CAVE A' VIN

Architectural & Engineering Design Specifications: Custom Walk-In Wine Cellars

DESIGN PROFESSIONAL EDITION

Applicability: High-End Residential & Hospitality
Thermal Standard: 55°F @ 60–70% RH Continuous

> **Primary Architectural Objective:** A wine cellar is an active preservation biome, not merely an aesthetic display. Over 90% of field failures stem from building envelope leaks, undersized stud cavities for foam displacement, and inappropriate glass specification. This guide aligns architectural schematic planning with mechanical thermodynamics.

1. PROGRAMMATIC DESIGN: AGING VS. SHOW CELLARS & GLASS SELECTION

During the schematic phase, architects must determine the client's genuine objective: **Long-Term Preservation** versus a **Showcase/Display Cellar**.

PRESERVATION STANDARD

Long-Term Aging Cellar (Target: 55°F, 60–70% RH)

- **Glass Limitation:** Minimize glass surface area. Direct visible and UV light breaks down tannins, premature ages phenolic compounds, and spikes heat loads.
- **Glass Type:** Dual-pane Insulated Glazing Units (IGU) with low-E coating and thermally broken frames.
- **Thermal Cycling:** Low thermal mass exchange keeps the refrigeration equipment cycling within optimal run ratios, preventing premature compressor wear.

DISPLAY COMPROMISE

Frameless Glass / Showcase Cellar (Target: 60°F)

- **Single-Pane Frameless Glass:** Has virtually zero insulating value. It bleeds ambient heat directly into the space.
- **Design Temperature:** Must be designed around **60°F**. Forcing 55°F causes severe exterior glass condensation ("sweating"), pooling water, and continuous compressor operation.
- **Client Expectation:** Wine preserves well at 60°F, but will age faster than at 55°F. It cannot be guaranteed for multi-decade archival storage.

2. SPATIAL PLANNING, ROOM SIZING & SERVICEABILITY

Vertical Dimensioning & Ceiling Heights

- **Service Access:** Evaporator coils require regular maintenance (coil cleaning, filter service, TXV adjustment). Design ceilings so technicians can reach equipment safely via a standard stepladder.
- **Ergonomics:** Keep wine racking and ceiling-mounted mechanical equipment within reasonable ladder reach. Excessively tall ceilings also exaggerate warm air stratification at the top of the room.

Overall Room Footprint & Target Capacity

- **Capacity vs. Volume:** While Cave a' Vin handles all custom racking engineering, the overall planned room footprint must be scaled proportionally to the client's target bottle count.
- **Large Format Impact:** A very small room cannot accommodate a high bottle count, particularly if the client intends to store substantial collections of large format bottles (Magnums, Champagne) or bulk wooden crates.

3. THERMAL ENVELOPE, FRAMING & VAPOR BARRIER SPECIFICATIONS

A continuous thermal envelope and vapor barrier on all 6 sides is paramount. Cave a' Vin specifies **closed-cell spray foam (minimum 2.0 lb density)**, which provides both high R-value and an impermeable vapor retarder.

Envelope Component	Required Framing	Minimum Foam Depth	Architectural & Detailing Notes
Perimeter Walls w/ MEP (Outlets, Switches, Drains)	**2x6 Framing Mandatory**	3.5" to 5.5" Closed-Cell	Standard electrical boxes exceed 3" in depth. 2x4 framing leaves zero space for foam behind boxes, causing condensation cold spots.
Partition Walls (Zero MEP)	2x4 Framing Permitted	3.5" (Shaved flush to stud)	Strictly forbidden to have plumbing, switch boxes, or receptacles in 2x4 wine cellar walls.
Masonry / Exterior CMU Walls	Furred 2x4 or 2x6 off CMU	**3.5" Minimum**	Spray directly to interior face of block. If exposed to intense exterior sun/heat, increase depth.
Ceiling below Conditioned Space	Dropped 2x4 Framing on 1/2" Plywood Deck	**3.0" to 4.0"**	Continuous envelope detail: 1/2" plywood fastened to floor trusses, 2x4 dropped ceiling + 2x2 nailer (5.5" cavity).
Ceiling below Hot Unconditioned Attic	Dropped 2x4 Framing on 1/2" Plywood Deck	**5.0" Minimum**	Attics in warm climates exceed 130°F. Minimum 5" foam prevents attic radiant heat drive from sweating ceiling drywall.
Wall Framing Corners	Offset Corner Studs	Continuous flow	Specify 1" gap at all wall framing corners so spray foam flows seamlessly behind corner studs without voids.

4. LIGHTING & MEP INTEGRATION RULES

- **Recessed Can Lights: Strictly Prohibited.** Pot lights breach the vapor barrier, create continuous convection air leaks, and radiate localized high-temperature infrared heat directly over racking.
- **Approved Ceiling Fixtures:**
  - Shallow surface-mounted pancake junction boxes with sealed gaskets.
  - Ultra-thin LED wafer lights *with remote transformers* located outside the vapor barrier (e.g., in adjacent mechanical closet or ceiling access). Never use fixtures with attached transformers buried in closed-cell spray foam.
- **Drywall:** 1/2" moisture-rated drywall (mold/mildew resistant purple/green board) on all interior ceiling and wall surfaces.

5. MECHANICAL ENGINEERING: LRC EVAPORATOR & COPELAND CONDENSER ARCHITECTURE

Cave a' Vin specifies commercial-grade split systems utilizing **LRC low-profile evaporators** (lrccoil.com) and **Copeland air-cooled condensing units**.

System Element	Specification Standard	Engineering & Site Coordination Details
Indoor Evaporator	LRC Commercial In-Room Low-Profile Coil	In-room evaporators provide superior efficiency, lower cost, and direct serviceability compared to ducted units. Must maintain unobstructed airflow intake/discharge and ladder clearance.
Outdoor Condenser	Copeland Air-Cooled Condensing Unit	Compact footprint (~large microwave oven size; substantially smaller than standard residential A/C). Mount on exterior wall utilizing heavy-duty aluminum hurricane brackets.
Refrigerant Line Set Length Limits	**Small Rooms: Max 50 ft Equiv.** **Large Rooms: Max 75 ft Equiv.**	Includes total horizontal + vertical rise. Small displacement wine compressors lack the oil return velocity and pumping capacity for long runs. Condenser MUST be planned within these limits.

System Element	Specification Standard	Engineering & Site Coordination Details
Ducted Split Limitations	Copeland Ducted Systems	Bulky footprint. Duct runs must remain extremely short; requires mechanical closet immediately adjacent to wine room. Rarely recommended over in-room LRC coils.
Condensate Drainage (Gravity vs. Pump)	**Primary:** Gravity-fall insulated drain line in 2x6 wall or under-slab. **Secondary:** Condensate pump through floor joists or attic.	**Preferred:** Gravity drainage via insulated drain line through a 2x6 wall or rough-in under slab during groundwork. Continuous fall without mechanical pumps is best practice. **Alternative (Pump Required):** If site conditions do not permit 2x6 wall rough-in or under-slab gravity drain, Cave a' Vin can provide an active condensate pump to lift condensate through floor framing or up into an attic and out. *Note: Mechanical pumps introduce an active point of failure and require periodic service.*