Typical Florida HVAC Design - Critical Items Missing

(1) **Adequate Exposure Diversity Calculations** are the first calculations performed on the building to determine if standard single stage cooling equipment with a single thermostat will provide comfort in each room of the building served by the cooling system. Buildings have AED when the peak hour fenestration heat load does not exceed the average fenestration load by more than 30%, allowing a single thermostat to provide comfort – defined as plus or minus 3 degrees of the thermostat setting. For buildings that do not have AED a duct zoning system would be required to maintain comfort in each thermal zone served by each cooling system, a typical modern building will have 4 thermostats per cooling system. For buildings that do not have AED with a calculation exceeding 50%, a variable capacity cooling unit is required. This AED calculation studies hourly solar radiation variations per room and is performed prior to the ACCA HVAC design manuals. AED calculation results determine which of the two Manual J procedures is used, **peak** load or **average** load. Each Manual J procedure produces a unique duct design and HVAC equipment selection. Buildings that have about the same amount of fenestration exposure on each exterior wall will have AED, while buildings with much different fenestration amounts on each exterior wall exposure will not have AED. Manual J Peak load duct designs use the room's peak hour air flow requirement for branch duct sizing and the thermal zone thermostat allows air flow only when required to maintain comfort. HVAC peer review of the typical Florida "code documents", usually consisting of only a Manual J and energy code form, shows that most permit documents are missing this AED calculation resulting in an incorrect Manual J procedure, and in some cases this AED calculation was performed but the results are ignored by the designer resulting in incorrect duct sizes in each room.

(2) **ACCA Design Manuals** include Manual's J,D,S,T,ZR and are used to design comfort systems for buildings. Manual J alone is not equal to a comfort system design as this J Manual calculation relies on results from all 4 HVAC design manuals referenced in the Manual J design guide. Once the AED results are known, Manual ZR is used to select the thermal zones required to maintain comfort throughout the building. AED results are also used by the graphic Manual D CAD tool to quantify the actual duct area and duct mounting environment for each duct, duct section, and duct fittings. Manual D data links the duct heat loads, pressures, velocities, and duct heat rise for use in the Manual S equipment selection procedure. Manual T room air device selection procedure is data linked to Manual D for automatic air device selection. Manual S HVAC equipment selection procedure is the final ACCA design guide performed and uses the previous Manual's AED,ZR, D,T,J calculation results for proper equipment selection and capacity adjustments. Energy code calculations are performed after the HVAC comfort system design is completed, to ensure the HVAC equipment selected efficiencies are code compliant. HVAC peer review of the typical Florida "code documents" shows that most permit documents include only the Manual J and energy code forms resulting in the most common HVAC complaints: high levels of indoor contamination, noisy hvac equipment and ducts, uneven room temperatures, high levels of moisture inside the building.

(3) Thermal Zone Control is used when buildings that do not have adequate exposure diversity. Zoning systems (either equipment or duct zoning) divide rooms with similar exposures and uses into thermal zones, each thermal zone has a dedicated thermostat capable of providing comfort anytime with a maximum of 30 thermal zones per HVAC system. Manual ZR is also used on multilevel buildings served by a single cooling system, providing at least one thermostat per living level, each thermal zone duct system is sized based on the peak heat load resulting in a larger duct system capable of meeting the peak heat load conditions at the peak hour per thermal zone. Manual ZR also contains proper design procedures and selection of ducted and ductless mini split equipment. HVAC peer review of the typical Florida "code documents" shows that most permit documents are missing the Manual ZR thermal zone map, the AED calculations, specific duct design required for comfort, and many times ductless mini splits are installed in violation of the ACCA and code requirements.

(4) Best Practice HVAC Design uses every ACCA design guide and the energy code requirements. Best practice designs always contain a scaled duct design that includes multiple high mount return air grilles, supply air registers in every conditioned space, mechanically induced ventilation air for a pressurized healthy building interior, spot exhaust, appliance exhaust duct, volume control dampers, options for dehumidification, HEPA filtration, variable capacity equipment, and zoning for alternate indoor temperatures. HVAC peer review of the typical Florida "code documents" shows that most permit documents include only the Manual J and energy code forms and are missing a best practice HVAC design resulting in the many complaints I see from building owners. The Manual J and energy code form alone are not comfort system designs and would require several more hours of HVAC design work to be code and ACCA compliant. Too often the HVAC installer is expected to correctly guess on the duct design and correct size HVAC equipment based on the partial HVAC design effort used to obtain a Florida building permit even though our codes adopted the ACCA design guides as a code requirement in year 2001 (Manual J, D, S are listed specifically in Florida code books). Very few designers are producing ACCA best practice comfort system designs that are code compliant {2024}.

(5) Occupant Health Ventilation Air is required by the Florida Mechanical code and requires the introduction of ventilation air for all buildings to maintain an acceptable indoor environment for the occupants within the enclosed space. The ventilation air {a.k.a. fresh air} is first conditioned by the HVAC equipment prior to delivery into the breathing zone of each occupied space. The ventilation air duct, air volume control damper, and motorized closure device is added to the HVAC system for "run time" ventilation air. This code minimum ventilation air duct is controlled by the hvac equipment indoor fan interlock to operate only during modes: "fan on", "heating", or "cooling", the ventilation air duct remains sealed airtight while the HVAC system indoor fan motor is not in operation. Optional year-round ventilating dehumidifiers should be used for year-round controlled ventilation and dehumidification that is de-coupled from the HVAC system indoor fan interlock and ducting when required. HVAC peer review of the typical Florida "code documents" shows that most permit documents include only the Manual J and energy code forms and are missing a best practice HVAC design that shows the ventilation air duct and CFM amounts. Also noticed in peer review was that many Manual J forms that claim infiltration as the ventilation rate, an ACCA violation and outdated assumption, modern building envelopes are leak tested during construction to ensure the building is nearly leak free with many buildings scoring an infiltration rate far below the ventilation rate required for occupant health. Also noted in some reviews is that the "building occupants can simply open a window for fresh air or turn on a few bath exhaust fans" – similar to the infiltration claim both window opening and exhaust fan operation violate the ACCA design guides.

(6) Year-Round Moisture Control beyond design condition requires a dedicated process. Part load conditions like spring, fall, night and cloudy hours make up about 85% of the cooling season in Florida. Full load conditions like a hot sunny design hour make up only 15% of the cooling season when indoor moisture control is accomplished by the cooling system. Cooling systems process both sensible and latent heat {heat and moisture) simultaneously and are controlled by a thermostat that only measures and reacts to sensible heat. Cooling systems will not just dehumidify, defined as removing moisture without changing the air temperature, so cooling systems will be a poor choice if you expect to remove moisture in a controlled manner year-round. Buildings equipped with a dedicated dehumidifier and humidistat will monitor and remove moisture as desired by the occupants without relying on the cooling systems latent heat removal process, dedicated dehumidifiers operate during the part load conditions to maintain about 40% relative humidity and require no assistance from the cooling system. Modern dehumidifiers include HEPA filtration and ventilation air duct connection ports and can be used in several configurations including stand alone or connection to the buildings main duct system. HVAC peer review of the typical Florida "code documents" shows that most permit documents include only the Manual J and energy code forms and are missing a best practice HVAC design that shows the dedicated dehumidification option. Florida mechanical codes require all interior spaces to maintain a relative humidity of 60% or less including conditioned spaces, unvented crawl spaces, and unvented attic spaces.

(7) High Efficient Particle Arrestance or HEPA filtration is an upgrade to the common air duct filter. One-inch filters commonly seen in the return air grille or at the air handling unit are used to protect the air handler cooling and heating coil from dust accumulation and do not address small particle sizes that can affect human health. Standard 1" filters capture the very largest and least harmful dust size particles while 5" HEPA filters capture the more harmful tiny particles that pass through 1" standard filters. Modern 5" thick HEPA filters are usually located at the air handler main return air duct plenum and filters all the building air, while the 1" dust catcher filter is used at the return air grilles. HVAC peer review of the typical Florida "code documents" shows that most permit documents include only the Manual J and energy code forms and are missing any mention of occupant health and indoor filtration options.

(8) Florida Energy Code Calculations submitted for permit are typically based on only the Manual J calculations and will be inaccurate because a complete HVAC comfort system design is required prior to energy code calculations. Energy code calculations and the ACCA design guides are performed simultaneously with the final results used in the HVAC comfort system design. HVAC peer review of the typical Florida "code documents" shows that most permit documents include only the Manual J and energy code forms and are missing the critical Manual D duct design and Manual S equipment selection adjustment results that are required by the energy and mechanical codes. Duct exposure square feet per mounting environment, duct pressures that determine blower watts and total pressure the air handler must overcome, duct heat rise for use in the manual S equipment selection procedure, total adjusted equipment capacities for the site-specific design conditions, and fenestration exterior and interior shading devices are among the most common items missing from typical Florida permit documents.

(9) Safety is built into an ACCA best practice design to include several water damage control devices, air infiltration reduction dampers, sound and vibration attenuation, and high voltage disconnect switches.

HVAC peer review of the typical Florida "code documents" shows that most permit documents are missing a comfort system design and therefore do not address the optional safety's available to the HVAC industry.

(10) Adjustments are also rarely included in a typical HVAC design in Florida even though both ACCA and codes show the requirements. Mandatory air flow adjustments to the branch ducts using a volume control damper and correct air handler fan speed setting are the two most common. Missing these critical items could result in an HVAC system capacity out of balance with the buildings sensible heat ratio and missing the branch duct volume control dampers results in unacceptable room to room temperature differences because no duct system is self-balancing. HVAC peer review of the typical Florida "code documents" shows that most permit documents are missing a comfort system design and therefore do not address the code and ACCA required test and balance of the HVAC system and ducts.

Professional Advice:

Hire an independent HVAC designer capable of performing all ACCA design guides and an accurate energy code form. Use the independently designed HVAC permit documents to form a contract with the HVAC installer. ACCA design guides quantify the only HVAC math solution for the building and the Graphic Manual D duct design shows this math in a drawing format easily read by everyone. Ask the independent designer for samples of recent designs performed, check to see the design package includes all ACCA design guides, the duct drawings to match, and energy code forms.

Avoid use of permit documents that are missing any of the ACCA design guides and required duct design because the permit documents would be based on too many guesses of the most critical items like ducts, ventilation air, volume control dampers, and correct equipment sizing.

References / Florida building code required = Manual J 8thedition v2.5 is the reference standard + Manual S required:R403.6 or ACCA183 commercial heat load CLTD:FECC403.2.2 /Manual D required:FECC403.2.7.5+FMC603.2/building envelope component materials required prior to permit acquistion:FECC103.2+FECR103.2/ HVAC drawings and required drawing Information: FBC101.4.2+ FBC101.4.6 +FBC105.3.1.2+FBC107.3.5/AHRI capacity data cannot be used:FECCR403.6.1.1

References / HVAC Manuals J,D,S,T,ZR required = special thanks to Hank Rutkowski P.E. the genius author of the Manual J 8th edition load calculation procedure (first printing, April 2002 / current v2.5 2016))// Introduction: how HVAC works, 8th edition is room by room calculations, continuous equipment operation is normal at design conditions, 7-10 minutes to reach dew point conditions at the cooling coil, part load and full load description, sensible heat ratio of building and sensible heat ratio at equipment differences ,no benefit to oversizing equipment, "An HVAC design involves much more than a heat load estimate – producing a heat load estimate is not equivalent to designing a comfort system"/ Section one: cooling and heating loads room by room, peak heat load and average heat load procedure, adequate exposure diversity and thermal zone grouping, thermal zoning and zone control per level minimum, evaluating zoning requirements/ Section five: indoor design conditions authority (DOE) determined by Manual J (indoor temperature was previously decided by the home owner) with a warning about oversizing equipment for unlikely scenarios like "I like it cold at night = bigger HVAC equipment", educating home owners about the disadvantages of oversized equipment, solar heat load reduction at night/ Section ten: Manual D software is available for both modeling new and existing HVAC systems, default duct heat load (ASHRAE 152) should only be used for rough estimates (usually resulting in much higher values than using graphic Manual D), computer method for Manual D graphic is required for permit documents and installation, CAD HVAC design tools that tie together all 5 of the HVAC designs manuals produces the most accurate results/ Survey section appendix one: thermal zone identification, north arrow super critical, indoor design conditions, building envelope component make up/ Fenestration appendix 4: solar heat gain is the major heat load, thermal storage absorption at peak conditions extends the cooling cycle, cooling dominate climates and low e coatings / Appendix section seven: duct system efficiency and the environment that surrounds the duct, whimsical guidelines and unreliable rules of thumb (ducts not based on graphic manual D)/ Table 1A: climatic conditions for USA.

Home Energy Modeling for this study courtesy of ⇨ HVAC Designs Inc. ⇨ "Precise, Calculating, and Cool"