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4 MODELING WITH ASEAM3.0

4.1 Modeling Buildings

When using any building energy analysis tool to simulate a building's energy consumption, there are several steps you must perform to complete the analysis. The steps involved depend upon whether the analysis to be performed is for new buildings (not yet built) or existing buildings.

4.1.1 Modeling New Buildings

For new buildings or those not built, several steps can be eliminated: visiting the building, collecting data, validating calculated energy consumption against actual energy bills, etc. You are also less constrained in investigating alternatives (e.g., comparing system and plant types, architectural configurations, etc.). The cost-effectiveness of the same alternatives (new versus existing buildings) may vary greatly. Not only is the installation cost lower for alternatives in new buildings (as opposed to existing buildings), but also equipment sizes and costs owing to the alternatives are reduced. If the equipment in existing buildings is not changed, alternatives with major load changes may result in oversized equipment with lower operating efficiency.

4.1.2 Modeling Existing Buildings

The steps involved in using a building energy analysis program for existing buildings are more demanding. You must survey the building to determine actual conditions. You may have to make several runs to validate predicted energy consumption against actual energy bills, and the alternatives you investigate are more constrained.

4.2 Modeling Steps

Outlined below are several steps that you may need to perform to use a building energy analysis program. The steps required will depend on the client's needs and the type of building analyzed (new or existing).

4.2.1 Step 1. Obtain Presurvey Information

Before visiting the building, you should obtain the following from your client:

1. *Architectural, Mechanical, and Electrical Blueprints*: Because you will probably mark-up the drawings, you should make copies of the most important pages: floor plans, elevations, HVAC distribution, HVAC schedules, lighting layouts, etc. There is no need to study these prints in detail at this point because there may be significant changes between the actual building and the blueprints.

You may also want to obtain a small building plan (8 1/2 x 11) for data collection while walking through the building. Your client may already have these (e.g., fire escape plans). You will need several copies, or at least one per floor.

2. *Energy Bills:* For existing buildings, ask your client to furnish recent energy bills for all utilities. Bills from the past two years should be adequate. Such factors as the addition of new equipment (e.g., computers), building additions and alterations, and changes in operating personnel (e.g., maintenance) can have a significant impact on energy usage in buildings. Energy consumption data from the bills should be used to "validate" the energy calculations. If you discover significant differences between anticipated and actual consumption, you should change the necessary input parameters to better simulate the building's energy usage (see Step 9).

3. *Name of Contact Person:* For existing buildings only, you should also obtain the names of people who are most familiar with the building's operation (e.g., maintenance foreman). Such people will be most useful because they "live" with the building and know its mechanical systems, problem areas, equipment not shown on the blueprints, and the like.

4.2.2 Step 2. Visit Building/Quick Walk-Through

After obtaining the necessary presurvey information, you should briefly visit the building, if possible. The purpose of the visit is not to perform the complete data collection, but to familiarize yourself with the building and its operation.

You should first interview your client or your client's representative to determine the building's operating schedule and learn whether there are any planned changes or alterations you should investigate. After the interview, walk through the building with the contact person to visit typical and atypical (e.g., computer rooms, kitchens, auditoriums, etc.) spaces and mechanical rooms. Make note of any changes you notice from the blueprints, and interview the contact person.

4.2.3 Step 3. Zone the Building

After the walk-through, you should "zone" the building by dividing it into smaller areas (called zones) of similar thermal and system loads. This is a very important step and is discussed in more detail in section 4.3.

4.2.4 Step 4. Detailed Walk-Through and Data Collection (Existing Buildings)

Once you have zoned the building, you are ready to begin collecting data for the simulation. If the blueprints accurately describe the building, the time you need to perform this step may be greatly reduced. You should also be familiar with the input data requirements for ASEAM3.0 for each segment (loads, systems, plant).

The input data are entered into ASEAM3.0 separately for each zone and system. It is therefore important to record the zone or system number for the data you collect. You may want to outline the different zones on the small building plans before starting this step, and then take notes on these plans.

As you walk through each area, you must look for any items that consume energy or affect the heating or cooling loads in some manner. Look for ways to save energy, and collect data for any alterations you find. Note that the alteration data also include factors that impact the alteration cost.

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You should have a systematic plan to ensure complete data collection. For example, first walk around the exterior of the building to determine any security and parking lighting requirements. Next, visit several typical interior spaces to look at the type and condition of the windows, determine typical lighting type and power requirements for lighting and receptacles, and determine people density. Note any diversities you find, such as differences between average and installed capacity (e.g., overhead lighting turned off near windows, significant number of people out of the office on business or at lunchtime). You may need to ask the occupants or your contact person about typical diversity factors.

Once you have visited several typical areas, you may find a pattern emerging of similar lighting, people, and miscellaneous (receptacle) electric loads. If so, note only the exceptions on your small building plans.

After completing the data collection for typical spaces, survey areas in the building that have different characteristics. Such areas include computer rooms, kitchen areas, large conference rooms, and lobbies. The load profiles, both in terms of installed capacity and diversity factors, vary widely in these "atypical" spaces. Your contact person may be the best source of information about the diversity factors for these areas.

You may next want to visit the mechanical rooms to collect systems and plant input data. The contact person, again, should be your best source of information. It is nearly impossible, for example, to determine if a system has discriminator controls just by looking at it. Likewise, heating and cooling availability schedules, and control of outside air (ventilation) dampers, for example, are very important input data items that can drastically affect your energy calculations. Consult your contact person if there is any doubt.

Again, collect data not only for the base-case run but also for any energy conservation opportunities (ECOs) you want to study. If you notice any operational and maintenance (O&M) items (e.g., disconnected damper linkages or dirty coils), make note of these also.

You may wish, if time and budget permit, to use instrumentation to help with your system and plant data requirements. Be forewarned, however, that measured data provide only a "snapshot" of the conditions. Measuring the boiler efficiency or fan motor power requirements for a VAV system at low load conditions, for example, may give you misleading information. The boiler may be losing steam through leaky traps or may have a much higher efficiency during the more severe heating season. You must therefore use your best judgment when using measured data.

Likewise, be forewarned that manufacturers' "nameplate" data and equipment specifications can also provide erroneous input information. If a designer calculates a VAV system needs a 32.3 horsepower fan motor, he or she may be likely to specify a much larger motor (e.g., 50 horsepower) to include a safety factor. Meanwhile, the cooling loads may have been drastically reduced through lighting modifications by your client, and so a 25 horsepower motor would be sufficient. Using the nameplate data in this case would significantly overestimate the fan energy requirements.

4.2.5 Step 5. Discuss Walk-Through Data with Client (Existing Buildings)

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Having completed the data collection, discuss your findings with your client before entering any data into ASEAM3.0 for modeling. In general, you should discuss the following:

- Point out any operational and maintenance problems you found. They can have a significant impact on your energy analysis results. Because many of these items have little or no cost associated with their correction (e.g., connecting damper linkages, replacing broken windows, setting thermostats at their proper setting), your client may want you to assume the problems will be corrected for the base-case run. Note, however, that using any data for the modeling that do not reflect actual conditions will make the validation step (see Step 9) nearly impossible.
- Discuss any ECOs that you feel are appropriate. Your client may rule out some ECOs because of their expense or operational problems. Your client also may suggest a few ECOs of his or her own.
- Decide, with your client, initially what ASEAM3.0 runs are to be performed. Based on the above discussions, you and your client should have a firm understanding of what ECOs and O&M items will be studied. Time and budget constraints may make it impossible to study each ECO and O&M individually and in all possible combinations.

Warning: The number of possible runs for a given number of ECOs and O&M items grows exponentially. For example, three different ECOs can be combined in seven different ways. Assuming they are labeled A, B, and C, the following ECO combinations are possible:

A: ECO `A' by itself
B: ECO `B' by itself
C: ECO `C' by itself
A+B: ECOs `A' and `B' in combination
A+C: ECOs `A' and `C' in combination
B+C: ECOs `B' and `C' in combination
A+B+C: ECOs `A' and `B' and `C' in combination

The formula for calculating these possibilities is:

$$NCOMB = 2^{(NECO)-1}$$

where

NCOMB = number of possible combinations

NECO = total number of ECOs and O&M items to be studied

The following table illustrates the necessity of organizing your runs:

Total Number of ECO's and O&M Items	Number of Possible Run Combinations
5	31
8	255
10	1,023
15	32,767
20	1,048,575

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Note that the above table assumes that all ECOs are interactive. Many ECOs, however, are not. For example, a domestic hot water ECO would not have to be studied in all possible combinations with other ECOs because the savings would be the same.

You can suggest grouping the ECOs and O&M items that are assumed to be cost-effective into one run, labeling it "Base Case with Assumed Cost-Effective ECOs Implemented." Given your client's budget and payback criteria for implementing ECOs, you can also suggest eliminating those ECOs with higher implementation cost and marginal payback period, based on your engineering experience. You can suggest studying ECOs individually first, and eliminate those that are marginally cost-effective from any combination run performed later. This last method is recommended. However the runs are to be analyzed, you and your client should agree beforehand on how and what ECOs to be investigated.

4.2.6 Step 6. Complete Input Forms

After meeting with your client, you are ready to complete the data input forms. The input forms for the loads, systems, plant, and economics input segments have been included in Appendix B. Make photocopies of these forms, and save the originals as master copies. Select those forms relevant to your analyses, and photocopy sets of them for each zone and system.

It also is useful to keep data sheets when you complete the input forms. On these you can record, for example, how the U-factor for walls and wall areas was calculated, on what blueprint page the wall construction section is found, etc.

4.2.7 Step 7. Enter Input Data into ASEAM3.0

Once the data input forms are completed, enter the base-case information into the ASEAM3.0 input programs. Since you are entering the building data for the first time, you must follow the sequence of steps outlined below. Do *not* attempt to edit previous ASEAM3.0 input files. Enter only base-case input data first; ECO inputs will be entered later, at Steps 11 and 12.

Always create a new data subdirectory for each building you model. The data subdirectory will be used to store all input files, weather files, ECO input files, life-cycle costing files (entered later), and output results.

Next, insure the required bin temperature and solar data file are located in the weather subdirectory. See Appendices A and E for a list of these files. Both a bin temperature file *and* a solar data file are required for the calculations.

Data should be entered in the following sequence:

1. Enter the Loads Input program first, and select "Enter New Data" from the main loads input menu. The screens will appear sequentially, just as they appear on the input forms.

Note: If you do not complete the loads input data entry in one sitting, be sure to *save your work before exiting*. When you are ready to enter additional data, use "Get Loads File" to retrieve your existing data, and then "Edit Loads

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Data" to continue with your data entry. Then choose the "All Data" command on the secondary bar menu, and select those zones that are not completed. Do *not* use the "Enter New Data" command, as this command erases all data in memory. These menu options are covered in more detail in Chapter 5.

2. After *all* of the loads input data has been entered and saved, enter the Systems Input program. As above, select the "Enter New Data" command from the menu bar. It is imperative that the complete loads data be entered before moving to the Systems Input program because the load zones must be assigned to systems. When using the "Enter New Data" command, you will be prompted to select the appropriate loads input file for the systems specification. ASEAM3.0 will then retrieve the number of zones and zone labels (names) from the load input file before starting any systems input questions. The note in step 1 above also applies to the systems input data entry.

3. After *all* of the systems input data has been entered and saved, you should finally enter the Plant Input program. From the main menu bar of this program, again select the "Enter New Data" command. As with the systems input program, it is imperative that systems input be completed first because the plant assignments (for the heating, cooling, preheat, coil loads) are entered on the systems input screens. When using the "Enter New Data" command, you will be prompted to select the appropriate systems input file for the plant specification. ASEAM3.0 will then retrieve the plants assigned in the systems from this system input file before proceeding with any plant input questions. The note in step 1 above also applies to the plant input data entry.

4.2.8 Step 8. Specify Base-Case Run Data and Run Calculations

Once the complete base-case input files for the loads, systems, and plant segments have been completed, you are ready to perform the first calculation. To do so, select the "Specify Analysis" command from the ASEAM3.0 Main Menu. The program will then perform a "directory" command on the data subdirectory to determine the available input files and weather files. The "directory" command is necessary to insure that you specify valid input files for the calculations.

Once the valid file names have been determined, several input screens will appear in sequence, and here you enter configuration data and file names to be used for the calculations, as well as select output reports. The first screen in the sequence contains configuration input data (three questions). First, indicate whether a printer is available (the first question asked). Since only one set of compatible loads, systems, and plant input files should be on the data subdirectory at this point, you will want to select "Single Run" for the calculation mode (the second question asked). Use the F8 function key and select "Enter New File" for the runfile analysis (third question asked). Enter a valid file name (e.g., `BASECASE`) to save the analysis specifications.

The second input screen is used to indicate the titles of the report and to specify the input files to be used for the calculations.

The third and fourth screens allow you to select output reports. Do not be overly ambitious when selecting the output results at this point. The Peak Loads and BEPS reports will be sufficient for the first run. See Chapter 11 for additional information about specifying analyses.

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Immediately after you "Specify Analysis," you should "Run Calcs." The runtime specifications just entered will then be saved on your data subdirectory. The calculations will then be performed. If you have a printer installed, a BEPS report (see Chapter 12) will be printed at the end of the calculations. If there is no printer available, the screen will display the BEPS report at the end of the calculations. Chapter 12 outlines how the requested calculation reports may be accessed after the calculations are performed.

4.2.9 Step 9. Validate Base Case Run (Existing Buildings)

After the first energy calculation is performed, you are ready to validate the predicted, or calculated, energy consumption against the actual energy bills, if available. In this step, you may need to change the input parameters to match the predicted and actual energy consumption more closely. This can be the most difficult and time-consuming step of all. Also, as discussed above in Step 5, if your base case input data used "assumed" cost-effective ECOs and O&M items, it may not be possible to validate the data.

Your experience with building energy analysis will help you determine which inputs should be adjusted up or down and which have a significant impact on the predicted annual consumption. Many input items can be termed "soft," and you must use assumptions when entering data for them. Examples include infiltration rates, diversity factors, ventilation rates, and equipment efficiencies. Even the "hard" inputs can be erroneous: for example, wall U-factors may be incorrect if the insulation contains moisture; you may have incorrectly calculated the wall areas; or you may have omitted a large computer's power and cooling load requirements in your modeling. The possibilities for input errors are nearly limitless.

By comparing the predicted and actual individual end-use energy consumption, you may find potential input data corrections easily. If, for example, a building's gas consumption is low, and gas is used only for heating, you need only adjust inputs that affect the heating load. If, on the other hand, predicted electricity consumption is high, you may reduce the lighting diversity factors, but you will also affect the heating load in the building. If the building uses electricity as its only energy source, your problems in finding the right input values are more severe.

Given such considerations, you should not attempt to match the energy consumption exactly. What is most valid in any building analysis are the comparative results while looking at alternatives. The predicted savings from most ECOs can be quite accurate, even though you cannot closely validate the base-case run.

When validating your base-case input data, you must change input parameters and rerun the calculations. There are two ways to perform this validation:

1. Change the suspect input data in the loads, systems, and plant input programs by editing the original file data. You may want to save the edited data with new file names. After new input data files are created, you must again "Specify Analysis" and "Run Calcs" from the ASEAM3.0 Main Menu. When the calculations are done and the new predicted consumption is determined, review the results. You may have to do this many times.
2. Use the parametric processor calculation mode to adjust the "soft" inputs,

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changing, for example, the infiltration rate, diversity factors, ventilation rates, and equipment efficiencies. These data items can also be investigated interactively by running "all possible combinations" of the changed variables. Once the calculations are complete, load the results into LOTUS and sort them to find which combinations of inputs give the closest match to the actual. Then adjust the input values in your base-case input files, and rerun the calculations in the "Single Run" calculation mode.

4.2.10 Step 10. Estimate ECO Costs

Having established your base-case input files through the validation step, you can begin the ECO modeling. You may first want to determine the cost for each ECO to be analyzed. Review the input data requirements for the BLCC programs (see Chapter 10). The data requirements for the BLCC input programs are quite complex, and you will need to obtain information from your client regarding such variables as tax rate, depreciation method, and discount rate.

If your client requires only a simple payback calculation, you can omit Step 11 below. If an BLCC calculation is required, however, be prepared to explain the results.

4.2.11 Step 11. Enter ECO/BLCC Input Data

To perform an BLCC analysis, you need to create an BLCC input file for each ECO to be analyzed. Chapter 10 discusses the BLCC integration into ASEAM3.0 calculation results. If your client requires only a simple payback calculation, proceed to Step 12.

Because both the BLCC input files and the ECO files need to be created before performing the integrated ECO/BLCC calculations, you may choose to perform Step 12 first, before entering the BLCC input data.

4.2.12 Step 12. Enter ECO Input

Your next step is to create the ECO input data files for each ECO to be investigated. There are two ways of doing this, and you can use either one or both methods.

1. Editing your original loads, systems, or plant input files to model the ECO: For more complicated ECOs (e.g., changing the system and plant types), you will have to use this method. You will use the input programs for each segment, saving each ECO with a different file name. Reread the *Warning* in Step 5 before deciding to use this method entirely.
2. Using the ECO input program discussed in Chapter 8: There are both advantages and limitations to using this program. This method is recommended wherever possible, however, and can be used in conjunction with the first method.

4.2.13 Step 13. Run ECO Calculations (Single)

As discussed in Step 5, it is recommended that you first analyze each ECO individually before performing calculations to determine the combined effects of several ECOs. By doing this, you can eliminate some ECOs from consideration before analyzing the combined ECO effects.

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To do this step, you need first to create all the ECO input files using one or both of the methods described in Step 12. Then, at the ASEAM3.0 Main Menu, you should "Specify Analysis" again, and use "ECO Runs (Single)" for the calculation mode input.

Two different input screens appear in this mode. On the first screen, specify the base- case set of loads, systems, plant, and economic (if applicable) input files for the calculations. On the second input screen, which is repeated for each ECO to be analyzed, specify the ECO input file to be used. *Note:* In this mode, only *one* change is allowed_ either a different input file (loads, systems, or plant) or a single ECO file created in the ECO Input Program. All other data used in the calculations will be the same as in the base-case analysis. You also will specify the type of economic analysis to be performed: none, simple payback only, or detailed BLCC. If you choose the latter, you must enter the BLCC input file name.

As many as 40 single ECO runs can be specified at one time. That is, based on your "specify analysis" inputs, ASEAM3.0 will calculate the base-case run first, store the results, then automatically proceed with the calculations for the first ECO case, including BLCC results if specified, store the results for this analysis, automatically start the second ECO case, and so on. There is no need for you to be present during the calculations (in any mode). ASEAM3.0 will perform all analyses specified and store the results in output files. It is always advisable, however, to ensure that the first run is executed properly. You may be expecting to find volumes of output data the next morning, whereas ASEAM3.0 may abort on the first run.

Warning: Input, ECO, BLCC, and output files, all stored on your data subdirectory, are used throughout ASEAM3.0. If you use floppy diskettes instead of a hard disk subdirectory for data storage, be advised that floppy diskettes can store only a certain amount of information or number of files. Before you start calculations that may require a large amount of data storage, it is advisable to make sure there is sufficient space available on your data disk.

ASEAM3.0 *never* deletes any files for you. From time to time, you must remove unnecessary files from your data subdirectory if you expect to store more and more information on it. You can either delete or erase unneeded files, or copy files from the data subdirectory you are using to a storage diskette, and then delete the files from your data subdirectory. Both must be performed from DOS.

4.2.14 Step 14. Enter Combined ECO-BLCC Input Data

Once you have performed the ECO analyses individually, analyze the results to help determine which ECO combinations should be studied. For example, if an ECO is not cost-effective by itself, it is probably not cost-effective when combined with other ECOs. You may want to establish priorities for the ECOs, run individually, from most to least cost-effective, and then discuss with your client which ECO combinations need to be analyzed. You will then need to create BLCC input files for the combined ECO analyses, if a BLCC analysis is to be performed. To do this, you must aggregate the individual BLCC input parameters for each ECO run into one BLCC input file. ASEAM3.0 cannot do this for you. For each combination ECO analysis to be performed, you must create an BLCC input file that represents the combined cost input parameters for the individual ECOs.

4.2.15 Step 15. Run ECO Calculations (Combined)

Input files have already been created that model the ECO cases individually. To study the combined effects of many ECOs, it is necessary only to specify which ECO combinations you want analyzed together. There are some limitations, discussed in Chapter 8, when combining single ECOs into one run.

To perform a combined ECO analysis, you must again use the "Specify Analysis" command from the ASEAM3.0 Main Menu. Then select the "Multiple ECO Run (Combination)" calculation mode. As with the individual ECO mode, you will first select the base-case input files. The second and third input screens for each combination ECO run allow you to enter the individual ECOs that are to be combined. Up to 39 individual ECOs can be combined into one run_13 each for loads, systems, and plant type ECOs. A maximum of 20 combination runs can be specified for overnight execution. A printer is not required. The results of each ECO run, whether singularly or in combination, will be stored automatically in files on your data subdirectory.

4.2.16 Step 16. Present Findings

The final step is to present the results of your analysis to your client. There are numerous ASEAM3.0 outputs that could be included in your report, but you must first consider your client's background. Your client may be interested only in the BLCC data and find the ASEAM3.0 engineering type reports meaningless. In this case, be prepared to discuss the details of the BLCC outputs with your client.

Not all ASEAM3.0 outputs are available in every calculation mode. See Chapter 11 (Specify Analysis) and Chapter 12 (Output Reports) for a discussion of available output reports and how to access and interpret them.

4.3 Zoning

As mentioned above, zoning the building is one of the most important steps in any building energy analysis program. This step *must* be performed before the data collection and data entry steps. All loads input data, except for general building data, must be entered by zone. The accuracy of the model is largely determined by how you define the thermal zones. Once you have defined the zones and entered the data into the loads input program, it is difficult to change the zoning. If you add or delete zones, the data must be collated again using the new zone definitions, and the data must be re-entered.

4.3.1 Zone Definition

A zone is an area of the building (more precisely, a volume) that is modeled as one thermal unit. It is defined to be at a uniform space temperature, and all thermal heat gains and losses are calculated on a per zone basis. Ideally, the areas served by each thermostat in the building would constitute a zone. Realistically, however, it is necessary to combine those areas in a building with similar load profiles into one zone.

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The heating and cooling loads of a zone can be satisfied by only one system. (Note: baseboard heating may be added to any system and need not constitute a system in itself.) A system, on the other hand, may serve one or many zones. ASEAM3.0 can model up to 15 zones.

4.3.2 Zoning Steps

There is not one fixed, correct way to zone a building. Different definitions of the zones will result in different zone loads, equipment operating time, and energy consumption.

The zones of a building must reflect *both* architectural and systems layout. If the building is served by more than one system (not counting baseboard heaters as a separate system), the zone boundaries should reflect, first, the system boundaries and, second, the architectural layout. If the building has only one system, however, the zone boundaries should reflect the architectural layout of the building. It is usual in this case to have core and perimeter zones. Perimeter zones have exterior walls and windows, and hence the loads may be strongly driven by outdoor temperature and solar gains. The interior core zone, however, typically has relatively constant internal gains (people, lights, and equipment) and low conductive losses, since its only exterior surface may be the roof.

Because the thermal heating and cooling load profiles for the core and perimeter areas are so different, these areas should be divided into different zones. Perimeter areas often are subdivided into exposures (i.e., north, south, east, and west, or one zone per building face) because the amount of solar gain varies widely from face to face throughout the day. For example, on an afternoon with moderate (e.g., 40 degrees F) outside air temperature, an east-facing perimeter zone could require heating, and a west-facing perimeter zone could require cooling. If these two areas were combined into a single zone, the heating and cooling loads would be summed together, canceling each other to some extent, and would therefore not provide an accurate indication of the loads on the system.

The following steps may be used to zone the building:

1. Divide the building into areas served by each separate system. If the building has unitary system types (e.g., fan coil units, heat pumps, etc.), you should consider these as one system, not a separate system for each room.
2. Divide the systems areas defined above into thermostatic zones and areas with similar load profiles. Note that some central system types may have only one thermostat for a relatively large area of the building. For example, some large areas of a building may be served by a single zone system, and one duct (and discharge air temperature) serves the entire area even though the area may have both interior and perimeter type spaces. In this case, a return air thermostat may only be used. The discharge air temperature to the entire area would be lowered if the return air temperature is high, or the discharge air temperature would be raised if the return air temperature is lower than its setpoint.

If the system is capable of controlling each space individually, you should divide the system areas (from step 1 above) into zones with

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similar load profiles (e.g., exposures). Such subdivisions would be appropriate only if the system has many thermostats (e.g., unitary systems), or large central systems with reheat boxes, mixing boxes (dual duct or multizone), or variable air volume boxes. If one discharge air temperature satisfies the entire area, as in the case of single zone, furnaces, or heating and ventilating units, for example, it would not be appropriate to subdivide this area into separate zones by exposure. A house, for example, has different load profiles for each exposure, but generally only one thermostat.

In subdividing system areas into zones with similar load profiles, you should consider not only exposures but also the function or use of the areas. For example, a south-facing office area would have a different load profile than a south-facing computer room, cafeteria, conference room, or entrance lobby. Because ASEAM3.0 uses diversified or average loads for occupied and unoccupied periods, the division by use or function is more important for building energy analysis programs that use hour-by-hour calculations.

Given the constraint that ASEAM3.0 can model a maximum of 15 zones, it may be necessary to combine different areas into a single zone. In this case, you must weight-average your data entries. For example, the activity of (and heat generated by) people in a gymnasium zone varies widely, and your data entry should reflect a weighted average of all the people. If you must combine office areas with storage space, corridors, and toilets, the data requirements for lighting, people, miscellaneous electrical loads, and diversity factors should also be a weighted average value for the entire zone.

Finally, you also may want to consider the ECOs in subdividing building areas into zones. If you plan to investigate several changes in one particular area of the building, it may be advantageous to make this area a unique zone. Because ECOs may only apply to certain areas, data entry can be facilitated by making these areas individual zones at the beginning rather than calculating new weighted average values (e.g., lighting) for all ECO changes.

4.4 Peak Versus Diversified Loads

ASEAM3.0 calculates both peak (design) heating and cooling loads and diversified, or average, loads during the loads calculation. A seldom-used conference room, for example, may have a large lighting and people load when occupied, and the system must be "sized" to satisfy these peak loads. On average, however, the room is generally unoccupied, and the cooling loads for lighting and people are much less than the design values.

What is most important in the prediction of annual energy use is *not* the peak loads, but the diversified, or average, loads. Peak loads are important primarily in determining the sizes of the HVAC equipment required to satisfy the worst-case heating and cooling loads. ASEAM3.0 uses "diversity factors," or average usage factors, to scale down the peak loads to the diversified or average loads.

Once ASEAM3.0 completes the loads calculations (both peak and diversified), the

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results are then passed to the systems calculations. Note that the systems calculations, while "autosized" based on the peak zone loads, are performed only with the "diversified" loads. The results of the systems calculations (coil loads on the boilers and chiller plants using diversified loads) then are passed to the plant calculations. *Plant loads, therefore, are based only on diversified loads - not peak loads.* Plant equipment sizes, when using the "autosizing" option, therefore are based on worst-case combinations of diversified system loads.

Warning: The peak loads report from the loads calculation should be used with cautions. The peak cooling and heating loads DO NOT include ventilation and latent cooling loads for the system. Using these peak loads to "size" the cooling and heating coils may result in drastically under-sized coils if your building has high ventilations requirements. You MUST manually adjust the cooling coil size to include the effects of ventilation and latent cooling. The heating coil sizes should be adjusted to include ventilation loads. Also, do not use ASEAM3.0 to size the plant equipment. Design loads on the central heating and cooling plants may rarely be coincident with the peak loads from the loads calculations. Peak chiller loads may be driven more by high latent cooling requirements, not peak sensible loads. Boilers may experience greater humidification loads, not at lower but higher outside air temperatures when additional outside air is introduced with an economizer cycle. If the building has an extended unoccupied cycle, your peak chiller and boiler loads may not occur at 4 p.m. and 4 a.m., but rather at 7 a.m. when the systems start up to provide comfort conditions at occupancy.

When using ASEAM3.0 for estimating peak zone loads, you should always use the "installed" or maximum capacity for lighting, miscellaneous electrical, and maximum number of people in a zone, etc. If you use known system sizes (not autosizing) for the conference room in the example above, the annual energy requirements would be the same whether you used 100 people with a diversity factor of 10% or 10 people with a diversity factor of 100%. The peak loads, however, would be entirely different with these two methods.

