Oversized HVAC Equipment

Recently our building codes changed, the energy conservation codes now requires all phases of HVAC work to include engineering for sizing of HVAC equipment. The practice of installing (new work and change outs) equipment based on ones "experience" or simply using the existing equipment size (change outs) as the criteria for the size of replacement equipment is now abolished. An exact change out of the existing equipment is no longer allowed because the equipment will most likely be oversized, and on new construction (additions too) our code already requires engineering to determine the correct size air conditioner for the space. Our codes require a heat load (manual J or manual N) mathematical calculation to determine the correct size HVAC system for all buildings, our code does not allow equipment that is too small (not even 1 btuh short is allowed) or too large (not greater than 15% of the calculated heat load).

The heat load calculation required is both time consuming and complicated, as each building envelope component heat transfer will vary per component type and orientation in reference to compass north. A typical single HVAC system heat load calculation can consume about 4 hours of time (manual J 8^{th} edition) when done correctly (linked to manual's D,S,T). The reason for this code change is obvious, many buildings in Florida have either never had a heat load calculations performed – and many buildings have had major envelope component changes, like new energy efficient windows or increased insulation. The typical older Florida home that has had one or two HVAC equipment change outs is most likely oversized because each time equipment is changed, the typical HVAC contractor increases the existing size by ½ ton, so if the home has had a few change outs over time – it most likely is oversized. Also many older homes have had windows upgraded, vented attics converted to sealed attics, additional insulation added, or any other change that would affect the buildings heat load calculation – my home is the perfect example, I reduced my required tons 25% just by installing new energy efficient windows and sealing the vented attic. So many HVAC contractors use a square feet per ton as a short cut to select equipment size, this too was abolished in 2001, as the practice of guessing is forbidden and absurd. 25 years ago, most homes used minimum insulation and single pane clear glass, usually about 18% GFA (glass to floor area)– the homes back then would fall in the 400 to 500 square feet per ton, but today's homes are using greater insulation R values and double pane low e windows – so today's homes heat load calculations compute in the 600 to 800 square feet per ton and can go all the way to 1300 square feet per ton if using the best building materials like ICF walls, low GFA, and the best low e windows.

Oversized equipment in a space will most likely lead to high indoor humidity levels because the equipment is controlled by a thermostat – a thermostat only measures sensible heat and not latent heat (humidity). With oversized equipment, the operation time of the equipment is too short, because the equipment's sensible heat removal ability does not match the sensible heat load calculation. Keep in mind that properly sized HVAC equipment will operate continuously during worst case conditions, so when the outdoor temperature is 93 degrees – the HVAC system should operate the entire time and the indoor space conditions will be met (both temperature and humidity). If you have an

HVAC system that does not operate the entire hour during worst case conditions – the equipment is too large (oversized). Part load conditions (when it's not 95 degrees outside) exist for most of the year (85%), so correctly sized equipment will cycle a few times per hour because the demand is lower than the equipment's ability. Because most HVAC equipment is single speed, the demand (load calculation) and equipment ability (equipment size selected) only match each other during the very worst case – for most of the year the equipment is oversized. For moisture control, operation times are critical because the typical HVAC cooling coil requires about 7-10 minutes of operation time to reach dew point, so no moisture is removed from the building until dew point is reached at the air handler indoor coil (about 55 degrees). The typical building in our region requires at least 30 minutes of operation time at this dew point temperature in order to meet the latent heat load demand (humidity). So we must add the 30 minutes required to meet the heat load demand to the 10 minutes required for the indoor coil to reach the dew point for a total minimum operation time of 40 minutes – this would best represent a typical part load condition day in our region. If your equipment is oversized by more than the 15% allowed by code, it will struggle to keep a desired humidity level in the building.

It's not the heat, it's the humidity – our bodies use the natural evaporation process to maintain our body temperature in the comfort range – so if our indoor environment has a high humidity level, the people will feel uncomfortable. Oversized HVAC equipment will not only struggle to control the humidity levels, it has the extra power (oversized) to create an indoor environment that is very cool and very moist (overcooling), resulting in water damage to the building envelope components. A home owner with no knowledge of "overcooling" will most likely set the thermostat to a lower temperature because the people feel uncomfortable; this of course is huge mistake. Homes have a moisture balance point of about 78 degrees; this is nearly equal to the expected worst case dew point that occurs outdoors at the worst case month like August. As the building owner drives the indoor temperature below 78 degrees, the indoor relative humidity levels will increase dramatically – causing a cold and moist indoor environment. As the building natural infiltration air comes in contact with this cold moist environment – the vapor condenses to liquid and the problems occur indoors. The only way to maintain a buildings humidity level year round is with a stand-alone dehumidification system, connected to a humidistat. These stand-alone units remove moisture without changing the indoor temperature, so the indoor humidity levels drop with no change to the indoor temperature. HVAC systems that combine the heat and moisture removal into one process will not be able to control humidity levels year round because the two processes (sensible heat removal and latent heat removal) are not de-coupled and controlled independently. So even if the HVAC system is properly sized, it's unlikely able to control the humidity levels - and if the equipment is oversized – its very likely to cause many building problems like mold and rot especially when the building owner drives the temperature below the energy conservation set point of 78 degrees.