

— WELCOME

9 / 14 / 21 — DALLAS ASHRAE

INDOOR AG DESIGN

—



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— 02

AGENDA

The Client

The Plant

The Spaces

Design Considerations

System Selection

Questions



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THE CLIENT

Often Dealing with the Grower/Cultivator

- Tasked with wearing **multiple hats**
- **Makes decisions on everything** from benches to lights to HVAC equipment
- **Limited facilities staff**

New Operators/License Holders

- **Higher first cost** equals **less equity**

Existing Operators/License Holders

- **Most have felt pain** of first-cost driven solution
- Looking for a **"trusted advisor"**



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THE PLANT

Design Around the Occupant

- **Higher temperatures and humidity requirements** than commercial HVAC projects
- Outside air is **the enemy**

Predictably Dynamic

- This **occupant does not “go home”**
- Lights on and lights off **dynamics are the same** every day
- Systems need to be capable of **reacting to both load scenarios**

THE SPACE

INDOOR GROW



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Traditionally Referring to a Cannabis Facility

Infrastructure Heavy Facility

- HPS or LED **lights used to mimic the sun**
- Need **cooling and dehumidification systems** to maintain tight environmental control

Existing Versus New Buildings



THE SPACE

VERTICAL FARM



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Traditionally Referring to Agriculture

- **Leafy greens, tomatoes, strawberries, etc.**

Multiple Tiers

- **Maximizes building footprint** by going vertical

Unique Air Distribution Approach Needed

- **How to distribute air equally** through multiple tiered racks?



THE SPACE

GREENHOUSE



— 07

References Both Agriculture and Cannabis Facilities

Traditional Greenhouses

- **Steel structure** with either glass or polycarbonate panels
- Open to the atmosphere **-OR-** cooled with evaporative pads

Sealed/Hybrid Greenhouses

- Structure is **more robust** to allow tight environmental control
- Facility **needs HVAC equipment**



DESIGN CONSIDERATIONS

ZONE TYPES



— 08 —

Mother/Clone

- **Small plants, limited quantity, regular lights**

Veg

- **Slightly larger plants, LED/HPS lights**

Flower

- **Mature plants, highest watering rates**

Dry/Cure

- Cut plants that **need to dry**
- **Cooler, drier environment** than other spaces



DESIGN CONSIDERATIONS

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DESIGN CONSIDERATIONS

LOAD CALCULATIONS

Information Needed to Size a Facility

- **Location**
- **Light quantity**
- **Light power**
- Daily **irrigation rate**
- **Photo period**
- **Desired temperature** (daytime/lights on)
- **Desired humidity level** (daytime/lights on)

Don't Forget Additional Heat Loads

- Ancillary **fans**
- Distributed **dehumidifiers**

LOAD CALCULATIONS



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Much Lower Sensible Heat Ratios

- Typical commercial building ranges from **0.80 to 0.90 SHR**
- Typical grow room ranges from **0.30 to 0.75 SHR**
- **Latent heat** is the **driving factor** to size equipment

Evapotranspiration

- **Latent load** is so high it **removes sensible heat** from the space
- Important to properly size the **reheat source**



DESIGN CONSIDERATIONS

LOAD CALCULATIONS

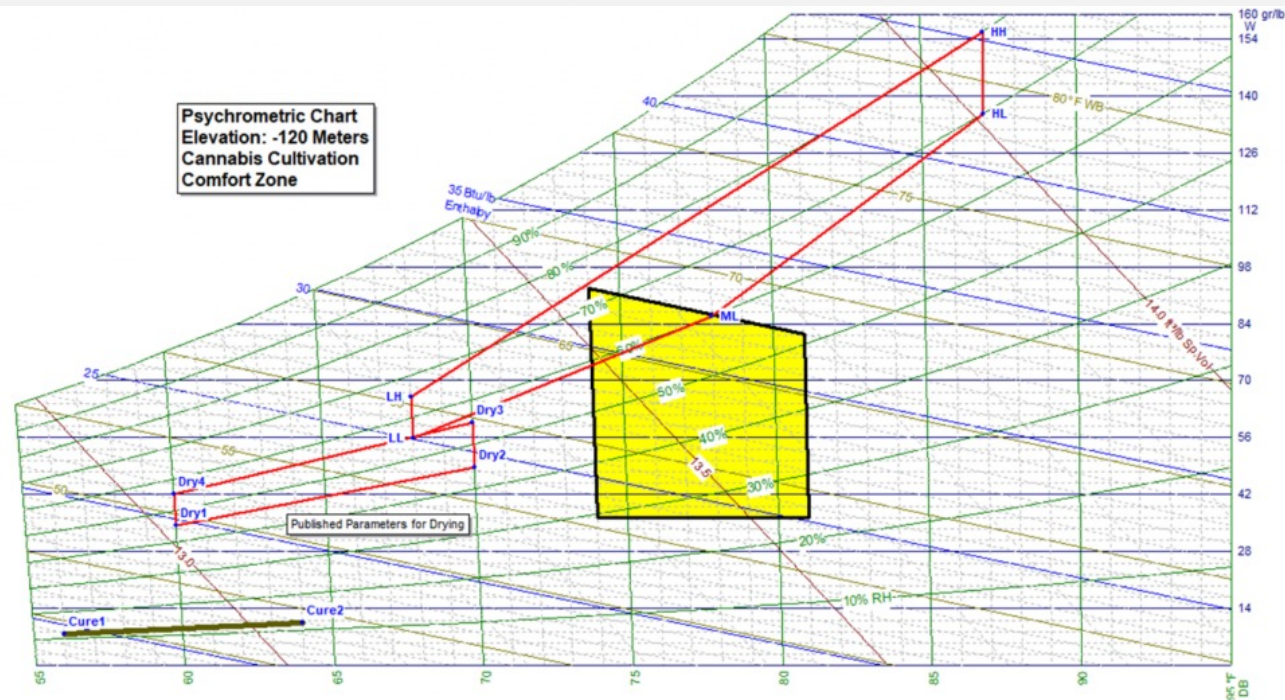


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COOLING/DEHUMIDIFICATION



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24/7/365 Operation

- The **plant does not “go home”**
- Daytime/lights on – **high sensible and latent component**
- Nighttime/lights off – **virtually no sensible and extremely low latent**
- **How will the system handle** these varying load scenarios?

Critical Environment

- **Zero downtime** is often required
- How do we want to tackle **redundancy?**



HEATING



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Lighting/Solar Load

- Most heating **covered by internal sources**
- Still need to take care of the **skin load in the winter**

Decouple from the Cooling/Dehumidification System

System Types

- **Unit heaters** in **smaller grows**
- **Hot water** in **larger grows**





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DESIGN CONSIDERATIONS

CONTROLS

Control Both Temperature and Humidity

- **Client will talk in RH%,** not dew point

Specialized Horticultural Controls Companies

- **Argus, Priva, Rhythm, etc.**
- **Specialize in the plant,** not HVAC
- Important to engage **HVAC supplier and controls company early** to avoid scope gaps



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DESIGN CONSIDERATIONS

CO₂

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Plants Need CO₂ to Survive

- **Opposite** of what we are used to

CO₂ Generation

- Hot **water storage**
- Hot **water dump**
- **CO₂ storage tanks**

CO₂ Distribution

- **Through HVAC units**
- **Direct** to the space

What Happens if Levels Get Too High?

DESIGN CONSIDERATIONS

CO₂



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DESIGN CONSIDERATIONS

CO2

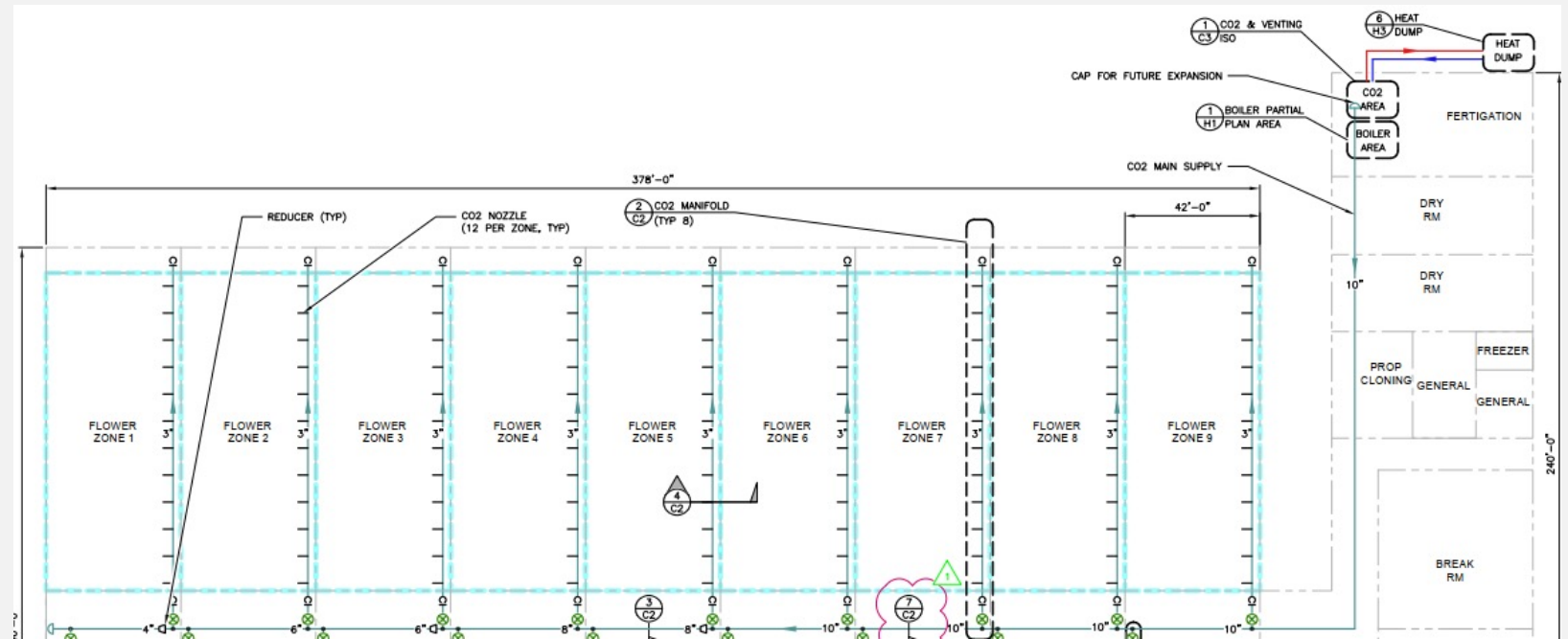


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DESIGN CONSIDERATIONS

FILTRATION/IAQ

OA is Bad for These Facilities

- Introduces **pests and pathogens**
- **Dilutes CO2**

Filtration Types

- MERV 8 – **bare minimum, not recommended**
- MERV 13 – **catches mold and mildew spores**
- HEPA – it's an option, but **overkill**

IAQ Management

- **UV in the space**...not the unit
- Bi-polar **ionization**
- **Carbon** filtration for exhaust systems



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DESIGN CONSIDERATIONS

AIR DISTRIBUTION

Single Most Overlooked Part of the System

- **Designed to avoid microclimates**

Dependent on Building and System Type

Overhead Air Distribution

- Reserved for **indoor grows** and **vertical farms**
- **How to get the air through the canopy?**

Under-Bench Air Distribution

- Similar to **under-floor air** in office building
- Low supply/high return **pulls air through canopy**

Other Options?

DESIGN CONSIDERATIONS

AIR DISTRIBUTION



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DESIGN CONSIDERATIONS

AIR DISTRIBUTION



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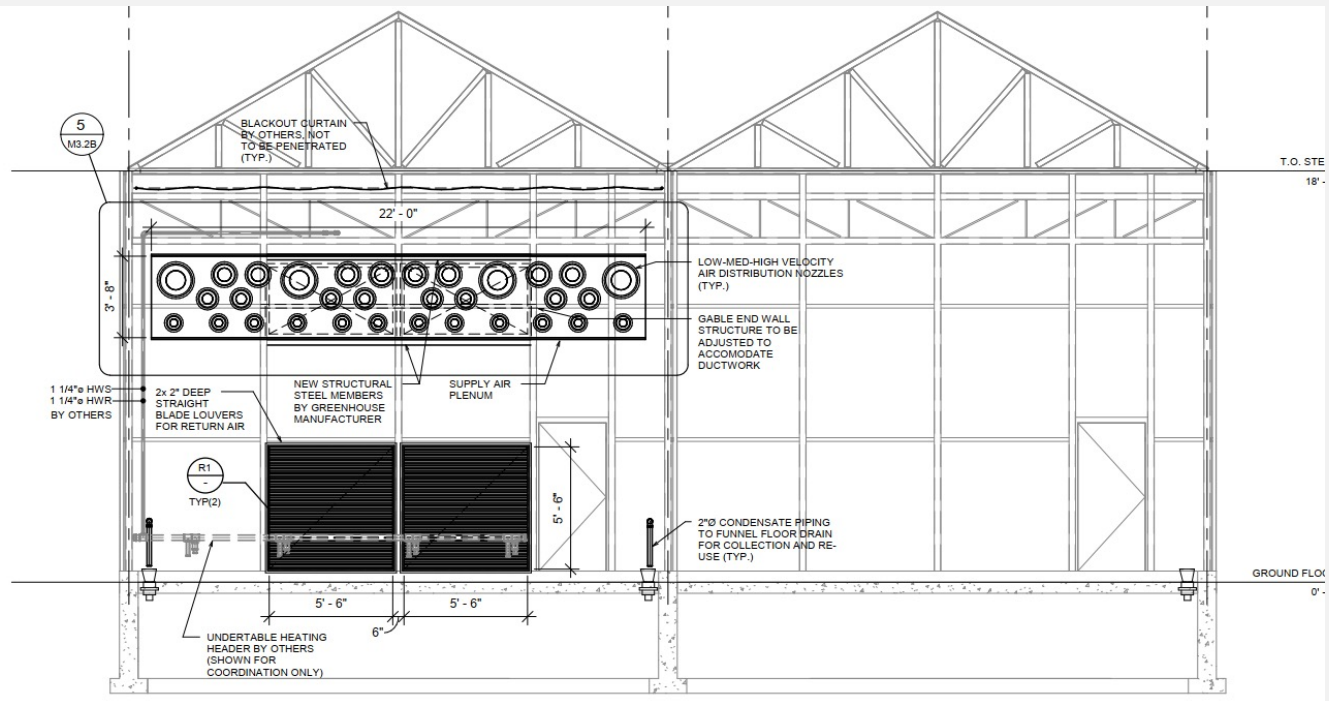
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DESIGN CONSIDERATIONS

AIR DISTRIBUTION



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DESIGN CONSIDERATIONS

ANCILLARY SYSTEMS

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Air Movement Fans

- Fancy box/oscillating **fans distributed throughout the space** to keep the canopy moving

Pressurization

- Some **state regulations** call for the space to positively pressurized...see OA concerns

CO2 Purge

- **Life safety system** in case the CO2 enrichment system gets out of hand

How to Incorporate These Into the Design?

SYSTEM SELECTION



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Decoupled Systems vs. Packaged vs. CHW

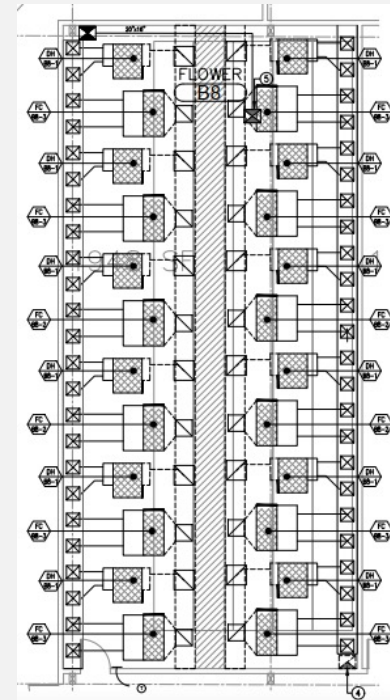
- **Phasing**
- **Unit cost versus system cost**

First Cost vs. Installed Cost

- Client often is getting **advice from multiple entities**
- **Needs your help** to wade through all the information

How to Address Redundancy?

- **Unit** level
- **Component** level



SYSTEM SELECTION



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Process Efficiency

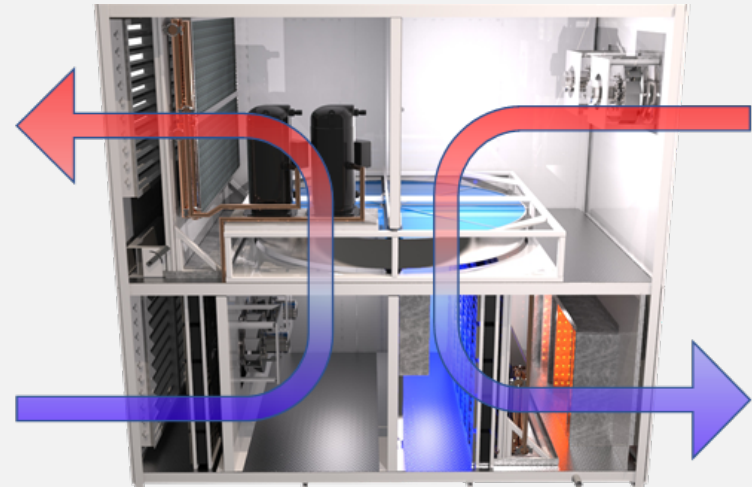
- How can we **get this facility operating the fastest?**

Capital Efficiency

- What is the **best way to utilize the customer's money?**

Energy Efficiency

- Building are **energy hogs**
- **Lighting has been optimized already**
- **How do we optimize the HVAC system?**





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H A R V E S T I N T E G R A T E D

Q A



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THANK YOU