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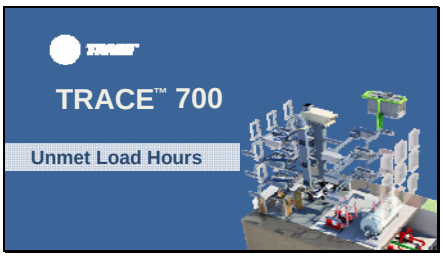


Hello, my name is Audra Benzschawel and I'm a marketing engineer in the C.D.S. group at TRANE. Today I will be talking about unmet hours. What are they, common causes, and possible solutions.

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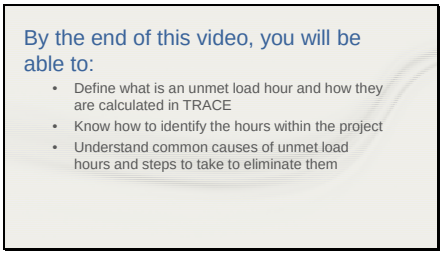


By the end of this video, you will be able to:

-define what is an unmet load hour and how they are calculated in TRACE
-know how to identify the hours within the project
-understand common causes of unmet load hours and steps to take to eliminate them.

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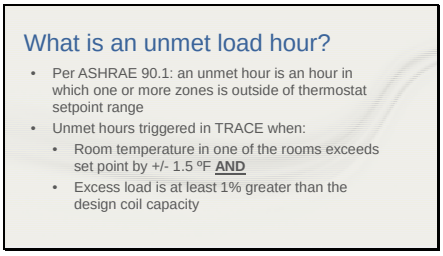


Let's first start by defining exactly an unmet hour is. Per ASHRAE 90.1, an unmet hour is an hour in which one or more zones is outside of the thermostat setpoint range. The total unmet hours of a building are the summation of the number of hours when the heating or cooling set point temperature of a zone is not met either by the HVAC system or plant.

Unmet hours can occur for a wide variety of reasons and are triggered in TRACE when there is an excess load on the coil that is at least 1% greater than the design coil capacity and at least one room attached to that coil is in excess of +/- 1.5 degrees of the thermostat set point for that hour.

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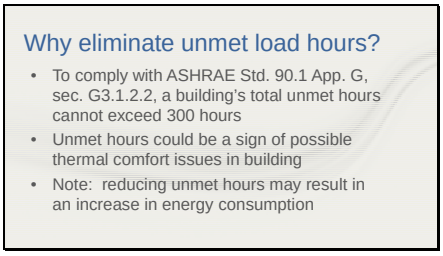


The next question to address is why is it important to eliminate unmet load hours from building model.

To comply with ASHRAE std. 90.1 Appendix G Performance Rating method, the total unmet load hours for both the propose and baseline models cannot exceed 300, meaning the combined total of unmet cooling and heating hours must be below 300. If using 2007 version of the standard, the proposed model cannot exceed the unmet load hours in the baseline building by more than 50 hours. This requirement was removed in the 2010 version of the standard. (G3.1.2.2)

As well, unmet hours occur because the room thermostat set points are not being met within an acceptable margin which can be a sign of thermal comfort issues in the building. Unmet load hours typically mean that the building is not being controlled well or not reflecting proper operation of the building. Further exploration as to the cause of the unmet load hours will need to be done to understand what is happening in the model and possible solutions. One thing to note is that reducing unmet hours can result in an increase in energy consumption as the equipment may have to provide more heating or cooling.

We will now step through the process of identifying and solving unmet load hours.

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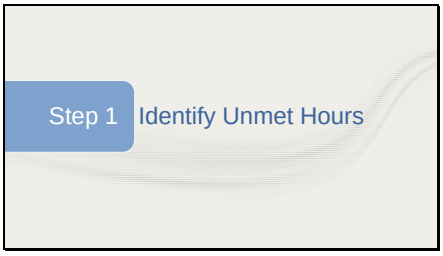


The first step is to identify the unmet hours…How many unmet cooling and heating hours? What rooms and systems have unmet hours? What time during the day are they occurring?

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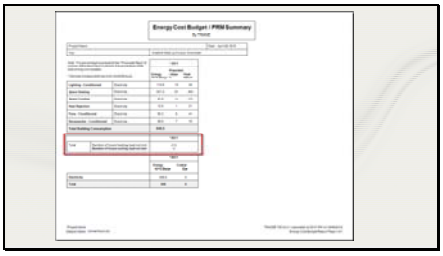
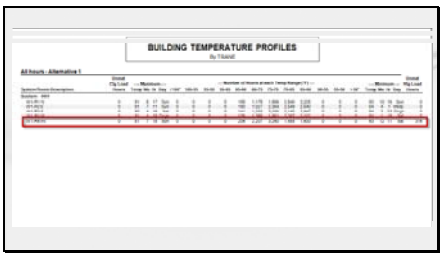


The Energy Cost Budget report will give the cumulative number of unmet cooling and heating hours per alternative. This report will give a good high level overview regarding problematic alternatives.

Slide 7




To view more granular information about unmet load hours, we will need to view the Building Temperature Profile Report. This report has detailed accounting of unmet hours by listing rooms by system showing the number of cooling and heating unmet hours associated with each. This is the report to identify rooms and systems responsible for the unmet hours.

If we page through this report, we will see an unmet hours section that will provide more detailed information about during hours and months that the hours are occurring in each room.

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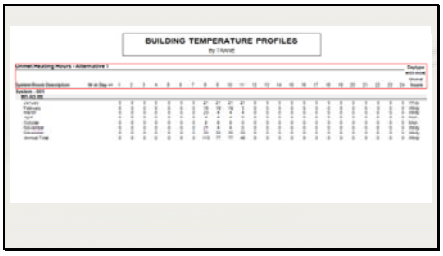


We are now looking at the Unmet Heating Hours portion of the report. This section will tell us in what months, time of day, and day types the unmet hours are occurring. In order to solve the unmet hours, it is first important to understand what is causing them to happen in the first place. By seeing when they occur and thinking about what is happening in that room during that time, we can begin to get an idea of the possible issue.

Note: that the unmet hours in the Building Temperature Profile report are not additive. Any space can trigger an unmet hour, but if multiple spaces have unmet conditions during the same hours, then only a single unmet hour is tallied. This means that an alternative can have a maximum of 8760 unmet hours for either heating or cooling.

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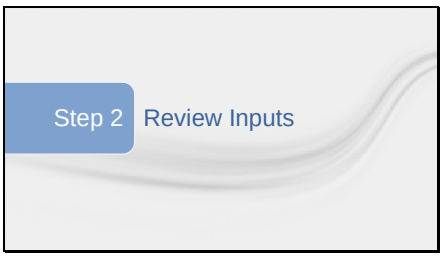


Once the problem areas have been identified, we can focus on the data entry process. The important thing to remember is that these are only suggestions for solving unmet hours, and only solutions that apply to your project should be applied. This is meant to only bring attention and does not necessarily require action to ensure the model is set up as intended.

These steps target commonly overlooked assumptions in the TRACE data entry process; as well as, the complex interactions that typically occur in building simulations. Each building model is unique, and the impact of each of these steps may be different.

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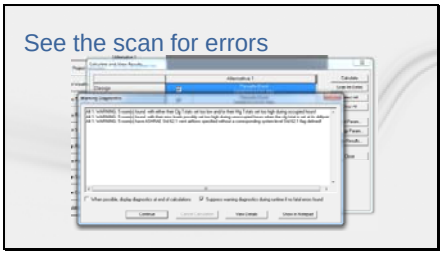


Utilizing the scan for errors feature prior to calculating will help identify any potential errors and inconsistencies. These are just warnings from TRACE and do not necessarily require action. It will report many but not all of the items to be discussed and can help solve simple causes of unmet load hours such as mismatched schedules or thermostat setpoints too high or low during occupied and unoccupied times.

Users should try to understand the underlying cause of the loss of space control rather than arbitrary adjusting inputs to reduce or eliminate unmet hours.

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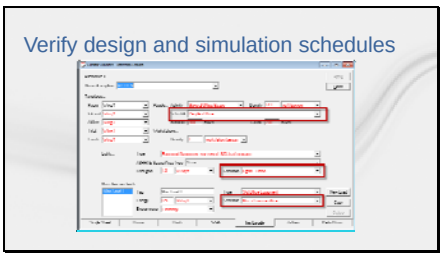
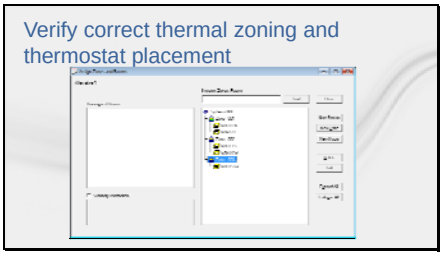



Perhaps the single largest area of uncertainty in a building simulation occurs when scheduling internal loads. TRACE allows different design and simulation internal load schedules for proper coil sizing. If the design schedules are too moderate, coils could be undersized. Alternatively, if the simulation schedules are overly conservative, the coils could also be undersized and not able to handle dynamic building changes that are not accounted for during design calculation.

For more information about creating and using schedules properly, see our TRACE 700 Utilization Schedules Video.

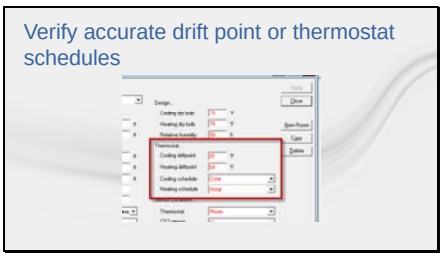
Slide 12




Proper thermal zoning of spaces and properly modeling thermostat locations is vital to proper building simulation. Ensure that spaces have been properly zoned per design documents and have been modeled correctly in the Assign Rooms to Systems section. For more information about proper thermal zoning, please view our video on Assign Rooms to Systems.

If there are questions regarding how to appropriately model various thermostat placement options, please view the F1 Help regarding this input.

Slide 13




When a space is unoccupied (less than 5% occupancy) and there is no thermostat schedule applied, the space is allowed to use the drift temperatures. If there is a wide variance between the occupied set point and the drift point, the HVAC equipment may not be able to handle the pull-up or pull-down loads in the one-hour time increment as the building becomes occupied because the equipment is sized per the thermostat set points and assumes steady state conditions. Verify the temperatures entered are an accurate representation of the actual building thermostat controls.

The same suggestion applies when utilizing thermostat schedules. However, realize thermostat schedule are not affected by occupancy. They follow the user-defined schedule.

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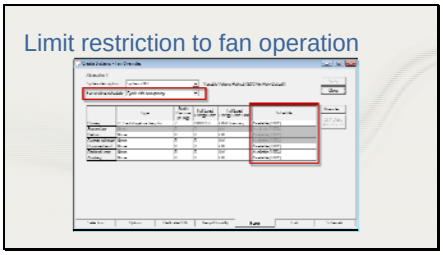
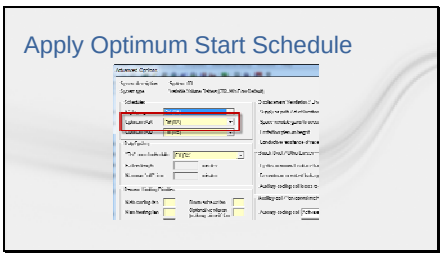



TRACE has fan control options allowing the program to intelligently cycle the fan to meet changing load conditions. Avoid scheduling fans manually because the simulation may not match up with the expected fan operation schedule. Leaving the fan schedule set to “Available (100%)” and applying a fan cycling schedule provides the most accurate method for controlling the fan operation.

Scheduling a fan as something other than “Available (100%)” can quickly lead to a high number of unmet hours.

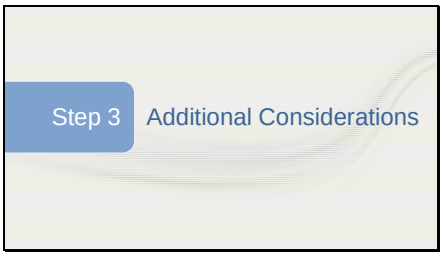
Slide 15




TRACE design coil capacities are determined at steady state conditions assuming the space is always controlled to the desired design space set point. In some instances, pull-up or pull-down loads associated with dynamic building operation can exceed the capacity of a coil. These dynamic conditions are not accounted for in the design process. A common example of this is night setback thermostat control that allows the building to drift during unoccupied hours. When the building becoming occupied, the design coil capacity may not be large enough to condition the space(s) to the desired set point in a single hour, triggering unmet hours.

Applying Optimum Start control strategy allows the building automation system to condition the spaces in advance to reach the desired set point for when the building becomes occupied. It is recommended to set this schedule to Available (100%)

Slide 16




Hopefully, the preceding strategies have helped solve the unmet hour issues. If not, here are some additional “non-typical” solutions to investigate.

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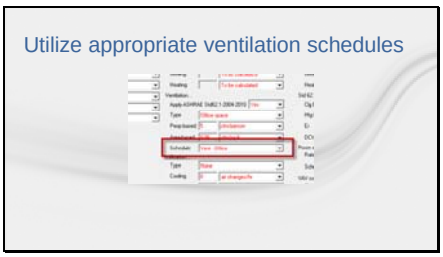
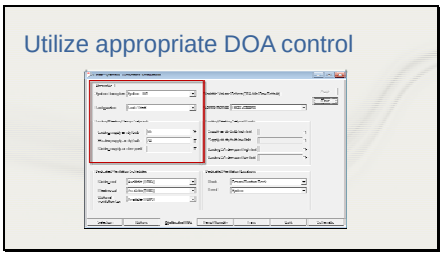



Users often wanted to schedule ventilation to follow the occupancy schedule. This concept is valid, but incorrectly modeling this causes problems. The standard occupancy schedules in TRACE do not work well for ventilation. Since ASHRAE recommends not taking credit for internal heat gains, standard occupancy schedules set the heating design schedule values to 0%. When used as a ventilation schedule, the 0% value for heating design exempts ventilation from the heating design calculations and results in undersized heating coils that cannot properly heat the space when the ventilation air is introduced during weekday, Saturday, and Sunday calculations.

Instead, a more conservative approach would be to utilize a standard ventilation schedule. The only difference between a standard ventilation schedule and corresponding standard occupancy schedule is the heating design value is set to 100% for ventilation.

Slide 18




When applying a dedicated outdoor air (DOA) unit on a system, it is important to make sure that the set up does not cause conflict with the system or spaces that it will be serving or unmet hours may result. If the DOA supply air temperature set points allow for sending cold (or hot) air down the ductwork during heating (or cooling) mode such as if the space requires heating but the outside air is greater due to ambient conditions, TRACE does not account for this during the design calculations which can under size the heating or cooling coils. Additionally, the operation between the space and DOA unit can cause them to “fight” each other which may also increase the unmet load hours.

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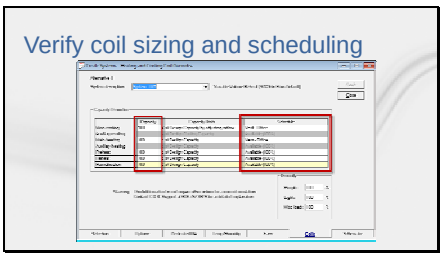
Typically this occurs with VAV systems and manifests as unmet heating hours. Since heating airflow is limited by the minimum stop of a VAV box, sufficient airflow may not reach the space to satisfy the load. By reviewing the Zone Checksums report, if the heating supply temperature appears unusually high, consider increasing the VAV minimum for the space.

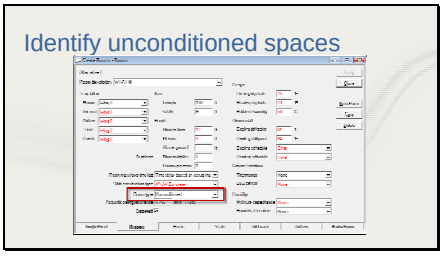
Likewise, if the space does not receive the required ventilation during heating due to the minimum stop, select Actions -> Change Load Parameters from the menu bar. On the Change Load Parameters screen, check the “Force VAV minimum always >= nomination ventilation during design” box. This will adjust the VAV minimum automatically to ensure the space receives the defined amount of ventilation.

Slide 20




Much like with fan schedule, applying a schedule other than “Available (100%)” can quickly lead to a high number of unmet load hours. If TRACE needs the coil to satisfy a load and the coil is scheduled off, then the load will not be satisfied and will be carried over to the next hour. Likewise, undersizing coils or turning coils off can lead to unmet hours.

Slide 21



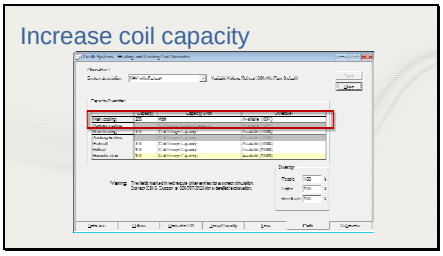

Most building contain rooms like closets that are not conditioned directly by a mechanical system. If these types of rooms have been included in the model, they may be defined as unconditioned in Create Rooms – Rooms tab. An unconditioned space will not receive any cooling or heating from the system to which it is assigned.

As well, light and miscellaneous loads are calculated but space temperature is allowed to drift. Unconditioned spaces are not factored into the unmet load hour calculation and will use “None” as the location for the thermostat, CO2 sensor, and humidistat. An unconditioned space may impact a conditioned space if the ceiling or underfloor plenum is shared with a conditioned space or if the conditioned and unconditioned space are connected by an adjacent airflow, partition, or exposed floor.

Slide 22

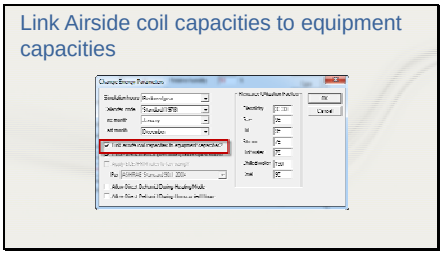

This should be a last resort to solving the unmet hours issue.
—consider increasing the appropriate system coil capacities on the Create Systems – Coils tab to help reduce the hours.

Slide 23




The coil capacities can be increased in Create Systems on the Coils tab. These coil capacities are automatically carried over to the plants that they are assigned to, thus increasing the plant size. The coils size can be increase either by a % Design Capacity or have an actual capacity unit specified.

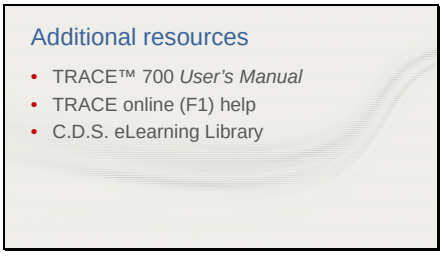
Slide 24




If you do not want to adjust capacities by using the coils tab, the other option is by using the plants and selecting the “link airside coil capacities” Changing the equipment capacities under the Create Plants section of the program has no impact on the system simulation unless you have checked the box to link the equipment capacity to the system coil capacities on the Change Energy Parameters screen.

If the coil capacities are adjusted in the Create Systems section, the plant linking feature should not be utilized. Generally, equipment capacities are only used for energy calculations.

Slide 25

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