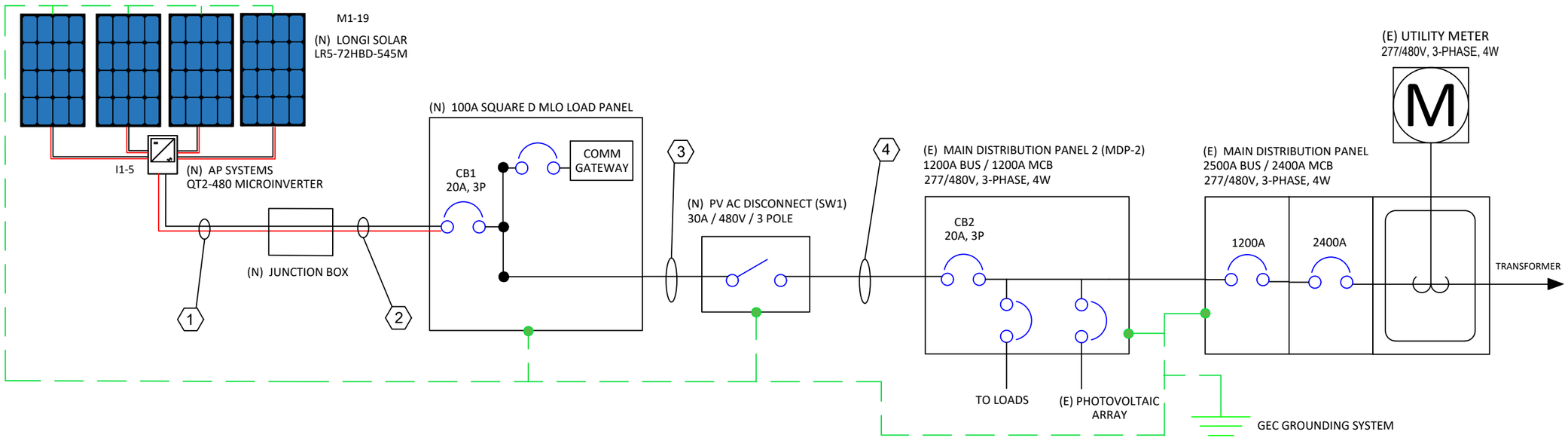
OCPD				
REF.	QTY.	AMP	VOLT	POLES
CB1-2	2	20A	480V	3

DISCONNECTS				
REF.	QTY.	AMP	VOLT	POLES
SW1	1	30A	480V	3

CONDUCTOR AND CONDUIT SCHEDULE													
ID	TYPE COUNT	CONDUCTOR	CONDUIT / CABLE	CURRENT-CARRYING CONDUCTORS IN CONDUIT / CABLE	OCPD	EGC	CONTINUOUS CURRENT	MAX AMPS (125%)	CONDUCTOR BASE AMPS	TERMINAL TEMPERATURE RATING	CONDUCTOR AMPS @ TERMINAL TEMPERATURE	MAX LENGTH	VOLTAGE DROP %
1	5	10 AWG PV WIRE, COPPER	FREE AIR	N/A	N/A	6 AWG BARE, COPPER	13.04A	16.3A	40A	90 C	40A	2'	0.03%
2	1	10 AWG PV WIRE, COPPER	FREE AIR	N/A	N/A	6 AWG BARE, COPPER	13.04A	16.3A	40A	90 C	40A	2'	0.03%
3	1	10 AWG THWN-2, COPPER	3/4" DIA. EMT	4	20A	10 AWG THWN-2, COPPER	16A	20A	55A	75 C	50A	100'	0.51%
4	1	10 AWG THWN-2, COPPER	3/4" DIA. EMT	4	20A	10 AWG THWN-2, COPPER	16A	20A	55A	75 C	50A	100'	0.51%

SYSTEM SUMMARY	
	STRING 1
NUMBER OF MODULES	19
ARRAY OPERATING CURRENT	10.85A
ARRAY STC POWER	10,355W
MAX AC CURRENT	10.85A
MAX AC POWER OUTPUT	9,000W

1. ALL EQUIPMENT SHALL BE TESTED AND LISTED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL).
2. INSTALLATION AND GROUNDING OF THE PV SYSTEM SHALL, AT A MINIMUM, CONFORM TO THE APPLICABLE VERSION OF THE NEC.
3. ALL GROUNDING ELECTRODE CONDUCTORS SHALL BE INSTALLED IN A CONTINUOUS LENGTH EXCEPT WHERE SPLICED BY AN IRREVERSIBLE CONNECTOR OR EXOTHERMIC WELD.
4. NON-CURRENT CARRYING METAL PARTS SHALL BE PROPERLY BONDED PER NEC. CARE SHALL BE TAKEN TO ENSURE A PROPER BOND WHEN FIELD INSTALLING TERMINAL LUGS IN ENCLOSURES BY FIRST REMOVING ANY INSULATING PAINT OR FINISH.
5. ALL CONDUCTORS SHALL HAVE A 90°C RATING TO ENSURE CODE COMPLIANCE.
6. MODULE CERTIFICATION SHALL MEET UL1703, IEC61215 AND IEC61730.
7. INVERTER CERTIFICATION SHALL MEET UL1741.1
8. INVERTERS SHALL COMPLY WITH RAPID SHUTDOWN REQUIREMENTS, PER NEC, IF REQUIRED.
9. STRINGS OF MODULES WILL BE WIRED IN SERIES UNLESS OTHERWISE NOTED.
10. CONDUIT SPECIFICATIONS SHALL BE BASED ON MINIMUM NEC REQUIREMENTS. CONTRACTOR MAY UPSIZE FOR FIELD CONDITIONS, PROVIDED NEC REQUIREMENTS FOR COVER, FILL AND SPACING ARE MET.
11. WORKING CLEARANCE FOR ALL ELECTRICAL EQUIPMENT SHALL COMPLY WITH NEC REQUIREMENTS.
12. LINE DIAGRAM SCHEMATICS WILL REPRESENT EQUIPMENT IN THE DE-ENERGIZED STATE.
13. EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED TO COMPLY WITH NEC REQUIREMENTS.
14. ALL CONDUCTORS SHALL BE TERMINATED IN DEVICES THAT HAVE BEEN PROPERLY TIGHTEN IN ACCORDANCE WITH THE MANUFACTURER'S TORQUE SPECIFICATIONS AND NEC REQUIREMENTS.
15. LISTED GROUNDING / GROUND BAR KITS SHALL BE USED TO BOND ENCLOSURES. SHEET METAL OR TEK STYLE SCREW SHALL NOT BE USED.
16. INSTALLATION CREWS SHALL HAVE A MINIMUM OF ONE ELECTRICIAN ON SITE AT ALL TIMES WHEN ELECTRICAL WORK IS BEING PERFORMED.
17. RACEWAY POINTS OF PENETRATION OF INVERTERS, COMBINERS AND SIMILAR EQUIPMENT SHALL BE SEALED TO PREVENT INGRESS OF MOISTURE AND WILDLIFE.
18. MODULE WIRING SHALL BE LOCATED AND SECURED UNDER THE ARRAY USING SUITABLE WIRING CLIPS, TIE-WRAPS OR SIMILAR. WIRIG SHALL NOT MAKE CONTACT WITH THE GROUND SURFACE AND SHALL BE MANAGED IN AN INDUSTRY-STANDARD WAY.
19. PV SOURCE CIRCUIT CONNECTORS SHALL BE IDENTICAL TO MAKE AND MODEL OF THE MODULE CONNECTORS. CONNECTORS LISTED AS "COMPATIBLE" BUT NOT IDENTICAL SHALL NOT BE ACCEPTED.
20. CONDUIT EMERGING FROM GRADE SHALL BE CONSIDERED SUBJECT TO PHYSICAL DAMAGE AND SHALL BE, AT A MINIMUM, SCHEDULE 80 PVC, UNLESS OTHERWISE NOTED.
21. POINT-OF-CONNECTION IS ON THE LOAD SIDE OF THE MAIN SERVICE DISCONNECT.



STRINGING:
- EACH QT2-480 SUPPORTS 4X LR5 MODULES (4:1 RATIO)
- PROPOSED STRINGING FOR N=19 MODS:
  4X FULL STRINGS OF QT2-480 (N=16 MODS)
  1X PARTIAL STRINGS OF QT2-480 (N=3 MODS)

1029

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CSU POWERHOUSE

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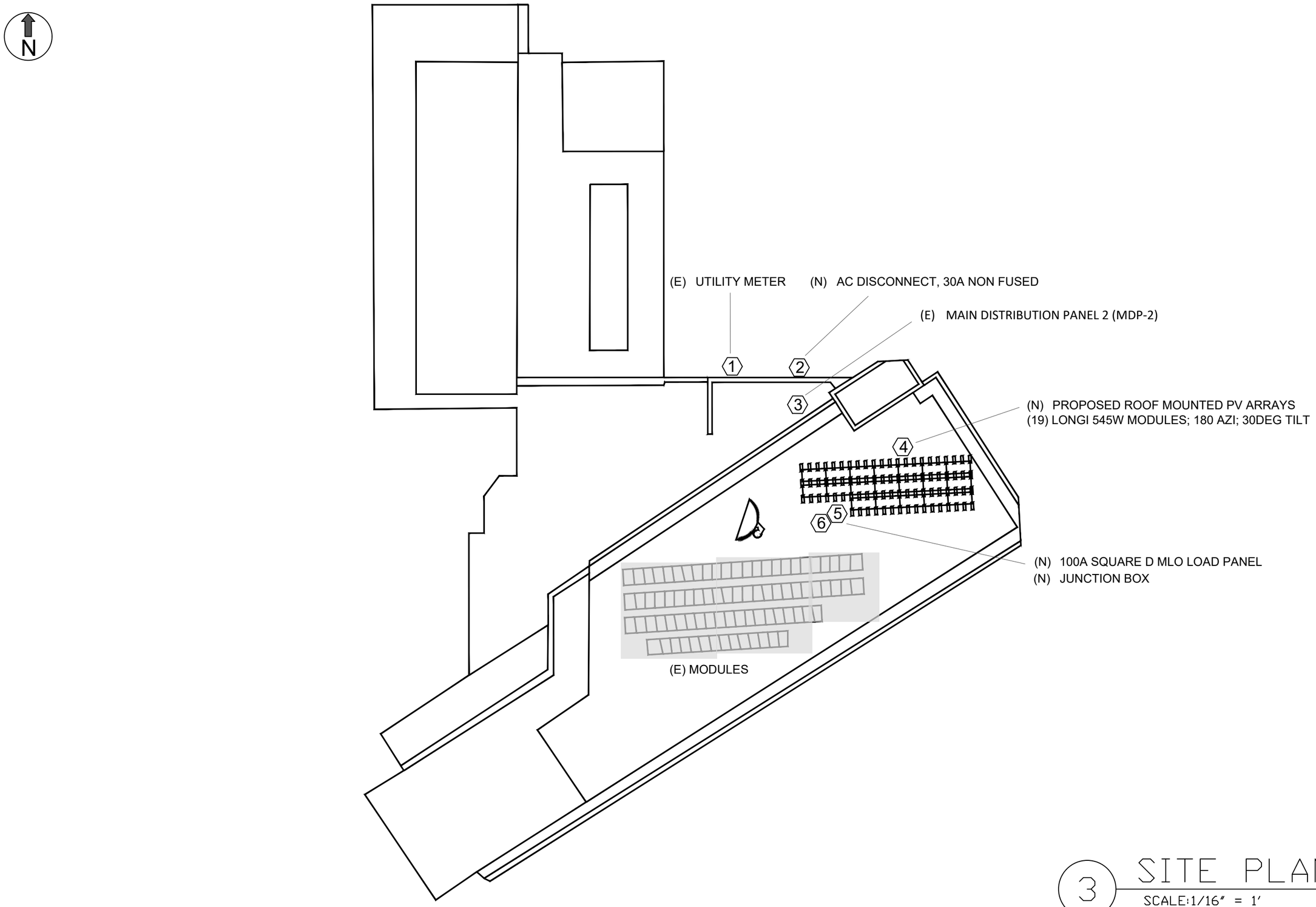
FORT COLLINS, CO 80524

LINE DIAGRAM

PROJECT ID:	1029
DATE:	7/9/25
CREATED BY:	DEREK H.
REVIEWED BY:	

REVISIONS

PV-2



3 SITE PLAN

SCALE: 1/16" = 1'

1029

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Exp. 10/31/2025

SITE PLAN

PROJECT ID:	1029
DATE:	7/9/25
CREATED BY:	DEREK H.
REVIEWED BY:	

REVISIONS

PV-3

Hi-MO 5 (V4)

LR5-72HBD
540~560M

- Based on M10 wafer, best choice for ultra-large power plants
- Advanced module technology delivers superior module efficiency
  - M10 Gallium-doped Wafer
  - Integrated Segmented Ribbons
  - 18-busbar Half-cut Cell
- Globally validated bifacial energy yield
- High module quality ensures long-term reliability

12-year Warranty for Materials and Processing

30-year Warranty for Extra Linear Power Output

Complete System and Product Certifications

IEC 61215, IEC 61730, UL 61730
ISO9001:2015: ISO Quality Management System
ISO14001: 2015: ISO Environment Management System
ISO45001: 2018: Occupational Health and Safety
IEC62941: Guideline for module design qualification and type approval

LONGi

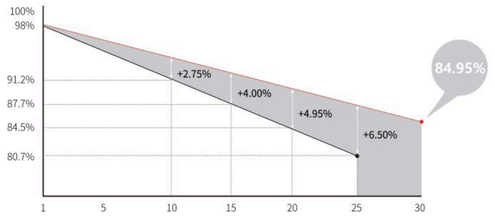
Hi-MO 5

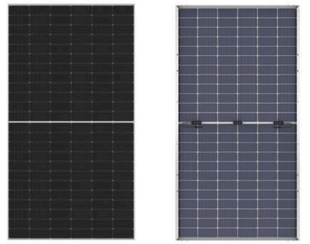
LR5-72HBD 540~560M

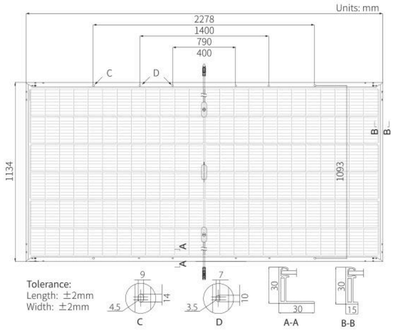
21.7%	0~3%	<2%	0.45%	HALF-CELL
MAX MODULE EFFICIENCY	POWER TOLERANCE	FIRST YEAR POWER DEGRADATION	YEAR 2-30 POWER DEGRADATION	Lower operating temperature

Additional Value

30-Year Power Warranty







Mechanical Parameters

Cell Orientation	144 (6×24)
Junction Box	IP68, three diodes
Output Cable	4mm², +400, -200mm/±1400mm length can be customized
Glass	Dual glass, 2.0+2.0mm heat strengthened glass
Frame	Anodized aluminum alloy frame
Weight	31.8kg
Dimension	2278×1134×30mm
Packaging	36pcs per pallet / 180pcs per 20' GP / 720pcs or 576pcs (Only for USA) per 40' HC

Electrical Characteristics

STC : AM1.5 1000W/m² 25°C NOCT : AM1.5 800W/m² 20°C 1m/s Test uncertainty for Pmax: ±3%

Module Type	LR5-72HBD-540M		LR5-72HBD-545M		LR5-72HBD-550M		LR5-72HBD-555M		LR5-72HBD-560M	
Testing Condition	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax/W)	540	403.6	545	407.4	550	411.1	555	414.8	560	418.6
Open Circuit Voltage (Voc/V)	49.50	46.54	49.65	46.68	49.80	46.82	49.95	46.97	50.10	47.11
Short Circuit Current (Isc/A)	13.85	11.17	13.92	11.23	13.99	11.29	14.05	11.34	14.10	11.38
Voltage at Maximum Power (Vmp/V)	41.65	38.86	41.80	39.00	41.95	39.14	42.10	39.28	42.25	39.42
Current at Maximum Power (Imp/A)	12.97	10.39	13.04	10.45	13.12	10.51	13.19	10.56	13.26	10.62
Module Efficiency(%)	20.9		21.1		21.3		21.5		21.7	

Electrical characteristics with different rear side power gain (reference to 550W front)

Pmax /W	Voc/V	Isc /A	Vmp/V	Imp /A	Pmax gain
578	49.80	14.68	41.95	13.77	5%
605	49.80	15.38	41.95	14.43	10%
633	49.90	16.08	42.05	15.08	15%
660	49.90	16.78	42.05	15.74	20%
688	49.90	17.48	42.05	16.39	25%

Operating Parameters

Operational Temperature	-40°C ~ +85°C
Power Output Tolerance	0 ~ 3%
Voc and Isc Tolerance	±3%
Maximum System Voltage	DC1500V (IEC/UL)
Maximum Series Fuse Rating	30A
Nominal Operating Cell Temperature	45±2°C
Protection Class	Class II
Bifaciality	70±5%
Fire Rating	UL type 29 IEC Class C

Mechanical Loading

Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

Temperature Ratings (STC)

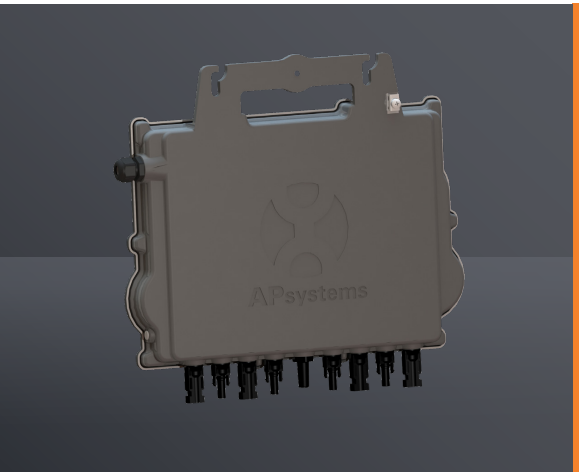
Temperature Coefficient of Isc	+0.050%/°C
Temperature Coefficient of Voc	-0.265%/°C
Temperature Coefficient of Pmax	-0.340%/°C

LONGi

No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China.
Web: www.longi.com

APsystems
ALTENERGY POWER

Leading the Industry in
Solar Microinverter Technology



QT2

The most powerful 3-phase Quad microinverter

- Designed for 3-phase grid connection (208V or 480V)
- Single unit connects to 4 modules, 2 MPPTs, module-level DC voltage
- Maximum continuous AC output power 1728VA @ 208V, 1800VA @ 480V
- Engineered to harness today's high-capacity PV modules (Maximum input current 20A)
- Integrated safety protection relay
- Adjustable power factor
- Balancing 3-phase output
- Compatible with both △ and Y 3-phase grid

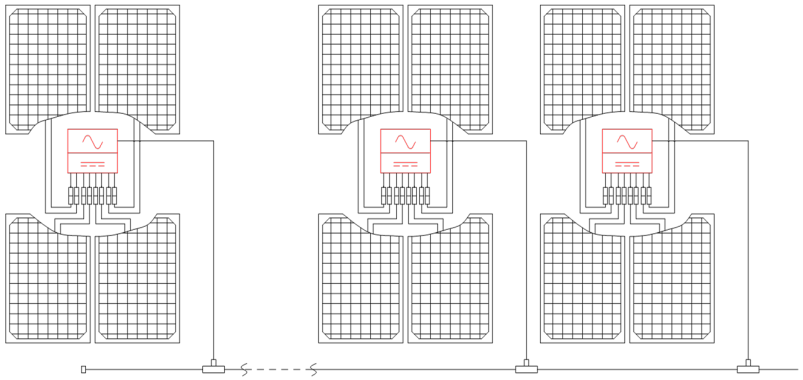
PRODUCT FEATURES

APsystems introduces its 2nd generation of native 3-phase quad microinverters, reaching unprecedented power outputs of 1728VA (for 208V) and 1800VA (for 480V) to harness the power of today's high-output PV modules. The QT2 microinverter gives commercial installers a powerful plug-and-play MLPE inverter that installs faster than competing solutions and is inherently compliant to rapid shutdown requirements.

With balancing 3-phase output, 4 DC inputs and encrypted ZigBee wireless, installers and system owners alike benefit from new QT2 architecture platform. The innovative design facilitates thermal dissipation while maximizing power production. The components are encapsulated with silicone to reduce stress on the electronics, dissipate heat, enhance waterproof properties, and ensure maximum reliability of the system. 24/7 access to performance data through apps or APsystems EMA web-based portal facilitate remote diagnosis and troubleshooting.

The new QT2 is grid interactive through its Reactive Power Control (RPC) feature, designed to better manage photovoltaic power spikes in the grid. At 96.5% peak efficiency and improved reliability, the QT2 is a game changer for commercial solar.

WIRING SCHEMATIC



2023/06/25 Rev1.5

Datasheet | QT2 3-Phase Microinverter

Model	QT2-208	QT2-480
Region	USA/Canada	
Input Data (DC)		
Recommended PV Module Power (STC) Range	315Wp-670Wp+	
Peak Power Tracking Voltage	30V-45V	
Operating Voltage Range	26V-60V	
Maximum Input Voltage	60V	
Maximum Input Current	20A x 4	
Maximum input short circuit current	25A per input	
Output Data (AC)		
Maximum Continuous Output Power	1728VA	1800VA
Nominal Output Voltage/Range(1)	208V/183V-229V	480V/422V-528V
Adjustable Output Voltage Range	166V-240V	385V-552V
Nominal Output Current	4.8Ax3	2.17Ax3
Maximum Output Fault Current (ac) And Duration	L-L:85.4Apk, 13.6ms of duration, 4.967Arms	L-L:35.1Apk, 13.9ms of duration, 2.199Arms
Nominal Output Frequency/Range(1)	60Hz/58.8Hz-61.2Hz(HECO:57Hz-63Hz)	
Adjustable Output Frequency Range	55Hz-65Hz	
Power Factor(Default/Adjustable)	0.99/0.8 leading...0.8 lagging	
Maximum Units per 30A branch(2)	5	11
AC Bus Cable	10AWG	
Efficiency		
Peak Efficiency	96.5%	
CEC Efficiency	96%	95.5%
Nominal MPPT Efficiency	99.5%	
Night Power Consumption	80mW	200mW
Mechanical Data		
Operating Ambient Temperature Range(3)	-40 °F to +149 °F (-40 °C to +65 °C)	
Storage Temperature Range	-40 °F to +185 °F (-40 °C to +85 °C)	
Dimensions (W x H x D)	14" × 9.5" × 1.8" (359mm X 242mm X 46mm)	
Weight	13 lbs (6kg)	
DC Connector Type	Stäubli MC4 PV-ADBP4-S2&ADSP4-S2	
Cooling	Natural Convection - No Fans	
Enclosure Environmental Rating	Type 6	
Features		
Communication (Inverter To ECU)(4)	Encrypted ZigBee	
Isolation Design	High Frequency Transformers, Galvanically Isolated	
Energy Management	Energy Management Analysis (EMA) system	
Warranty(5)	10 Years Standard ; 25 Years Optional	
Compliances		
Safety, EMC & Grid Compliances	UL1741; CSA C22.2 No. 107.1-16; UL1741SA; UL1741SB; IEEE1547; Rule 21; SRD-V2.0; FCC Part15; ICES-003; NEC2014&NEC2017&NEC2020 Section 690.11 DC Arc-Fault circuit Protection; NEC2014&NEC2017&NEC2020 Section 690.12 Rapid Shutdown of PV systems on Buildings	

(1) Nominal voltage/frequency range can be extended beyond nominal if required by the utility.
(2) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.
(3) The inverter may enter to power de-grade mode under poor ventilation and heat dissipation installation environment.
(4) Recommend no more than 80 inverters register to one ECU for stable communication.
(5) To be eligible for the warranty, APsystems microinverters need to be monitored via the EMA portal. Please refer to our warranty T&Cs available on usa.APsystems.com.

Specifications subject to change without notice please ensure you are using the most recent update found at usa.APsystems.com or canada.APsystems.com

APsystems
8627 N. Mopac Expy, Suite 150, Austin, TX 78759 | APsystems.com

Meets the standard requirements for Distributed Energy Resources (UL 1741) and identified with the CSA Listed Mark

Product data sheet

Specifications

Load center, QO, 3 phase, 27 spaces, 27 circuits, 100A convertible main breaker, NEMA1

QO327M100

Product availability: Stock - Normally stocked in distribution facility

Main

Marketing Trade Name	QO
Product Type	Load Center
Cover Type	Order separately

Complementary

Tightening Torque	Cover 20 lb.in
PoN Convertible Mains (lugs)	Main breaker
Rated Current	100 A
Number of Spaces	27
Max Short Circuit Current Rating	25 kA
Maximum Number of Single Pole Circuits	27
Maximum Number of Tandem Breakers	0
Number of Phases	3 phase 4 wires 3 phase 3 wires
Voltage Rating	208Y/120 V AC 240/120 V delta AC 240 V delta AC
Wire Size	AWG 4...AWG 2/0 aluminium/copper
Ground Bar	Grounding bar (ordered separately)
Electrical Connection	Lugs
Busbar Material	Tin plated copper: busbar
Enclosure Material	Welded sheet steel
Surface Finish	Baked enamel Gray
Box Number	9
Height	29.8 in (758 mm)
Width	14.3 in (362 mm)

Environment

Enclosure Rating	NEMA 1 indoor enclosure
Ambient Air Temperature for Operation	23 °F (-5 °C) 104 °F (40 °C)
Product Certifications	UL Listed

Price is “List Price” and may be subject to a trade discount – check with your local distributor or retailer for actual price.

Ordering and shipping details

Category	US10DE300011
Discount Schedule	0DE3
GTIN	785901295464
Returnability	Yes
Country of origin	US

Packing Units

Unit Type of Package 1	PCE
Nbr. of units in pkg.	1
Package 1 Height	4.20 in (10.668 cm)
Package 1 Width	14.50 in (36.830 cm)
Package 1 Length	31.00 in (78.740 cm)
Package weight(Lbs)	18.040 lb(US) (8.183 kg)
Unit Type of Package 2	PAL
Number of Units in Package 2	27
Package 2 Height	42.00 in (106.680 cm)
Package 2 Width	40.00 in (101.600 cm)
Package 2 Length	48.00 in (121.920 cm)
Package 2 Weight	486.0006 lb(US) (220.446 kg)

Contractual warranty

Warranty	18 months

Product data sheet
Characteristics

DU323RB
Safety switch, general duty, non fusible, 100A, 3 poles, 30 hp, 240 VAC, NEMA 3R, bolt-on provision

Main

Product	Single Throw Safety Switch
Duty Rating	General duty
Device application	Residential
Disconnect Type	Non-fusible disconnect switch
Factory Installed Neutral	None
Phase	3 phase
Number of Poles	3
Current Rating	100 A
Voltage Rating	240 V AC
Enclosure Rating NEMA	NEMA 3R
Maximum Horse Power Rating	15 Hp 240 V at AC 60 Hz for 1 phase conforming to NEC 430.52 30 hp 240 V at AC 60 Hz for 3 phase conforming to NEC 430.52

Complementary

Mounting Type	Surface
Electrical Connection	Lugs
Wiring configuration	3-wire
Wire Size	AWG 14...AWG 1 copper AWG 12...AWG 1 aluminium
Tightening torque	35 Lbf.In (3.95 N.m) 0.00…0.01 in² (2.08…5.26 mm²) (AWG 14...AWG 10) 35 Lbf.In (3.95 N.m) (AWG 14...AWG 10) 40 Lbf.In (4.52 N.m) 0.01 in² (8.37 mm²) (AWG 8) 45 Lbf.In (5.08 N.m) 0.02…0.03 in² (12.3…21.12 mm²) (AWG 6...AWG 4) 50 lbf.in (5.65 N.m) (AWG 3...AWG 1)
Depth	6.5 in (165.10 mm)
Width	10.5 in (266.70 mm)
Height	17.5 in (444.50 mm)
Net Weight	15.43 lb(US) (7 kg)

Environment

Certifications	UL listed file E2875

Ordering and shipping details

Category	00106 - D & DU SW,NEMA3R, 30-200A
Discount Schedule	DE1A
GTIN	00785901491828
Nbr. of units in pkg.	1
Package weight(Lbs)	14.78 lb(US) (6.70 kg)
Returnability	Yes
Country of origin	US

Packing Units

Unit Type of Package 1	PCE
Package 1 Height	7.30 in (18.542 cm)
Package 1 width	10.50 in (26.67 cm)
Package 1 Length	19.90 in (50.546 cm)
Unit Type of Package 2	PAL
Number of Units in Package 2	40
Package 2 Weight	632.00 lb(US) (286.67 kg)
Package 2 Height	40.00 in (101.6 cm)
Package 2 width	40.00 in (101.6 cm)
Package 2 Length	48.00 in (121.92 cm)

Offer Sustainability

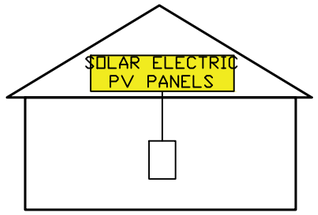
Sustainable offer status	Green Premium product
California proposition 65	WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
REACh free of SVHC	Yes
EU RoHS Directive	Compliant EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS Declaration
Environmental Disclosure	Product Environmental Profile
PVC free	Yes

Contractual warranty

Warranty	18 months

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF"POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY



SIGNAGE LOCATIONS:
·MAIN DISTRIBUTION PANEL

⚠ WARNING

ELECTRICAL SHOCK HAZARD

TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

SIGNAGE LOCATIONS:
MAIN DISTRIBUTION PANEL
PV AC DISCONNECT

⚠ WARNING

POWER SOURCE OUTPUT CONNECTION. DO NOT RELOCATE THIS OVERCURRENT DEVICE.

SIGNAGE LOCATIONS:
MAIN DISTRIBUTION PANEL

⚠WARNING DUAL POWER SOURCE

SECOND SOURCE IS PHOTOVOLTAIC SYSTEM

SIGNAGE LOCATIONS:
MAIN DISTRIBUION PANEL

Maximum voltage :
Maximum Circuit Current:

Max rated output current of the charge controller DC - to DC Converter (If installed):

SIGNAGE LOCATIONS:
PV AC DISCONNECT

PHOTOVOLTAIC AC DISCONNECT

RATED AC OUTPUT CURRENT	10.85A
NOMINAL OPERATING AC VOLTAGE	480V

SIGNAGE LOCATIONS:
PV AC DISCONNECT

PHOTOVOLTAIC POWER SOURCE

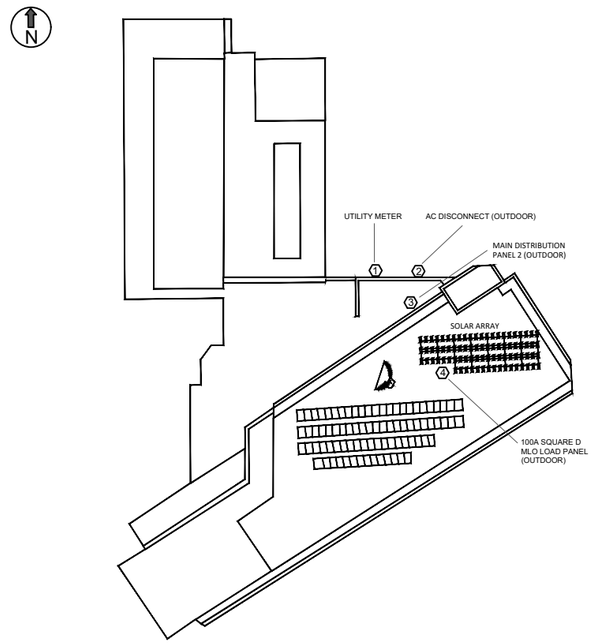
SIGNAGE LOCATIONS:
RACEWAYS

MAIN PHOTOVOLTAIC SYSTEM DISCONNECT

SIGNAGE LOCATIONS:
PV AC DISCONNECT

CAUTION

POWER TO THIS BUILDING IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN



SIGNAGE LOCATIONS:
AC DISCONNECT
MAIN SERVICE DISCONNECT
MAIN DISTRIBUTION PANEL

PHOTOVOLTAIC RAPID SHUTDOWN

SIGNAGE LOCATIONS:
PV AC DISCONNECT

SUNBALLAST COMPLIANCE WITH ANSI/UL 2703 – ISSUED 12/18/24 – STANDARD FOR SAFETY OF MOUNTING SYSTEMS, MOUNTING DEVICES, CLAMPING/ RETENTION DEVICES, AND GROUND LUGS FOR USE WITH FLAT-PLATE PHOTOVOLTAIC MODULES AND PANELS

1029

SANDBOX SOLAR

(970) 673-7733

CSU POWERHOUSE

430 N COLLEGE AVE
FORT COLLINS, CO 80524

PLACARDING & SIGNAGE

PROJECT ID: 1029
DATE: 7/9/25
CREATED BY: DEREK H.
REVIEWED BY:

REVISIONS

PV-5

GENERAL NOTES:

1. ALL SITE, PROJECT, AND BUILDING DETAILS ARE PROVIDED BY CUSTOMER OR GENERATED VIA SATELLITE IMAGERY FROM INFORMATION PROVIDED BY CUSTOMER. SUNBALLAST IS NOT RESPONSIBLE FOR SITE INACCURACIES THAT COULD LEAD TO CHANGES TO THESE DRAWING DETAILS AND ARRAY LAYOUT CONFIGURATIONS. ALL INFORMATION CONTAINED WITHIN THESE DOCUMENTS ARE TO BE FIELD VERIFIED BY CUSTOMER AND INSTALLER. ANY CHANGES OR MODIFICATIONS TO THESE DOCUMENTS, CONTAINED INFORMATION, OR FINAL ARRAY AND MOUNTING SYSTEM INSTALLATIONS MUST BE SUBMITTED TO SUNBALLAST AND OTHER PROJECT AUTHORITIES FOR APPROVAL.
2. REFER TO AND FOLLOW THE APPROPRIATE SUNBALLAST INSTALLATION MANUALS AND PROCEDURES DURING THE INSTALLATION PROCESS. NOT FOLLOWING SUCH PROCEDURES AND METHODS COULD RESULT IN DAMAGE TO THE COMPONENTS OR MAY VOID THE PRODUCT WARRANTY.
3. ARRAY SETBACKS: ALL ARRAYS ARE REQUIRED TO BE SETBACK 4-FEET FROM ALL ROOF EDGES UNLESS OTHERWISE SPECIFIED AND CALLED OUT ON THE ARRAY DIAGRAMS ON THIS PAGE OR ON ADDITIONAL ARRAY BALLAST PAGES
4. REFER TO THE SPECIFIC ARRAY BALLAST SHEETS FOR BALLASTING REQUIREMENTS BASED ON THE PROVIDED SITE INFORMATION
5. SYSTEM PSF INCLUDES ALL SUNBALLAST RACKING COMPONENTS, MECHANICAL ATTACHMENTS (IF APPLICABLE), PV MODULE AND BALLAST BLOCKS. FOR MAXIMUM SYSTEM POINT LOAD SUMMARY (PLS), REFER TO CALCULATIONS.
6. SUNBALLAST AND/OR SUNBALLAST CONSULTING ENGINEERS ARE NOT RESPONSIBLE FOR DETERMINING THE ADEQUACY OF THE STRUCTURE TO SUPPORT LOADS IMPOSED BY THE ARRAY AND MOUNTING SYSTEM. SUPPORT STRUCTURE TO BE CHECKED BY OTHERS
7. ALWAYS ALLOW 6” CLEARANCE BETWEEN NEIGHBORING SUBARRAYS, 6” BETWEEN SUBARRAYS AND ALL FIXED ROOF OBJECTS AND 4' BETWEEN SUBARRAYS AND ROOF EDGES. REFER TO LOCAL FIRE CODES AND ELECTRICAL CODES FOR ADDITIONAL REQUIREMENTS WHICH MAY GOVERN DESIGN. SUBARRAYS THAT USE A SEISMIC ANALYSIS METHOD OF DELTA MPV PER SEAOC OR ASCE 7-16 HAVE THEIR OWN CLEARANCE REQUIREMENTS. REFER TO THE BALLAST LAYOUT SHEETS WITHIN THIS DOCUMENT FOR DETAILS.

AERIAL PHOTO / SITE DIAGRAM

THIS CONSTRUCTION SET PROVIDES THE RACKING LAYOUT FOR ALL ARRAYS WITH NUMBER OF BALLAST BLOCKS AND/OR MECHANICAL ATTACHMENTS BASED ON THE APPROVED STRUCTURAL CALCULATIONS FOR THE COMPLETED INSTALLED CONDITION OF THE SOLAR ARRAY. THE INSTALLER IS RESPONSIBLE FOR THE SAFETY AND CARE OF THE ARRAY DURING ALL PHASES OF INSTALLATION. THEREFORE, THE INSTALLER MUST MONITOR THE WEATHER FORECAST AND TAKE NECESSARY PRECAUTIONS (SEE GENERAL NOTE #10) TO TEMPORARILY SHORE/BRACE ALL ARRAYS DURING CONSTRUCTION UNTIL INSTALLATION IS COMPLETED IN CONFORMANCE WITH THIS APPROVED CONSTRUCTION SET AND THE PRODUCT INSTALLATION MANUAL (SEE GENERAL NOTE #2). THE INSTALLER HAS SOLE RESPONSIBILITY FOR THE MEANS, METHODS, AND TECHNIQUES OF CONSTRUCTION OF THE SOLAR ARRAY FOR COMPLIANCE WITH LAWS, REGULATIONS, AND CODES, AND FOR THE SAFETY OF CONSTRUCTION APPLICABLE TO THIS WORK.

DESIGN CRITERIA

BUILDING CODE:	(ASCE 7-16)
OCCUPANCY CATEGORY=	III
IMPORTANCE FACTOR=	See individual calculations
WIND SPEED=	125
EXPOSURE CATEGORY=	C
SEISMIC DESIGN CATEGORY=	D

STAMP:

COLORADO LICENSED · AKASH TANDON · 53832 · PROFESSIONAL ENGINEER

Exp. 10/31/2025

SUN BALLAST Made to last Patented systems

1841 N Hercules Ave
Clearwater, FL, 33765
United States of America

SCALE: -

ORIGINAL SIZE 36"X24" SHEET SIZE ARCH "D"

PREPARED FOR: Sandbox Solar

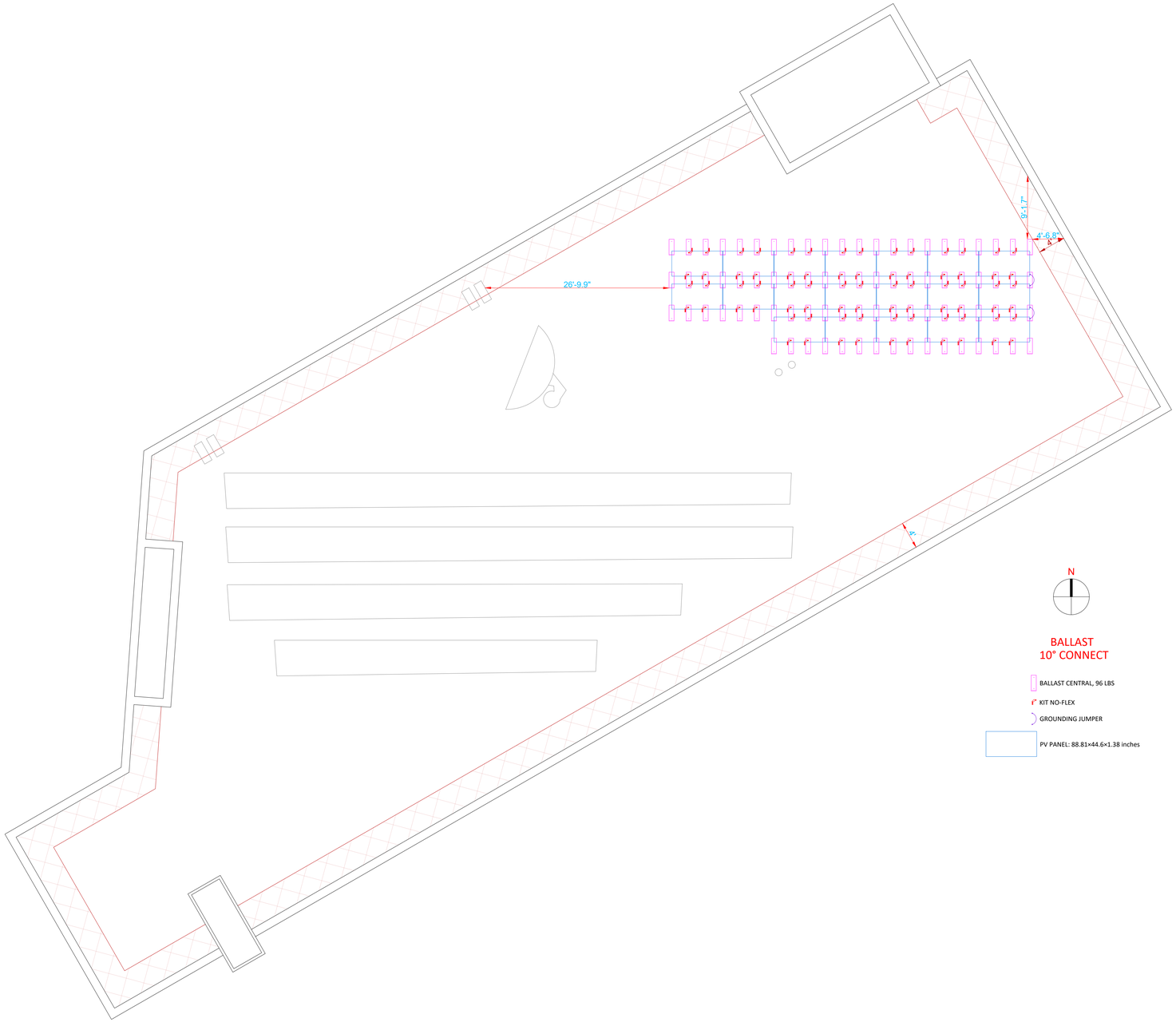
PROJECT: 430 N College Ave

LOCATION: 430 N College Ave, Fort Collins, CO 80524

SHEET TITLE: COVER SHEET

Project №: 9795-25-A-R2

SHEET: PV-6



N

BALLAST
10° CONNECT

BALLAST CENTRAL, 96 LBS

KIT NO-FLEX

GROUNDING JUMPER

PV PANEL: 88.81×44.6×1.38 inches

LEGEND

N

BALLAST
10° CONNECT

BALLAST CENTRAL, 96 LBS

KIT NO-FLEX

GROUNDING JUMPER

PV PANEL: 88.81×44.6×1.38 inches

CODE	PRODUCT	Q.TY
23010.CRH.US	Heavy 10 degree ballast connect 96LBS	82
KGN23125	Rubber mat X 2	85
K23711	Kit no Flex Connect (L shaped extension + cage nut + washer + bolt M8x25) x 10	8
23920/PWC	End plate for Powerclamp x 10	9
K23900/PWC.50	Mid Clamp Powerclamp x 10	12
K.14.GND.JMP	Grounding jumper	1

STAMP:

COLORADO LICENSED
ARASH ZANDIEH
53832
PROFESSIONAL ENGINEER
Exp. 10/31/2025

SUN BALLAST
Made to last
Patented systems

1841 N Hercules Ave
Clearwater, FL, 33765
United States of America

SCALE: 1:100

ORIGINAL SIZE 36"X24" SHEET SIZE ARCH "D"

PREPARED FOR: Sandbox Solar

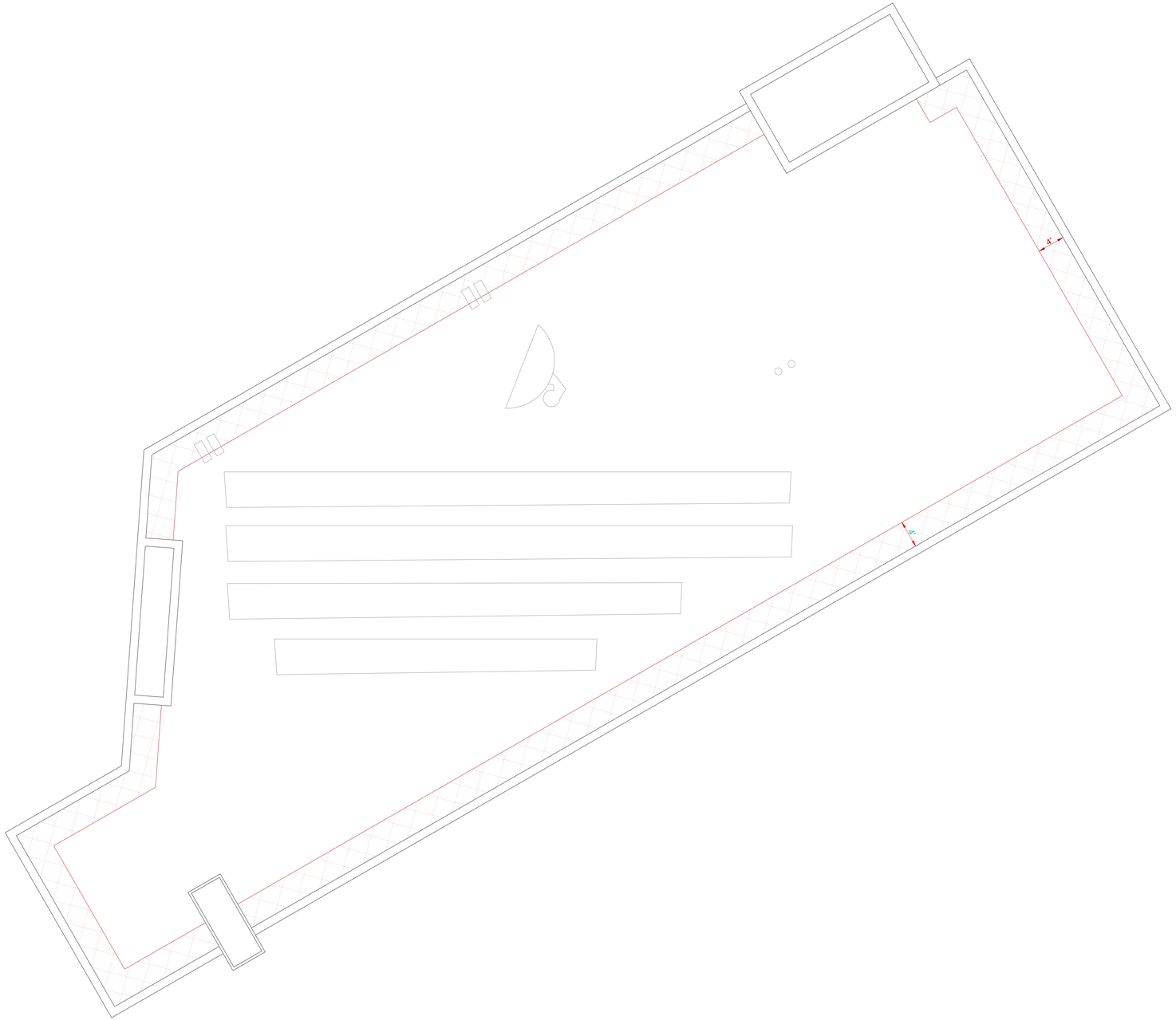
PROJECT: 430 N College Ave

LOCATION: 430 N College Ave, Fort Collins, CO 80524

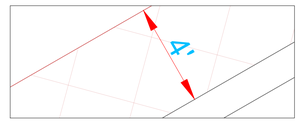
SHEET TITLE: ARRAY SITE MAP

Project №: 9795-25-A-R2

SHEET: PV-6.1



N



SETBACK FROM ROOF EDGES

Description system:	Connect
Applicant:	Sandbox Solar
Destination	USA
Installation address:	430 N College Ave, Fort Collins, CO 80524
Height of the building:	50 ft.
Type of area coverage:	Sheath
Parapet:	48 in.
Number of modules:	19 (10.35 kW)
Dimensions of the module:	88.81×44.6×1.38 in - 71.21 lbs

STAMP:

COLORADO LICENSED MARK LANDIS 53832 PROFESSIONAL ENGINEER

Exp. 10/31/2025

SUN BALLAST Made to last Patented systems

1841 N Hercules Ave
Clearwater, FL, 33765
United States of America

SCALE: 1:100

ORIGINAL SIZE 36"X24" SHEET SIZE ARCH "D"

PREPARED FOR: Sandbox Solar

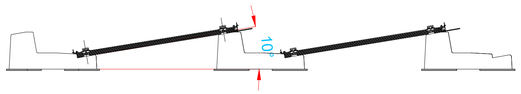
PROJECT: 430 N College Ave

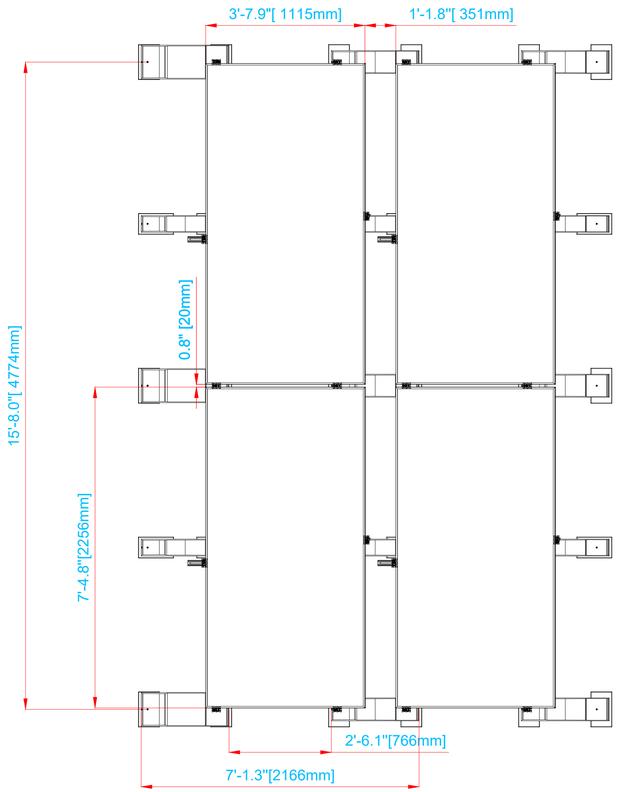
LOCATION: 430 N College Ave, Fort Collins, CO 80524

SHEET TITLE: PROJECT SUMMARY

Project №: 9795-25-A-R2

SHEET: PV-6.2





STAMP:

COLORADO LICENSED
AKASH TANDON
53832
PROFESSIONAL ENGINEER
Exp. 10/31/2025

SUN BALLAST
Made to last
Patented systems

1841 N Hercules Ave
Clearwater, FL, 33765
United States of America

SCALE: 1:20

ORIGINAL SIZE 36"X24" SHEET SIZE ARCH "D"

PREPARED FOR: Sandbox Solar

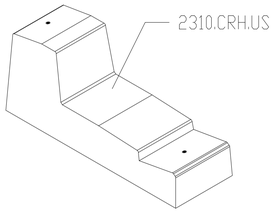
PROJECT: 430 N College Ave

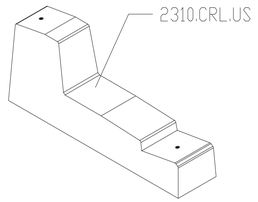
LOCATION: 430 N College Ave, Fort Collins, CO 80524

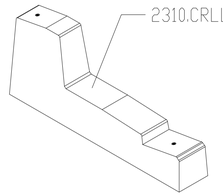
SHEET TITLE: TYPICAL ARRAY DIMENSIONS

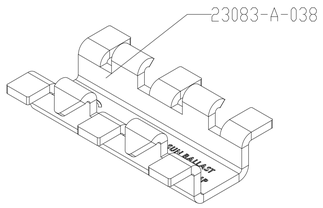
Project №: 9795-25-A-R2

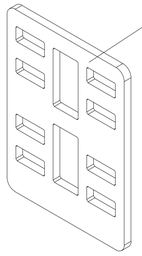
SHEET: PV-6.3

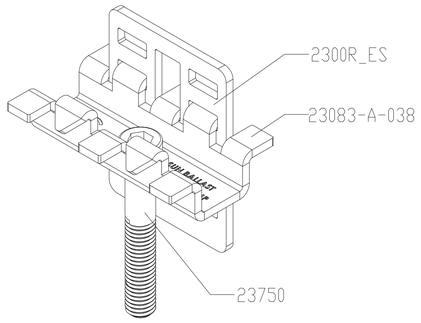


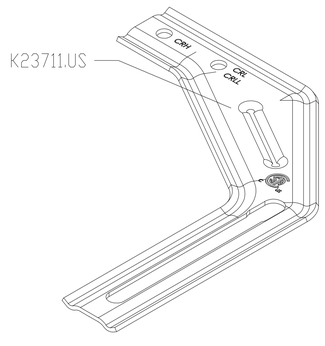


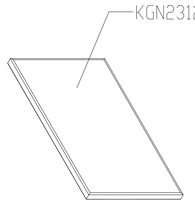


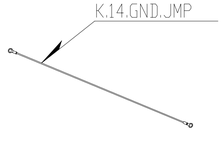












STAMP:

COLORADO LICENSED
AKASH ZANDIEH
53832
PROFESSIONAL ENGINEER
Exp. 10/31/2025

SUN BALLAST
Made to last
Patented systems

1841 N Hercules Ave
Clearwater, FL, 33765
United States of America

SCALE: -

ORIGINAL SIZE 36"X24" SHEET SIZE ARCH "D"

PROJECT: 430 N College Ave

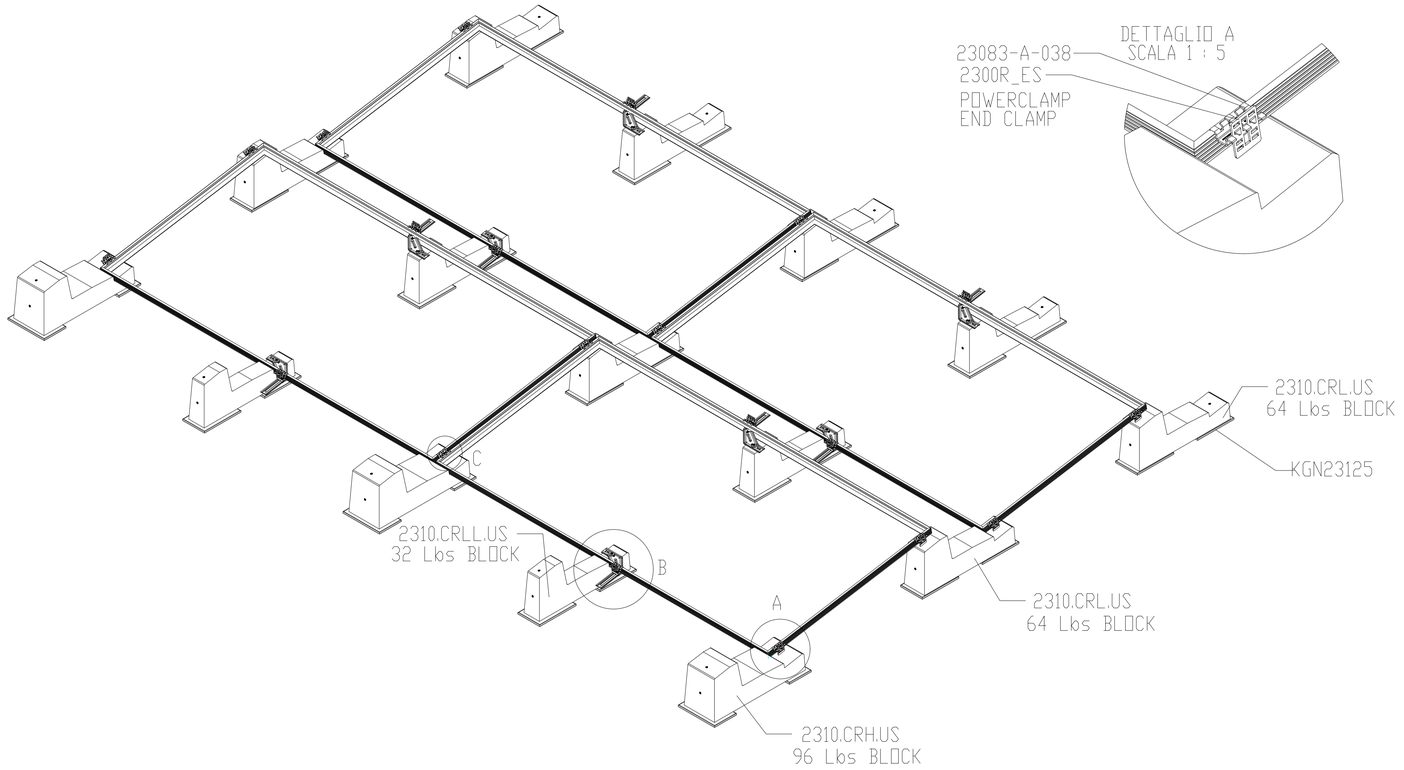
SHEET TITLE: RACKING COMPONENTS

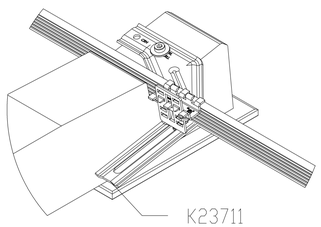
PREPARED FOR: Sandbox Solar

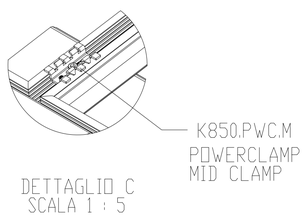
LOCATION: 430 N College Ave, Fort Collins, CO 80524

Project №: 9795-25-A-R2

SHEET: PV-6.4







STAMP:

COLORADO LICENSED
RAJESH TANDEL
53832
PROFESSIONAL ENGINEER

Exp. 10/31/2025

SUN BALLAST
Made to last
Patented systems

1841 N Hercules Ave
Clearwater, FL, 33765
United States of America

SCALE: -

ORIGINAL SIZE 36"X24" SHEET SIZE ARCH "D"

PREPARED FOR: Sandbox Solar

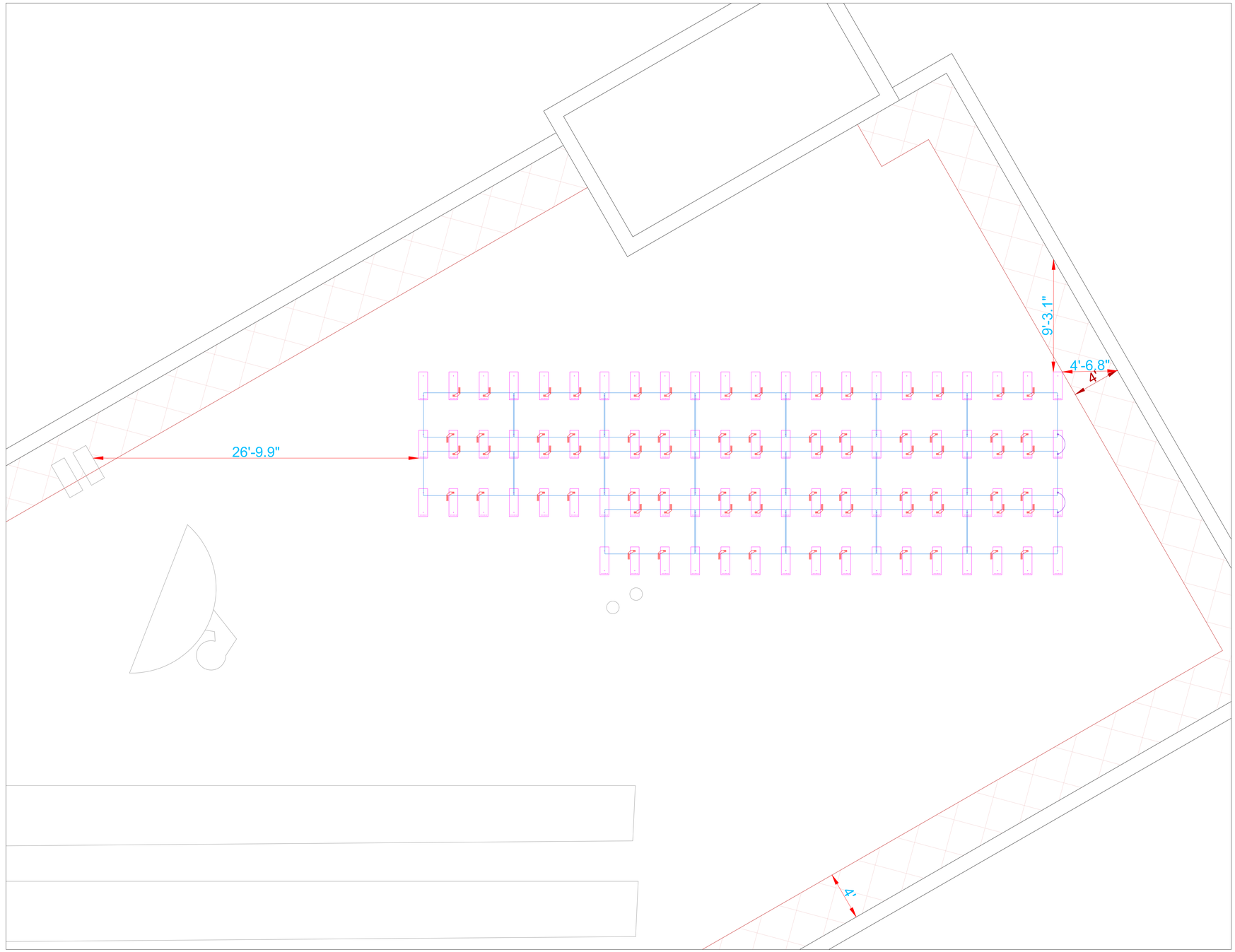
PROJECT: 430 N College Ave

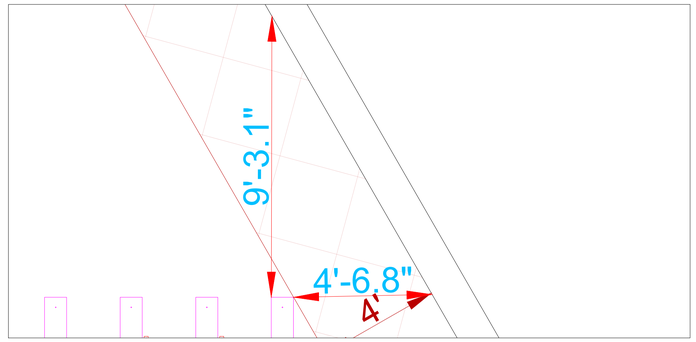
LOCATION: 430 N College Ave, Fort Collins, CO 80524

SHEET TITLE: BALLAST LEGEND

Project №: 9795-25-A-R2

SHEET: PV-6.5





ARRAY 1

Roof Information	
Roof Height (ft.)	50
Parapet Height (in.)	48
Roof Tilt (deg.)	0
Roof Type	Sheath
Specifications	
Number of Modules	19
Number of rows	3
Module Power (W)	545
Array Output (kW)	10.4
Array Area (sq.ft.)	814.5
Distributed Dead Load (psf.)	11.3
Part Quantities	
Heavy 10 degree ballast connect 96 LBS	82
Rubber mat x 2	82
Kit no Flex Connect	76
End plate for Powerclamp	88
Mid Clamp Powerclamp	120
Grounding jumper	2

STAMP:

COLORADO LICENSED ARASH ZANDIEH 53832 PROFESSIONAL ENGINEER

Exp. 10/31/2025

SUN BALLAST Made to last Patented systems

1841 N Hercules Ave
Clearwater, FL, 33765
United States of America

SCALE: 1:50

ORIGINAL SIZE 36"X24" SHEET SIZE ARCH "D"

PREPARED FOR: Sandbox Solar

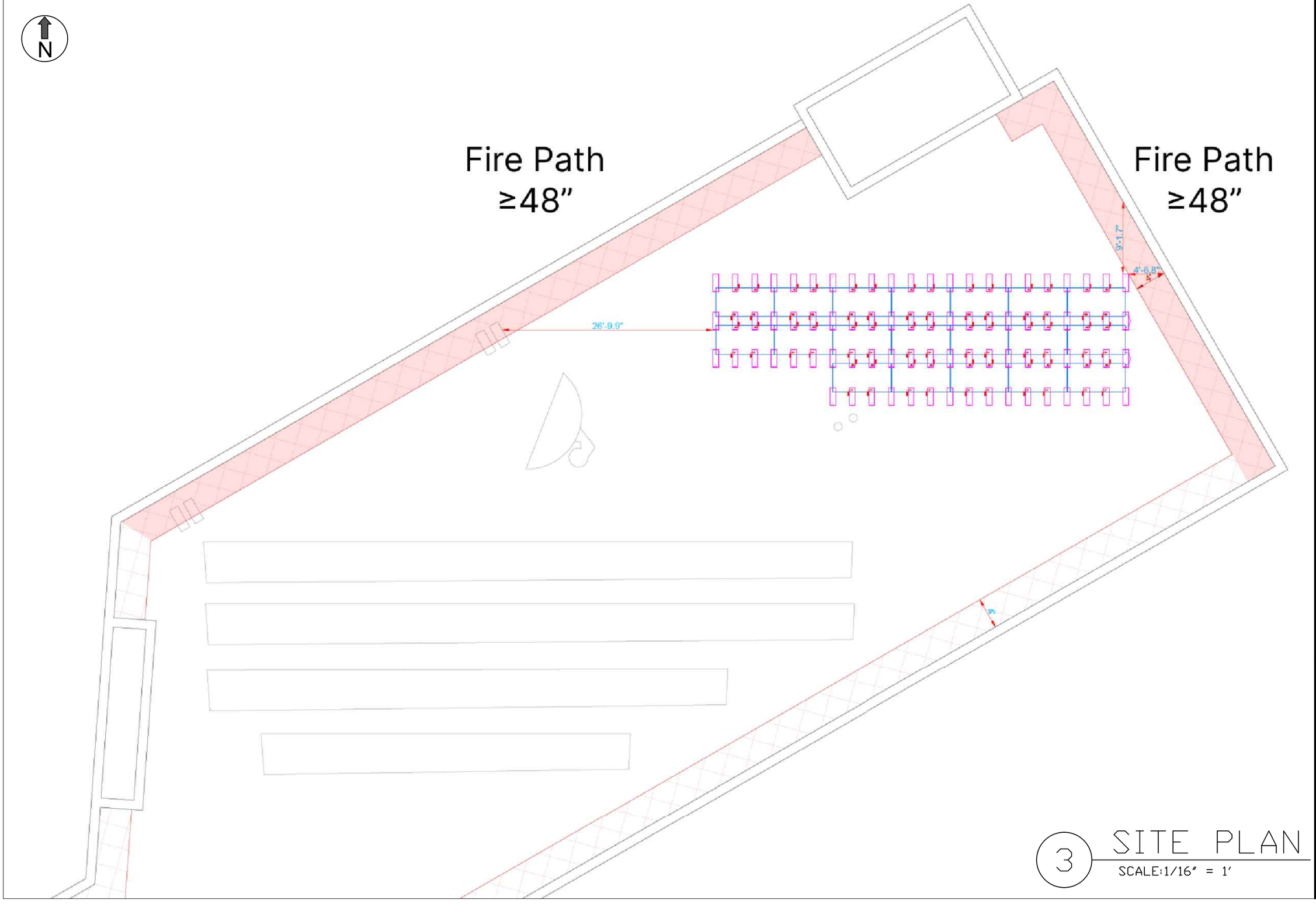
PROJECT: 430 N College Ave

LOCATION: 430 N College Ave, Fort Collins, CO 80524

SHEET TITLE: ARRAY 1 DETAILS

Project №: 9795-25-A-R2

SHEET: PV-6.6



3 SITE PLAN

SCALE: 1/16" = 1'

1029

SANDBOX SOLAR

(970) 673-7733

CSU POWERHOUSE

430 N COLLEGE AVE
FORT COLLINS, CO 80524

FIRE PLAN

PROJECT ID:	1029
DATE:	7/9/25
CREATED BY:	DEREK H.
REVIEWED BY:	

REVISIONS

PV-7

AHZ Consulting Engineers, Inc.
111 Rodeo
Irvine, CA 92602
(949) 466-1544
(901) 692-0431

06/12/2025

REFERENCE: 430 N College Ave Fort Collins, CO 80524

To Whom It May Concern:

Per your request, we have reviewed the existing roof framing at the above referenced site. The purpose of our review was to determine the adequacy of the existing structure to support the proposed installation of solar panels on the roof as shown on the panel layout plan. Based upon our review, we conclude that the existing structure is adequate to support the proposed solar panel installation with the given geometry and weight restriction outline in this report.

The mechanical attachment for the PV ballast system is also designed in this calculation and can be used if applicable.

The PV ballast system including requirements for blocks and mechanical attachments to resist the wind and seismic forces (uplift, drag, lateral) to be designed by others. The design of the PV ballast system is out of scope of this calculation.

If you have any questions, don't hesitate to contact.

Sincerely,
Arash Zandieh, Ph.D., P.E.
a.zandieh@ahzengineers.com | 901-692-0431
AHZ Consulting Engineers, Inc.

Exp. 10/31/2025

ARASH ZANDIEH
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14:18:00

Design Codes and Guidelines:

1. IBC (2021). International Building Code.
2. ASCE (2016). "Minimum Design Loads for Buildings and Other Structures. ASCE/SEI Standard 7-16."

Design parameters:

Risk Category: II
Design wind speed: 100 mph
Wind exposure category: C
Ground snow load: 30 psf
Flat snow load: 30 psf
Live Load (Psf): 20 (Not Applied at Panels)

Solar Module:

Trina Solar TSM-DEG19C.20 545			
	Length	7.83	ft
	Width	3.60	ft
	Weight	71.90	lbs

Weight of PV panels:

W_{PV}=	2.60	psf

Wind Load on PV panels:

Basic Wind Speed:	V	100	mph
Exposure Category:	C		
Risk Category:	II		
PV Module Angle:	θ	10	degree
Building Roof Height:	h	35	ft
Velocity Pressure Exposure Coefficient:	K_z	1.03	ASCE 7-16, Table 26.10.1
Topographic Factor:	K_{zt}	1	ASCE 7-16, Section 26.8.2
Wind Directionality Factor:	K_d	0.85	ASCE 7-16, Table 26.6.1
ground elevation factor	K_e	0.828	ASCE 7-16, Section 26.9 (Conservative)
Velocity pressure $q_z = 0.00256\ K_z K_{zt} K_d V^2$:	18.59	psf	ASCE 7-16, Equation 26.10-1

ASCE 7-16 Section 29.4.4

$p = q_h (GC_p)(\gamma_E)(\gamma_a)$ ASCE 7-16, Equation 29.4-7

γ_a	0.8		ASCE 7-16, Figure 9.4.8 (Conservat
γ_E	1.5		Assume Exposed
GC_p:			ASCE 7-16, Figure 30.3.2A
External pressure coefficient Zone 1':	GC_p	0.9	
External pressure coefficient Zone 1:	GC_p	1.7	
External pressure coefficient Zone 2:	GC_p	2.3	
External pressure coefficient Zone 3:	GC_p	3.2	

External pressure coefficient (downward):	GC_p	0.3	
Roof Length:	155.0	ft	
Roof Width:	70.0	ft	
Edge Zone, *0.6h*:	21.0	ft	Zone 2
Use GC_p for Zone 2			

Minimum Design Wind Pressures	16	psf	ASCE 7-16, Section 30.2.2
Downward Wind load on modules:	6.7	psf	<16 psf ; Use 16 psf

Snow loads:

pg = Ground Snow Load =	30	psf	
pf = 0.7 Ce Ct I pg			(ASCE7-16 - Eq 7.3-1)
Ce = Exposure Factor =	1		(ASCE7-16 - Table 7.3-1)
Ct = Thermal Factor =	1		(ASCE7-16 - Table 7.3-2)
I = Importance Factor =	1		(ASCE7-16- 7.3.3)
pf = Flat Roof Snow Load =	21	psf	
ps = Cspf			(ASCE7-16- Eq 7.4-1)
Cs = Slope Factor =	1		(ASCE7-16- Fig. 7.4-1)
ps = Roof Snow Load =	30	psf	

Check The Maximum Dead Load (PSF) For Ballast System:

Calculations were performed to assess the roof's capacity for an additional 16 psf dead load from the ballast system. Steel beams were analyzed using ASDIP software, with results verified against the Steel Design Manual.

W18X35 Check:

The W18X35 sections are modeled and analyzed using the ASDIP – Steel Beam Design software. The load distribution on the beam is illustrated below:

Span= 33'

Tributary Width= 7'-4"

Max. Dead Load= 130 psf (include ballast and PV*)

*A dead load of 16 psf is assumed for the additional weight of the ballast system.

Ground Snow Load= 30 psf

Flat-Roof Snow Load= 30 psf

Downward Wind Load= 16 psf

Check Members' Strength:

The capacity of the beam is checked against the demand, calculated from the above loads, using ASDIP – Steel Beam Design. The Steel Design Manual is used to verify the member's strength against the demand. The demand-to-capacity ratios for the beam are shown on the following pages. As indicated, the ratios are below one. Therefore, the W18×35 section has sufficient strength to withstand the applied loads.

Project: CSU Powerhouse Expansion Page # ___
Engineer: 6/12/2025
Descrip: W18X35

ASDIP Steel 6.3.2.5 **STEEL BEAM DESIGN** *www.asdipsoft.com*

GEOMETRY

Beam Designation W18X35

Span	Length		Support	Type
①	33.00 ft		①	Pinned
②	N.A.		②	Pinned
③	N.A.		③	N.A.
④	N.A.		④	N.A.
⑤	N.A.		⑤	N.A.
			⑥	N.A.

PROPERTIES

Area ..	10.3	in²	Sx ...	57.6	in³
Depth	17.7	in	Zx ...	66.5	in³
bf	6.0	in	rx	7.04	in
tw	0.30	in	Iy	15.3	in⁴
tf	0.43	in	Sy ...	5.1	in³
k des .	0.83	in	Zy ...	8.1	in³
Ix	510.0	in⁴	ry	1.22	in
Cw	1140.0	in⁶	J	0.51	in⁴

LRFD SUPPORT REACTIONS (kip)

Load Comb.	△	△
1.4D	29.4	29.4
1.2D+1.6L+0.5Lr	25.2	25.2
1.2D+1.6L+0.5S	27.1	27.1
1.2D+0.5L+1.6Lr	25.2	25.2
1.2D+0.5L+1.6S	31.1	31.1
1.2D+1.6Lr+0.5W	26.2	26.2
1.2D+1.6S+0.5W	32.1	32.1
1.2D+0.5L+0.5Lr+W	27.2	27.2
1.2D+0.5L+0.5S+W	29.0	29.0
1.2D+0.5L+0.2S+E	25.9	25.9
0.9D+W	20.9	20.9
0.9D+E	18.9	18.9
1.2CD+1.6CL	5.9	5.9

SLAB AND DECK

Overall Slab Thickness	5.0	in	OK
Interior Beam. Beam Spacing = 5.0 ft			
Effective Slab Width	5.00	ft	
Concrete Strength f'c	3000.0	psi	OK
Concrete Density	150.0	pcf	OK
Metal Deck Type	VULCRAFT 2 VLI		
Deck Ribs Height hr	2.0	in	
Deck Ribs Avg. Width wr ..	6.0	in	
Deck Ribs Run Perpendicular to the Beam			

DESIGN FOR SHEAR

Shear Coefficient Cv	1.00		
Maximum Shear Force V ...	32.1	kip	
Limit States	Nominal Vn		
Shear Yielding	159.3	kip	←
Shear Buckling	159.3	kip	
Nominal Strength Vn	159.3	kip	
Resistance Factor ϕ	0.90		
Design Strength ϕVn	143.4	kip	
V / ϕVn Design Ratio	0.22		OK

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Engineer: 6/12/2025
Descrip: W18X35

ASDIP Steel 6.3.2.5 **STEEL BEAM DESIGN** *www.asdipsoft.com*

FLEXURE (NON-COMPOSITE)

Lateral Bracing	Continuous (Top)		
- Construction Loads			
Max. Bending Moment M ..	48.6	k-ft	
L. T. Buckling Cb-factor	3.00		
Limit States	Nominal Mn		
Yielding	277.1	k-ft	←
Lateral Torsional Buckling	277.1	k-ft	
Flange Local Buckling	N.A.	k-ft	
Web Local Buckling	N.A.	k-ft	
Nominal Strength Mn	277.1	k-ft	
Resistance Factor ϕ	0.90		
Design Strength ϕMn	249.4	k-ft	
M / ϕMn Design Ratio	0.19		OK
- Final Loads			
Max. Bending Moment M ..	0.0	k-ft	
L. T. Buckling Cb-factor	1.14		
Limit States	Nominal Mn		
Yielding	277.1	k-ft	
Lateral Torsional Buckling	44.0	k-ft	←
Flange Local Buckling	N.A.	k-ft	
Web Local Buckling	N.A.	k-ft	
Nominal Strength Mn	277.1	k-ft	
Resistance Factor ϕ	0.90		
Design Strength ϕMn	39.6	k-ft	
M / ϕMn Design Ratio	0.00		OK

FLEXURE (COMPOSITE)

Max. Bending Moment M	265.0	k-ft	
Limit States	Nominal Mn		
Plastic Yielding	387.6	k-ft	←
Elastic Yielding	N.A.	k-ft	
Nominal Strength Mn	387.6	k-ft	
Resistance Factor ϕ	0.90		
Design Strength ϕMn	348.9	k-ft	
M / ϕMn Design Ratio	0.76		OK

LOCAL BUCKLING

Flanges in Flexure	Compact
Flanges in Compression	Non-compact
Web in Flexure	Compact
Web in Compression	Non-compact

SHEAR CONNECTORS

Shear Stud Diameter	3/4"		OK
Shear Stud Length	4.5	in	OK
Tensile Strength Fu	65.0	ksi	
Shear Stud Capacity Qn	17.2	kip	
Horizontal Shear Force	103.3	kip	
# of Studs for Full Composite	56		
Partial Composite Action %	25	%	
Minimum Spacing Allowed	4.5	in	
# of Studs at Any Section	1		

Span	# of Studs	Ratio	
1	16 studs @ 25 in	0.76	OK

DEFLECTIONS (IBC 1604)

Stiffness factor	1.0				
Required Camber	1.20	in			
Long-term Deflection	0.40	in			
Loading	δ (in)	L/δ	L/δ Min	Ratio	
CL	0.00	9999	360	0.04	OK
CD+CL .	-0.66	598	240	0.40	OK
L	0.00	9999	360	0.04	OK
D+L	0.80	493	240	0.49	OK
Lr, S, W	-0.95	415	360	0.87	

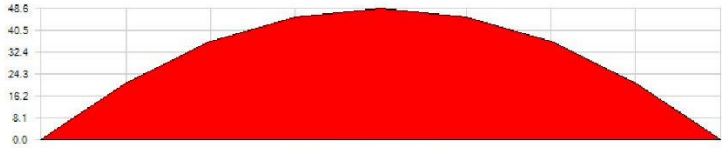
DESIGN CODES

Steel Design	AISC 360-16
Load Combinations	ASCE 7-10/16

Project: CSU Powerhouse Expansion Page # ___
Engineer: 6/12/2025
Descrip: W18X35

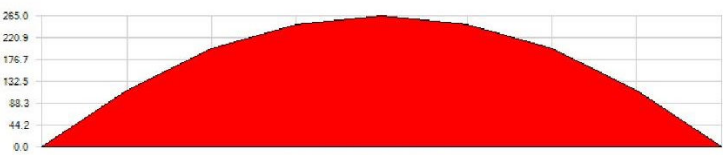
ASDIP Steel 6.3.2.5 **STEEL BEAM DESIGN** *www.asdipsoft.com*

SHEAR DIAGRAM (kip)



MOMENT DIAGRAM (k-ft)
(Comb: 1.2CD+1.6CL)

SHEAR DIAGRAM (kip)



MOMENT DIAGRAM (k-ft)
(Comb: 1.2D+1.6S+0.5W)

W18X40 Check:

The W18X40 sections are modeled and analyzed using the ASDIP – Steel Beam Design software. The load distribution on the beam is illustrated below:

Span= 22’

Tributary Width= 33’

Max. Dead Load= 130 psf (include ballast and PV*)

*A dead load of 16 psf is assumed for the additional weight of the ballast system.

Ground Snow Load= 30 psf

Flat-Roof Snow Load= 30 psf

Downward Wind Load= 16 psf

Check members’ strength:

The capacity of the beam is checked against the demand, calculated from the above loads, using ASDIP – Steel Beam Design. The Steel Design Manual is used to verify the member's strength against the demand. The demand-to-capacity ratios for the beam are shown on the following pages. As indicated, the ratios are below one. Therefore, the W18×40 section has sufficient strength to withstand the applied loads.

Project: CSU Powerhouse Expansion Page # ___
Engineer: 6/12/2025
Descrip: W18X40

ASDIP Steel 6.3.2.5 **STEEL BEAM DESIGN** *www.asdipsoft.com*

GEOMETRY

Beam Designation W18X40

Span	Length	Support	Type
①	22.00 ft	①	Pinned
②	N.A.	②	Pinned
③	N.A.	③	N.A.
④	N.A.	④	N.A.
⑤	N.A.	⑤	N.A.
		⑥	N.A.

PROPERTIES

Area ..	11.8	in²	Sx ...	68.4	in³
Depth	17.9	in	Zx ...	78.4	in³
bf	6.0	in	rx	7.21	in
tw	0.32	in	Iy	19.1	in⁴
tf	0.53	in	Sy ...	6.4	in³
k des .	0.93	in	Zy ...	10.0	in³
Ix	612.0	in⁴	ry	1.27	in
Cw	1440.0	in⁶	J	0.81	in⁴

ASD SUPPORT REACTIONS (kip)

Load Comb.	△	△
D+L	50.5	50.5
D+Lr	50.5	50.5
D+S	61.4	61.4
D+0.75L+0.75Lr	50.5	50.5
D+0.75L+0.75S	58.7	58.7
D+0.6W	54.0	54.0
D+0.7E	50.5	50.5
D+0.75L+0.75Lr+0.45W	53.1	53.1
D+0.75L+0.75S+0.45W	61.3	61.3
D+0.75L+0.75S+0.525E	58.7	58.7
0.6D+0.6W	33.8	33.8
0.6D+0.7E	30.3	30.3
CD	3.3	3.3

SLAB AND DECK

Overall Slab Thickness	5.0	in	OK
Interior Beam. Beam Spacing = 5.0 ft			
Effective Slab Width	5.00	ft	
Concrete Strength f'c	3000.0	psi	OK
Concrete Density	150.0	pcf	OK
Metal Deck Type	VULCRAFT 2 VLI		
Deck Ribs Height hr	2.0	in	
Deck Ribs Avg. Width wr ..	6.0	in	
Deck Ribs Run Perpendicular to the Beam			

DESIGN FOR SHEAR

Shear Coefficient Cv	1.00		
Maximum Shear Force V ...	61.4	kip	
Limit States	Nominal Vn		
Shear Yielding	169.2	kip	←
Shear Buckling	169.2	kip	
Nominal Strength Vn	169.2	kip	
Safety Factor Ω	1.50		
Allowable Strength Vn/Ω ..	112.8	kip	
V / Vn/Ω Design Ratio	0.54		OK

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Engineer: 6/12/2025
Descrip: W18X40

ASDIP Steel 6.3.2.5 **STEEL BEAM DESIGN** *www.asdipsoft.com*

FLEXURE (NON-COMPOSITE)

Lateral Bracing	Continuous (Top)		
- Construction Loads			
Max. Bending Moment M ..	18.3	k-ft	
L. T. Buckling Cb-factor	3.00		
Limit States	Nominal Mn		
Yielding	326.7	k-ft	←
Lateral Torsional Buckling	326.7	k-ft	
Flange Local Buckling	N.A.	k-ft	
Web Local Buckling	N.A.	k-ft	
Nominal Strength Mn	326.7	k-ft	
Safety Factor Ω	1.67		
Allowable Strength Mn/Ω ...	195.6	k-ft	
M / Mn/Ω Design Ratio	0.09		OK
- Final Loads			
Max. Bending Moment M ..	0.0	k-ft	
L. T. Buckling Cb-factor	1.14		
Limit States	Nominal Mn		
Yielding	326.7	k-ft	
Lateral Torsional Buckling	102.5	k-ft	←
Flange Local Buckling	N.A.	k-ft	
Web Local Buckling	N.A.	k-ft	
Nominal Strength Mn	102.5	k-ft	
Safety Factor Ω	1.67		
Allowable Strength Mn/Ω ...	61.4	k-ft	
M / Mn/Ω Design Ratio	0.00		OK

FLEXURE (COMPOSITE)

Max. Bending Moment M	337.7	k-ft	
Limit States	Nominal Mn		
Plastic Yielding	572.7	k-ft	←
Elastic Yielding	N.A.	k-ft	
Nominal Strength Mn	572.7	k-ft	
Safety Factor Ω	1.67		
Allowable Strength Mn/Ω	343.0	k-ft	
M / Mn/Ω Design Ratio	0.98		OK

LOCAL BUCKLING

Flanges in Flexure	Compact
Flanges in Compression	Non-compact
Web in Flexure	Compact
Web in Compression	Non-compact

SHEAR CONNECTORS

Shear Stud Diameter	3/4"		OK
Shear Stud Length	4.5	in	OK
Tensile Strength Fu	65.0	ksi	
Shear Stud Capacity Qn	17.2	kip	
Horizontal Shear Force	285.5	kip	
# of Studs for Full Composite	56		
Partial Composite Action %	100	%	
Minimum Spacing Allowed	4.5	in	
# of Studs at Any Section	1		

Span	# of Studs	Ratio	
1	58 studs @ 5 in	0.98	OK

DEFLECTIONS (IBC 1604)

Stiffness factor	1.0				
Required Camber	0.00	in			
Long-term Deflection	0.12	in			
Loading	δ (in)	L/δ	L/δ Min	Ratio	
CL	0.00	9999	360	0.04	OK
CD+CL .	0.09	2939	240	0.08	OK
L	0.00	9999	360	0.04	OK
D+L	0.79	332	240	0.72	OK
Lr, S, W	0.13	1970	360	0.18	

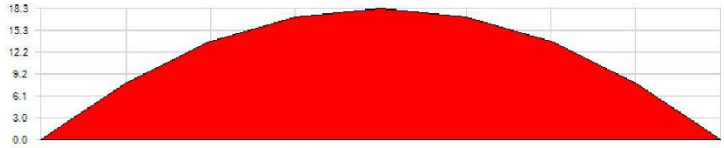
DESIGN CODES

Steel Design	AISC 360-16
Load Combinations	ASCE 7-10/16

Project: CSU Powerhouse Expansion Page # ___
Engineer: 6/12/2025
Descrip: W18X40

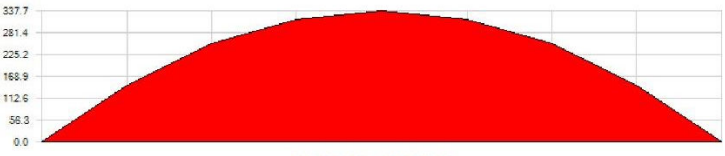
ASDIP Steel 6.3.2.5 **STEEL BEAM DESIGN** *www.asdipsoft.com*

SHEAR DIAGRAM (kip)



MOMENT DIAGRAM (k-ft)
(Comb: CD)

SHEAR DIAGRAM (kip)



MOMENT DIAGRAM (k-ft)
(Comb: D+S)