



**BE BOLD. Shape the Future.**  
**College of Engineering**

## Mission/SOW

NMSU college of ACES requested we design a farm from a 20' X 8' shipping container that can compete with commercialized retailers to address water-scarce food deserts in remote areas

- Use off-the-shelf UL listed equipment
- Reduce startup capital needed
- Lower overhead costs from energy consumption
- Minimize the need for extensive labor
- Continuously yield a product that is profitable and in demand in the market

As manufacturing we are responsible for the design, purchasing of parts and coordinated construction of the container with the other groups

## Research

- 58% of farms using hydroponics profitable  
49% Operation expenses = labor
- 45% of farms w/ leafy greens are profitable
- 46% profit margin w/ hydroponic leafy greens
- 50% of container farms are profitable (Agrilyst 2017)
- Commercial retailers range from around \$100 - \$150,000 - structure alone
- Target specialty and short-cycle crops
- Automation is the name of the game

- Relevant equations that were used for calculating heat in the container using the cooling load Equation

$$Q_C = Q_F + Q_R + Q_G + Q_D + Q_W + Q_V + Q_S + Q_L + Q_P$$

- Equation for cooling load

$$Q = AU(t_o - t_i)$$

- Equation for solar radiation

$$Q = (A)(H)(S)$$

- Equation for Individual Heat Loss

$$Q = AU(t_i - t_o)$$

where

$Q$  = heat loss for facility component

$A$  = area of facility component

$U$  = coefficient of transmission of facility component

$t_i$  = temperature inside the facility

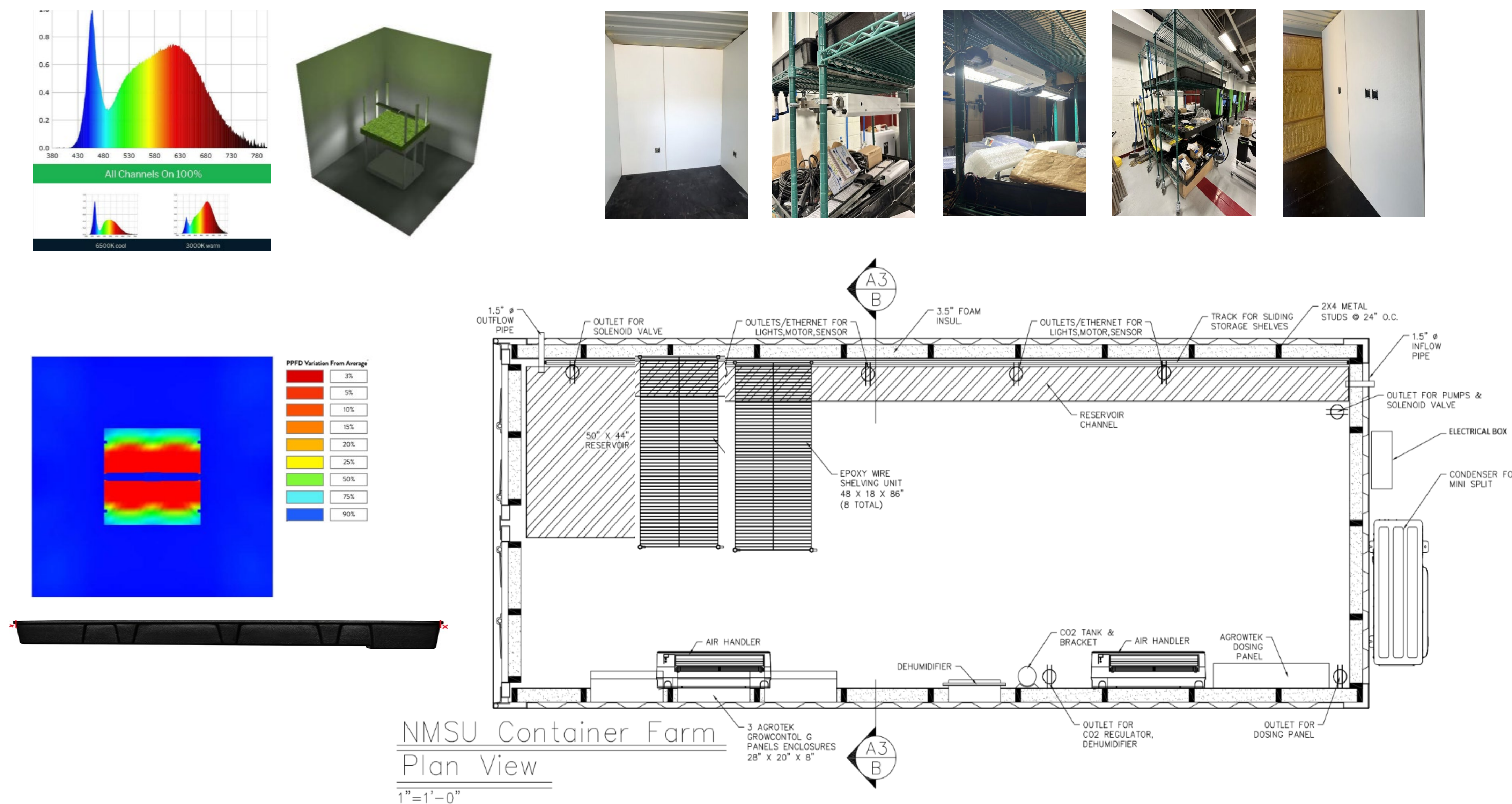
$t_o$  = temperature outside the facility

## NMSU Container Farm – Manufacturing, Planning, and Construction Team

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## NMSU College of Agriculture Cooperative Extension Service

### Final Design



### Container Specifications:

- 20-foot insulated shipping container with conduit pipes for 220V outlets and an emergency release mechanism on the door.

### Growing Racks:

- Modular racks designed for horizontal plant growth, featuring adjustable lighting mounts for flexible height adjustment.
- Each rack supports multiple growth cycles with easy access for harvesting and maintenance.

### Lighting System:

- High-efficiency Synce LED Raging Kale lights with adjustable spectra to optimize plant growth stages.
- Mounted on a double-winch mechanism, allowing height adjustments to accommodate plant growth.

### Hydroponics System:

- Integrated water reservoir and nutrient delivery system with automated inflow and outflow valves.
- Designed to recycle 90% of water used, ensuring sustainability and reduced resource consumption.

### Control System:

- Agrowtek control boxes to manage lighting, HVAC, CO<sub>2</sub> levels, and nutrient delivery.
- Centralized interface for real-time monitoring and system adjustments.

### HVAC and Environmental Controls:

- Multi-unit HVAC system to maintain a stable internal temperature of 70 °F.
- Dehumidifier and CO<sub>2</sub> canisters integrated to ensure ideal growing conditions.

### Energy Efficiency:

- System designed for optimal power use, leveraging energy-efficient LED lights and modular components.

### Accessibility:

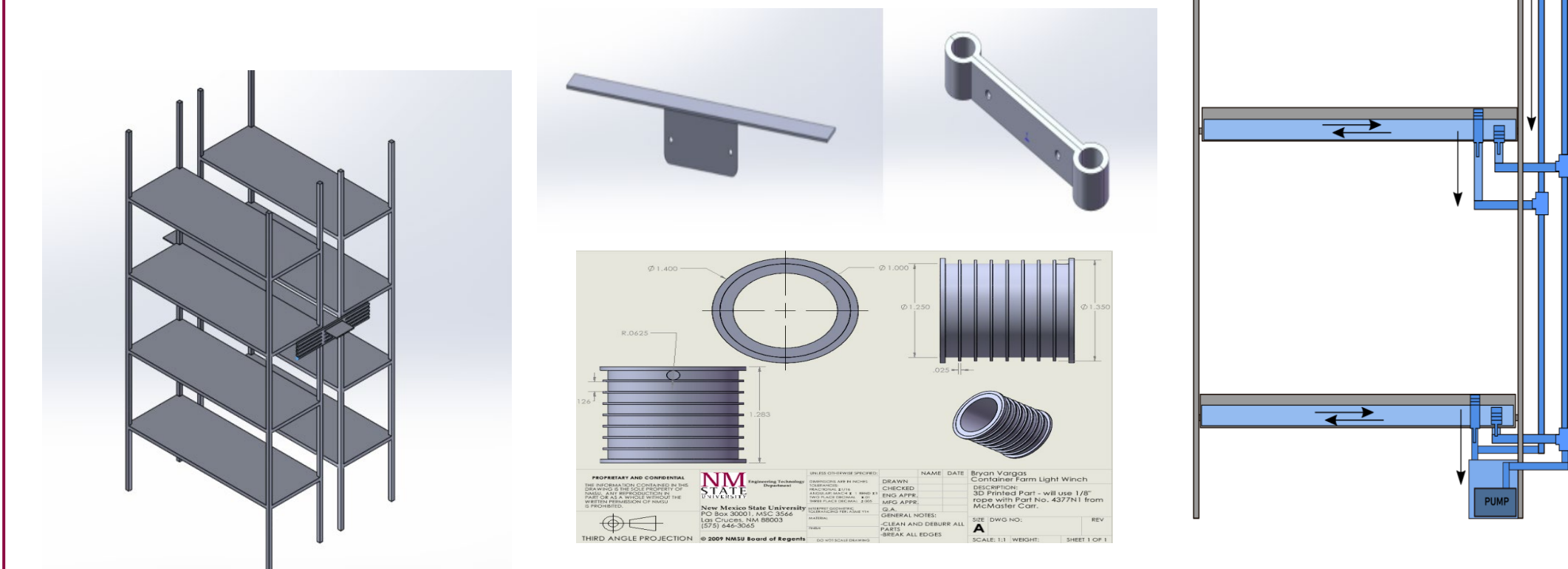
- Layout designed to maximize space utilization while ensuring all components are easily accessible for maintenance and operation.



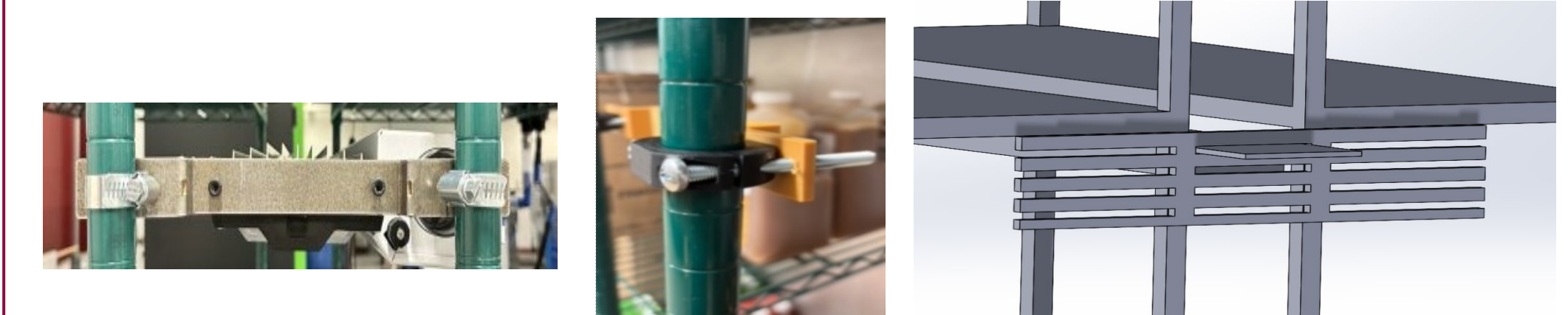
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### Concept Development

- **Hydroponics Schematic Diagram**  
All 3 shelves will have the piping to connect each shelf to each other  
There will be one reservoir pre rack

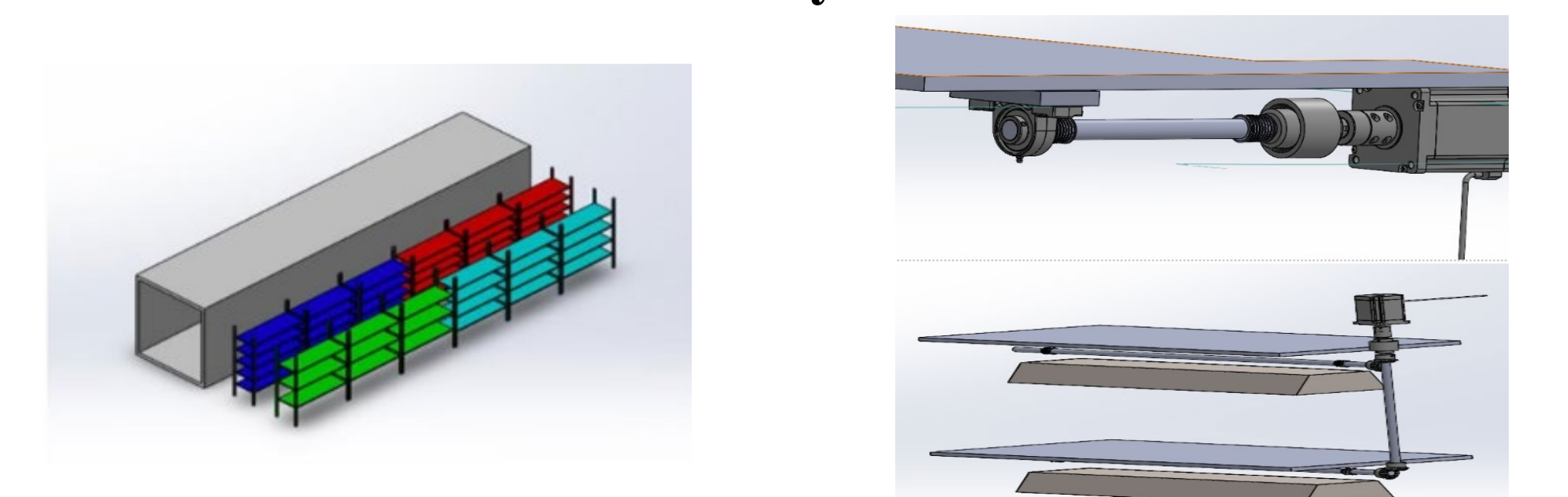


- **Lighting and Rack Design**  
two racks will be coupled together to hold one light between both racks

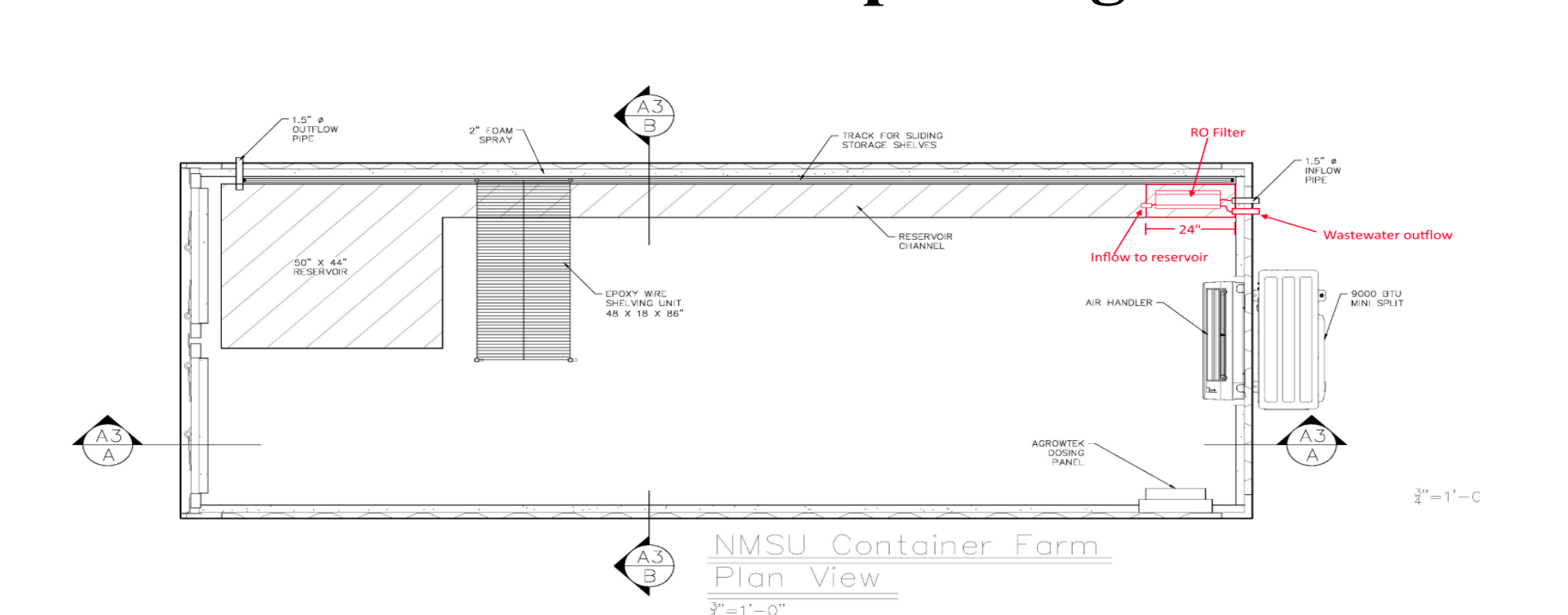


- CAD model shows DALI Design

- 12 Rack Layout



- RO Filter Placement Concept Design



## References

- <https://zipgrow.com/planning-your-farm-calculating-farm-expenses/>
- <https://www.freightfarms.com/blog/why-container-farming>
- <https://www.sciencedirect.com/science/article/abs/pii/S2214785322056048>
- <https://www.sciencedirect.com/science/article/abs/pii/S0959652623025118>