Heat Load Demand Calculations - 2021

The Residential and Commercial cooling demand calculations are a peak hour measurement of heat transfer through the building envelope components plus internally generated heat. Infiltration, duct gain / loss, people and appliance allowances are also computed. Heat transfers into the building during summer and heat transfers out of the building during the winter. The heat load calculations determine hvac equipment size for both the heating and cooling seasons, room airflow amounts, and duct sizes required to meet each room demand. Heat load calculation results quantify the amount of heat that must be added to warm the building interior during winter and the amount of heat that must be removed to cool the building interior during summer. Ductwork further slices the total equipment capacity into just the right amount capacity for each room so that each room served by the equipment maintains a 3 degree or less temperature swing. Room air flow amounts are balanced by the hvac contractor using volume control dampers in each supply and return branch duct. This heat load calculation also computes the homes latent heat (moisture) demand which is used to select the de-humidification equipment. Current Energy Codes require ACCA Manual J 8th Edition version 2.5 to be the reference standard used worldwide to 2023. This modern design guide includes Adequate Exposure Diversity calculations to determine thermal zones that maintain 3 degrees or less temperature swing from the thermostat set point. AED also determines if the thermal zone(s) requires single capacity cooling equipment, variable capacity cooling equipment, and duct zoning with multiple thermostats.

Cooling peak hour design calculations are based on the following: 91 to 93 degree outdoor dry bulb temperature with a 77 to 79 degree outdoor wet bulb temperature, 3 p.m. hot sunny Florida day with window blinds @45 degree, maximum occupants located in the spaces, with expected appliances and lighting operating. The desired indoor temperature is 75 degree dry bulb @ 60% relative humidity or less. Cooling equipment selection is based on the sensible heat gain, NOT the total heat gain! Selected cooling equipment capacity must meet both the sensible heat gains and the latent heat gains. The average Florida home has an 80% sensible heat demand with only a 20 % latent heat demand. Standard matched cooling equipment performance on average is 75% sensible heat removal ability and 25% latent heat removal ability. The difference in percentage between the building heat load calculation and the equipment performance is the reason why the total heat gain btuh's cannot be used to select cooling equipment. The total heat demand must be divided into (1) total sensible heat gain and (2) total latent heat gain. Cooling equipment selection is based on both loads with the emphasis on total sensible heat gain, The Florida Energy code requires that the total calculated sensible heat gain must be met by the cooling equipment ability allowing the designer to oversize the equipment up to 15% or the closest available equipment size. Also, the manual S equipment selection procedure allows one half of the unused latent heat capacity (reserve btuh) be converted and added to the equipment sensible capacity.

Heating peak hour design calculations are based on the following: 40-degree outdoor dry bulb temperature, pre-dawn, cold breezy night, no lighting or appliances operating. The desired indoor temperature is 70 degree indoor dry bulb @ 60% relative humidity or less. Heating equipment selection is based on the total sensible heat loss only, the Florida Energy code requires the selected heating equipment meets the total calculated sensible heat loss but uses the cooling demand calculations (cooling dominant region) for heat pumps thus allowing a greater percentage of oversizing.

Building compass orientation (or true north) is very important to consider before performing a heat load calculation in Florida. Building compass orientation is extremely important because solar heat gains through windows and glass doors can account for nearly 50% of the total sensible heat gain in a typical Florida building (based on 22% glass area to conditioned floor area). West facing glass is by far the worst, peaking in the hot afternoon sun; some types of west glass have a heat transfer multiplier of 89 BTUH per square foot of single pane clear glass. North facing glass has the lowest heat transfer multiplier - only 30 BTUH per square foot of single pane clear glass. It's easy to see that building compass orientation is critical as few buildings have equally distributed glass for all compass orientations. Also, very important is the roof overhang projection ratio. The first number required in the ratio is the amount of feet the roof overhangs the building and the second number required is the window offset – or the amount of feet the window is located below the roof overhang. Overhangs project a shade line across windows and the shaded portion of the window has a heat transfer multiplier of only 30, exterior roof overhangs greatly effect the sensible heat gain and should always be calculated for each window. A typical "model" has multiple compass orientations must have a heat load calculation performed for each different compass orientation to ensure proper cooling equipment and duct sizes. The rotation also affects the adequate exposure diversity calculations, some compass orientations may produce AED while other compass orientations will not produce AED and would require zoning. The hvac equipment size, CFM airflow values, and duct sizes can vary greatly when a house is rotated to another compass orientation even though the building envelope components remain exactly the same. In many cases the exact same house placed on lots facing different compass orientations require different amounts of air conditioning tons, different room by room CFM airflow values and different duct sizes. Contractors should be aware of this heat load shift especially on "model" homes that have large glass amounts. Be aware that designing an HVAC system based solely on the "worst" case compass orientation for a model home is the correct procedure only if the home actually faces the worst case, but the same calculations and HVAC duct design will not work properly for the same home facing a different compass direction! The only correct way to design HVAC systems in Florida is to know the homes compass orientation. Using a worst case calculation and HVAC design for the "model" home that does not face worse case will certainly result in a home that has oversized equipment, improper room airflow, un-even temperatures, moisture control problems, and if the home is multi-story – a first floor duct system located in a sealed floor truss cavity that is not accessible for airflow adjustments.

Florida climate: mostly hot and humid, sometimes very cool and humid, not easily tamed by the standard air conditioning system. Properly designed cooling equipment will operate continuously during peak design conditions because the cooling equipment selection is nearly equal to the heat load demands based on the peak design sensible heat gain. Thermostats measure and respond to sensible heat, so during peak design conditions, cooling equipment connected to a thermostat will operate continuously and perform well at removing humidity present in the building. This very same equipment cannot perform as well during periods when the daily outdoor high temperature is only 70 degrees and it rains for several days (February)! To accomplish desired indoor conditions during those cool rainy days, a dedicated dehumidification system is required. A stand-alone ventilating dehumidifier connected to a space mounted humidistat is a great approach for the Florida home during these part load conditions. Florida homes that have average to tight building envelope construction would benefit greatly during part load conditions by installing an optional ventilating dehumidifier because a standard central air conditioning system cannot remove moisture during part load conditions without over cooling the indoor air.