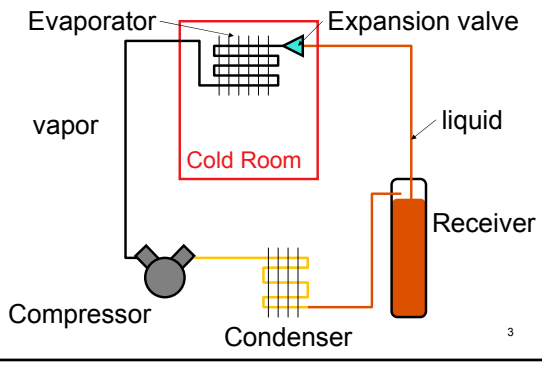
Cold Storage

Jim Thompson
Biological & Agricultural
Engineering, UC Davis

Mechanical Refrigeration



Cold Storage

- Temperature variation < 2°F (1°C).

Maintaining Temperature

- Refrigeration capacity.

Reciprocating Compressor

Maintaining Temperature

- Refrigeration capacity.
- Evaporator coils.

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Finned-Tube Evaporators

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Maintaining Temperature

- Refrigeration capacity
- Evaporator coils
- Insulation

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Insulation

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Maintaining Temperature

- Refrigeration capacity.
- Evaporator coils.
- Insulation.
- Controls/thermostat.

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Calibrate control system

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Maintaining Temperature

- Refrigeration capacity.
- Evaporator coils.
- Insulation.
- Controls/thermostat.
- Air mixing volume (usually above fruit).

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Cold Storage

- Temperature variation < 2°F.
- Relative Humidity > 90% - 95%.

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Maintaining High Humidity

- Large evaporator surface.
- High evaporator temperature.

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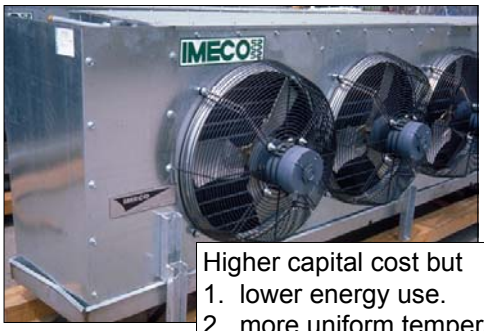

Higher capital cost but
1. lower energy use.
2. more uniform temperature.
3. higher humidity.

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Maintaining High Humidity

- Large evaporator surface.
- High evaporator temperature.
- Reduce refrigeration load.

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Maintaining High Humidity

- Large evaporator surface.
- High evaporator temperature.
- Reduce refrigeration load.
- Humidifier.

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Adds water to packing materials

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Maintain High Humidity

High humidity requires uniform air temperature.

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Reduce Moisture Loss

- Minimize paper & wood packaging.

A 2lb fiberboard box can absorb water equal to 1% of fruit weight.

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Reduce Moisture Loss

- Minimize paper & wood packaging.
- Reduce time between picking and cooling.

Reduce Moisture Loss

- Minimize paper & wood packaging.
- Reduce time between picking and cooling.
- Harvest during the cool hours of the day & protect fruit from heating.

Cold Storage

- Temperature variation < 2°F.
- Relative Humidity > 90% - 95%.
- Adequate airflow & good uniformity.

Airflow Capacity

- 100 cfm per ton of product for initial cooling.
- 20 -40 cfm per ton for long term storage.

Use only as much air as is needed to maintain uniform temperature.

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Airflow Uniformity

Solid ceiling plenum or duct

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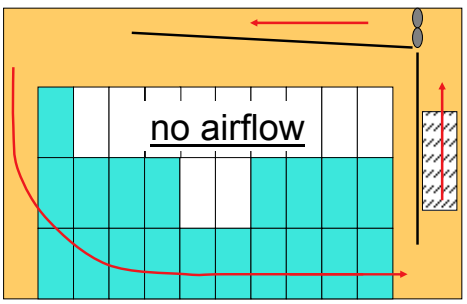
Airflow Uniformity

Solid ceiling plenum



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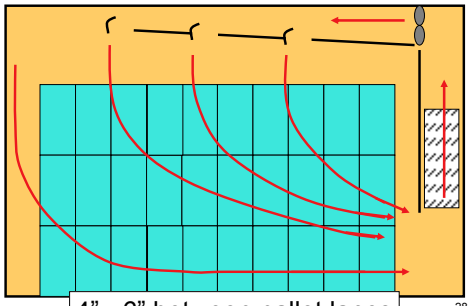
Airflow Uniformity

Slotted ceiling plenum



4” - 6” between pallet lanes

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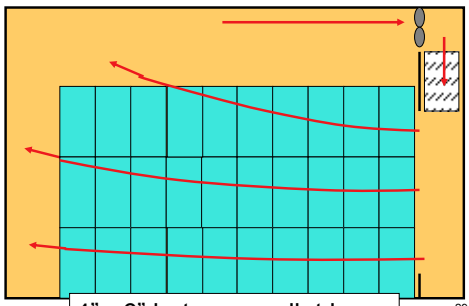
Airflow Uniformity

Vertical Slots in Plenum Wall



4” - 6” between pallet lanes

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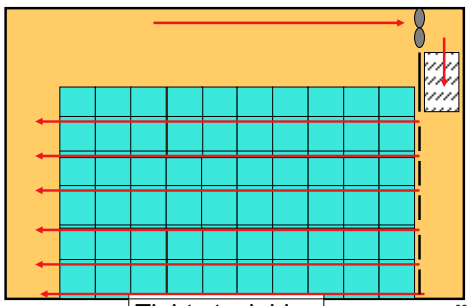
Airflow Uniformity

Horizontal Slots in Plenum Wall



Tight stack bins

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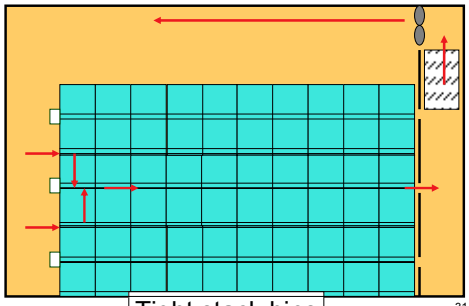
Airflow Uniformity

Serpentine - Letter box



Tight stack bins

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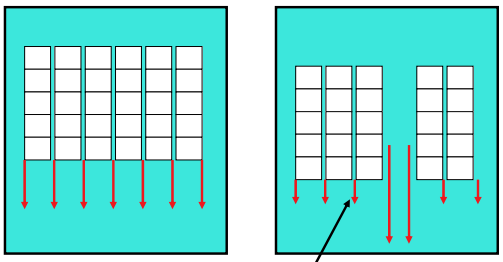
Airflow Uniformity

Effect of missing lane



Air speed reduced by 43%

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Alternate Refrigeration Sources

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Evaporative Cooling

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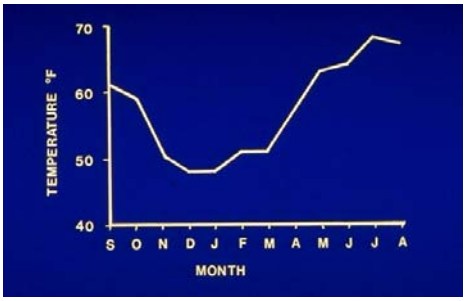
Evaporative Cooling



Air temperature = wet bulb temp + 1 to 3°C

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Evaporatively Cooled Storage

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Underground Storage

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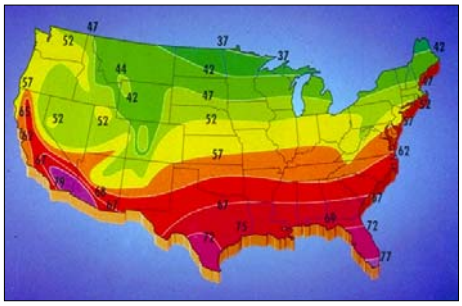
Well Water Temperature



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Construction
Steel Frame

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Insulation

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Construction - Wood Frame

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Construction - Tilt-up Concrete

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Concrete Dome

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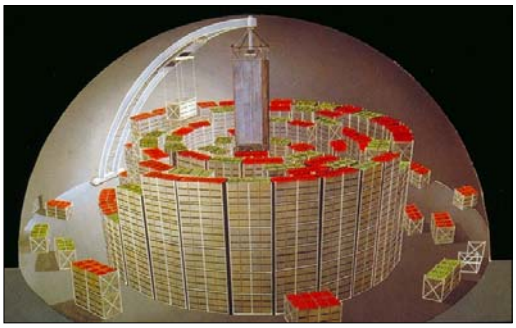
Controlled Atmosphere



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