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115/34.5kV Solar Plant & Substation Senior Design Project

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| Senior Design Team 41

| 10/17/2024

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AGENDA

- Safety Moment
- New Technology
- Voltage Drop Calculation
- Expand on Cost Estimations
- Drawings for Project

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Safety Moment

- **Relevant IEEE Safety Standards**

1. IEEE 1584-2018 – Arc-Flash Hazard Calculations
- Determines incident energy to select proper **PPE** and ensure safe working distances.
2. IEEE 80-2013 – Substation Grounding Safety
- Ensures proper **grounding grid design** to prevent dangerous step and touch potentials.
3. IEEE C37.20.7-2017 – Arc-Resistant Switchgear
- Provides guidelines for **circuit breaker testing** to protect personnel from internal arc faults.
4. IEEE 524-2016 – Overhead Line Installation
- Focuses on **safe installation practices** for transmission lines, including fall protection and PPE.

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New Technology

Solar Ocean Farms

1. **Definition:** represent an innovative solar technology that integrates solar power generation with offshore environments. These farms involve floating solar arrays installed on bodies of water, including oceans, lakes, and reservoirs.

2. **Advantages:**

- **Land Conservation**: By using water surfaces, Solar Ocean Farms reduce the need for large land areas, which is crucial in densely populated regions.
- **Cooling Effect**: The water helps cool the solar panels, increasing their efficiency compared to land-based systems.
- **Potential for Synergies**: Floating solar farms can be combined with aquaculture or offshore wind to maximize energy and resource use.

Example:

The floating solar farm in Singapore which is known as the Tengeh Reservoir Floating Solar Farm

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Voltage Drop Calculation

Voltage drop is defined as the amount of voltage loss that occurs through all or part of a circuit due to conductor resistance.

Factors Affecting Voltage Drop

- **Wire Material**:
  - Copper (low resistance, better conductor)
  - Aluminum (higher resistance, more cost-effective)
- **Wire Size**:
  - Larger cross-sectional areas (thicker wires) result in lower resistance and less voltage drop.
- **Wire Length**:
  - Shorter cable runs reduce voltage drop.

wire size selection:

- **High Current Sections**: For sections with high current (**up to 300 amps**), **3/0 AWG** wires are appropriate for distances around 28-40 feet.

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- **Lower Current Sections**: For smaller current sections (e.g., **40-55 amps**), **8 AWG** wires would work for short distances up to **40-50 feet**.

Voltage Drop *= 2 x L x I x R / 1,000*

Where:

- L = Cable length in ft
- I = max Current in amps
- R = Resistance

Current(A)	Length(ft.) 0-13	13-18	18-23	23-28	28-40	40-50	50-60	60-70	70-80
0-18	18AWG	16AWG	14AWG	14AWG	14AWG	12AWG	12AWG	10AWG	10AWG
18-24	16AWG	14AWG	14AWG	14AWG	12AWG	12AWG	10AWG	10AWG	10AWG
24-35	14AWG	12AWG	12AWG	10AWG	10AWG	8AWG	8AWG	6AWG	6AWG
35-40	12AWG	12AWG	10AWG	10AWG	8AWG	8AWG	6AWG	4AWG	4AWG
40-55	10AWG	10AWG	8AWG	8AWG	6AWG	4AWG	3AWG	2AWG	2AWG
55-80	8AWG	6AWG	6AWG	4AWG	3AWG	2AWG	2AWG	1AWG	1AWG
80-105	6AWG	6AWG	4AWG	3AWG	2AWG	1AWG	1/0AWG	2/0AWG	2/0AWG
105-140	4AWG	3AWG	2AWG	1AWG	1/0AWG	2/0AWG	2/0AWG	3/0AWG	3/0AWG
140-165	3AWG	2AWG	1AWG	1/0AWG	2/0AWG	2/0AWG	3/0AWG	3/0AWG	4/0AWG
165-190	2AWG	2AWG	1AWG	1/0AWG	2/0AWG	2/0AWG	3/0AWG	4/0AWG	
190-220	1AWG	1AWG	1/0AWG	2/0AWG	3/0AWG	3/0AWG	4/0AWG		
220-260	1/0AWG	2/0AWG	2/0AWG	3/0AWG	4/0AWG				
260-300	2/0AWG	3/0AWG	3/0AWG	4/0AWG					
300-350	3/0AWG	4/0AWG							
350-405	4/0AWG								

Renogy

https://www.renogy.com/learning-center/size-wire-accessory/pv-wire-options?srsltid=AfmBOopES7GXqGmNTbayH69M1yuxI9-4Lf0DnLYvj-yFdqhrvaIEiLY2

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COST ESTIMATION

- Solar cells

$ 250 per panel

  - 7540 panels total
  - $1,885,000

- Combiner boxes
- Skids
- Land: 162 Acres, $ 2,000 per acre
- Labor

- Average Salary in New Mexico: $ 18-24 per hour per worker
- Workday: 8 hours
- 6+ months for labor

- Average EE salary in New Mexico: $ 104,272- Per month is around $ 8,700
- 3-6 Months for planning/ engineering phase as well

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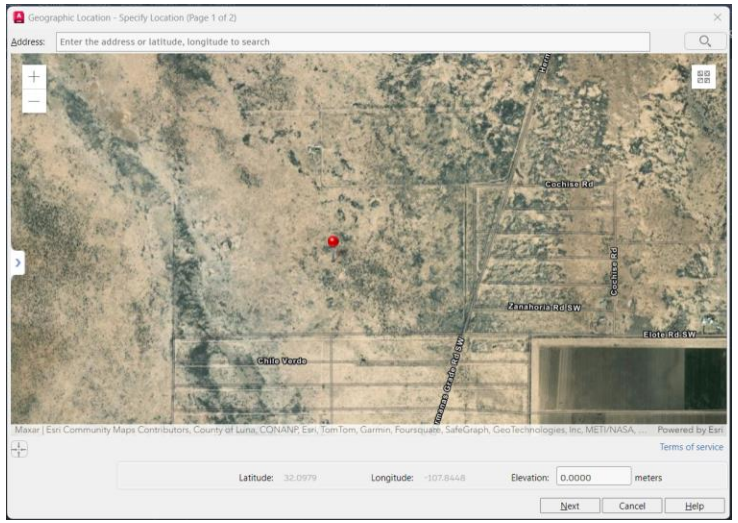
AutoCAD Drawings Progress

- Listing:https://www.zillow.com/homedetails/0-Hermanas-Grade-Rd-SW-Deming-NM-88030/346215623_zpid/
- Parcel #: 3056149254397
- Property Layout: https://app.regrid.com/us/nm



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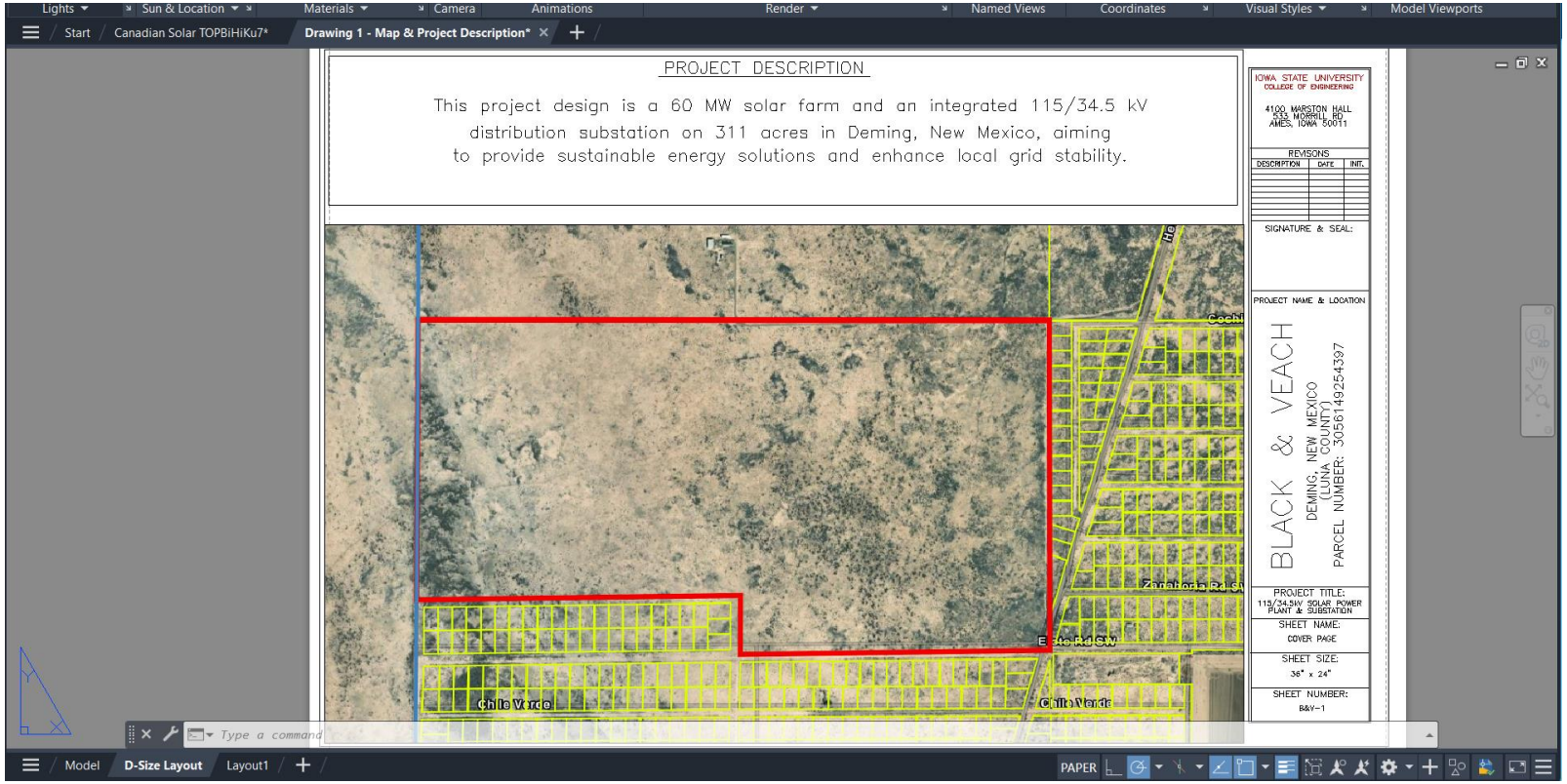
AutoCAD Drawings Progress

- Initial AutoCAD designs started
- Design location & project description



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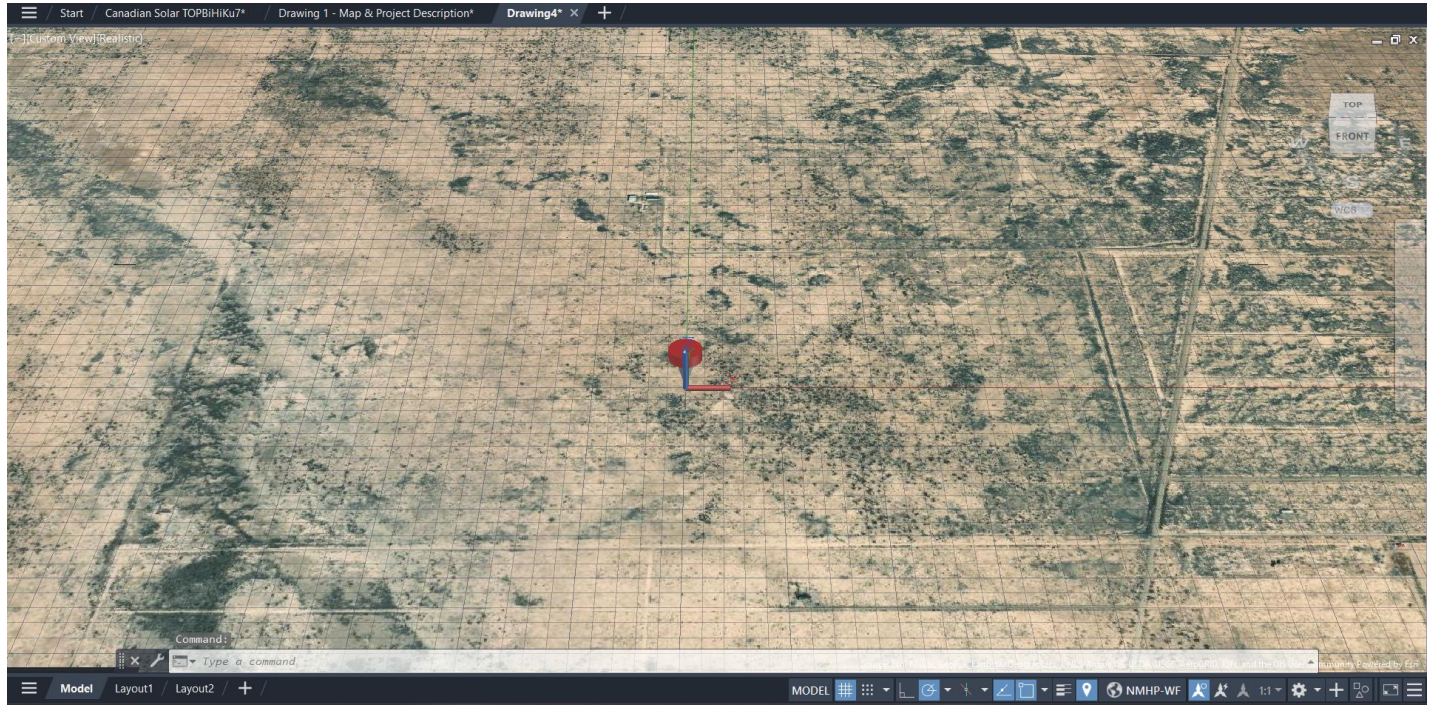
AutoCAD Drawings Progress

- Location in AutoCAD



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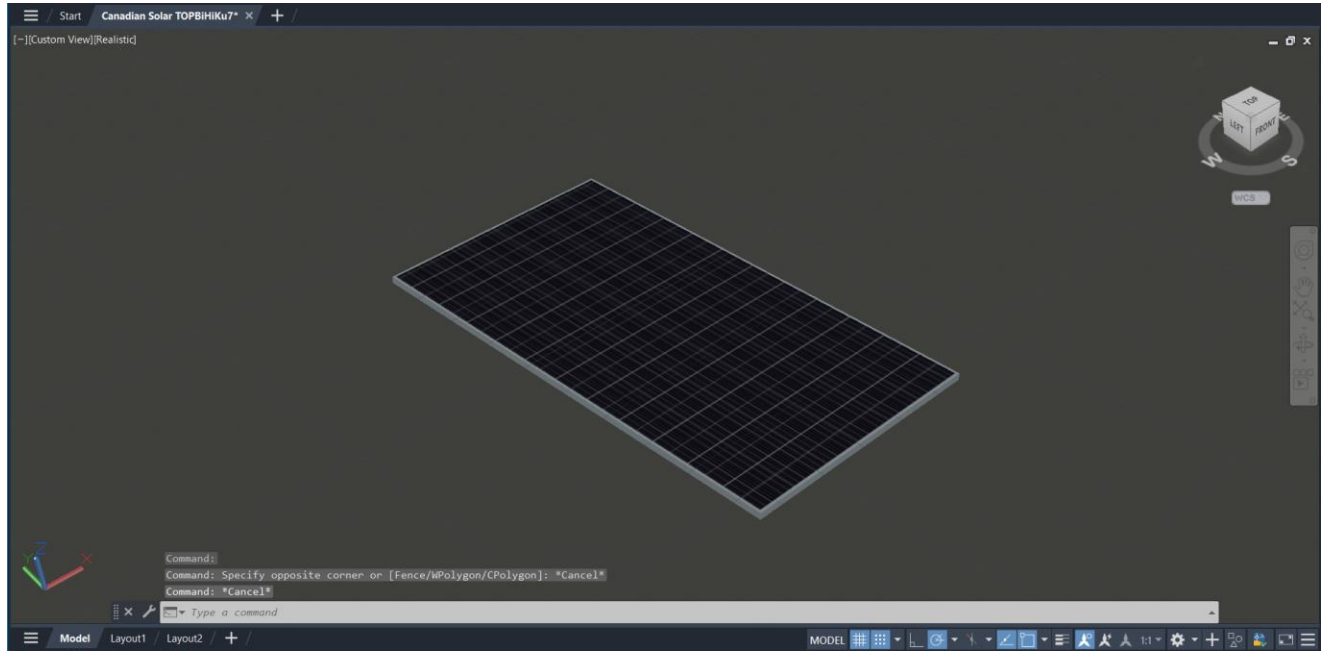
AutoCAD Drawings Progress

- Canadian Solar TOPBiHiKu7 Solar Panels



MECHANICAL DATA

Specification	Data
Cell Type	TOPCon cells
Cell Arrangement	132 [2 x (11 x 6)]
Dimensions	2384 × 1303 × 33 mm (93.9 × 51.3 × 1.30 in)

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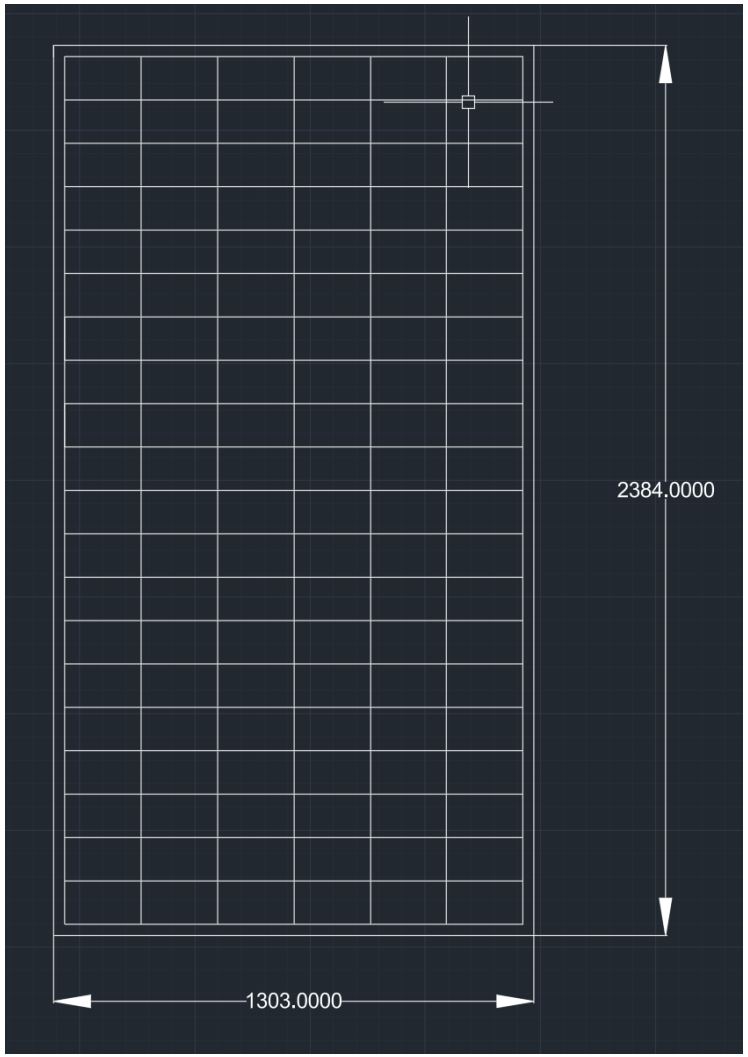
AutoCAD Drawings Progress



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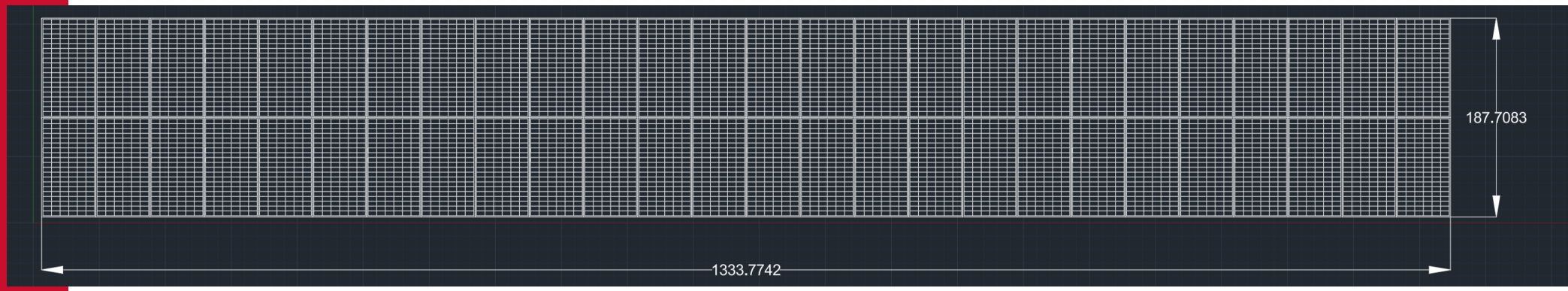
AutoCAD Drawings Progress

- Rack



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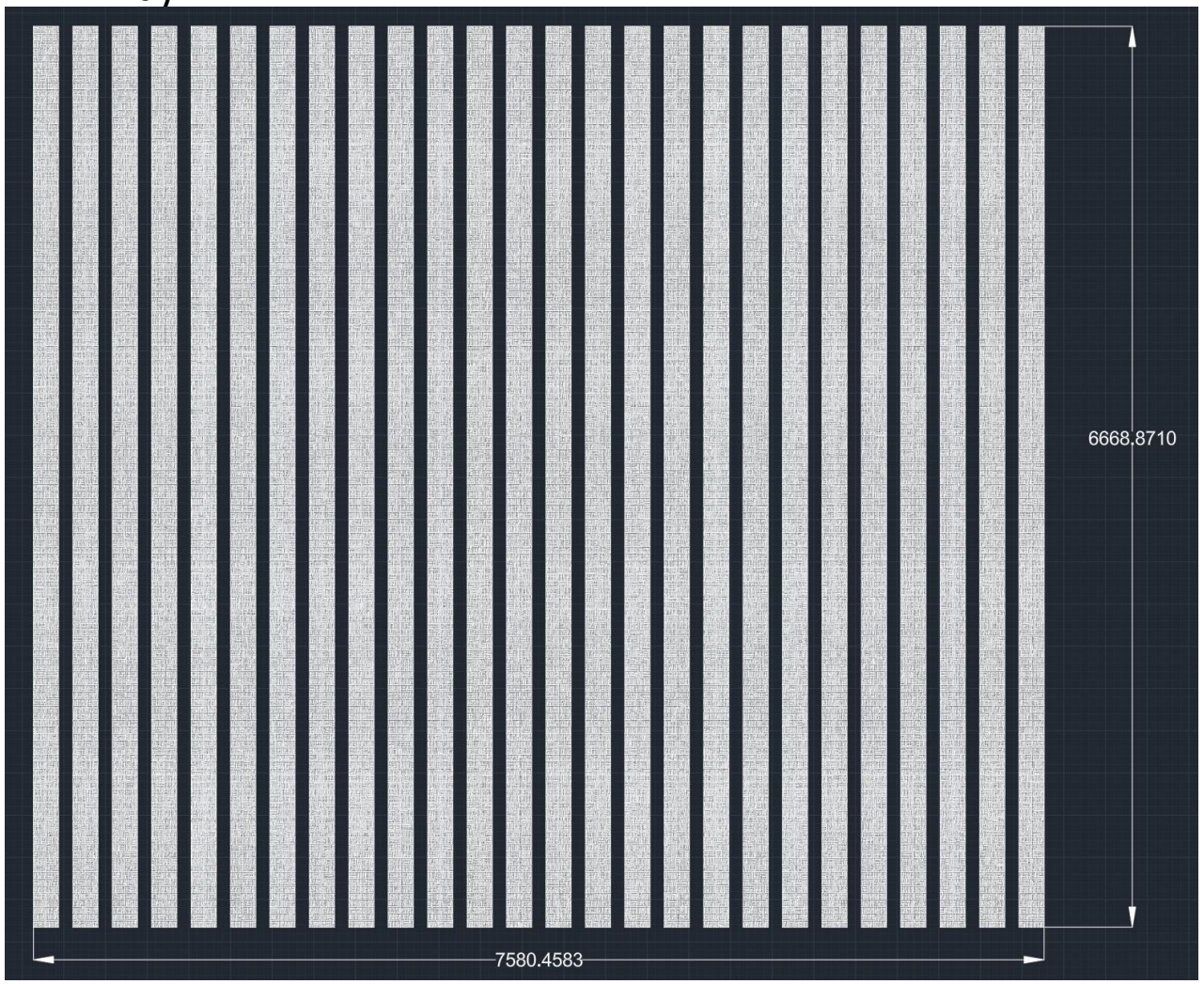
AutoCAD Drawings Progress

- Array



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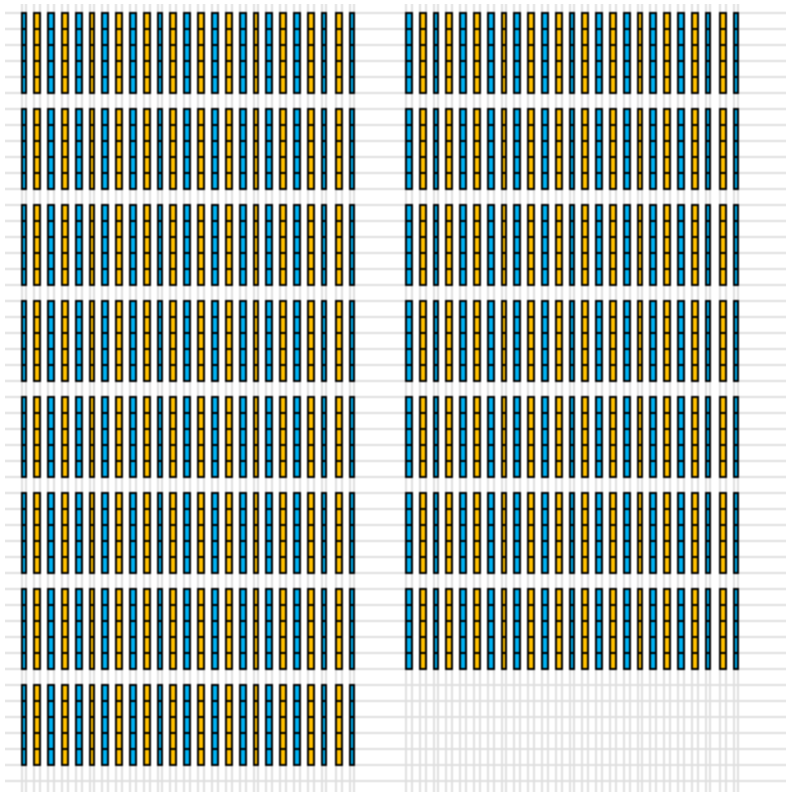
AutoCAD Drawings Progress

- Full Array – Final Design TBD



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THANK YOU

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