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Duct Leakage Modeling in EnergyPlus and Analysis of Energy Savings from Implementing SAV with InCITe™

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ABSTRACT

This project addressed two significant deficiencies in air-handling systems for large commercial building: duct leakage and duct static pressure reset. Both constitute significant energy reduction opportunities for these buildings.

The overall project goal is to bridge the gaps in current duct performance modeling capabilities, and to expand our understanding of air-handling system performance in California large commercial buildings. The purpose of this project is to provide technical support for the implementation of a duct leakage modeling capability in EnergyPlus, to demonstrate the capabilities of the new model, and to carry out analyses of field measurements intended to demonstrate the energy saving potential of the SAV with InCITE™ duct static pressure reset (SPR) technology.

A new duct leakage model has been successfully implemented in EnergyPlus, which will enable simulation users to assess the impacts of leakage on whole-building energy use and operation in a coupled manner. This feature also provides a foundation to support code change proposals and compliance analyses related to Title 24 where duct leakage is an issue. Our example simulations continue to show that leaky ducts substantially increase fan power: 10% upstream and 10% downstream leakage increases supply fan power 30% on average compared to a tight duct system (2.5% upstream and 2.5% downstream leakage). Much of this increase is related to the upstream leakage rather than to the downstream leakage. This does not mean, however, that downstream leakage is unimportant. Our simulations also demonstrate that ceiling heat transfer is a significant effect that needs to be included when assessing the impacts of duct leakage in large commercial buildings. This is not particularly surprising, given that “ceiling regain” issues have already been included in residential analyses as long as a decade ago (e.g., ASHRAE Standard 152); mainstream simulation programs that are used for large commercial building energy analyses have not had this capability until now.

Our analyses of data that we collected during our 2005 tests of the SAV with InCITE™ duct static pressure reset technology show that this technology can substantially reduce fan power (in this case, by about 25 to 30%). Tempering this assessment, however, is that cooling and heating coil loads were observed to increase or decrease significantly depending on the time window used. Their impact on cooling and heating plant power needs to be addressed in future studies; without translating the coil loads to plant equipment energy use, it is not possible to judge the net impact of this SPR technology on whole-building energy use. If all of the loads had decreased, such a step would not be as necessary.

Keywords: airflow, buildings, duct, energy, fan, HVAC, power, retrofits, simulation, system

INTRODUCTION

Overview

Typically in North American large commercial buildings, central HVAC systems supply heated or cooled air to conditioned spaces through a complex network of ducts. Fans generate the large pressure rises needed to circulate the air through the typically long duct runs; the associated fan power is a substantial fraction of HVAC energy use. For example, based on Year 2000 energy estimates by the California Energy Commission (Brook 2002), site electricity consumption for commercial buildings in California was 91,800 GWh that year, with a peak demand of 20,200 MW; 27% (25,200 GWh) of this energy and 50% (10,200 MW) of this peak demand were related to HVAC equipment operation. The CEC also estimates that 39% (9,800 GWh) of this HVAC consumption and 21% (2,100 MW) of this HVAC demand was associated with fan operation; central system supply and return fans represented 56% (5,500 GWh) of this fan-related consumption and 48% (1,000 MW) of this fan-related demand. National energy consumption and peak demand values are on the order of ten times larger.

Although the energy efficiency of many HVAC components in commercial buildings has substantially improved over the past 20 years (e.g., chillers, air-handler drives), there is still a need to make other equally critical components more efficient (e.g., the air handling system itself, which links heating and cooling equipment to occupied spaces). For example, field tests by Lawrence Berkeley National Laboratory (LBNL) in a dozen large commercial buildings suggest that supply duct leakage is widespread and can be as large as 10 to 25% of air-handler flow (Wray et al. 2005). Measurements by Diamond et al. (2003) in a large commercial building confirmed research-grade simulation results (Franconi 1999; Wray and Matson 2003) that supply duct leakage alone can significantly increase HVAC system energy consumption: adding 15% leakage (referenced to the average flow through the supply fan during its operation) leads to a fan energy increase of 25 to 35%.

Using a duct-static-pressure reset (SPR) control strategy to reduce duct static pressures (so that at least one terminal box damper is nearly fully open) has the potential to save as much fan energy as does sealing supply duct leaks. For example, recent measurements of duct static pressures by Hydeman et al. (2003) and Federspiel (2005) in three large commercial buildings with variable-air-volume (VAV) systems and constant duct-static-pressure set points showed that the set points were 1.3 to 2.0 times what was needed to operate the system, even at maximum load. Assuming a system is oversized about 60% (EPA 2008) and ignoring other effects on fan pressure rise and efficiency, this suggests that supply fan energy might be reduced by about 25 to 50% in some cases simply by using SPR control. Implementing fan staging strategies and correcting other fan and duct system deficiencies (e.g., reversed fan rotation, belt slippage, inefficient motors, and restrictive duct entries) offer further opportunities for savings.

California Title 24 (CEC 2008a) is one of the most advanced energy codes in the United States and, like ASHRAE Standard 90.1 (2007), already requires SPR for new buildings with VAV systems that include zone-level direct-digital controls (DDC). However, buildings without zone-level DDC, which includes at least half of the building stock (Brook 2002), are not required to use SPR. Furthermore, despite the potential for significant energy savings by improving air-handling systems in large commercial buildings, there are no provisions to credit airtight duct systems in these buildings.

As an example of the possible savings from improving air-handling systems, we crudely estimate that implementing SPR and reducing supply duct leakage airflows has the statewide potential to save about 900 to 2,200 GWh (\$90 to \$220 million) annually and about 170 to 410 MW in peak demand. Our estimates assume that SPR can be implemented in half of the estimated 8 to 39% of existing large commercial buildings with VAV systems, that static pressure set points are 1.3 to 2.0 times what is needed to operate the system even at maximum load (assuming that reducing the pressure translates to fan power savings of 25 to 50%), that three-quarters of existing buildings can benefit from supply duct leakage sealing (Wray et al. 2005), and that the duct leakage that can be eliminated ranges from 10 to 20% of the nominal design supply airflow in each building (fan power increases associated with this duct leakage are 26 to 70% respectively; eliminating this duct leakage translates to fan power savings of 21 to 41%). The lower bounds for savings are based upon LBNL measurements in a Sacramento building; the upper bounds are based upon predictions by Hydeman et al. (2003) and Franconi (1999). Dollar savings assume an electricity price of \$0.10 per kWh.

There are several reasons for the system deficiencies and absence of code requirements described earlier in this section. One, there is a lack of skilled people and procedures to carry out functional performance tests and efficiently operate buildings (PECI 2004). Second, there are no standardized test methods to characterize fan and duct system performance in these buildings, and testing is widely perceived as too expensive and/or unnecessary. Third, demonstrations of the energy savings potentials of related technology are extremely limited. Fourth, mainstream simulation tools such as EnergyPlus with their simplified fan models and lack of duct system models have been unable to simulate the effects of duct leakage, SPR, or other fan and duct system component improvements, so they cannot be used to demonstrate the energy-saving benefits associated with efficient fan and duct systems.

A Duct Leakage Model for EnergyPlus

To support new energy-efficiency standards for duct performance, and to improve calibrated simulations for large commercial buildings that might be used in applications such as fault-detection diagnostics or demand-response analyses, there is a need now to add a duct leakage model to programs such as EnergyPlus. Although the Florida Solar Energy Center (FSEC) has already implemented a duct model in EnergyPlus for residential and small commercial buildings, their implementation is not easily extensible to large commercial buildings. One reason is that the FSEC model relies upon detailed airflow versus pressure modeling of the entire duct network. Consequently, modeling a large commercial building's duct system would require a vast number of inputs, and defining all these inputs is not practical for standards compliance analyses. Other reasons are that the duct models themselves are not well developed (e.g., for junctions) and in many cases the inputs are unknowable (e.g., the location and size of each and every duct leak).

The simple “data driven” leakage-fraction-based TRNSYS models that we developed and used in the California Energy Commission’s “High Performance Commercial Buildings” PIER project (Wray 2003, Wray and Matson 2003) are more practical than the FSEC model, because one can actually measure the few parameters needed for inputs. For example, to model a variable-air-volume (VAV) system, the simpler model only requires specifying the leakage flow upstream of terminal boxes and leakage flow fraction downstream of each box (instead of doing very complicated detailed duct network simulations). Inputs for the simpler model can be determined

using a new diagnostic that LBNL has developed to accurately, rapidly, and inexpensively measure duct leakage flows for entire duct systems (Delporte 2004, Wang and Sherman 2004). This new diagnostic is a simple extension of current test and balance activities (and duct leakage area testing) in large commercial buildings. It will also be useful for verifying duct sealing if credits are claimed in future standards compliance analyses.

Field Evaluation of New Duct Static Pressure Reset Technology

Over the past several years, with support from the Commission's EISG program, Federspiel Controls developed a simplified method for SPR control of VAV systems. The method is called Static pressure Adjustment from Volume flow (SAV). SAV controls duct static pressure based on a duct pressure-supply fan airflow correlation that is determined using InCITe™, which is a simple diagnostic procedure and model of system operation. Significant advantages of the new method are that it is potentially more reliable than SPR strategies that rely on zone-level DDC-control and VAV box damper position sensing, and it extends the applicability of SPR control to most VAV systems.

To assess the energy savings achievable by the SAV with InCITe™ method, in 2005, LBNL carried out a DOE-funded SPR intervention study in a 955,000 ft² office building located in Sacramento. This building is particularly useful because we had already extensively characterized its air-handling systems on Floors 16 and 17 for our 2002 CEC/DOE-funded duct leakage intervention study, and we had validated relevant sensors in the building's Energy Management Control System (EMCS).

In the SPR intervention study, we continuously measured supply fan, VAV box induction fan, and electric reheat coil power on the reference "control" floor (Floor 16, where constant static pressure was maintained in the main duct), and on the "intervention" floor (Floor 17, before and after we changed constant static pressure control to SPR control). For each of the two floors, we also measured the supply fan airflows and, on the intervention floor, the static pressure rises across the supply fans.

In addition to the electrical energy measurements, we also made measurements to assess the impact of static pressure reset on HVAC system thermal performance (e.g., changes in heating and cooling coil loads). Specifically, we also measured air temperatures and relative humidities upstream and downstream of the preheat and cooling coils, and at the air-handler exit (downstream of the supply fan). These measurements allow us to calculate coil loads.

Monitoring was carried out over about a one month period before and one month after the SPR intervention so that we could average out the separate effects of weather-induced thermal loads. Data were recorded once per minute. Until this project, only a preliminary analysis of two days of data had been carried out. The results are encouraging: it appears that the SAV with InCITe™ strategy saved about one third of the supply fan power. Detailed analyses still need to be completed and the results need to be disseminated. Completion of this work would contribute to the PIER program objective of improving the energy cost and value of California's electricity by demonstrating through measurements how Commission-funded technology (SAV with InCITe™) can save substantial amounts of the HVAC energy in large commercial buildings. We expect that the knowledge gained from this research could be used to craft new requirements for commercial duct system efficiency in future revisions of California's Title 24.

Goal and Purpose. The overall goal of this project is to bridge the gaps in current duct performance modeling capabilities, and to expand our understanding of air-handling system performance in California large commercial buildings. The purpose of this project is to provide technical support for the implementation of a duct leakage modeling capability in EnergyPlus, to demonstrate the capabilities of the new model, and to carry out analyses of field measurements intended to demonstrate the energy saving potential of the SAV with InCITe™ technology. We expect that this new capability and information will assist the California building industry in designing better thermal distribution systems for new commercial buildings and in retrofitting existing systems to reduce their energy consumption and peak electrical demand. We also expect that this work will provide a solid foundation for future efforts that address the energy efficiency of large commercial duct systems in Title 24.

Objectives. To address the needs described above, there are three technical objectives in this project:

- Provide technical assistance to the Simulation Research Group (SRG) at LBNL to support implementation of our duct leakage model in EnergyPlus.
- Carry out simulations to demonstrate the utility of the new duct leakage model. This effort provides an opportunity for us to assess the impacts of duct leakage on the heat transfer between the conditioned spaces and ceiling return plenum, which could not be done using the sequential “user hostile” DOE-2/TRNSYS simulation techniques that we used previously.
- Carry out analyses of the measured data to determine the energy savings from implementing the SAV with InCITe™ SPR control in a large commercial building, and document our findings.

The remainder of this report describes the work carried out to meet these objectives and presents the related results.

DUCT LEAKAGE MODELING WITH ENERGYPLUS

Energy Performance of Buildings Group staff at LBNL already had documented the simple “data driven” duct leakage model that is now successfully implemented in EnergyPlus, by publishing details about the model in a report for the California Energy Commission’s “High Performance Commercial Buildings” PIER project. Originally, the model was not in a form that could be directly inserted into EnergyPlus, nor was the documentation in a format consistent with EnergyPlus engineering and source code documentation requirements. In this task, we worked with Simulation Research Group (SRG) staff at LBNL to translate the model and its documentation into a format that is usable for EnergyPlus. This effort included generating input descriptors for EnergyPlus’s Input Data Dictionary (IDD), generating default input values, and identifying appropriate output report parameters. It also included providing technical review of SRG’s debugging efforts during initial and detailed programming phases of the model implementation. The model is available in the current release of EnergyPlus.

In particular, the EnergyPlus improvements involved inserting elements of the TRNSYS duct model into EnergyPlus to account for the transfer of air and energy between the ducts and the environment surrounding the ducts (e.g., a ceiling return plenum). EnergyPlus already had models for coils, fans, and the ceiling return plenum, so there was no need to add those capabilities from TRNSYS. The engineering and input/output reference documentation produced

from these efforts is publicly-available at: <http://apps1.eere.energy.gov/buildings/energyplus/>, and is also included in Appendices A and B, respectively. The source code related to the new model is provided is available from DOE upon request, subject to license requirements. Because of the size of the modules containing the leakage model (several hundred pages), for practical reasons we have not included them as part of this report. Inserting only the changed lines of code would be meaningless, because the code cannot be read out of context.

Simulation Inputs

To test the new duct leakage model and to demonstrate its utility, we used the modified version of EnergyPlus with the new duct leakage model (Version 3.1) to simulate a single-duct VAV system in a prototypical large office building, which we used in previous modeling efforts (Wray and Matson 2003). The building represents new construction practice in a Sacramento climate. It is a ten story, 150,000 ft² office building. Each story has a floor area of 15,000 ft² and is divided into five zones: four 15-ft wide perimeter zones and one core zone. Each set of five zones has a ceiling plenum above them that serves as the return air plenum. The supply and return fans in the VAV system each have variable-speed-drive control. Although not modeled explicitly, we assumed that the HVAC control system varies the supply fan airflow to maintain a constant duct static pressure upstream of the VAV boxes. A water-cooled hermetic centrifugal chiller supplies chilled water to the air-handling system cooling coil, and rejects heat outdoors using a forced-draft cooling tower. A natural-gas-fired boiler supplies hot water to the VAV box reheat coils. The chiller, boiler, and pumps are located in a below-grade basement.

The five combinations of upstream and downstream duct leakage (fractions referenced to design flows) that we simulated were as follows:

- zero duct leakage (an ideal that is not likely attainable in practice),
- 2.5% upstream and 2.5% downstream of the VAV boxes (a realistic tight system),
- 10% upstream and 2.5% downstream (a system with leaky main ducts),
- 2.5% upstream and 10% downstream (a system with leaky branch ducts, and
- 10% upstream and 10% downstream (a system with leakage in all sections).

We simulated only one building and climate combination, because our past analyses showed that climate and building vintage differences do not cause significant variability in duct leakage impacts on fan energy use or on operating cost for leaky duct systems.

The VAV system that we simulated used the same size system and plant equipment for the various duct leakage cases. In particular, the supply (and return) fan design airflow was determined by the high-leakage case (10+10), because the maximum airflow occurs for that case. EnergyPlus “autosizing” was used to determine equipment capacities for this case.

An important step in this task was the translation of the DOE-2 and TRNSYS simulation inputs to create comparable EnergyPlus Input Data Files (IDF). The input data files that we generated in this task are usable as test files for the EnergyPlus test suite, and could be included in the future as part of the minimum conformance test series in the Title 24 Alternative Calculation Method (ACM) Approval Manual. The input file for the last combination of duct leakage is included in Appendix C.

Upstream and downstream duct leakage is specified simply in the EnergyPlus IDF using the “ZoneHVAC:AirDistributionUnit” object for each above-grade occupied zone. An example for one of the zones that we simulated is as follows:

```

ZoneHVAC:AirDistributionUnit,
PER-1T ATU,           !- Name
PER-1T Supply Inlet,  !- Air Distribution Unit Outlet Node Name
AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
PER-1T VAV Reheat,   !- Air Terminal Name
0.1,                 !- Nominal Upstream Leakage Fraction
0.1;                 !- Constant Downstream Leakage Fraction
    
```

Simulation Results

We begin by presenting graphical results from our simulations of the leakiest case (10% upstream and 10% downstream) relative to the “tight” case (2.5% upstream and 2.5% downstream), followed by a summary of energy impacts for all five leakage cases.

Figure 1 shows that fan power significantly increases with duct leakage, but the increase is not constant over the year. As Figure 2 shows, the most frequent increase is a factor of 1.3 compared to the 2.5+2.5 case. Ratios of 1.22 to 1.40 also occur in several cases, but much less frequently.

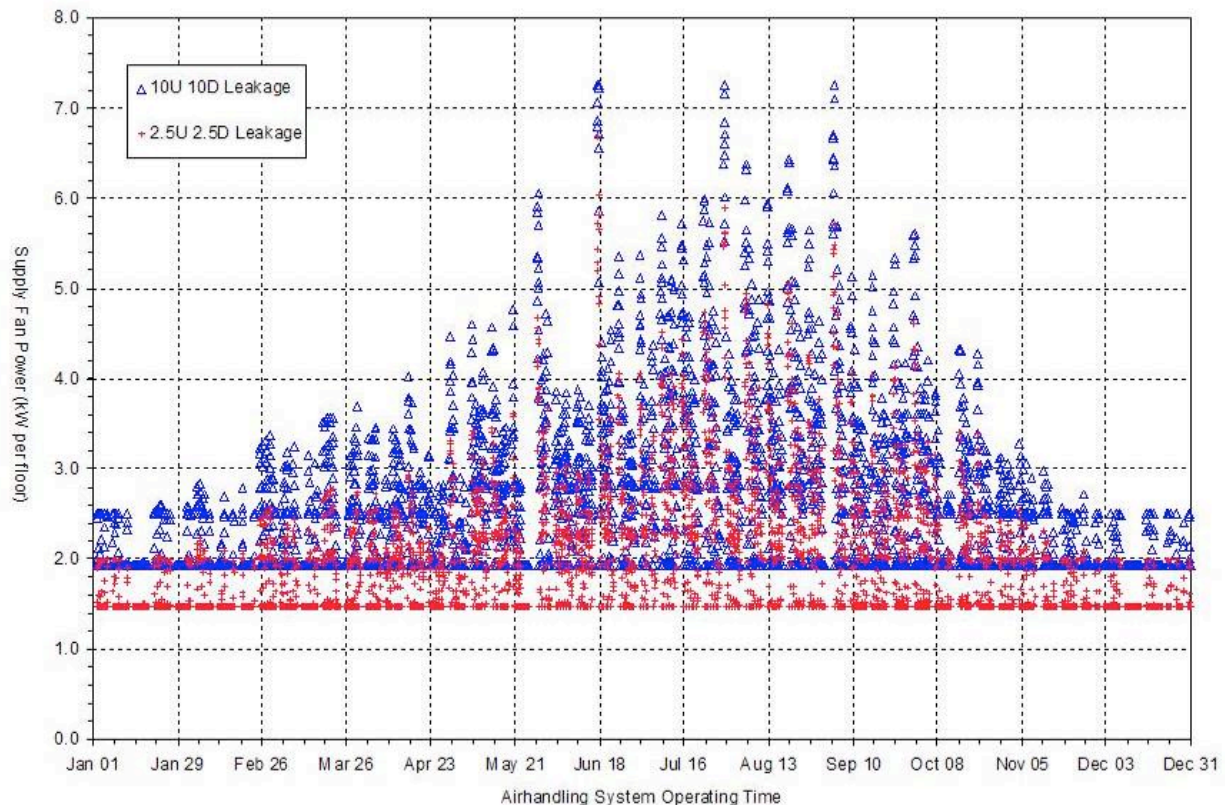


Figure 1. Supply Fan Power Variation with Leakage and Time

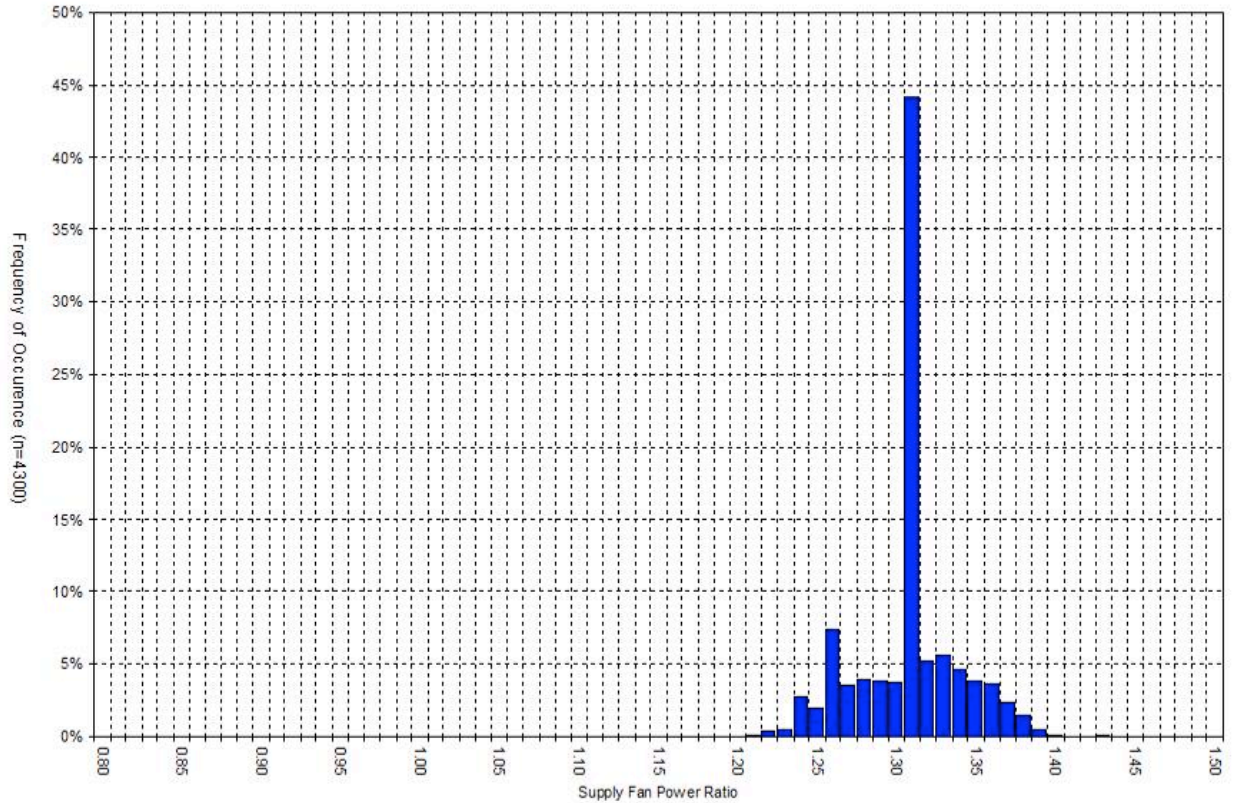


Figure 2. Supply Fan Power Increase (10+10 Case Relative to 2.5+2.5 Case)

These increases are substantially less than had been previously predicted using the hybrid DOE-2/TRNSYS simulation approach (ratios of about 1.5 for a similar comparison, Wray and Matson 2003). They agree, however, reasonably well with our field test results (Diamond et al. 2003): factors of 1.25 to 1.35 for similar leakage conditions.

Some of the differences can be explained by the heat transfer between the ceiling plenum and the conditioned spaces. As Figure 3 shows, when cool air leaks from the ducts, it tends to decrease the temperature of the plenum. In a similar manner, when heated air leaks out (from ducts after the VAV box reheat coil), the plenum temperature rises, but this is an infrequent occurrence. Like fan power, the temperature decrease varies throughout the year, and is largest during peak cooling times (e.g., summer). The largest temperature decrease is about 1.1°C to 1.4°C.

The result of the plenum cooling by duct leakage is that the conduction temperature difference across the ceiling increases, and heat is transferred ("lost") from warmer conditioned spaces to the cool plenum. Consequently, the cooler plenum helps to reduce the space cooling load of the conditioned spaces and less air needs to be delivered through the duct system to meet the thermostat call for cooling.

Figure 4 shows the ceiling heat loss and net zone cooling load relative to the maximum net zone load for the entire year's simulation. The zone load fraction varies between -1.0 (maximum heating) and +1.0 (maximum cooling). As discussed above, relative to the 2.5+2.5 case, the 10+10 case generally has higher heat loss from the conditioned spaces to the plenum. Because of the scatter, however, it is difficult to understand how the heat loss varies with zone load. Figure 5 provides a frequency distribution to simplify the data.

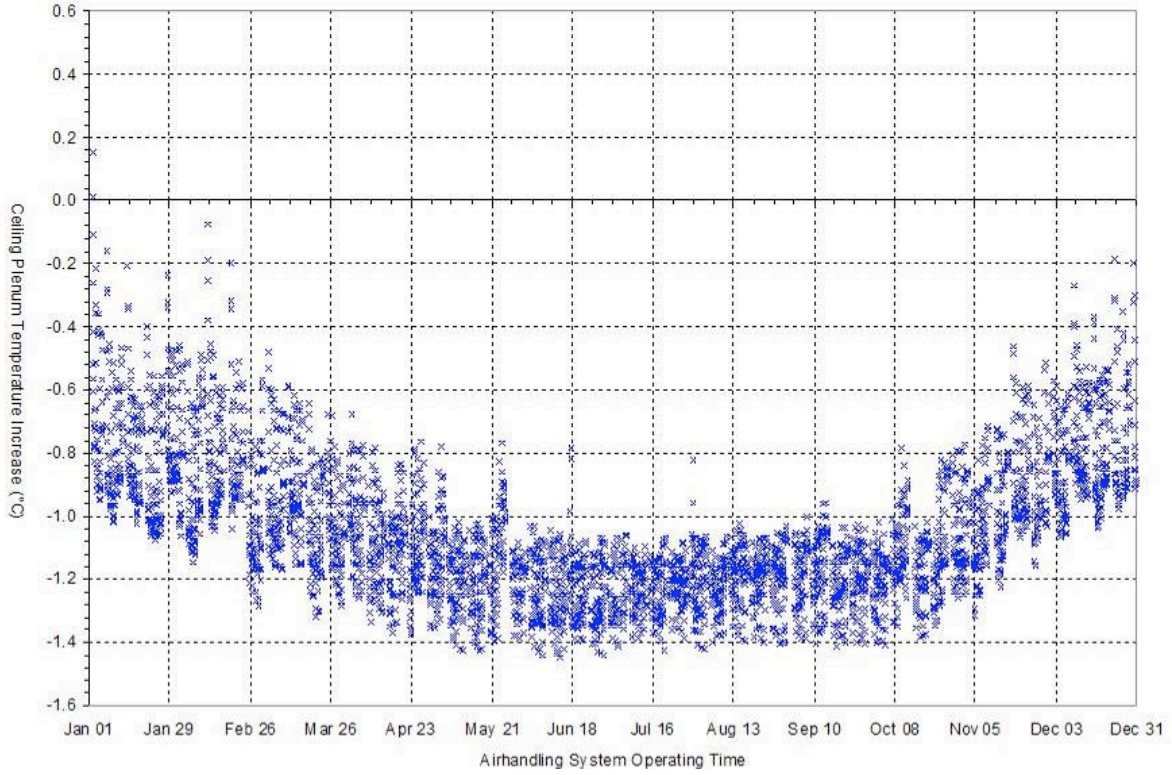


Figure 3. Ceiling Plenum Air Temperature Changes (10+10 Case Relative to 2.5+2.5 Case)

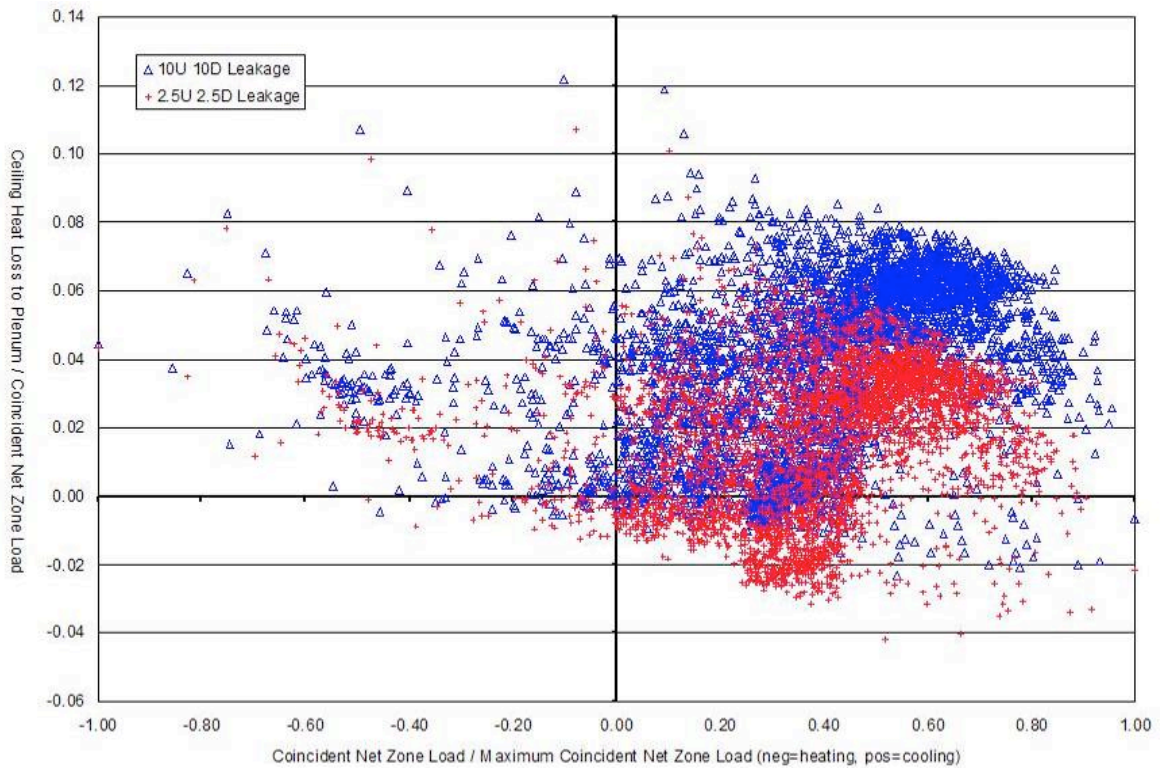


Figure 4. Ceiling Heat Loss Variation with Zone Load Fraction

In Figure 5, two distributions are shown, which are similar in shape, but are not aligned with load. In particular, the ceiling heat loss fraction for the 2.5+2.5 case peaks at +0.035 (11.7% frequency), but has another smaller peak near zero (-0.005, 6.6%), and varies widely from -0.040 to +0.080. For this “tight” duct system, heat loss is usually a small fraction of the zone load. For the “leaky” case (10+10), the heat loss fractions are shifted toward higher losses (greater cooling of the plenum and reduced space conditioning load). In this latter case, the largest peak occurs at a fraction of +0.065 (11.0% frequency), and the heat loss fractions range from -0.020 to +0.125. While still not a large fraction of the zone heat load, not accounting for the impact of the ceiling heat loss and the zone load will lead to overestimates of the effects of duct leakage, as occurred in previous simulations. Because the larger zone loads require more air to be delivered through the VAV boxes and thus by the fan, and because fan power is somewhere between a quadratic and cubic function of airflow, small changes in airflow requirements driven by errors in zone loads can have large impacts on fan power.

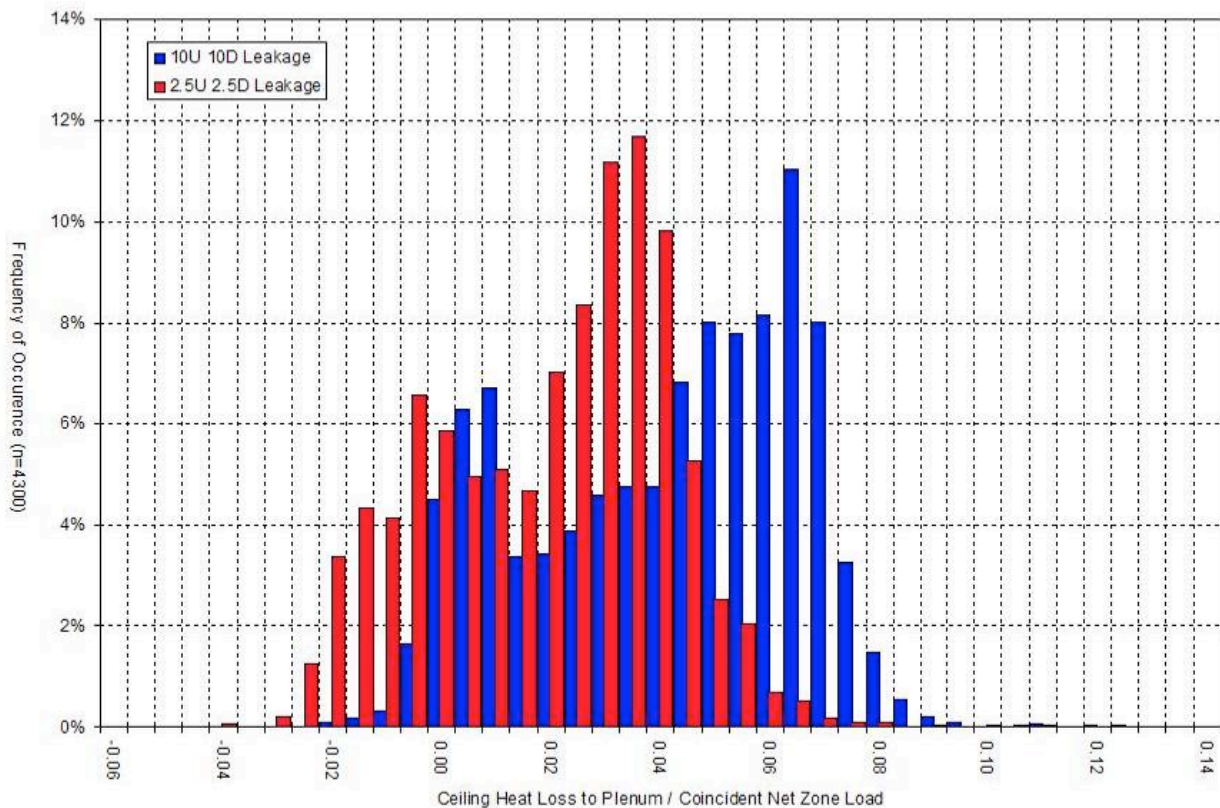


Figure 5. Frequency Distribution of Ceiling Heat Loss Relative to Net Zone Load

Figures 6 through 9 show the effects of increased leakage on cooling and reheat coil loads. These coil loads generally increase only slightly with added leakage. For the cooling coil, most frequently (23.3%), loads do not increase at all. The distribution of increases ranges from zero up to 0.070, with most fractional increases above zero centered in the range of +0.025 to +0.035. For the reheat coils, even more frequently (58.2%), there is no effect of leakage (zero fractional increase). The distribution, however, in this case ranges from -0.005 to 0.060.

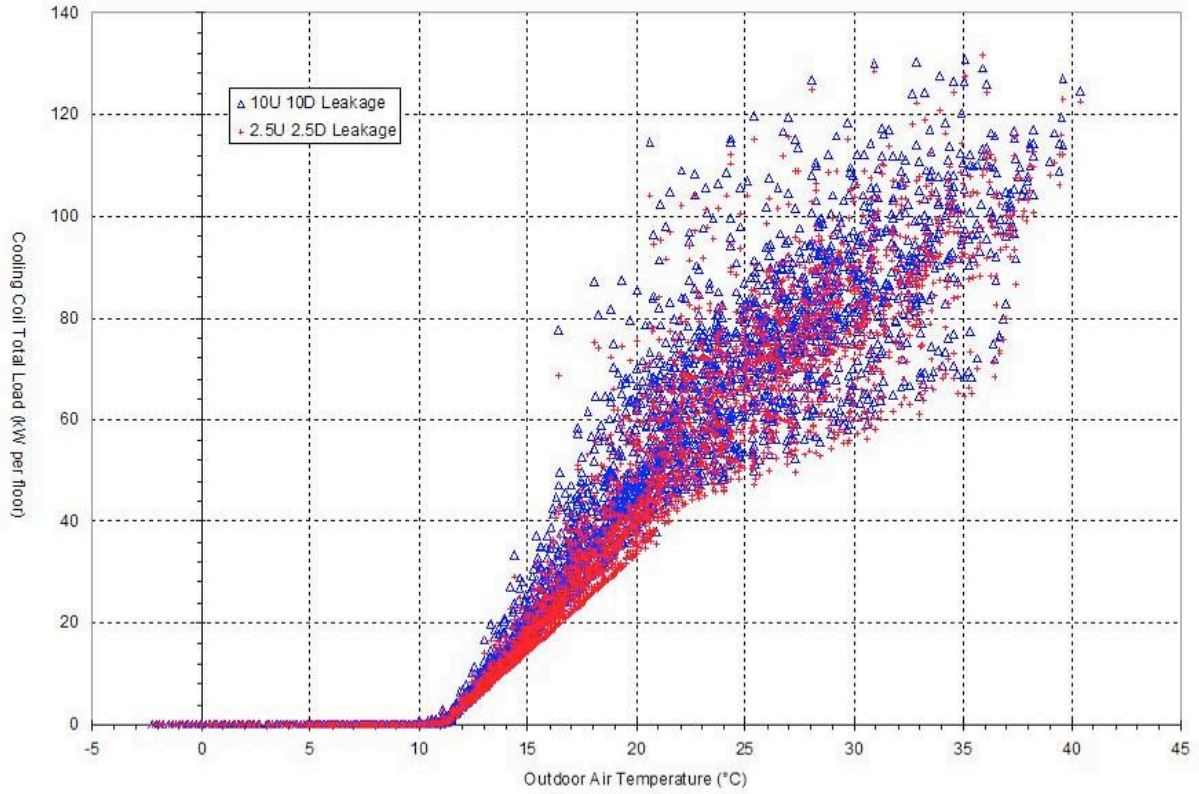


Figure 6. Cooling Coil Load versus Outdoor Air Temperature

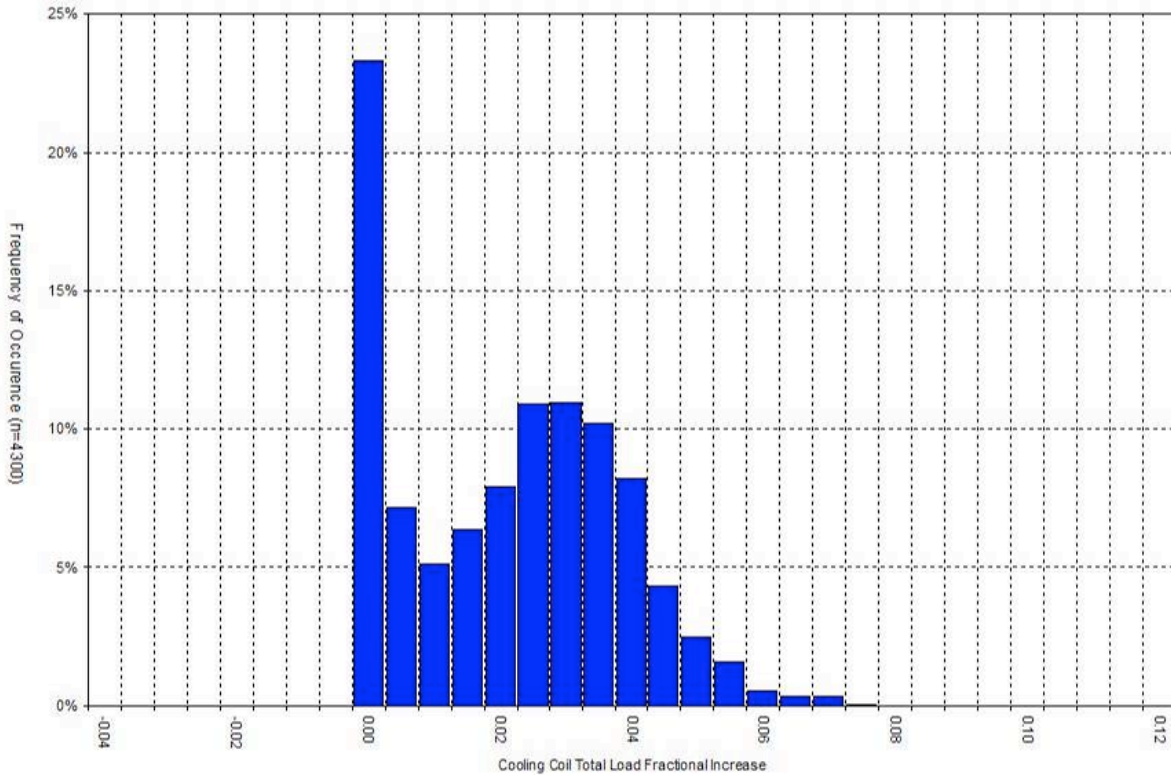


Figure 7. Cooling Coil Load Fractional Increase

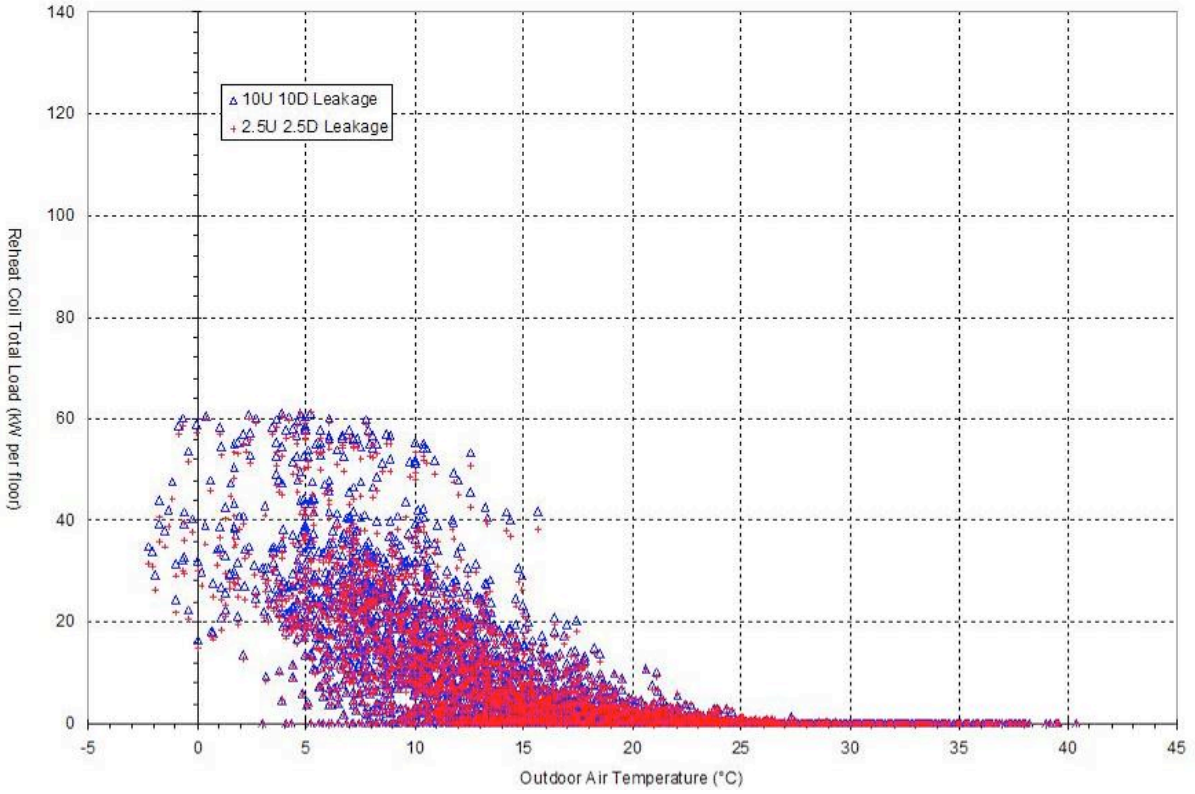


Figure 8. Reheat Coil Load versus Outdoor Air Temperature

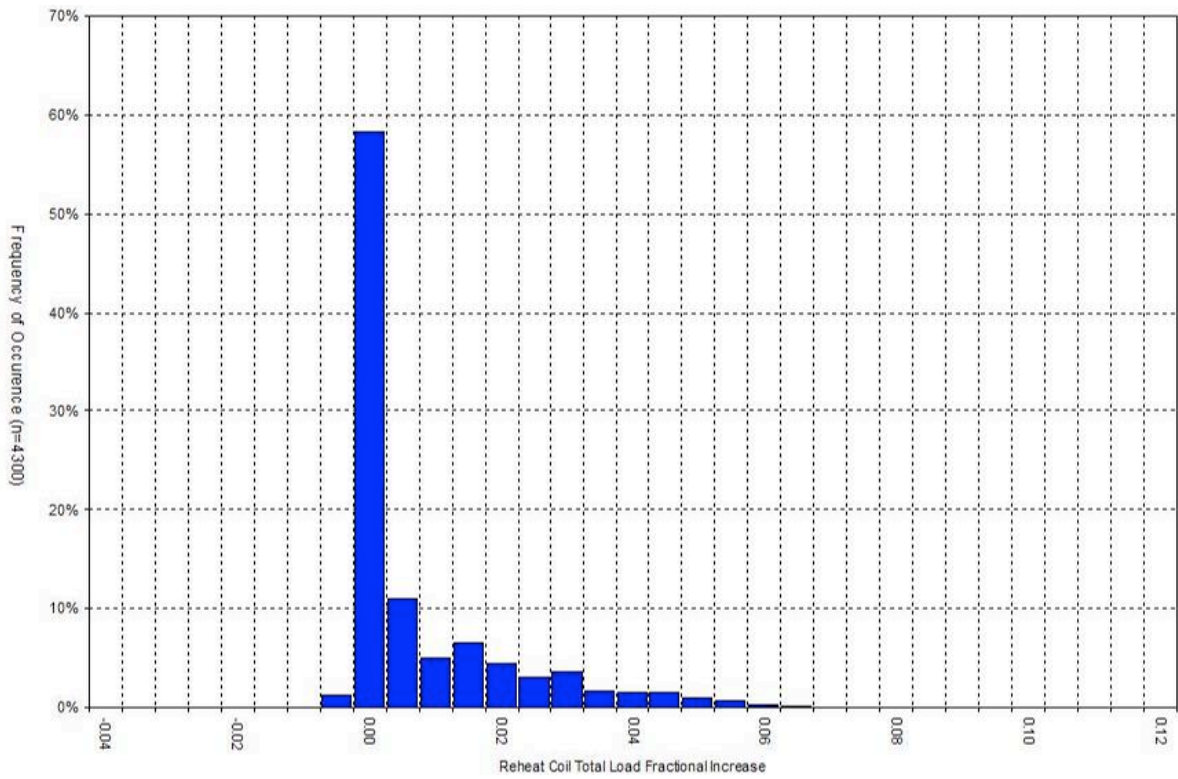


Figure 9. Reheat Coil Load Fractional Increase

Table 1 summarizes the energy impacts of leakage relative to the “tight” 2.5+2.5 case. Annual cooling plant energy is the largest energy use component and ranges from 54 to 57% of the total HVAC system source energy consumption. The fan energy is smaller, but still significant (about 15 to 20%). The leaky system (10+10) increases total HVAC source energy use about 8.4%.

Table 1. Summary of Duct Leakage Impacts on HVAC Site and Source Energy Use

		Leakage Fraction (%)									
		0	2.5	2.5	10	10	0	2.5	2.5	10	10
Upstream	Downstream	0	2.5	10	2.5	10	0	2.5	10	2.5	10
		Site Energy Use (kWh)					Site Energy Use Increase (%)				
Supply Fan		78,282	85,524	90,041	106,685	111,269	-8.5	0.0	5.3	24.7	30.1
Return Fan		26,094	28,508	30,014	35,562	37,090	-8.5	0.0	5.3	24.7	30.1
Chiller		275,713	281,334	284,941	295,112	298,103	-2.0	0.0	1.3	4.9	6.0
Tower		103,918	103,898	103,964	104,324	104,305	0.0	0.0	0.1	0.4	0.4
Boiler Elec		487	502	503	546	548	-3.1	0.0	0.2	8.7	9.2
TOT Elec		484,493	499,766	509,463	542,228	551,315	-3.1	0.0	1.9	8.5	10.3

		Leakage Fraction (%)									
		0	2.5	2.5	10	10	0	2.5	2.5	10	10
Upstream	Downstream	0	2.5	10	2.5	10	0	2.5	10	2.5	10
		Source Energy Use (kWh)					Source Energy Use Increase (%)				
Supply Fan		234,845	256,573	270,124	320,054	333,807	-8.5	0.0	5.3	24.7	30.1
Return Fan		78,282	85,524	90,041	106,685	111,269	-8.5	0.0	5.3	24.7	30.1
Chiller		827,139	844,001	854,822	885,335	894,310	-2.0	0.0	1.3	4.9	6.0
Tower		311,755	311,694	311,893	312,973	312,914	0.0	0.0	0.1	0.4	0.4
Boiler Elec		1,460	1,505	1,510	1,637	1,644	-3.0	0.0	0.3	8.8	9.2
Boiler Fuel		555,038	561,899	538,520	604,144	579,623	-1.2	0.0	-4.2	7.5	3.2
TOT		2,008,518	2,061,197	2,066,909	2,230,829	2,233,567	-2.6	0.0	0.3	8.2	8.4

		Leakage Fraction (%)									
		0	2.5	2.5	10	10	0	2.5	2.5	10	10
Upstream	Downstream	0	2.5	10	2.5	10	0	2.5	10	2.5	10
		Source Energy Use (kWh)					Source Energy Use Increase (%)				
Fans		313,126	342,097	360,165	426,739	445,076	-8.5	0.0	5.3	24.7	30.1
Cooling		1,138,894	1,155,695	1,166,715	1,198,308	1,207,225	-1.5	0.0	1.0	3.7	4.5
Heating		556,498	563,404	540,029	605,781	581,267	-1.2	0.0	-4.1	7.5	3.2
TOTAL		2,008,518	2,061,196	2,066,909	2,230,829	2,233,567	-2.6	0.0	0.3	8.2	8.4

		Leakage Fraction (%)				
		0	2.5	2.5	10	10
Upstream	Downstream	0	2.5	10	2.5	10
		Fraction of Total Source energy Use (%)				
Fans		15.6	16.6	17.4	19.1	19.9
Cooling		56.7	56.1	56.4	53.7	54.0
Heating		27.7	27.3	26.1	27.2	26.0

Interestingly, downstream leakage has a smaller impact than upstream leakage. In the 10+2.5 case (leaky main ducts), supply fan energy increases 24.7%. In the 2.5+10 case (leaky branch ducts), the increase is only 5.3%. The reason for this behavior needs further investigation, but we speculate that leaks downstream of the VAV boxes “look” like supply grilles to the box airflow controller and fan. Consequently, dampers will not modulate to increase box flows when there is downstream leakage, unless the zone temperature deviates from the thermostat set point. Even if the damper does not modulate, the fan energy still increases, however, in the downstream leakage case because insufficient air is delivered to zones (the fan runs longer to deliver enough cooling or heating to meet the load) and because of changes to zone loads caused by related

changes in plenum air temperatures. Previous simulations could not account for the zone coupling effects.

IMPLEMENTING A SIMPLIFIED SPR STRATEGY: ENERGY SAVINGS ANALYSIS

This project analyzed data that resulted from implementing a new duct static pressure reset strategy in an actual large commercial building. The SPR technology was developed with support from the CEC's Energy Innovations Small Grant Program. In particular, Federspiel Controls developed a simple diagnostic procedure and model of system operation that linearly correlates duct static pressure and supply fan airflow (Federspiel 2004, 2005). The diagnostic method simply involves measuring the velocity pressure near the fan inlet (represents fan flow) and the duct static pressure at multiple points over the fan's operating range, while the VAV box dampers attempt to control flow in response to a nominally constant thermostat set point. The goal is to define the characteristics of the linear region where all VAV boxes are in control (dampers modulating). In this model, the linear correlation between P_{sm} and Q_{fan} that is used to determine the duct static pressure set point is as follows:

$$P_{sm} = P_{sm,\min} + (P_{sm,\max} - P_{sm,\min}) * \frac{(Q_{fan} - Q_{fan,\min})}{(Q_{fan,\max} - Q_{fan,\min})} = C_1 + C_2 * \frac{(Q_{fan} - Q_{fan,\min})}{(Q_{fan,\max} - Q_{fan,\min})}$$

where P_{sm} is the duct static pressure set point and Q_{fan} is the airflow through the supply fan at standard conditions. In a separate project funded by DOE, work is currently underway to implement this strategy in EnergyPlus, along with a fan system component model (fan, belt, motor, and variable-frequency-drive), and a duct system model (to determine fan pressure rise).

Energy Performance of Buildings Group staff at LBNL carried out analyses of the data that we measured in 2005 to determine the energy savings from implementing SAV with InCITETM. This effort included:

- synchronizing the data that we collected from approximately 250 sensors, each of which recorded time separately,
- normalizing the post-intervention performance data using the pre-intervention data as a reference to account for weather and operational differences between monitoring periods, and
- calculating the fan, preheat and reheat coil, and cooling coil energy savings relative to the pre-intervention period.

The following describes the test building, our measurements, the analysis, and our findings regarding the energy savings from implementing SAV with InCITETM.

Test Building

Diamond et al. (2003) describe the office building in Sacramento where we implemented the SPR strategy. In summary, the building was first occupied in 2001, has 25 stories, and a total floor area of 955,000 ft². Our study focused on two floors with similar occupancy and use (each approximately 29,000 ft²). We had already extensively characterized the HVAC system operation on the intervention (17th) floor in our past efforts to study the impacts of duct leakage; this is where we installed the SPR technology. We used the 16th floor as a control (i.e., no changes to the HVAC system) for comparison to the intervention floor.

Each floor has four separate air-handlers, with two nominal 15,000 cfm, 15 hp supply air-handlers per floor and two nominal 10,000 cfm, 5 hp relief air-handlers per floor. Each pair of supply and relief air-handlers is located in a separate mechanical room at the northeast and northwest corners of each floor, and each air-handler uses an EMCS-controlled variable-frequency-drive. Each supply air-handler is a draw-through packaged unit that is equipped with an air mixing chamber, a filter section, a hot-water air preheat coil, a chilled-water air cooling coil, and a backward-curved plug fan. Each relief air-handler uses a backward-curved tube-axial centrifugal fan. A central plant with boilers and chillers supplies the appropriate air-handler coils with cold and hot water.

Together, the two supply air-handlers on each floor serve a single-duct VAV system supply loop that in turn serves 34 VAV boxes on the intervention floor and 38 boxes on the control floor (see Figure 10). The difference between the numbers of zones on the two floors is due to slight changes in room configuration, and does not affect our findings. A single duct-static-pressure-sensor in each loop is located at the farthest point from the air-handlers. The 13 perimeter VAV boxes on the intervention floor and the 14 perimeter boxes on the control floor have discharge electric reheat coils (750 to 2,500 W, staged) and are parallel-fan-powered (1/6 and 1/4 hp induction fans), with the fans drawing their induction air from the ceiling plenum return through a pleated filter and discharging into the primary air section of the box through an adjustable fixed-stop gravity backdraft damper. The core VAV boxes have no reheat and no induction fans. Each VAV box inlet has a flow grid located immediately upstream of its EMCS-controlled primary air damper.

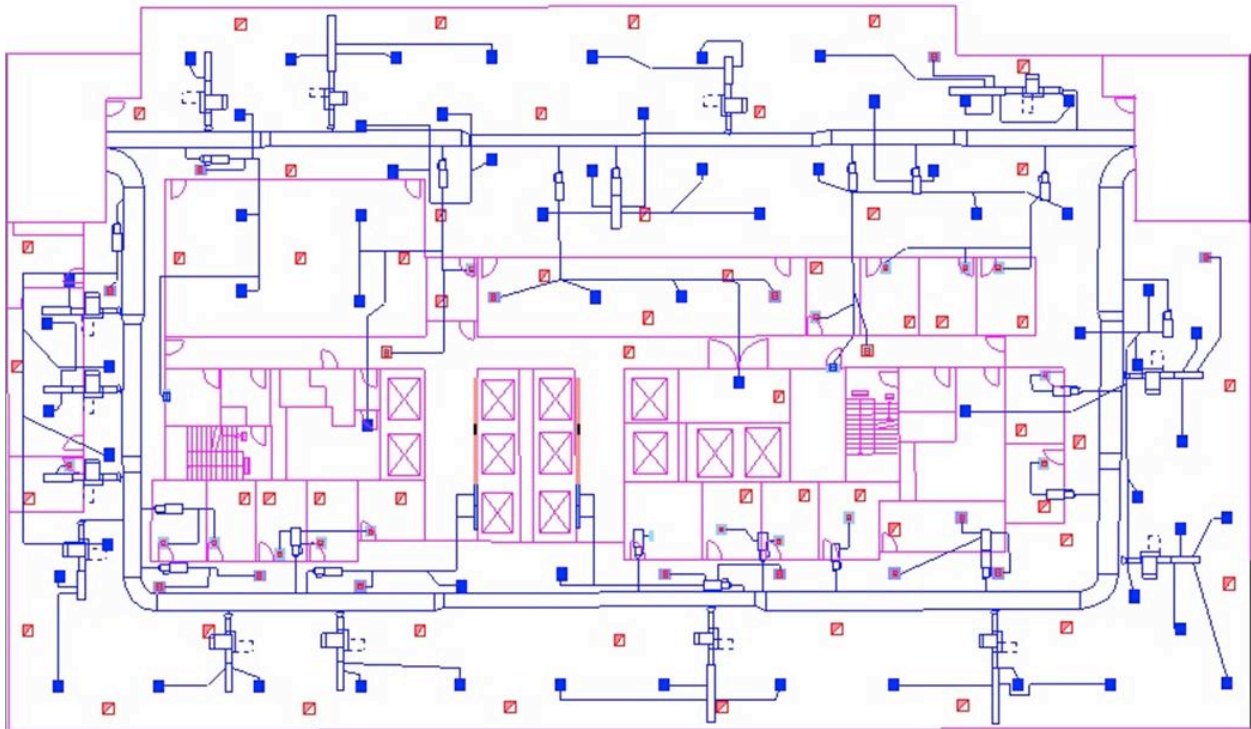


Figure 10. Duct Layout for Intervention Floor (control floor duct layout is similar)

In total, the VAV boxes on the intervention floor serve 103 supply grilles, each with a manual volume damper located near the branch takeoff. Most supply grilles use 2' x 2' perforated-face

grilles and discharge in multiple directions; exceptions are the wall grilles in the two electrical rooms, a discharge with no grille in the communications equipment room, and the linear slot diffusers in the two main elevator lobbies. The 2' x 2' grilles sit in the ceiling between T-bar sections, with a small gap between the grille edges and the T-bar sections.

With the exception of the elevator lobbies (portions of the slot diffusers also serve as return grilles), ceiling returns are 2' x 2' perforated-face grilles. The mechanical rooms are each connected to the ceiling space through a short return transfer duct, and serve as a large plenum from which the supply air-handler draws its return air through EMCS-controlled return dampers.

Using duct leakage airflow diagnostics, we previously determined that the actual airflow through the duct leaks is small (about 5% of total air-handler supply airflow at operating conditions). The test building showed every indication of a “tight” thermal distribution system: good application of mastic, metal bands at joints, and overall high quality.

Outdoor air is ducted to each supply air-handler mixing box from a wall louver and through two parallel EMCS-controlled dampers: a minimum outdoor air damper and a larger economizer damper. Return air is exhausted directly from each mechanical room to outdoors by the relief air-handler, as needed to control indoor-outdoor pressure difference for the floor. The indoor pressure appears to be referenced to the outdoor pressure at the building roof.

The building operated in cooling mode during our SPR intervention study. If pre-cooling is not needed, the HVAC systems are put into occupied mode around 5:00 a.m. and the systems run to maintain zone temperature conditions until 6:00 p.m. If pre-cooling is needed (dictated by building and outdoor temperatures measured at midnight), the corresponding HVAC system is put into economizer mode (outdoor air dampers fully open) and the air-handler supply fans are operated for pre-cooling. The relief fans run as needed to maintain building pressures.

During the occupied mode, the discharge duct temperature measured at the outlet of the supply air-handlers is used to control the heating and cooling valves serving the coils upstream of the air handler supply fan. A supply air temperature reset strategy is used. In particular, on each floor, the EMCS monitors about a dozen zone thermostats to identify the temperature of the warmest zone. Using that temperature, supply air temperature is linearly reset: a supply air temperature of 60°F corresponds to a zone temperature of 78°F; a supply air temperature of 70°F corresponds to a zone temperature of 74°F.

Measurements

We extensively monitored the intervention and control floors to characterize HVAC system operation and to determine the impact of SPR on fan and coil energy consumption. The monitoring occurred over the period from early June 2005 to early August 2005. Results from past monitoring during 2001 to 2003 were useful to troubleshoot the operation of our monitoring equipment and to validate the data being collected using the building’s Energy Management Control System (EMCS). Our monitoring using the EMCS involved recording data for 310 measurement points. In addition, we installed 44 temperature, relative humidity, pressure, and power monitoring points. Table 2 summarizes these 354 points.

Table 2. Monitoring Point Summary

	<i>EMCS Monitoring</i>	<i>LBNL Installed Monitoring</i>
<i>Supply Fans</i>		Electricity consumption, fan pressure rise, fan airflow
<i>Relief Fans</i>		Electricity consumption
<i>Outdoor Air Supply</i>	Minimum outdoor airflow; economizer damper position	Air temperature; relative humidity
<i>Return Air</i>	Damper position; air temperature; relative humidity	Airflow, air temperature; relative humidity
<i>Air Handler Cabinet</i>	Supply air temperature (after fan)	Supply air temperature and relative humidity (after supply fan and before preheat coil); air temperature between cooling coil and supply fan
<i>Zones (All)</i>	Zone air temperature, primary airflow	
<i>Zones (All with Induction Fans and Heaters)</i>	Induction fan status (off / on); box reheat status (off / 1 st stage / 2 nd stage)	
<i>Zones (Selected)</i>		Supply air temperature at the farthest grille from each of six selected VAV boxes
<i>Outdoor Conditions</i>	Air temperature; relative humidity	Air temperature; relative humidity
<i>Miscellaneous Temperatures and Pressures</i>	Static pressure in supply loop (one location per floor); indoor-outdoor static pressure difference	Static pressure in middle of each supply loop section (east, south, west, and north); ceiling plenum air temperature (four locations, intervention floor)

Duct static pressures that we measured were sampled using approximately 1 mm diameter holes drilled into the middle of each of four duct walls. The holes were each covered with a magnet that had a pressure tap attached using epoxy. The four taps were connected together with tubing to provide one “average” duct static pressure signal for each location. All single-ended measured pressures (e.g., duct static pressure) were referenced to the ceiling plenum.

On the zone level, for the VAV boxes with induction fans, the EMCS recorded induction fan status (on / off) and box heater status (off / stage 1 / stage 2). In our previous tests, we had already measured the induction fan power as a function of VAV box primary airflow reported by the EMCS. The EMCS primary airflow and fan status data were then used to calculate induction fan energy over the test period. We also used previously measured data for the heater power for each powered VAV box to calculate reheat coil power.

Data Synchronization

We used the duct static pressure signal to synchronize data. Our data were recorded at 1 minute intervals; EMCS data were recorded at 5 minute intervals. We interpolated to estimate missing values. For longer time periods (up to 60 observations once or twice a week during EMCS data download by building staff), we interpolated based on two values: the average of the observations in the hour before the missing data and the average of the observations in the hour after the missing data. This approach did not change the results significantly. We used the factory calibration for the power transducers and used previously calibrated airflow and pressure measuring equipment as discussed by Diamond et al. (2003).

Analysis

We selected two approximately two-week periods for our analysis: June 8 to June 21 and July 20 to August 3. These periods had the most continuous sets of data from our monitoring period. Synchronized data were imported into Excel for graphing and energy saving calculations. A separate psychrometric calculator coded in Excel by LBNL staff, based on ASHRAE algorithms (1996), was used to generate humidity ratio, air density, and specific enthalpy values corresponding to each air temperature and relative humidity measurement. We found that the calculated humidity ratios, however, were inconsistent through the air-handlers. In many cases, humidity ratios increased from before the coils to after the fan, which should not happen unless water is added to the air-stream, which it was not. Consequently, because the humidity-based data were unreliable, our analyses of coil loads focused on sensible loads and not total loads.

Figure 11 shows a comparison between supply fan flow and outdoor air temperature. There is no apparent correlation visible. Consequently, it is not possible to scale parameters with outdoor temperature, as is sometimes done in savings analyses.

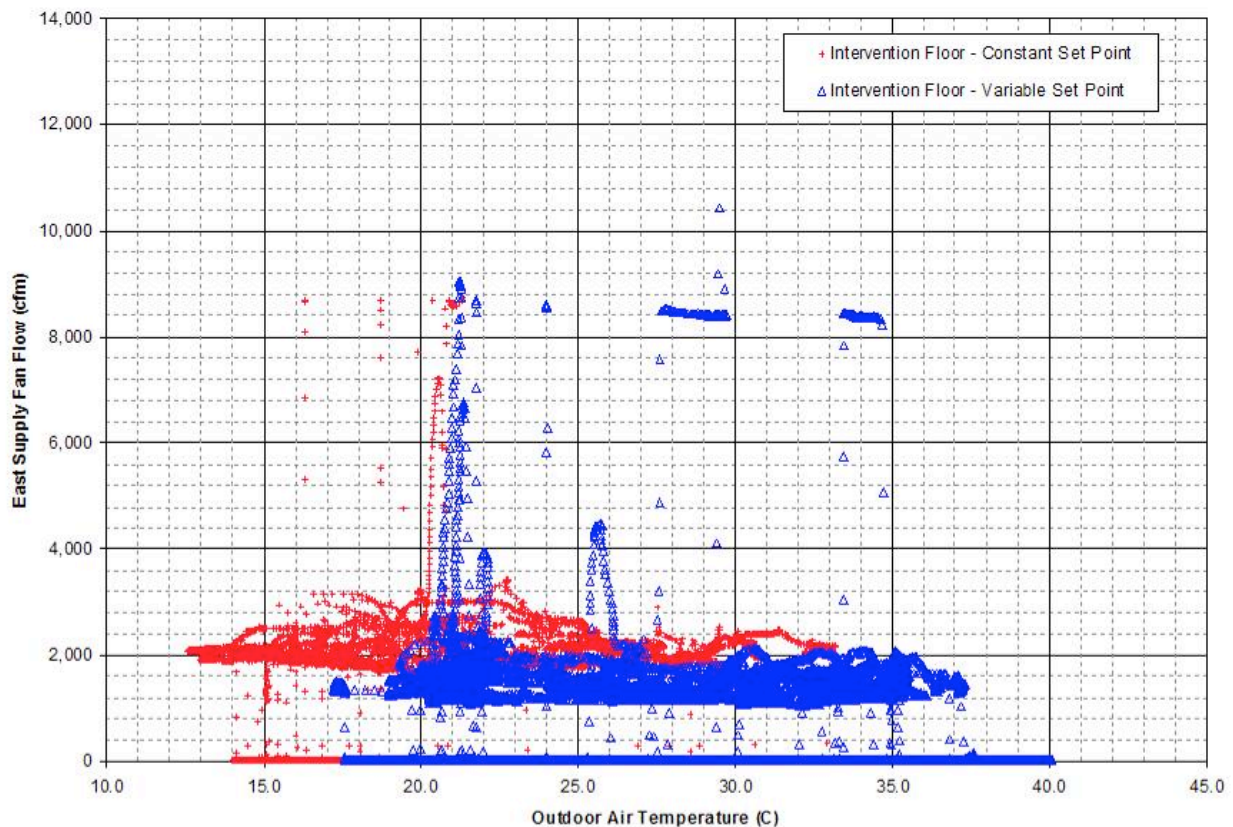


Figure 11. Comparison between Supply Fan Airflows and Outdoor Temperature

To take temperature differences and corresponding operational differences into account for different periods, a normalization procedure was used to adjust the airflows (or other variable such as power) measured on the intervention floor during the pre-SPR period to what would be measured during the SPR period if SPR had not been implemented, assuming that changes on the intervention floor occur in the same proportion as on the control floor. The adjusted value of interest is calculated as follows:

$$\bar{X}_{I,adjusted} = \bar{X}_{IB} \times \frac{\bar{X}_{CS}}{\bar{X}_{CB}}$$

where

- X = the variable being studied for the time period specified,
- IB = measured value for intervention floor, base case time period,
- CS = measured value for control floor, SPR time period, and
- CB = measured value for control floor, base case time period.

The fractional change in the parameter of interest is:

$$FractionalChange = 1 - \frac{\bar{X}_{IS}}{\bar{X}_{I,adjusted}}$$

where

- IS = measured value for intervention floor, SPR time period.

A *positive* fractional change represents a *reduction* in energy use. Conversely, a *negative* value represents an *increase*.

Unless otherwise noted, these equations were used to calculate the normalized changes due to SPR for two time periods: 5:00a to 6:00p and 2:00p to 6:00p (peak). In order to compare a variable for the same time period for both the control and intervention floor, we included only those observations when both control and intervention floor air-handler supply fans were on.

Findings

Figure 12 shows the duct static pressure set point strategies, before and after SAV with InCITE™ was implemented. Prior to implementation, the duct static pressure set point was constant at about 250 Pa (1 in.w.c.). After implementation, as expected, the set point varies with flow: from about 250 Pa at maximum flow to about 100 Pa at 4,000 cfm and below. It is unclear why some of the post-implementation set points deviate from the linear function of flow, but in general there are few instances where this occurs. The majority of the data are located between about 2,700 cfm and 6,400 cfm, well below the maximum flow of about 13,000 cfm. This means that the fan is operating at low part-loads. Without knowing more about the fan characteristics, however, it is not clear whether the part-load operation results in reduced efficiency or surge.

The actual response to the set points for the intervention floor is shown in Figure 13. Figure 14 shows the actual response for the control floor, where the set point remained constant at about 250 Pa throughout the tests. There are several instances when the measured pressure does not match the set point on the intervention floor. It is likely that many of these differences correspond to times when the fan is speeding up or slowing down. The points near zero are for times when the fan is off. The reason for the cluster of points at about 150 Pa and high flows is unknown. One possibility is that it corresponds to times when VAV box and other dampers are opened for pre-cooling and the system is unable to maintain its set point due to the low system resistance. It is unclear why similar behavior does not occur on the control floor.

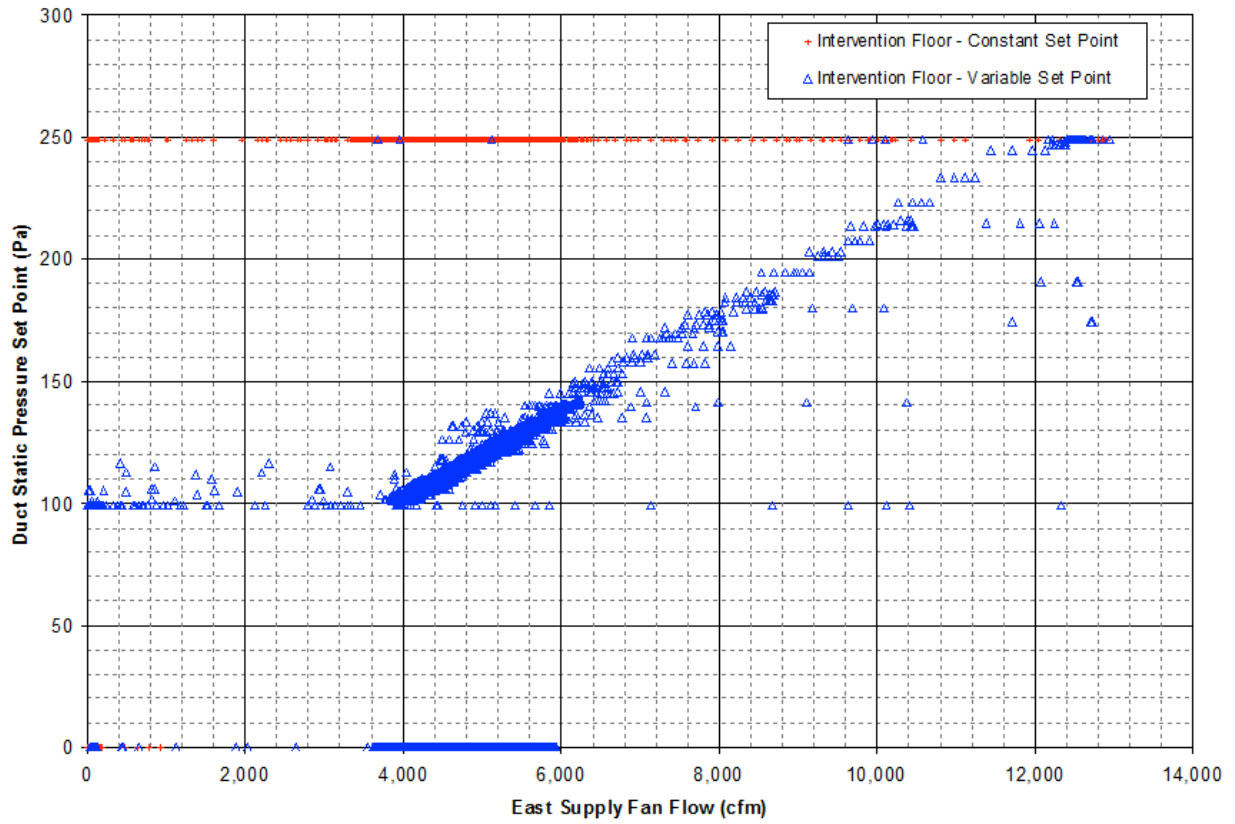


Figure 12. Duct Static Pressure Set Points - Intervention Floor

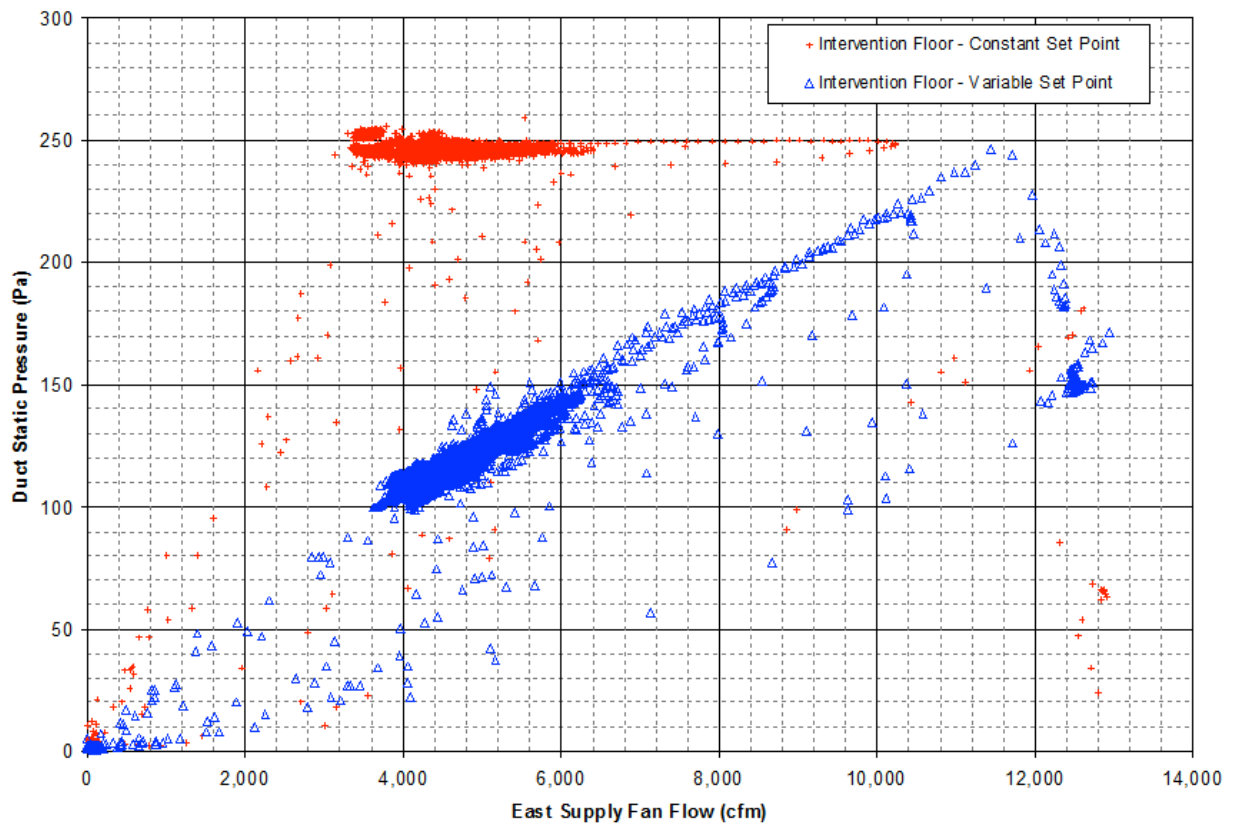


Figure 13. Measured Duct Static Pressures - Intervention Floor

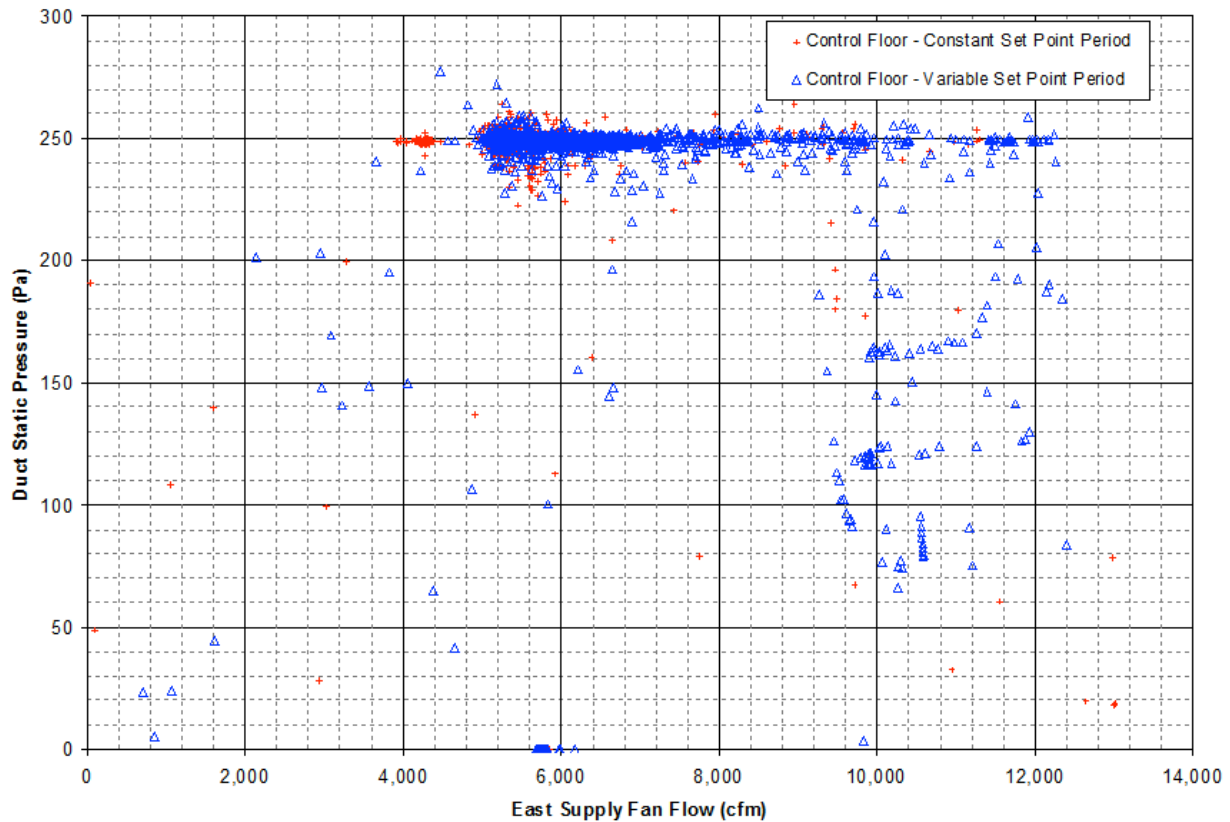


Figure 14. Measured Duct Static Pressures - Control Floor

Figure 15 shows the fan pressure rise for one of the fans on the intervention floor before and after SPR is implemented. As expected, the system curves differ substantially, because the duct static pressure set point changed significantly. In general, we expect that “system curves” for VAV systems with modulating VAV box dampers and duct static pressure control will be a quadratic function of flow ($DP_{fan} = a Q_{fan}^2 + b Q_{fan} + P_{sm}$), such as is observed in Figure 15 for flows above about 4,000 cfm. Ignoring times when the fan is off or speeding up or slowing down, the fan pressure rise as the flow approaches zero will be near the duct static pressure set point (assuming that the system can maintain control at low flow, especially in the presence of leaky ducts).

Fan power variation with flow for one fan on the intervention floor before and after SPR is implemented is shown in Figure 16. The variation in fan power is substantial at lower flows and near zero at high flows. This means that SPR will have the greatest effect if the system operates at reduced load, such as is observed for this system. Systems that operate near maximum flow most of the time will benefit less from implementing SPR. However, because high flows correspond to high power, small changes in fan pressure rise due to SPR might still result in significant energy savings at less than maximum flow.

Figures 17 and 18 show the fan power history for the two monitoring periods of interest. In particular, Figure 17 shows that fan power on the control and intervention floors is quite similar before implementing SPR. After implementing SPR, Figure 18 shows a substantial reduction in supply fan power for the intervention floor compared to the control floor. Figures 19 and 20 show the fan power variations for sample days, before and after implementing SPR, respectively.

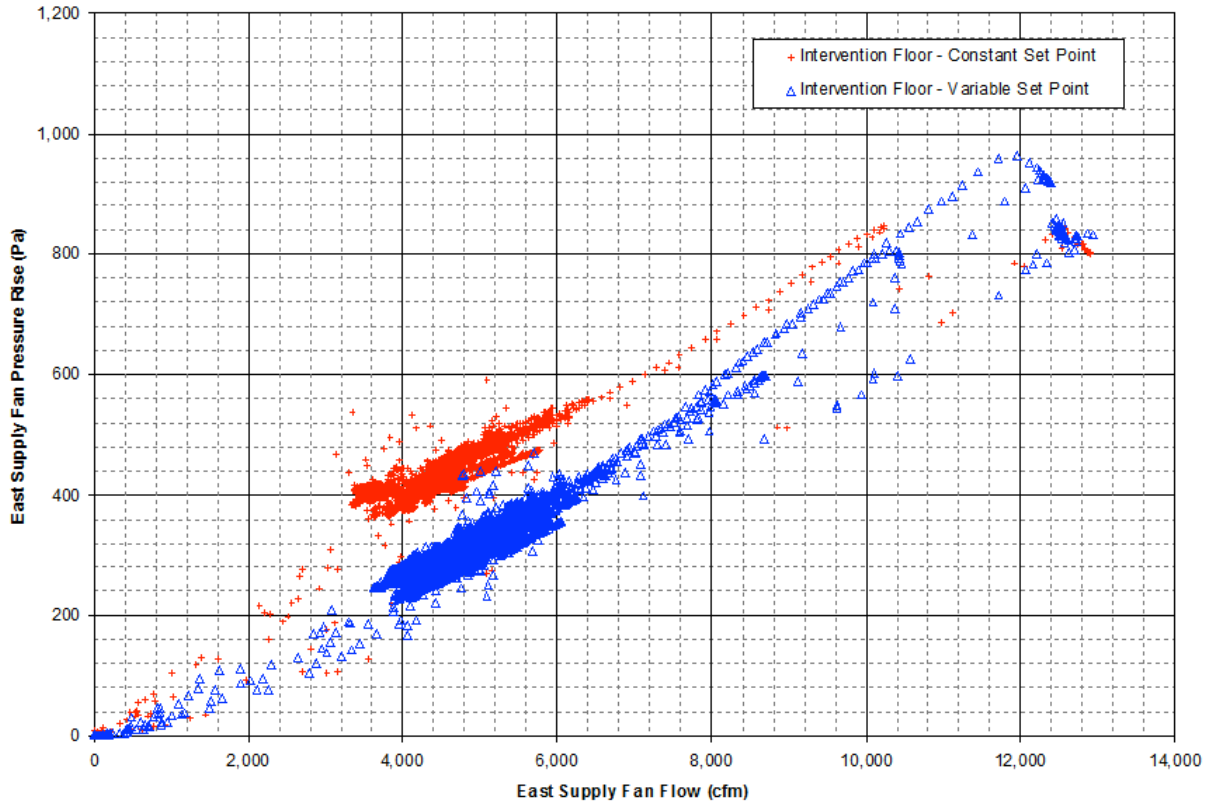


Figure 15. Measured Supply Fan Pressure Rises - Intervention Floor

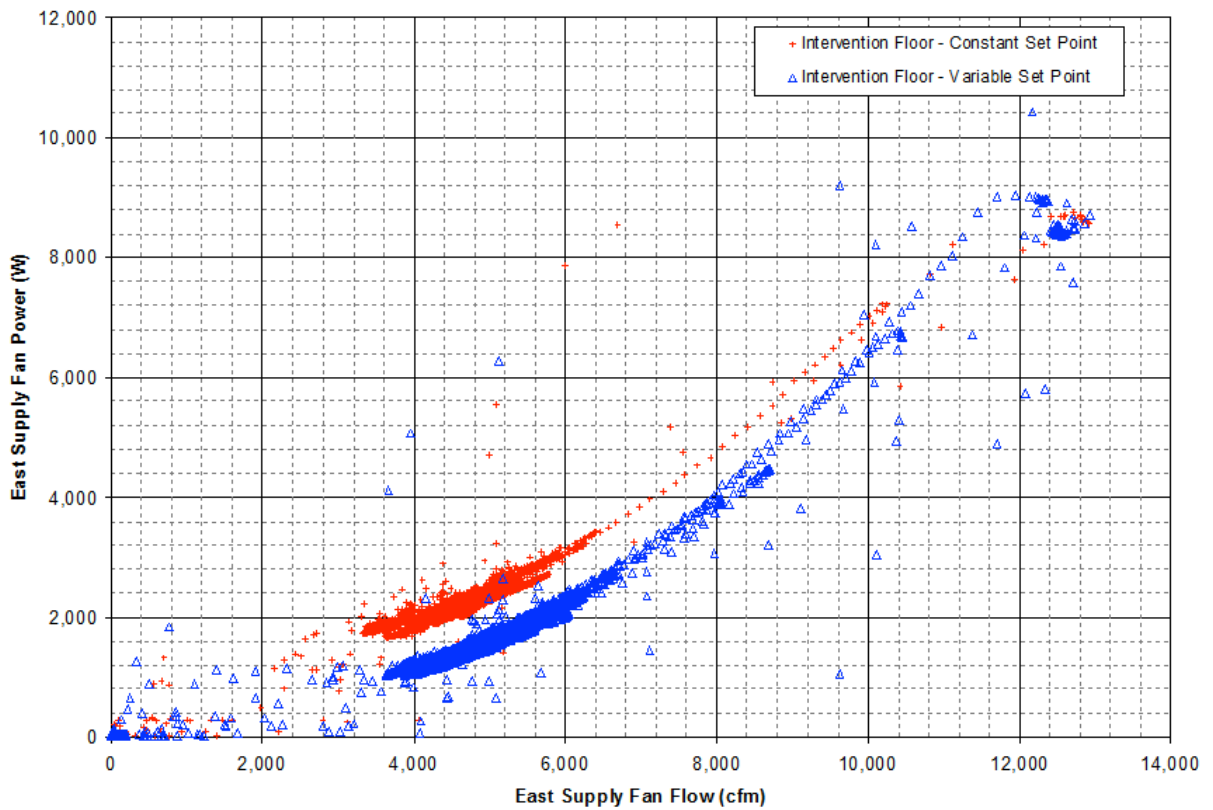


Figure 16. Measured Supply Fan Power - Intervention Floor

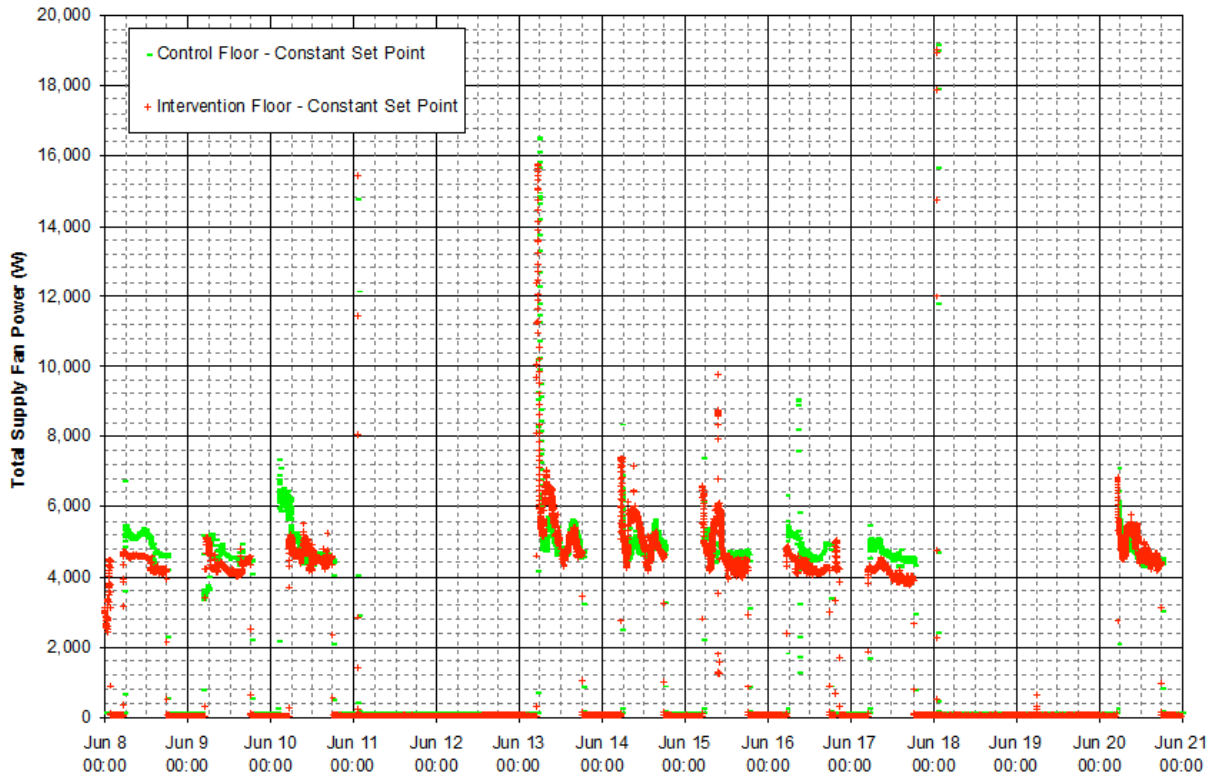


Figure 17. Fan Power History - Prior to Implementing SPR

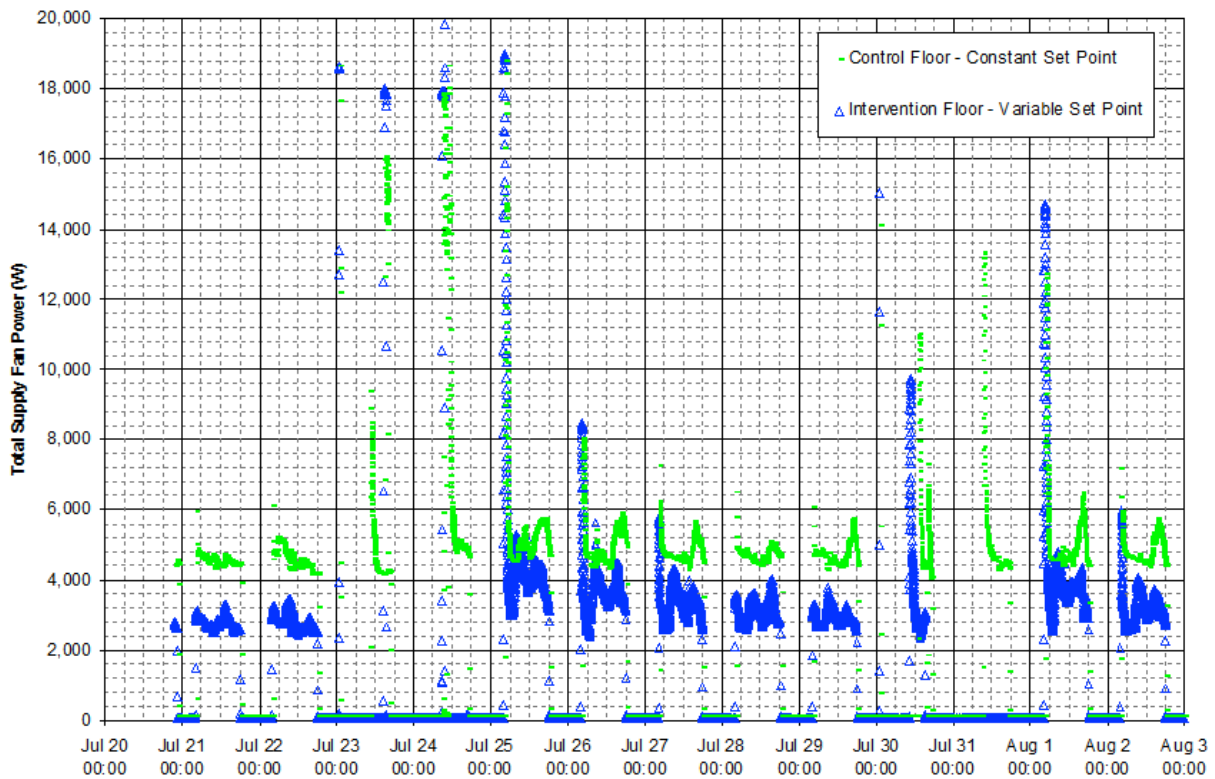


Figure 18. Fan Power History - After Implementing SPR

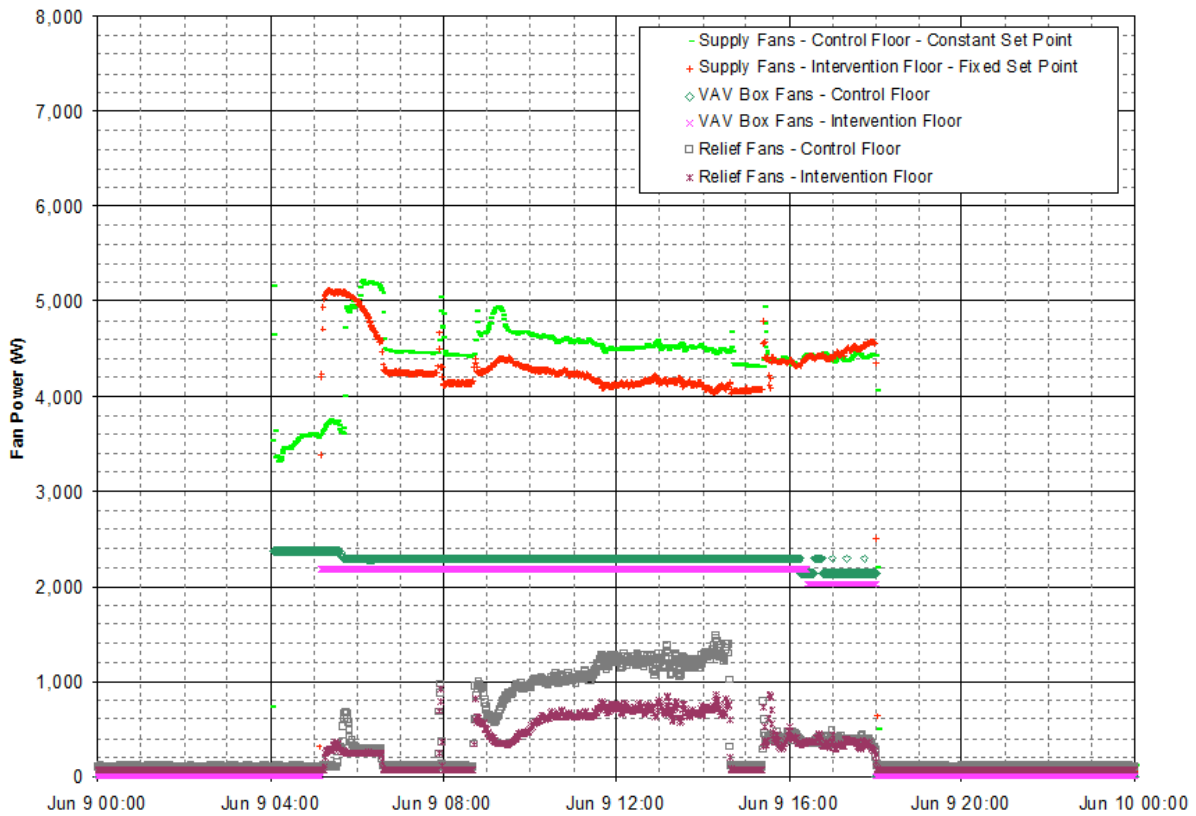


Figure 19. Daily Snapshot - Fan Power History - Prior to Implementing SPR - June 9

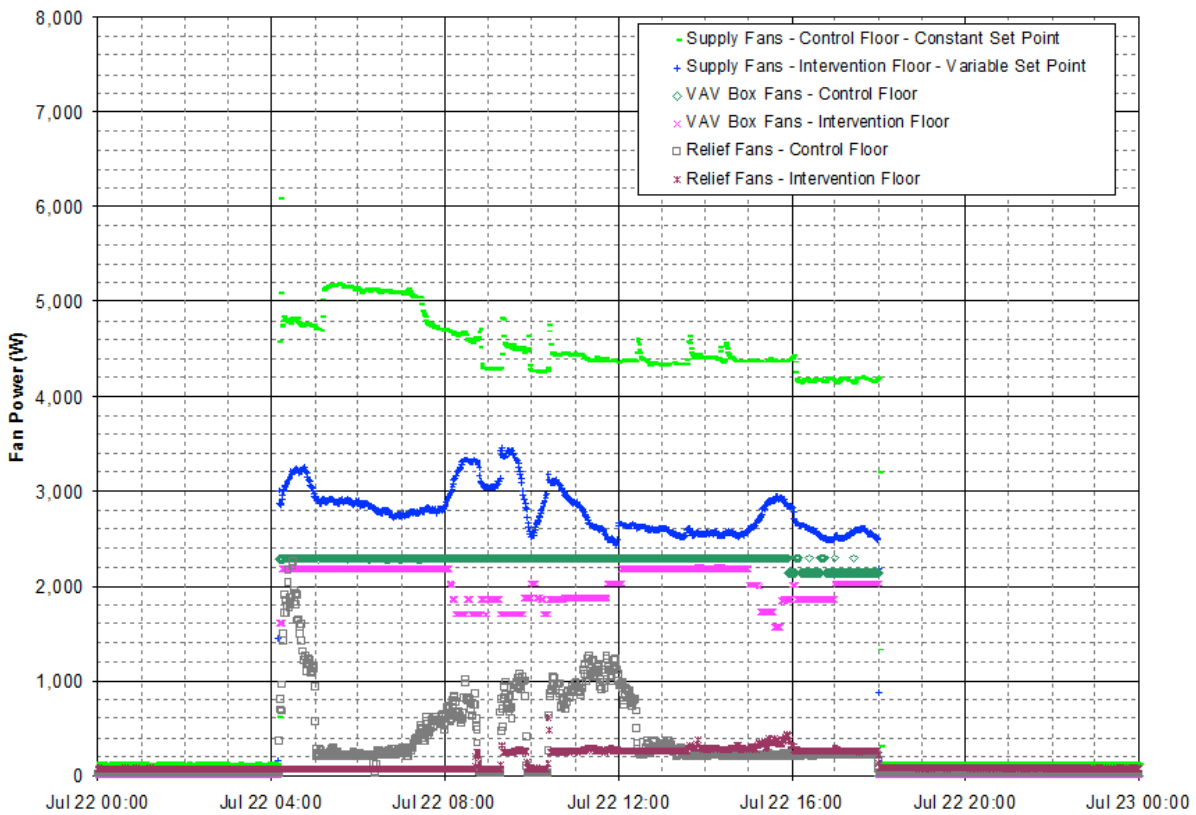


Figure 20. Daily Snapshot - Fan Power History - After Implementing SPR - July 22

Figure 20 shows that not only is supply fan power reduced significantly, but so also is relief fan power and VAV box fan power. Table 3 summarizes the power and load reductions associated with implementing SPR in the test building during normal fan operating hours (5:00a to 6:00p).

Table 3. Summary of Site Energy Reductions from Implementing SPR - Normal Operation

	Floor	Pre-SPR		Post-SPR	Post/Pre	Reduction		Units
		Measured	Adjusted	Measured	Ratio	Difference	Fraction	
Supply Fan Flow (East)	Control	5,543		5,748	1.0370			
	Intervention	4,373	4,535	4,693		-158	-3.5%	cfm
Supply Fan Flow (West)	Control	6,068		6,099	1.0052			
	Intervention	5,616	5,646	5,670		-24	-0.4%	cfm
Supply Fan Flow (East+West)	Control	11,610		11,847	1.0204			
	Intervention	9,990	10,194	10,363		-169	-1.7%	cfm
Supply Fan Power (East+West)	Control	4,760		4,738	0.9953			
	Intervention	4,639	4,617	3,240		1,377	29.8%	W
Return Fan Power (East+West)	Control	518		513	0.9897			
	Intervention	497	492	282		209	42.6%	W
VAV Box Fan Power (Total)	Control	2,135		2,077	0.9730			
	Intervention	1,924	1,872	1,705		167	11.4%	W
Total Fan Power (Total)	Control	7,413		7,327	0.9885			
	Intervention	7,060	6,978	5,230		1,748	25.9%	W
Cooling Coil Sensible Load (East+West)	Control	39,851		56,517	1.4182			
	Intervention	39,305	55,744	51,950		3,794	6.8%	W
Preheat Coil Sensible Load (East+West)	Control	-5,988		-3,665	0.6121			
	Intervention	-3,766	-2,305	-3,968		-1,663	-72.1%	W
VAV Box Reheat Coil Power (Total)	Control	55		0	0.0000			
	Intervention	0	0	0		0	0.0%	W

Table 3 indicates that implementing SPR had little impact on supply flows, but reduced average supply fan power about 30% (largely because of fan pressure rise reductions). Total fan power was reduced slightly less: about 26%. Cooling coil loads also decreased, but substantially less on a fractional basis compared to fan power. The absolute reduction in cooling coil loads is, however, substantial relative to the fan power reduction (slightly more than double). The actual impact on site electrical use is unknown though, because the coil load must be translated into chiller and cooling tower energy impacts. We do not have sufficient information about the building equipment and operation to make this translation. Although SPR reduced fan power and cooling coil loads, it *increased* preheat coil loads. The reason for this behavior is unknown. As with the cooling load changes, the heating loads would need to be translated to boiler energy impacts to assess the importance of this change.

Similar reductions occur during peak hours (2:00p to 6:00p) as well, as shown in Table 4. Two difference, however, is that preheat loads are negligible during the afternoon, and there is little change in preheat coil loads as a result. Also, cooling coil loads increased during this time. Again, this change needs to be translated to chiller and tower energy impacts to understand its significance in terms of whole building energy use, and especially on peak demand. Fortunately, in terms of average operation during the day, the net result is that cooling coil loads are reduced on average (as shown in Table 3).

In conclusion, although implementing SAV with InCITE™ substantially reduced fan power (as expected), the increases in cooling and heating coil loads require more information to assess the net savings resulting from this implementation of SPR.

Table 4. Summary of Site Energy Reductions from Implementing SPR - Peak Periods

	Floor	Pre-SPR		Post-SPR	Post/Pre Ratio	Reduction		Units
		Measured	Adjusted	Measured		Difference	Fraction	
Supply Fan Flow (East)	Control	5,491		6,131	1.1165			
	Intervention	4,047	4,518	4,767		-249	-5.5%	cfm
Supply Fan Flow (West)	Control	6,048		6,344	1.0489			
	Intervention	5,538	5,809	5,797		11	0.2%	cfm
Supply Fan Flow (East+West)	Control	11,539		12,475	1.0811			
	Intervention	9,584	10,361	10,564		-203	-2.0%	cfm
Supply Fan Power (East+West)	Control	4,616		5,014	1.0861			
	Intervention	4,380	4,758	3,277		1,481	31.1%	W
Return Fan Power (East+West)	Control	605		301	0.4969			
	Intervention	514	256	319		-63	-24.8%	W
VAV Box Fan Power (Total)	Control	2,156		1,844	0.8553			
	Intervention	1,975	1,689	1,394		295	29.4%	W
Total Fan Power (Total)	Control	7,378		7,159	0.9703			
	Intervention	6,870	6,666	4,990		1,676	27.4%	W
Cooling Coil Sensible Load (East+West)	Control	56,457		86,219	1.5272			
	Intervention	48,468	74,019	76,717		-2,697	-3.6%	W
Preheat Coil Sensible Load (East+West)	Control	-561		0	1.0000			
	Intervention	-733	-733	0		733	100.0%	W
VAV Box Reheat Coil Power (Total)	Control	0		0	0.0000			
	Intervention	0	0	0		0	0.0%	W

CONCLUSIONS

This project has addressed two significant deficiencies in air-handling systems for large commercial building: duct leakage and duct static pressure reset. Both constitute significant energy reduction opportunities for these buildings.

A new duct leakage model has been successfully implemented in EnergyPlus, which will enable simulation users to assess the impacts of leakage on whole-building energy use and operation in a coupled manner. This feature also provides a foundation to support code change proposals and compliance analyses related to Title 24 where duct leakage is an issue. Our example simulations continue to show that leaky ducts substantially increase fan power: 10% upstream and 10% downstream leakage increases supply fan power 30% on average compared to a tight duct system (2.5% upstream and 2.5% downstream leakage). Much of this increase is related to the upstream leakage rather than to the downstream leakage. This does not mean, however, that downstream leakage is unimportant. Our simulations also demonstrate that ceiling heat transfer is a significant effect that needs to be included when assessing the impacts of duct leakage in large commercial buildings. This is not particularly surprising, given that “ceiling regain” issues have already been included in residential analyses as long as a decade ago (e.g., ASHRAE Standard 152); mainstream simulation programs that are used for large commercial building energy analyses have not had this capability until now.

Our analyses of data that we collected during our 2005 tests of the SAV with InCITE™ duct static pressure reset technology show that this technology can substantially reduce fan power (in this case, by about 25 to 30%). Tempering this assessment, however, is that cooling and heating coil loads were observed to increase or decrease significantly depending on the time window used. Their impact on cooling and heating plant power needs to be addressed in future studies; without translating the coil loads to plant equipment energy use, it is not possible to judge the net

impact of this SPR technology on whole-building energy use. If all of the loads had decreased, such a step would not be as necessary.

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GLOSSARY

ACM	Alternative Calculation Method
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
CEC	California Energy Commission
cfm	Cubic feet per minute
DOE	U.S. Department of Energy
EIA	Energy Information Administration
EMCS	Energy management control system
GWh	Giga Watt hours, 10^9 Wh, 10^6 kWh
HVAC	Heating, ventilating, and air conditioning
LBNL	Lawrence Berkeley National Laboratory
MW	Mega Watt, 10^6 W
PIER	Public Interest Energy Research
RD&D	Research, Development, and Demonstration
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association

UC	University of California
VAV	Variable Air Volume

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APPENDIX A: ENERGYPLUS ENGINEERING DOCUMENTATION RELATED TO THE NEW DUCT LEAKAGE MODEL

The following is the documentation that was created in this project to describe the technical aspects of the duct leakage model that is now implemented in EnergyPlus:

Simple Duct Leakage Model

Overview

The input object ZoneHVAC:AirDistributionUnit also provides access to a model for duct leakage that can be a significant source of energy inefficiency in forced-air HVAC systems. Evaluating duct leakage energy losses can involve considerable user effort and computer resources if an airflow network is defined through a detailed description of the system components and airflow paths (including leakage paths). A nonlinear pressure-based solver is used to solve for pressures and flow rates in the network. By making certain assumptions and approximations for certain well defined configurations, however, it is possible to obtain accurate results with a simple mass and energy balance calculation and thus avoid the input and calculation costs of doing a full pressure-based airflow network simulation.

The Simple Duct Leakage Model (SDLM) assumes a central VAV air conditioning system with a constant static pressure setpoint. The model assumes that the leaks are in the supply ducts and that the system returns air through a ceiling plenum that contains the ducts. Thus, the ducts leak into the return plenum, and this part of the supply does not reach the conditioned zones. With the additional assumptions described below, it is possible to model this configuration with heat and mass balance equations and avoid the use of a nonlinear pressure-based solver. In the EnergyPlus context, this means that use of AirflowNetwork is avoided and the leakage calculations are obtained in the course of the normal thermal simulation.

Principles and Description

Constant Flow Rate

The airflow rate through a duct leak is a function of the pressure difference between the duct and the surrounding space:

$$\dot{V}_{leak} = C_1 \cdot \Delta p_{duct-space}^n \quad (1)$$

The exponent n is 0.5 for leaks that look like orifices (holes that are large relative to the thickness of the duct wall); for leaks that resemble cracks (e.g., lap joints), n is approximately 0.6 to 0.65.

For a duct with constant flow rate and a linear pressure drop through the duct, the average static pressure in the duct will equal half of the duct static pressure drop. Assuming turbulent flow in the duct, the duct pressure drop is proportional to the square of the airflow through the duct. This can be expressed as:

$$\Delta p_{duct-space} = \frac{\Delta p_{duct}}{2} = C_2 \left(\frac{\dot{V}_{duct}^2}{2} \right) \quad (2)$$

Combining equations (1) and (2) and assuming the leaks are large holes (n equals 0.5). gives:

$$\dot{V}_{leak} = C_1 \cdot \Delta p_{duct-space}^{0.5} = C_3 \cdot \dot{V}_{duct} \quad (3)$$

where

$$C_3 = C_1 \cdot (C_2 / 2)^{0.5} \quad (4)$$

Thus the leakage fraction C_3 remains constant regardless of the duct flow rate or static pressure. This result depends on the following assumptions:

- the duct airflow is turbulent;
- the duct pressure varies linearly along the duct;
- the average duct pressure approximates the pressure drop across the duct;
- the leaks are large and have pressure exponent 0.5.

Effects of Constant Pressure Upstream and Variable Flow and Pressure Downstream

Commonly VAV systems maintain a constant static pressure at some point in the duct system upstream of the VAV terminal units. That is, airflow rate will vary depending on the cooling requirement, but a constant pressure will be maintained at the static pressure sensor. Consequently, the leakage flow for a leak upstream of the VAV boxes will be approximately constant. Or to put it another way, the leakage fraction will vary in proportion to the flow rate.

For leaks downstream of the VAV terminal units, the airflow through the duct and the pressure in the downstream duct will vary as the box damper modulates in response to the differential between the room temperature and the thermostat setpoint. In this case, the situation is similar to the constant flow case: for an orifice-like leak, the pressure difference across the leak will vary linearly with the air speed (or flow rate); i.e., the leakage fraction will be approximately constant.

SDLM

For SDLM, our leakage model is then:

1. for leaks upstream of the terminal units, the leakage flow rate will be constant;
2. for leaks downstream of the terminal units, the leakage fraction will be constant.

This model assumes, in addition to the assumptions given above, that the VAV system is controlled to a constant static pressure setpoint. In EnergyPlus SDLM is not currently applicable to systems using static pressure reset. Using SDLM would require knowledge of static pressure as a function of system air flow rate.

Inputs and Data

User data for the SDLM is entered through The ZoneHVAC:AirDistributionUnit (ADU) object. There are 2 data items per ADU:

1. the upstream nominal leakage fraction;
2. the downstream fixed leakage fraction.

Both inputs are leakage fractions. Input (1) is the leakage fraction at design flow rate, which together can be used to determine the constant leakage flow rate upstream of the VAV boxes; this leakage fraction varies with the flow rate. Input (2) is a fixed leakage fraction and is constant as the flow rate varies.

Implementation

The various zone mass flow rates are related in the following manner.

$$\dot{m}_{s,us} = \dot{m}_{tu} + \dot{m}_{lk,us} \quad (5)$$

$$\dot{m}_{tu} = \dot{m}_{lk,ds} + \dot{m}_{s,z} \quad (6)$$

$$\dot{m}_{lk,us} = Frac_{us} \cdot \dot{m}_{s,us,max} \quad (7)$$

$$\dot{m}_{lk,ds} = Frac_{ds} \cdot \dot{m}_{tu} \quad (8)$$

Here

$\dot{m}_{s,us}$ is the constant zone supply air mass flow rate upstream of the leaks [kg/s];

\dot{m}_{tu} is the air mass flow rate through the terminal unit [kg/s];

$\dot{m}_{lk,us}$ is the upstream leakage air mass flow rate [kg/s];

$\dot{m}_{lk,ds}$ is the downstream leakage air mass flow rate [kg/s];

$\dot{m}_{s,us,max}$ is the maximum upstream supply air mass flow rate (program input) [kg/s];

$\dot{m}_{s,z}$ is the supply air mass flow rate delivered to the zone [kg/s];

$Frac_{us}$ is the design upstream leakage fraction (program input);

$Frac_{ds}$ is the constant downstream leakage fraction (program input);

\dot{m}_{tu} is calculated in the VAV terminal unit model in the usual manner: the mass flow rate is varied to meet the zone load. The limits on the mass flow rate variation are set by the $\dot{m}_{MaxAvail}$ and $\dot{m}_{MinAvail}$ values stored at the terminal unit's air inlet node. To account for upstream leakage the maximum air mass flow rate available is reset to:

$$\dot{m}'_{MaxAvail} = \dot{m}_{MaxAvail} - \dot{m}_{lk,us} \quad (9)$$

Downstream leakage must also be accounted for because not all of \dot{m}_{tu} will reach the zone. This is done by having \dot{m}_{tu} meet an adjusted zone load:

$$\dot{Q}_{z,adjusted} = \frac{1}{1 - Frac_{ds}} \dot{Q}_z \quad (10)$$

Here \dot{Q}_z [watts] is the actual zone load (met by $\dot{m}_{s,z}$) and $\dot{Q}_{z,adjusted}$ is the load used in the VAV terminal unit model to obtain \dot{m}_{tu} .

Once \dot{m}_{tu} is known, all the other flow rates can be calculated. $\dot{m}_{s,us}$ is assigned to the air distribution unit's air inlet node and $\dot{m}_{s,z}$ is assigned to the unit's air outlet node. Thus, air mass flow is not conserved through the unit: the two air leakage flow rates disappear. These two vanished flow rates are stored in the air distribution unit data structure. When the downstream return air plenum mass and energy balances are calculated, the leakage flow rate data is accessed and added back in as inlets to the return air plenum. Thus, the overall air system preserves a mass balance.

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APPENDIX B: ENERGYPLUS INPUT/OUTPUT DOCUMENTATION RELATED TO THE NEW DUCT LEAKAGE MODEL

The following is the documentation that was created in this project to describe the input and output aspects of the duct leakage model that is now implemented in EnergyPlus:

ZoneHVAC:AirDistributionUnit

The ZoneHVAC:AirDistributionUnit object gives further information on what air loop equipment (air terminal units) will be serving a particular zone. The ZoneHVAC:AirDistributionUnit is the part of the system that is supplied from a common main air handler simulated in the Air Loop Simulation and includes the equipment that controls or tempers the air going to each individual zone according to the desired thermostatic control. The current options for ZoneHVAC:AirDistributionUnit terminal unit types are:

```
AirTerminal:DualDuct:ConstantVolume
AirTerminal:DualDuct:VAV
AirTerminal:SingleDuct:ConstantVolume:Reheat
AirTerminal:SingleDuct:VAV:Reheat
AirTerminal:SingleDuct:VAV:NoReheat
AirTerminal:SingleDuct:SeriesPIU:Reheat
AirTerminal:SingleDuct:ParallelPIU:Reheat
AirTerminal:SingleDuct:ConstantVolume:FourPipeInduction
AirTerminal:SingleDuct:VAV:Reheat:VariableSpeedFan
AirTerminal:SingleDuct:VAV:HeatAndCool:Reheat
AirTerminal:SingleDuct:VAV:HeatAndCool:NoReheat
```

Connections between the air distribution unit, the supply air duct, and the zone are specified in the input syntax for the air distribution unit and the AirLoopHVAC:ZoneSplitter. The input syntax also explicitly defines an outlet identifier. This implies a connection to a zone through a NodeList for zone inlets (see the ZoneHVAC:EquipmentConnections statement). The air distribution unit is limited to one combined component-controller unit; because controls are normally based on the zone thermostat and can work in parallel or series in complex fashion. Since the control and the flow resolution can be complex, each air distribution unit is unique in addressing these combinations and therefore only one is allowed per zone.

The Air Distribution unit also allows the user to specify leaks in the supply air duct system. These inputs are used in the EnergyPlus Simplified Duct Leakage Model (SDLM). This model simulates a specific configuration: supply leaks to a return plenum in a commercial VAV or CV system. The system must have a constant static pressure setpoint. Within these limitations SDLM allows the user to easily evaluate the energy penalty due to duct leakage.

Field: Name

Unique identifying name of the air distribution unit.

Field: Air Distribution Unit Outlet Node Name

Outlet node name for the air distribution unit to the attached zone.

Field: Air Terminal Object Type

Single combined component/controller unit for that attached zone. Selection of components as listed above.

Field: Air Terminal Name

The unique identifying component name.

Field: Nominal Upstream Leakage Fraction

This is the leakage upstream of the terminal unit as a fraction of the design flow rate through the unit. It is the leakage fraction at the design flow rate. It is used to calculate a leakage flow rate which is then held constant while the system air flow varies. This input is optional; the default is zero.

Field: Constant Downstream Leakage Fraction

This is the leakage downstream of the terminal unit as a fraction of the current flow rate through the terminal unit. This fraction is held constant, so the leakage flow rate will vary proportionally with the supply air flow rate. This input is optional; the default is zero.

```
ZoneHVAC:AirDistributionUnit,
    \min-fields 4
    \memo A typical set of components for an air distribution unit will
    \memo consist of a single component Air Distribution Unit (ADU)
A1 , \field Name
    \required-field
    \reference AirDistributionUnits
A2 , \field Air Distribution Unit Outlet Node Name
    \required-field
A3 , \field Air Terminal Object Type
    \type choice
    \key AirTerminal:DualDuct:ConstantVolume
    \key AirTerminal:DualDuct:VAV
    \key AirTerminal:SingleDuct:ConstantVolume:Reheat
    \key AirTerminal:SingleDuct:VAV:Reheat
    \key AirTerminal:SingleDuct:VAV:NoReheat
    \key AirTerminal:SingleDuct:SeriesPIU:Reheat
    \key AirTerminal:SingleDuct:ParallelPIU:Reheat
    \key AirTerminal:SingleDuct:ConstantVolume:FourPipeInduction
    \key AirTerminal:SingleDuct:VAV:Reheat:VariableSpeedFan
    \key AirTerminal:SingleDuct:VAV:HeatAndCool:Reheat
    \key AirTerminal:SingleDuct:VAV:HeatAndCool:NoReheat
    \required-field
A4 , \field Air Terminal Name
    \required-field
N1 , \field Nominal Upstream Leakage Fraction
    \note fraction at system design Flow; leakage Flow constant, leakage fraction
    \note varies with variable system Flow Rate.
    \type real
    \minimum 0
    \maximum 0.3
    \default 0
N2 ; \field Constant Downstream Leakage Fraction
    \type real
    \minimum 0
    \maximum 0.3
    \default 0
```

Two example IDF excerpts (one without duct leakage, one with):

```
ZoneHVAC:AirDistributionUnit,  
  SPACE1-1 ATU,           !- Air Distribution Unit Name  
  SPACE1-1 In Node,      !- Air Dist Unit Outlet Node Name  
  SINGLE DUCT:VAV:REHEAT, !- KEY--System Component Type 1  
  SPACE1-1 VAV Reheat;   !- Component Name 1  
  
ZoneHVAC:AirDistributionUnit,  
  SPACE4-1 ATU,           !- Air Distribution Unit Name  
  SPACE4-1 In Node,      !- Air Dist Unit Outlet Node Name  
  SINGLE DUCT:VAV:REHEAT, !- KEY--System Component Type 1  
  SPACE4-1 VAV Reheat,   !- Component Name 1  
  0.05,                  !- upstream nominal leakage fraction  
  0.07;                  !- downstream constant leakage fraction
```

APPENDIX C: SAMPLE ENERGYPLUS INPUT DATA FILE RELATED TO THE NEW DUCT LEAKAGE MODEL

The following is one of the input data files that we used in our EnergyPlus simulations to demonstrate the use of the duct leakage model. This file corresponds to a leaky system with 10% leakage upstream of VAV boxes and 10% downstream.

```

! Translated from DOE2 input file: lol2_new_cav_10story.inp
! Title1= Duct Leakage Analysis Runs
! Title2= 10 Storey Large Office Building in Sacramento, CA (Climate Zone 12)
! Title3= "New" (Circa 1990) Construction Characteristics
! Title4= 10% Duct Leakage Upstream of VAV boxes at Design Flow; 10% Downstream of Boxes
!
! Simulation Location (Weather File): SACRAMENTO ctz12cDOE2_epw
!
! Design Days: Heating DB Design Conditions, MinDB= -2.8°C (Jan 6, coldest temperature in weather
file)
! Cooling DB Design Conditions, MaxDB= 36.7°C, MCWB 20.4°C (Jul 24, T24 1% DB)
!
! Building:
!
! Occupied floor area (above grade): 13,935 m2 (150,000 ft2), with dimensions: 37.33 m x 37.33 m
(122.5 ft x 122.5 ft).
! Each above-grade floor is modeled as four perimeter zones and one core zone. Perimeter zones
are all 4.57 m (15 ft) deep.
! Floor-ceiling height: 3.048 m (10 ft), plus 0.9144 m (3 ft) high ceiling plenum
! Windows are modeled as a horizontal strip of glazing running the length of each perimeter wall
from the middle to the top
! of the conditioned space wall, for a Window-to-Wall Ratio (WWR) of 0.50

! 10 conditioned floors above grade plus unconditioned basement. The eight intermediate floors
are modeled as one floor.
!
! ***Shell characteristics***
! | \ _____ / | Roof const: built-up roofing, 4 in. lightweight (80 lb/ft3)
concrete slab, insulation
! | \ _____ / | Roof insulation: 2.22 m2-K/W (12.6 ft2-hr-F/BTU)
! | | | | | Conditioned space ceiling constr: 3/4 in. 2x2 ft acoustic
tiles in steel T-bar frame
! | | | | | Wall const: 1 in. stone, 2x4 in. steel studs (16 in. o.c.),
cavity insulation, 5/8 in. gypsum board
! | | | | | 37.33 m Wall insulation: 1.06 m2-K/W (6 ft2-hr-F/BTU)
! | | | | | (122.5 ft) Window const: double-pane
! | | | | | Window U-value: 3.41 W/m2-K (0.60 BTU/hr-ft2-F)
! | | | | | Window SHGC: 0.62 (0.71 SC)
! | / _____ \ | Floor const: 4 in. lightweight (80 lb/ft3) concrete slab,
covered with carpet and fibrous pad
! | / _____ \ | Basement wall and floor const: 6 in. heavyweight concrete slab
in contact with soil
! 37.33 m (122.5 ft) Infiltration:
! Occupied spaces: 0.0 ACH occupied hrs, 0.30 ACH unoccupied
hrs
! Ceiling plenum: 0.0 ACH occupied hrs, 0.68 ACH unoccupied
hrs
! Basement: 2.0 ACH (boiler combustion+ventilation
air)
!
! Internal loads (peak) are:
!
! Occupancy: 133.6 W/person total (250 Btu/h sensible + 206 Btu/h latent); 9.29 m2/person
(100 ft2/person)
! Lighting: 13.99 W/m2 (1.3 W/ft2); 45% to occupied space, remainder to ceiling plenum
! Equipment: 8.07 W/m2 (0.75 W/ft2)
!
! HVAC: Single-duct VAV system with central chilled water cooling coil and zonal hot water reheat
coils.
! Central Plant is hermetic electric centrifugal chiller with water cooled condenser, plus
natural-gas-fired hot water boiler for reheat.

```

```

!
! Cooling coil control: constant supply air dry-bulb temperature of 11.7°C (53°F)
maintained downstream of supply fan.
! Temperature selected to achieve 11.1°C (20°F) supply air temperature difference relative
to 22.8°C (73°F)
! occupied hour cooling set-point temperature for conditioned spaces.
!
! All VAV boxes have same 40% minimum flow fraction. Fraction set to ensure sufficient heat
delivered to zone, assuming 82.2°C (180°F) water temperature entering reheat coils.
!
! Outside airflow to mixing box: 25 m3/hr/person (15 CFM/person)
! Economizer with limit temperature at 21.1°C (70°F)
!
! Zonal Equipment: AirTerminal:SingleDuct:VAV:Reheat
! Coils: Coil:Cooling:Water (at AHU), Coil:Heating:Water (in VAV boxes), no main
heating coil
! Fans: Fan:VariableVolume (supply and return)
! Pumps: Pump:VariableSpeed
! Boiler: Boiler:HotWater
! Chiller: Chiller:Electric:EIR
! Tower: CoolingTower:SingleSpeed
!
! Duct leakage fractions are specified in "ZoneHVAC:AirDistributionUnit" for each above-grade
occupied zone

! \group Simulation Parameters
VERSION,
  3.1.0;                !- Version Identifier

Site:Location,
  SACRAMENTO ctz12cDOE2_epw, !- Name
  38.5,                  !- Latitude {deg, N+ S-}
  -121.5,               !- Longitude {deg, W- E+}
  -8.,                 !- Time Zone {hr, relative to GMT}
  0.0;                 !- Elevation {m}

Building,
  CZ12_new_vavrh_10u10d, !- Name
  0.,                  !- North Axis {deg}
  City,               !- Terrain
  0.04,              !- Loads Convergence Tolerance Value
  0.4,               !- Temperature Convergence Tolerance Value {deltaC}
  FullExterior,      !- Solar Distribution
  25;                !- Maximum Number of Warmup Days

! Annual run period (assume 1991 reference year for calendar days -- Jan 1 was Tue)
RunPeriod,
  1,                 !- Begin Month
  1,                 !- Begin Day of Month
  12,               !- End Month
  31,               !- End Day of Month
  Tuesday,          !- Day of Week for Start Day
  Yes,              !- Use Weather File Holidays and Special Days
  Yes,              !- Use Weather File Daylight Saving Period
  Yes,              !- Apply Weekend Holiday Rule
  Yes,              !- Use Weather File Rain Indicators
  Yes,              !- Use Weather File Snow Indicators
  1;                !- Number of Times Runperiod to be Repeated

Timestep,
  4;                !- Number of Timesteps per Hour

SimulationControl,
  No,               !- Do Zone Sizing Calculation
  No,               !- Do System Sizing Calculation
  Yes,              !- Do Plant Sizing Calculation (need to leave this at "Yes" to
avoid erroneous results)
  Yes,              !- Run Simulation for Sizing Periods
  Yes;              !- Run Simulation for Weather File Run Periods

Output:DebuggingData,

```

```

0,                !- Report Debugging Data
0;                !- Report During Warmup

ZoneCapacitanceMultiplier,
1.;              !- Multiplier

SurfaceConvectionAlgorithm:Inside,
Simple;          !- Algorithm

SurfaceConvectionAlgorithm:Outside,
DOE-2;          !- Algorithm

HeatBalanceAlgorithm,
ConductionTransferFunction; !- Algorithm

!===== file: DesignDays.tmfinc ====Start=====
!Data determined from ctz12cDOE2_epw stats and weather file
!Use 2005 Title 24 Appendix II "winter median of extremes" DB (-3.3C)
!Use coldest day in weather file to approximate other data
!Use 1% DB and range data for cooling from 2005 Title 24 Appendix II

SizingPeriod:DesignDay,
Heating Design Day,          !- Name
7.3,                         !- Maximum Dry-Bulb Temperature {C} (45F)
10.6,                        !- Daily Temperature Range {deltaC} (19F -- corr. minimum DB
is 26F = -3.3C)
4.1,                         !- Humidity Indicating Conditions at Maximum Dry-Bulb {C}
(39F, MCWB for W=0.00390)
102280.0,                    !- Barometric Pressure {Pa} (30.35 inHg)
6.3,                         !- Wind Speed {m/s} -- MCWS for coldest DB (5.5 knots)
144.0,                       !- Wind Direction {deg} -- MCWD for coldest DB
0.0000000,                   !- Sky Clearness
0,                            !- Rain Indicator
0,                            !- Snow Indicator
6,                            !- Day of Month
1,                            !- Month
WinterDesignDay,            !- Day Type (no scheduled internal gains in above-grade
zones)
0,                            !- Daylight Saving Time Indicator
WetBulb;                     !- Humidity Indicating Type

SizingPeriod:DesignDay,
Cooling Design Day,          !- Name
36.7,                        !- Maximum Dry-Bulb Temperature {C} (98F)
19.4,                        !- Daily Temperature Range {deltaC} (35F -- corr. minimum DB
is 63F = 17.3C)
20.4,                        !- Humidity Indicating Conditions at Maximum Dry-Bulb {C}
(69F, 1% MCWB)
100490.0,                    !- Barometric Pressure {Pa} (29.82 inHg)
10.6,                        !- Wind Speed {m/s} -- MCWS for 1% DB (9.2 knots)
287.0,                       !- Wind Direction {deg} -- MCWD for 1% DB
1.0000000,                   !- Sky Clearness
0,                            !- Rain Indicator
0,                            !- Snow Indicator
24,                           !- Day of Month
7,                            !- Month
SummerDesignDay,            !- Day Type
0,                            !- Daylight Saving Time Indicator
WetBulb;                     !- Humidity Indicating Type

!===== file: DesignDays.tmfinc ====End=====

! Temperatures calculated iteratively using E+ auxiliary pre-processor program (GroundTempCalc -
Slab, Version .75)
Site:GroundTemperature:BuildingSurface,
15.4,                        !- January Ground Temperature {C}
16.0,                        !- February Ground Temperature {C}
17.0,                        !- March Ground Temperature {C}
18.2,                        !- April Ground Temperature {C}
20.2,                        !- May Ground Temperature {C}
22.0,                        !- June Ground Temperature {C}

```

```

23.6,           !- July Ground Temperature {C}
24.0,           !- August Ground Temperature {C}
23.5,           !- September Ground Temperature {C}
22.2,           !- October Ground Temperature {C}
19.6,           !- November Ground Temperature {C}
16.8;           !- December Ground Temperature {C}

! _END_ \group Location - Climate - Weather

! \group Surface Construction Elements

Material,
  WALL-1__ST01,      !- Name
  MediumRough,       !- Roughness
  0.02538984,        !- Thickness {m}
  1.801551,          !- Conductivity {W/m-K}
  2242.584,          !- Density {kg/m3}
  836.7661,          !- Specific Heat {J/kg-K}
  0.9,               !- Thermal Absorptance
  0.7;               !- Solar Absorptance

Material:NoMass,
  WALL-1__IN-W,      !- Name
  MediumRough,       !- Roughness
  1.057368,          !- Thermal Resistance {m2-K/W}
  0.9,               !- Thermal Absorptance
  0.7;               !- Solar Absorptance

Material,
  WALL-1__GP02,      !- Name
  MediumRough,       !- Roughness
  0.01588008,        !- Thickness {m}
  0.160161,          !- Conductivity {W/m-K}
  800.923,           !- Density {kg/m3}
  836.7661,          !- Specific Heat {J/kg-K}
  0.9,               !- Thermal Absorptance
  0.7;               !- Solar Absorptance

Material,
  ROOF-1__BR01,      !- Name
  MediumRough,       !- Roughness
  0.00954024,        !- Thickness {m}
  0.1624094,         !- Conductivity {W/m-K}
  1121.292,          !- Density {kg/m3}
  1464.341,          !- Specific Heat {J/kg-K}
  0.9,               !- Thermal Absorptance
  0.7;               !- Solar Absorptance

Material,
  ROOF-1__CC24,      !- Name
  MediumRough,       !- Roughness
  0.1015898,         !- Thickness {m}
  0.3602757,         !- Conductivity {W/m-K}
  1281.477,          !- Density {kg/m3}
  836.7661,          !- Specific Heat {J/kg-K}
  0.9,               !- Thermal Absorptance
  0.7;               !- Solar Absorptance

Material:NoMass,
  ROOF-1__IN-R,      !- Name
  MediumRough,       !- Roughness
  2.220473,          !- Thermal Resistance {m2-K/W}
  0.9,               !- Thermal Absorptance
  0.7;               !- Solar Absorptance

Material,
  CLG-1__AC03,       !- Name
  MediumRough,       !- Roughness
  0.01905,           !- Thickness {m}
  0.0570768,         !- Conductivity {W/m-K}
  288.3323,          !- Density {kg/m3}

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1338.826,      !- Specific Heat {J/kg-K}
0.9,          !- Thermal Absorptance
0.7;         !- Solar Absorptance

Material,
  FLOOR-1__CC24,      !- Name
  MediumRough,       !- Roughness
  0.1015898,         !- Thickness {m}
  0.3602757,         !- Conductivity {W/m-K}
  1281.477,          !- Density {kg/m3}
  836.7661,          !- Specific Heat {J/kg-K}
  0.9,              !- Thermal Absorptance
  0.7;              !- Solar Absorptance

Material:NoMass,
  FLOOR-1__CP01,     !- Name
  MediumRough,       !- Roughness
  0.3665542,         !- Thermal Resistance {m2-K/W}
  0.9,              !- Thermal Absorptance
  0.7;              !- Solar Absorptance

Material,
  SLAB-1__SOIL,      !- Name
  MediumRough,       !- Roughness
  0.6096,            !- Thickness {m}
  1.7296,           !- Conductivity {W/m-K}
  1842.123,          !- Density {kg/m3}
  1087.796,          !- Specific Heat {J/kg-K}
  0.9,              !- Thermal Absorptance
  0.7;              !- Solar Absorptance

Material,
  SLAB-1__CC15,      !- Name
  MediumRough,       !- Roughness
  0.1524,            !- Thickness {m}
  1.801724,          !- Conductivity {W/m-K}
  2242.584,          !- Density {kg/m3}
  836.7661,          !- Specific Heat {J/kg-K}
  0.9,              !- Thermal Absorptance
  0.7;              !- Solar Absorptance

! Use "air" material for interior wall cavity

Material:AirGap,
  WALL-1__AL21,      !- Name
  0.1570000;         !- Thermal Resistance {m2-K/W}

! Above-grade conditioned zone "FLOOR-WEIGHT" material for internal mass
! (floor plus this mass: 70 lb/ft2 from DOE-2 inputs)
! Material is Douglas fir plywood p.25.5 2005 ASHRAE Hdbk of Fundamentals
! (similar to LgOffVAV.idf example file)

Material,
  IntMassMaterial,   !- Name
  MediumSmooth,      !- Roughness
  0.4216,            !- Thickness {m}
  0.115,             !- Conductivity {W/m-K}
  545,               !- Density {kg/m3}
  1214,              !- Specific Heat {J/kg-K}
  0.9,              !- Thermal Absorptance
  0.78,              !- Solar Absorptance
  0.78;             !- Visible Absorptance

! Basement "FLOOR-WEIGHT" material for internal mass
! (floor plus this mass: 130 lb/ft2 from DOE-2 inputs)
! Material is Douglas fir plywood p.25.5 2005 ASHRAE Hdbk of Fundamentals
! Thickness increased to match "FLOOR-WEIGHT" ratio (130/70)
! (similar to LgOffVAV.idf example file)

Material,
  IntMassMaterial_Base, !- Name

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MediumSmooth,           !- Roughness
0.7830,                 !- Thickness {m}
0.115,                 !- Conductivity {W/m-K}
545,                   !- Density {kg/m3}
1214,                  !- Specific Heat {J/kg-K}
0.9,                   !- Thermal Absorptance
0.78,                  !- Solar Absorptance
0.78;                  !- Visible Absorptance

Construction,
ROOF-1,                 !- Name
ROOF-1__BR01,          !- Outside Layer
ROOF-1__CC24,          !- Layer 2
ROOF-1__IN-R;         !- Layer 3

Construction,
CLG-1,                 !- Name
CLG-1__AC03;          !- Outside Layer

Construction,
WALL-1,                !- Name
WALL-1__ST01,          !- Outside Layer
WALL-1__IN-W,          !- Layer 2
WALL-1__GP02;         !- Layer 3

Construction,
INT-WALL-1,           !- Name
WALL-1__GP02,          !- Outside Layer
WALL-1__AL21,          !- Layer 2
WALL-1__GP02;         !- Layer 3

Construction,
FLOOR-1,               !- Name
FLOOR-1__CC24,         !- Outside Layer
FLOOR-1__CP01;        !- Layer 2

Construction,
SLAB-1,                !- Name
SLAB-1__SOIL,          !- Outside Layer
SLAB-1__CC15;         !- Layer 2

! Internal mass construction for above-grade conditioned zones

Construction,
MediumFurniture,       !- Name
IntMassMaterial;      !- Outside Layer

! Internal mass construction for basement

Construction,
MediumFurniture_Base,  !- Name
IntMassMaterial_Base; !- Outside Layer

! _END_ \group Surface Construction Elements

! GLASS-TYPES
! Window5.2.17a glazing: outer pane - ID104, inner pane - ID411
! GLASS-CONDUCTANCE= 0.599 (DOE2), 0.601 (Window); SHADING-COEFF= 0.710 (DOE2), 0.704 (Window)

WindowMaterial:Glazing,
GRAY 3MM,              !- Name
SpectralAverage,        !- Optical Data Type
,                       !- Name of Window Glass Spectral Data Set
.0031,                 !- Thickness {m}
.609,                  !- Solar Transmittance at Normal Incidence
.060,                  !- Front Side Solar Reflectance at Normal Incidence
.061,                  !- Back Side Solar Reflectance at Normal Incidence
.617,                  !- Visible Transmittance at Normal Incidence
.062,                  !- Front Side Visible Reflectance at Normal Incidence
.063,                  !- Back Side Visible Reflectance at Normal Incidence
.0,                    !- Infrared Transmittance at Normal Incidence

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.84,           !- Front Side Infrared Hemispherical Emissivity
.84,           !- Back Side Infrared Hemispherical Emissivity
1.0;          !- Conductivity {W/m-K}

WindowMaterial:Gas,
AIR 4_5MM,     !- Name
Air,           !- Gas Type
.0045;        !- Thickness {m}

WindowMaterial:Glazing,
CLEAR 2_2MM,   !- Name
SpectralAverage, !- Optical Data Type
,             !- Name of Window Glass Spectral Data Set
.0022,        !- Thickness {m}
.856,         !- Solar Transmittance at Normal Incidence
.077,         !- Front Side Solar Reflectance at Normal Incidence
.078,         !- Back Side Solar Reflectance at Normal Incidence
.901,         !- Visible Transmittance at Normal Incidence
.084,         !- Front Side Visible Reflectance at Normal Incidence
.084,         !- Back Side Visible Reflectance at Normal Incidence
.0,           !- Infrared Transmittance at Normal Incidence
.84,         !- Front Side Infrared Hemispherical Emissivity
.84,         !- Back Side Infrared Hemispherical Emissivity
1.0;          !- Conductivity {W/m-K}

CONSTRUCTION,
COMP_N,        !- Name
GRAY 3MM,     !- Outside Layer
AIR 4_5MM,    !- Layer #2
CLEAR 2_2MM;  !- Layer #3

CONSTRUCTION,
COMP_NN,       !- Name
GRAY 3MM,     !- Outside Layer
AIR 4_5MM,    !- Layer #2
CLEAR 2_2MM;  !- Layer #3
! _END_ GLASS-TYPES

! \ Holidays

RunPeriodControl:SpecialDays,
Hol_1/1,       !- Name
1/1,          !- Start Date
1,            !- Duration {days}
Holiday;      !- Special Day Type

RunPeriodControl:SpecialDays,
Hol_2/18,     !- Name
2/18,        !- Start Date
1,           !- Duration {days}
Holiday;     !- Special Day Type

RunPeriodControl:SpecialDays,
Hol_5/27,     !- Name
5/27,        !- Start Date
1,           !- Duration {days}
Holiday;     !- Special Day Type

RunPeriodControl:SpecialDays,
Hol_7/4,      !- Name
7/4,         !- Start Date
1,           !- Duration {days}
Holiday;     !- Special Day Type

RunPeriodControl:SpecialDays,
Hol_9/2,      !- Name
9/2,         !- Start Date
1,           !- Duration {days}
Holiday;     !- Special Day Type

RunPeriodControl:SpecialDays,

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Hol_10/14,           !- Name
10/14,              !- Start Date
1,                  !- Duration {days}
Holiday;            !- Special Day Type

RunPeriodControl:SpecialDays,
Hol_11/11,          !- Name
11/11,              !- Start Date
1,                  !- Duration {days}
Holiday;            !- Special Day Type

RunPeriodControl:SpecialDays,
Hol_11/28,          !- Name
11/28,              !- Start Date
1,                  !- Duration {days}
Holiday;            !- Special Day Type

RunPeriodControl:SpecialDays,
Hol_12/25,          !- Name
12/25,              !- Start Date
1,                  !- Duration {days}
Holiday;            !- Special Day Type

! _END_ \ Holidays

! LDS Schedules

ScheduleTypeLimits,
sctAnyNumber,       !- Name
,                   !- Range
Continuous;         !- Numeric Type

ScheduleTypeLimits,
sctTemperature,    !- Name
-60:200,           !- Range
Continuous;         !- Numeric Type

ScheduleTypeLimits,
Control TypeHV,    !- Name
0:4,               !- Range
Discrete;          !- Numeric Type

ScheduleTypeLimits,
sctOnOff,           !- Name
0:100,             !- Range
Discrete;          !- Numeric Type

Schedule:Compact,
ALLWAYSON,         !- Name
sctAnyNumber,      !- Schedule Type Limits Name
Through: 12/31,    !- Field 1
For: AllDays,      !- Field 2
Until: 24:00,      !- Field 3
1.;               !- Field 4

Schedule:Compact,
INF-SCHED,         !- Name
sctAnyNumber,      !- Schedule Type Limits Name
Through: 12/31,    !- Field 1
For: Weekdays WinterDesignDay SummerDesignDay, !- Field 2
Until: 5:00,       !- Field 3
1.,               !- Field 4
Until: 20:00,     !- Field 5
0.,               !- Field 6
Until: 24:00,     !- Field 7
1.,               !- Field 8
For: Saturdays,   !- Field 9
Until: 5:00,      !- Field 10
1.,               !- Field 11
Until: 15:00,     !- Field 12
0.,               !- Field 13

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Until: 24:00,          !- Field 14
1.,                   !- Field 15
For: Sundays Holidays, !- Field 16
Until: 24:00,          !- Field 17
1.,                   !- Field 18
For: AllOtherDays,    !- Field 19
Until: 24:00,          !- Field 20
0.;                   !- Field 21

Schedule:Compact,
ActSched,              !- Name
sctAnyNumber,          !- Schedule Type Limits Name
Through: 12/31,        !- Field 1
For: AllDays,          !- Field 2
Until: 24:00,          !- Field 3
133.6;                 !- Field 4 -- total heat gain per person in zone under design
conditions {W/person}

Schedule:Compact,
OCC-SCHED,             !- Name
sctAnyNumber,          !- Schedule Type Limits Name
Through: 12/31,        !- Field 1
For: Weekdays SummerDesignDay, !- Field 2
Until: 4:00,           !- Field 3
0.,                   !- Field 4
Until: 5:00,           !- Field 5
0.05,                 !- Field 6
Until: 6:00,           !- Field 7
0.1,                  !- Field 8
Until: 7:00,           !- Field 9
0.25,                 !- Field 10
Until: 11:00,          !- Field 11
0.65,                 !- Field 12
Until: 13:00,          !- Field 13
0.6,                  !- Field 14
Until: 17:00,          !- Field 15
0.65,                 !- Field 16
Until: 18:00,          !- Field 17
0.4,                  !- Field 18
Until: 19:00,          !- Field 19
0.25,                 !- Field 20
Until: 20:00,          !- Field 21
0.1,                  !- Field 22
Until: 23:00,          !- Field 23
0.05,                 !- Field 24
Until: 24:00,          !- Field 25
0.,                   !- Field 26
For: Saturdays,       !- Field 27
Until: 6:00,           !- Field 28
0.,                   !- Field 29
Until: 7:00,           !- Field 30
0.05,                 !- Field 31
Until: 17:00,          !- Field 32
0.15,                 !- Field 33
Until: 20:00,          !- Field 34
0.05,                 !- Field 35
Until: 24:00,          !- Field 36
0.,                   !- Field 37
For: Sundays Holidays, !- Field 38
Until: 7:00,           !- Field 39
0.,                   !- Field 40
Until: 20:00,          !- Field 41
0.05,                 !- Field 42
Until: 24:00,          !- Field 43
0.,                   !- Field 44
For: WinterDesignDay, !- Field 45
Until: 24:00,          !- Field 46
0.0,                  !- Field 47
For: AllOtherDays,    !- Field 48
Until: 24:00,          !- Field 49
0.;                   !- Field 50

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```

Schedule:Compact,
LIT-SCHED,                !- Name
sctAnyNumber,            !- Schedule Type Limits Name
Through: 12/31,         !- Field 1
For: Weekdays SummerDesignDay, !- Field 2
Until: 4:00,             !- Field 3
0.05,                    !- Field 4
Until: 5:00,             !- Field 5
0.1,                     !- Field 6
Until: 6:00,             !- Field 7
0.2,                     !- Field 8
Until: 7:00,             !- Field 9
0.4,                     !- Field 10
Until: 8:00,             !- Field 11
0.7,                     !- Field 12
Until: 9:00,             !- Field 13
0.8,                     !- Field 14
Until: 17:00,           !- Field 15
0.85,                    !- Field 16
Until: 18:00,           !- Field 17
0.8,                     !- Field 18
Until: 19:00,           !- Field 19
0.35,                    !- Field 20
Until: 24:00,           !- Field 21
0.1,                     !- Field 22
For: Saturdays,         !- Field 23
Until: 5:00,             !- Field 24
0.05,                    !- Field 25
Until: 6:00,             !- Field 26
0.1,                     !- Field 27
Until: 7:00,             !- Field 28
0.15,                    !- Field 29
Until: 14:00,           !- Field 30
0.25,                    !- Field 31
Until: 17:00,           !- Field 32
0.2,                     !- Field 33
Until: 18:00,           !- Field 34
0.15,                    !- Field 35
Until: 24:00,           !- Field 36
0.1,                     !- Field 37
For: Sundays Holidays, !- Field 38
Until: 5:00,             !- Field 39
0.05,                    !- Field 40
Until: 7:00,             !- Field 41
0.1,                     !- Field 42
Until: 17:00,           !- Field 43
0.15,                    !- Field 44
Until: 20:00,           !- Field 45
0.1,                     !- Field 46
Until: 24:00,           !- Field 47
0.05,                    !- Field 48
For: WinterDesignDay,   !- Field 49
Until: 24:00,           !- Field 50
0.0,                     !- Field 51
For: AllOtherDays,      !- Field 52
Until: 24:00,           !- Field 53
0.;                      !- Field 54

```

```

Schedule:Compact,
EQP-SCHED,                !- Name
sctAnyNumber,            !- Schedule Type Limits Name
Through: 12/31,         !- Field 1
For: Weekdays SummerDesignDay, !- Field 2
Until: 5:00,             !- Field 3
0.15,                    !- Field 4
Until: 6:00,             !- Field 5
0.2,                     !- Field 6
Until: 7:00,             !- Field 7
0.35,                    !- Field 8
Until: 8:00,             !- Field 9

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0.6,                !- Field 10
Until: 16:00,       !- Field 11
0.7,                !- Field 12
Until: 17:00,       !- Field 13
0.65,              !- Field 14
Until: 18:00,       !- Field 15
0.45,              !- Field 16
Until: 19:00,       !- Field 17
0.3,               !- Field 18
Until: 21:00,       !- Field 19
0.2,               !- Field 20
Until: 24:00,       !- Field 21
0.15,              !- Field 22
For: Saturdays,    !- Field 23
Until: 7:00,        !- Field 24
0.15,              !- Field 25
Until: 8:00,        !- Field 26
0.2,               !- Field 27
Until: 14:00,       !- Field 28
0.25,              !- Field 29
Until: 17:00,       !- Field 30
0.2,               !- Field 31
Until: 24:00,       !- Field 32
0.15,              !- Field 33
For: Sundays Holidays, !- Field 34
Until: 7:00,        !- Field 35
0.15,              !- Field 36
Until: 17:00,       !- Field 37
0.2,               !- Field 38
Until: 24:00,       !- Field 39
0.15,              !- Field 40
For: WinterDesignDay, !- Field 41
Until: 24:00,       !- Field 42
0.0,               !- Field 43
For: AllOtherDays, !- Field 44
Until: 24:00,       !- Field 45
0.;                !- Field 46

! _END_ LDS Schedules
! _END_ \group Simulation Parameters

!*****
****
!
! Interior walls separate conditioned zones to complete enclosures (plenums have no interior
walls)
! Uses vertical zone origins to simplify geometry specification on each storey
!
! Located intermediate and top storey zones at heights expected for those stories if 10 stories
! because exterior convection coefficients change with height.
!
! No need to specify height dependent infiltration flows because, at each time step during
simulation,
! wind speed is adjusted to height of each zone centroid and this wind speed modifies
infiltration flow
!
! Use internal mass in conditioned zones and basement to represent DOE-2 "FLOOR-WEIGHT" mass
!
! Perimeter zone locations relative to core: PER-1:North, PER-2:East, PER-3:South, PER-4:West

GlobalGeometryRules,
  UpperLeftCorner,    !- Starting Vertex Position
  Counterclockwise,  !- Vertex Entry Direction
  Relative;           !- Coordinate System

Zone,
  PLE-10,             !- Name
  0.,                 !- Direction of Relative North {deg}
  0.,                 !- X Origin {m}
  0.,                 !- Y Origin {m}
  38.7096,            !- Z Origin {m}

```

```

1,                !- Type
1,                !- Multiplier
0.9144,          !- Ceiling Height {m}
0.;             !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
  RF1-P1,        !- Name
  Roof,         !- Surface Type
  ROOF-1,       !- Construction Name
  PLE-10,       !- Zone Name
  Outdoors,     !- Outside Boundary Condition
  ,            !- Outside Boundary Condition Object
  SunExposed,   !- Sun Exposure
  WindExposed,  !- Wind Exposure
  0.,          !- View Factor to Ground
  4,           !- Number of Vertices
  0.,37.3302,0.9144, !- X,Y,Z ==> Vertex 1
  0.,0.,0.9144, !- X,Y,Z ==> Vertex 2
  37.3302,0.,0.9144, !- X,Y,Z ==> Vertex 3
  37.3302,37.3302,0.9144; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PLE-10E_1,    !- Name
  Wall,         !- Surface Type
  WALL-1,       !- Construction Name
  PLE-10,       !- Zone Name
  Outdoors,     !- Outside Boundary Condition
  ,            !- Outside Boundary Condition Object
  SunExposed,   !- Sun Exposure
  WindExposed,  !- Wind Exposure
  0.5,         !- View Factor to Ground
  4,           !- Number of Vertices
  37.3302,37.3302,0.9144, !- X,Y,Z ==> Vertex 1
  37.3302,37.3302,0., !- X,Y,Z ==> Vertex 2
  0.,37.3302,0., !- X,Y,Z ==> Vertex 3
  0.,37.3302,0.9144; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PLE-10E_2,    !- Name
  Wall,         !- Surface Type
  WALL-1,       !- Construction Name
  PLE-10,       !- Zone Name
  Outdoors,     !- Outside Boundary Condition
  ,            !- Outside Boundary Condition Object
  SunExposed,   !- Sun Exposure
  WindExposed,  !- Wind Exposure
  0.5,         !- View Factor to Ground
  4,           !- Number of Vertices
  37.3302,0.,0.9144, !- X,Y,Z ==> Vertex 1
  37.3302,0.,0., !- X,Y,Z ==> Vertex 2
  37.3302,37.3302,0., !- X,Y,Z ==> Vertex 3
  37.3302,37.3302,0.9144; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PLE-10E_3,    !- Name
  Wall,         !- Surface Type
  WALL-1,       !- Construction Name
  PLE-10,       !- Zone Name
  Outdoors,     !- Outside Boundary Condition
  ,            !- Outside Boundary Condition Object
  SunExposed,   !- Sun Exposure
  WindExposed,  !- Wind Exposure
  0.5,         !- View Factor to Ground
  4,           !- Number of Vertices
  0.,0.,0.9144, !- X,Y,Z ==> Vertex 1
  0.,0.,0., !- X,Y,Z ==> Vertex 2
  37.3302,0.,0., !- X,Y,Z ==> Vertex 3
  37.3302,0.,0.9144; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PLE-10E_4,    !- Name

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Wall,                !- Surface Type
WALL-1,             !- Construction Name
PLE-10,            !- Zone Name
Outdoors,          !- Outside Boundary Condition
,                 !- Outside Boundary Condition Object
SunExposed,        !- Sun Exposure
WindExposed,       !- Wind Exposure
0.5,              !- View Factor to Ground
4,                !- Number of Vertices
0.,37.3302,0.9144, !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,    !- X,Y,Z ==> Vertex 2
0.,0.,0.,        !- X,Y,Z ==> Vertex 3
0.,0.,0.9144;    !- X,Y,Z ==> Vertex 4

ZoneInfiltration:DesignFlowRate,
PLE-10_INFILTRATION, !- Name
PLE-10,             !- Zone Name
INF-SCHED,         !- Schedule Name
AirChanges/Hour,   !- Design Flow Rate Calculation Method
,                 !- Design Flow Rate {m3/s}
,                 !- Flow per Zone Floor Area {m3/s-m2}
,                 !- Flow per Exterior Surface Area {m3/s-m2}
0.68,             !- Air Changes per Hour
0.,               !- Constant Term Coefficient
0.,               !- Temperature Term Coefficient
0.224,           !- Velocity Term Coefficient
0.;              !- Velocity Squared Term Coefficient

!*****
****

Zone,
PLE-I,            !- Name
0.,              !- Direction of Relative North {deg}
0.,              !- X Origin {m}
0.,              !- Y Origin {m}
18.8976,        !- Z Origin {m}
1,               !- Type
1,               !- Multiplier
0.9144,         !- Ceiling Height {m}
0.;             !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
PLE-IE_1,        !- Name
Wall,           !- Surface Type
WALL-1,        !- Construction Name
PLE-I,         !- Zone Name
Outdoors,     !- Outside Boundary Condition
,             !- Outside Boundary Condition Object
SunExposed,   !- Sun Exposure
WindExposed,  !- Wind Exposure
0.5,         !- View Factor to Ground
4,           !- Number of Vertices
37.3302,37.3302,0.9144, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0.,    !- X,Y,Z ==> Vertex 2
0.,37.3302,0.,        !- X,Y,Z ==> Vertex 3
0.,37.3302,0.9144;   !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PLE-IE_2,        !- Name
Wall,           !- Surface Type
WALL-1,        !- Construction Name
PLE-I,         !- Zone Name
Outdoors,     !- Outside Boundary Condition
,             !- Outside Boundary Condition Object
SunExposed,   !- Sun Exposure
WindExposed,  !- Wind Exposure
0.5,         !- View Factor to Ground
4,           !- Number of Vertices
37.3302,0.,0.9144,   !- X,Y,Z ==> Vertex 1
37.3302,0.,0.,      !- X,Y,Z ==> Vertex 2

```

```

37.3302,37.3302,0.,      !- X,Y,Z ==> Vertex 3
37.3302,37.3302,0.9144; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PLE-IE_3,              !- Name
  Wall,                  !- Surface Type
  WALL-1,                !- Construction Name
  PLE-I,                 !- Zone Name
  Outdoors,              !- Outside Boundary Condition
  ,                      !- Outside Boundary Condition Object
  SunExposed,            !- Sun Exposure
  WindExposed,           !- Wind Exposure
  0.5,                   !- View Factor to Ground
  4,                     !- Number of Vertices
  0.,0.,0.9144,          !- X,Y,Z ==> Vertex 1
  0.,0.,0.,              !- X,Y,Z ==> Vertex 2
  37.3302,0.,0.,        !- X,Y,Z ==> Vertex 3
  37.3302,0.,0.9144;    !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PLE-IE_4,              !- Name
  Wall,                  !- Surface Type
  WALL-1,                !- Construction Name
  PLE-I,                 !- Zone Name
  Outdoors,              !- Outside Boundary Condition
  ,                      !- Outside Boundary Condition Object
  SunExposed,            !- Sun Exposure
  WindExposed,           !- Wind Exposure
  0.5,                   !- View Factor to Ground
  4,                     !- Number of Vertices
  0.,37.3302,0.9144,    !- X,Y,Z ==> Vertex 1
  0.,37.3302,0.,        !- X,Y,Z ==> Vertex 2
  0.,0.,0.,              !- X,Y,Z ==> Vertex 3
  0.,0.,0.9144;         !- X,Y,Z ==> Vertex 4

ZoneInfiltration:DesignFlowRate,
  PLE-I_INFILTRATION,    !- Name
  PLE-I,                 !- Zone Name
  INF-SCHED,             !- Schedule Name
  AirChanges/Hour,       !- Design Flow Rate Calculation Method
  ,                      !- Design Flow Rate {m3/s}
  ,                      !- Flow per Zone Floor Area {m3/s-m2}
  ,                      !- Flow per Exterior Surface Area {m3/s-m2}
  0.68,                  !- Air Changes per Hour
  0.,                    !- Constant Term Coefficient
  0.,                    !- Temperature Term Coefficient
  0.224,                 !- Velocity Term Coefficient
  0.;                    !- Velocity Squared Term Coefficient

!*****
****

Zone,
  PLE-1,                 !- Name
  0.,                    !- Direction of Relative North {deg}
  0.,                    !- X Origin {m}
  0.,                    !- Y Origin {m}
  3.048,                 !- Z Origin {m}
  1,                     !- Type
  1,                     !- Multiplier
  0.9144,                !- Ceiling Height {m}
  0.;                    !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
  PLE-IE_1,              !- Name
  Wall,                  !- Surface Type
  WALL-1,                !- Construction Name
  PLE-1,                 !- Zone Name
  Outdoors,              !- Outside Boundary Condition
  ,                      !- Outside Boundary Condition Object
  SunExposed,            !- Sun Exposure

```



```

WindExposed,           !- Wind Exposure
0.5,                   !- View Factor to Ground
4,                     !- Number of Vertices
37.3302,37.3302,0.9144, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0.,   !- X,Y,Z ==> Vertex 2
0.,37.3302,0.,        !- X,Y,Z ==> Vertex 3
0.,37.3302,0.9144;   !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PLE-1E_2,              !- Name
Wall,                  !- Surface Type
WALL-1,                !- Construction Name
PLE-1,                 !- Zone Name
Outdoors,              !- Outside Boundary Condition
,                      !- Outside Boundary Condition Object
SunExposed,            !- Sun Exposure
WindExposed,           !- Wind Exposure
0.5,                   !- View Factor to Ground
4,                     !- Number of Vertices
37.3302,0.,0.9144,    !- X,Y,Z ==> Vertex 1
37.3302,0.,0.,        !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0.,  !- X,Y,Z ==> Vertex 3
37.3302,37.3302,0.9144; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PLE-1E_3,              !- Name
Wall,                  !- Surface Type
WALL-1,                !- Construction Name
PLE-1,                 !- Zone Name
Outdoors,              !- Outside Boundary Condition
,                      !- Outside Boundary Condition Object
SunExposed,            !- Sun Exposure
WindExposed,           !- Wind Exposure
0.5,                   !- View Factor to Ground
4,                     !- Number of Vertices
0.,0.,0.9144,         !- X,Y,Z ==> Vertex 1
0.,0.,0.,             !- X,Y,Z ==> Vertex 2
37.3302,0.,0.,       !- X,Y,Z ==> Vertex 3
37.3302,0.,0.9144;   !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PLE-1E_4,              !- Name
Wall,                  !- Surface Type
WALL-1,                !- Construction Name
PLE-1,                 !- Zone Name
Outdoors,              !- Outside Boundary Condition
,                      !- Outside Boundary Condition Object
SunExposed,            !- Sun Exposure
WindExposed,           !- Wind Exposure
0.5,                   !- View Factor to Ground
4,                     !- Number of Vertices
0.,37.3302,0.9144,    !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,        !- X,Y,Z ==> Vertex 2
0.,0.,0.,             !- X,Y,Z ==> Vertex 3
0.,0.,0.9144;        !- X,Y,Z ==> Vertex 4

ZoneInfiltration:DesignFlowRate,
PLE-1_INFILTRATION,   !- Name
PLE-1,                 !- Zone Name
INF-SCHED,             !- Schedule Name
AirChanges/Hour,      !- Design Flow Rate Calculation Method
,                      !- Design Flow Rate {m3/s}
,                      !- Flow per Zone Floor Area {m3/s-m2}
,                      !- Flow per Exterior Surface Area {m3/s-m2}
0.68,                 !- Air Changes per Hour
0.,                   !- Constant Term Coefficient
0.,                   !- Temperature Term Coefficient
0.224,                !- Velocity Term Coefficient
0.;                   !- Velocity Squared Term Coefficient

```

!*****

```
Zone,
  PER-1T,           !- Name
  0.,              !- Direction of Relative North {deg}
  0.,              !- X Origin {m}
  0.,              !- Y Origin {m}
  35.6616,         !- Z Origin {m}
  1,               !- Type
  1,               !- Multiplier
  3.048,           !- Ceiling Height {m}
  0.;             !- Volume {m3} -- Zero is autocalculate
```

```
BuildingSurface:Detailed,
  CLG-PI,          !- Name
  Ceiling,         !- Surface Type
  CLG-1,           !- Construction Name
  PER-1T,         !- Zone Name
  Zone,           !- Outside Boundary Condition
  PLE-10,         !- Outside Boundary Condition Object
  NoSun,          !- Sun Exposure
  NoWind,         !- Wind Exposure
  0.,             !- View Factor to Ground
  4,              !- Number of Vertices
  32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
  37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 2
  0.,37.3302,3.048, !- X,Y,Z ==> Vertex 3
  4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4
```

```
BuildingSurface:Detailed,
  EW1-P1T,        !- Name
  Wall,           !- Surface Type
  WALL-1,         !- Construction Name
  PER-1T,         !- Zone Name
  Outdoors,       !- Outside Boundary Condition
  ,              !- Outside Boundary Condition Object
  SunExposed,     !- Sun Exposure
  WindExposed,    !- Wind Exposure
  0.5,           !- View Factor to Ground
  4,              !- Number of Vertices
  37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
  37.3302,37.3302,0., !- X,Y,Z ==> Vertex 2
  0.,37.3302,0., !- X,Y,Z ==> Vertex 3
  0.,37.3302,3.048; !- X,Y,Z ==> Vertex 4
```

```
FenestrationSurface:Detailed,
  W1-P1T,         !- Name
  Window,         !- Surface Type
  COMP_N,         !- Construction Name
  EW1-P1T,        !- Building Surface Name
  ,              !- Outside Boundary Condition Object
  0.5,           !- View Factor to Ground
  ,              !- Shading Control Name
  ,              !- Frame and Divider Name
  1,              !- Multiplier
  4,              !- Number of Vertices
  37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
  37.3302,37.3302,1.524, !- X,Y,Z ==> Vertex 2
  0.,37.3302,1.524, !- X,Y,Z ==> Vertex 3
  0.,37.3302,3.048; !- X,Y,Z ==> Vertex 4
```

```
BuildingSurface:Detailed,
  IW12-P1T,       !- Name
  Wall,           !- Surface Type
  INT-WALL-1,     !- Construction Name
  PER-1T,         !- Zone Name
  Zone,           !- Outside Boundary Condition
  PER-2T,         !- Outside Boundary Condition Object
  NoSun,         !- Sun Exposure
  NoWind,        !- Wind Exposure
```

```

0.,          !- View Factor to Ground
4,          !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW14-P1T,   !- Name
Wall,      !- Surface Type
INT-WALL-1, !- Construction Name
PER-1T,    !- Zone Name
Zone,      !- Outside Boundary Condition
PER-4T,    !- Outside Boundary Condition Object
NoSun,     !- Sun Exposure
NoWind,    !- Wind Exposure
0.,        !- View Factor to Ground
4,         !- Number of Vertices
0.,37.3302,3.048, !- X,Y,Z ==> Vertex 1
0.,37.3302,0., !- X,Y,Z ==> Vertex 2
4.572,32.7582,0., !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW1C-P1T,   !- Name
Wall,      !- Surface Type
INT-WALL-1, !- Construction Name
PER-1T,    !- Zone Name
Zone,      !- Outside Boundary Condition
COR-1T,    !- Outside Boundary Condition Object
NoSun,     !- Sun Exposure
NoWind,    !- Wind Exposure
0.,        !- View Factor to Ground
4,         !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,32.7582,0., !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
F-P1,      !- Name
Floor,     !- Surface Type
FLOOR-1,   !- Construction Name
PER-1T,    !- Zone Name
Zone,      !- Outside Boundary Condition
PLE-I,     !- Outside Boundary Condition Object
NoSun,     !- Sun Exposure
NoWind,    !- Wind Exposure
0.,        !- View Factor to Ground
4,         !- Number of Vertices
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
4.572,32.7582,0., !- X,Y,Z ==> Vertex 3
0.,37.3302,0.; !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-P1T, !- Name
MediumFurniture, !- Construction Name
PER-1T,      !- Zone Name
137.916;    !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
PER-1T_INFILTRATION, !- Name
PER-1T,              !- Zone Name
INF-SCHED,           !- Schedule Name
AirChanges/Hour,     !- Design Flow Rate Calculation Method
,                    !- Design Flow Rate {m3/s}
,                    !- Flow per Zone Floor Area {m3/s-m2}
,                    !- Flow per Exterior Surface Area {m3/s-m2}

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```

0.3,           !- Air Changes per Hour
0.,           !- Constant Term Coefficient
0.,           !- Temperature Term Coefficient
0.224,        !- Velocity Term Coefficient
0.;           !- Velocity Squared Term Coefficient

People,
  PER-1T_PEOPLE,      !- Name
  PER-1T,             !- Zone Name
  OCC-SCHED,          !- Number of People Schedule Name
  Area/Person,        !- Number of People Calculation Method
  ,                  !- Number of People
  ,                  !- People per Zone Floor Area {person/m2}
  9.290304,          !- Zone Floor Area per Person {m2/person}
  0.3,               !- Fraction Radiant
  0.5482,            !- Sensible Heat Fraction
  ActSched;          !- Activity Level Schedule Name

Lights,
  PER-1T_LIGHTS,     !- Name
  PER-1T,             !- Zone Name
  LIT-SCHED,          !- Schedule Name
  Watts/Area,        !- Design Level Calculation Method
  ,                  !- Lighting Level {W}
  13.993084,         !- Watts per Zone Floor Area {W/m2}
  ,                  !- Watts per Person {W/person}
  0.55,              !- Return Air Fraction
  0.3015,            !- Fraction Radiant
  0.045,             !- Fraction Visible
  0.,                !- Fraction Replaceable
  GeneralLights;     !- End-Use Subcategory

ElectricEquipment,
  PER-1T_EQUIP,      !- Name
  PER-1T,             !- Zone Name
  EQP-SCHED,         !- Schedule Name
  Watts/Area,        !- Design Level Calculation Method
  ,                  !- Design Level {W}
  8.072933,         !- Watts per Zone Floor Area {W/m2}
  ,                  !- Watts per Person {W/person}
  0.,                !- Fraction Latent
  0.7,               !- Fraction Radiant
  0.,                !- Fraction Lost
  0;                 !- End-Use Subcategory

!*****
****

Zone,
  PER-2T,            !- Name
  0.,                !- Direction of Relative North {deg}
  0.,                !- X Origin {m}
  0.,                !- Y Origin {m}
  35.6616,           !- Z Origin {m}
  1,                 !- Type
  1,                 !- Multiplier
  3.048,             !- Ceiling Height {m}
  0.;               !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
  PER-2TI_2,        !- Name
  Ceiling,          !- Surface Type
  CLG-1,            !- Construction Name
  PER-2T,           !- Zone Name
  Zone,             !- Outside Boundary Condition
  PLE-10,           !- Outside Boundary Condition Object
  NoSun,            !- Sun Exposure
  NoWind,           !- Wind Exposure
  0.,               !- View Factor to Ground
  4,                !- Number of Vertices
  32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1

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```

37.3302,0.,3.048,      !- X,Y,Z ==> Vertex 2
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
EW1-P2T,              !- Name
Wall,                 !- Surface Type
WALL-1,               !- Construction Name
PER-2T,               !- Zone Name
Outdoors,             !- Outside Boundary Condition
,                     !- Outside Boundary Condition Object
SunExposed,           !- Sun Exposure
WindExposed,          !- Wind Exposure
0.5,                  !- View Factor to Ground
4,                    !- Number of Vertices
37.3302,0.,3.048,    !- X,Y,Z ==> Vertex 1
37.3302,0.,0.,       !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
W1-P2T,              !- Name
Window,              !- Surface Type
COMP_NN,             !- Construction Name
EW1-P2T,             !- Building Surface Name
,                     !- Outside Boundary Condition Object
0.5,                  !- View Factor to Ground
,                     !- Shading Control Name
,                     !- Frame and Divider Name
1,                    !- Multiplier
4,                    !- Number of Vertices
37.3302,0.,3.048,    !- X,Y,Z ==> Vertex 1
37.3302,0.,1.524,    !- X,Y,Z ==> Vertex 2
37.3302,37.3302,1.524, !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW23-P2T,            !- Name
Wall,                 !- Surface Type
INT-WALL-1,          !- Construction Name
PER-2T,               !- Zone Name
Zone,                 !- Outside Boundary Condition
PER-3T,               !- Outside Boundary Condition Object
NoSun,                !- Sun Exposure
NoWind,               !- Wind Exposure
0.,                   !- View Factor to Ground
4,                    !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,    !- X,Y,Z ==> Vertex 2
37.3302,0.,0.,       !- X,Y,Z ==> Vertex 3
37.3302,0.,3.048;    !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW21-P2T,            !- Name
Wall,                 !- Surface Type
INT-WALL-1,          !- Construction Name
PER-2T,               !- Zone Name
Zone,                 !- Outside Boundary Condition
PER-1T,               !- Outside Boundary Condition Object
NoSun,                !- Sun Exposure
NoWind,               !- Wind Exposure
0.,                   !- View Factor to Ground
4,                    !- Number of Vertices
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0.,    !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0.,    !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW2C-P2T,            !- Name
Wall,                 !- Surface Type

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INT-WALL-1,           !- Construction Name
PER-2T,              !- Zone Name
Zone,                !- Outside Boundary Condition
COR-1T,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-2TI_1,           !- Name
Floor,               !- Surface Type
FLOOR-1,             !- Construction Name
PER-2T,              !- Zone Name
Zone,                !- Outside Boundary Condition
PLE-I,               !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
37.3302,0.,0.,       !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
37.3302,37.3302,0.; !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-P2T,        !- Name
MediumFurniture,    !- Construction Name
PER-2T,              !- Zone Name
137.916;             !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
PER-2T_INFILTRATION, !- Name
PER-2T,              !- Zone Name
INF-SCHED,           !- Schedule Name
AirChanges/Hour,     !- Design Flow Rate Calculation Method
,                    !- Design Flow Rate {m3/s}
,                    !- Flow per Zone Floor Area {m3/s-m2}
,                    !- Flow per Exterior Surface Area {m3/s-m2}
0.3,                 !- Air Changes per Hour
0.,                  !- Constant Term Coefficient
0.,                  !- Temperature Term Coefficient
0.224,               !- Velocity Term Coefficient
0.;                  !- Velocity Squared Term Coefficient

People,
PER-2T_PEOPLE,       !- Name
PER-2T,              !- Zone Name
OCC-SCHED,           !- Number of People Schedule Name
Area/Person,         !- Number of People Calculation Method
,                    !- Number of People
,                    !- People per Zone Floor Area {person/m2}
9.290304,            !- Zone Floor Area per Person {m2/person}
0.3,                 !- Fraction Radiant
0.5482,              !- Sensible Heat Fraction
ActSched;            !- Activity Level Schedule Name

Lights,
PER-2T_LIGHTS,       !- Name
PER-2T,              !- Zone Name
LIT-SCHED,           !- Schedule Name
Watts/Area,          !- Design Level Calculation Method
,                    !- Lighting Level {W}
13.993084,           !- Watts per Zone Floor Area {W/m2}
,                    !- Watts per Person {W/person}

```

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0.55,                !- Return Air Fraction
0.3015,             !- Fraction Radiant
0.045,              !- Fraction Visible
0.,                  !- Fraction Replaceable
GeneralLights;      !- End-Use Subcategory

ElectricEquipment,
  PER-2T_EQUIP,      !- Name
  PER-2T,            !- Zone Name
  EQP-SCHED,         !- Schedule Name
  Watts/Area,        !- Design Level Calculation Method
  ,                  !- Design Level {W}
  8.072933,          !- Watts per Zone Floor Area {W/m2}
  ,                  !- Watts per Person {W/person}
  0.,                !- Fraction Latent
  0.7,               !- Fraction Radiant
  0.,                !- Fraction Lost
  0;                 !- End-Use Subcategory

!*****
****

Zone,
  PER-3T,            !- Name
  0.,                !- Direction of Relative North {deg}
  0.,                !- X Origin {m}
  0.,                !- Y Origin {m}
  35.6616,           !- Z Origin {m}
  1,                 !- Type
  1,                 !- Multiplier
  3.048,             !- Ceiling Height {m}
  0.;                !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
  PER-3TI_2,         !- Name
  Ceiling,           !- Surface Type
  CLG-1,             !- Construction Name
  PER-3T,            !- Zone Name
  Zone,              !- Outside Boundary Condition
  PLE-10,            !- Outside Boundary Condition Object
  NoSun,             !- Sun Exposure
  NoWind,            !- Wind Exposure
  0.,                !- View Factor to Ground
  4,                 !- Number of Vertices
  4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
  0.,0.,3.048,       !- X,Y,Z ==> Vertex 2
  37.3302,0.,3.048, !- X,Y,Z ==> Vertex 3
  32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  EW1-P3T,           !- Name
  Wall,              !- Surface Type
  WALL-1,            !- Construction Name
  PER-3T,            !- Zone Name
  Outdoors,          !- Outside Boundary Condition
  ,                  !- Outside Boundary Condition Object
  SunExposed,        !- Sun Exposure
  WindExposed,       !- Wind Exposure
  0.5,               !- View Factor to Ground
  4,                 !- Number of Vertices
  0.,0.,3.048,       !- X,Y,Z ==> Vertex 1
  0.,0.,0.,          !- X,Y,Z ==> Vertex 2
  37.3302,0.,0.,     !- X,Y,Z ==> Vertex 3
  37.3302,0.,3.048; !- X,Y,Z ==> Vertex 4

PenetrationSurface:Detailed,
  EW1-P3TW_1,        !- Name
  Window,            !- Surface Type
  COMP NN,           !- Construction Name
  EW1-P3T,           !- Building Surface Name
  ,                  !- Outside Boundary Condition Object

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```

0.5,           !- View Factor to Ground
,             !- Shading Control Name
,             !- Frame and Divider Name
1,            !- Multiplier
4,            !- Number of Vertices
0.,0.,3.048,  !- X,Y,Z ==> Vertex 1
0.,0.,1.524,  !- X,Y,Z ==> Vertex 2
37.3302,0.,1.524, !- X,Y,Z ==> Vertex 3
37.3302,0.,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW34-P3T,     !- Name
Wall,         !- Surface Type
INT-WALL-1,   !- Construction Name
PER-3T,       !- Zone Name
Zone,         !- Outside Boundary Condition
PER-4T,       !- Outside Boundary Condition Object
NoSun,        !- Sun Exposure
NoWind,       !- Wind Exposure
0.,           !- View Factor to Ground
4,            !- Number of Vertices
4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
4.572,4.572,0., !- X,Y,Z ==> Vertex 2
0.,0.,0.,    !- X,Y,Z ==> Vertex 3
0.,0.,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW32-P3T,     !- Name
Wall,         !- Surface Type
INT-WALL-1,   !- Construction Name
PER-3T,       !- Zone Name
Zone,         !- Outside Boundary Condition
PER-2T,       !- Outside Boundary Condition Object
NoSun,        !- Sun Exposure
NoWind,       !- Wind Exposure
0.,           !- View Factor to Ground
4,            !- Number of Vertices
37.3302,0.,3.048, !- X,Y,Z ==> Vertex 1
37.3302,0.,0.,  !- X,Y,Z ==> Vertex 2
32.7582,4.572,0., !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW3C-P3T,     !- Name
Wall,         !- Surface Type
INT-WALL-1,   !- Construction Name
PER-3T,       !- Zone Name
Zone,         !- Outside Boundary Condition
COR-1T,       !- Outside Boundary Condition Object
NoSun,        !- Sun Exposure
NoWind,       !- Wind Exposure
0.,           !- View Factor to Ground
4,            !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,  !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,    !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-3TI_1,    !- Name
Floor,        !- Surface Type
FLOOR-1,     !- Construction Name
PER-3T,       !- Zone Name
Zone,         !- Outside Boundary Condition
PLE-I,       !- Outside Boundary Condition Object
NoSun,        !- Sun Exposure
NoWind,       !- Wind Exposure
0.,           !- View Factor to Ground
4,            !- Number of Vertices
0.,0.,0.,    !- X,Y,Z ==> Vertex 1
4.572,4.572,0., !- X,Y,Z ==> Vertex 2

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32.7582,4.572,0.,      !- X,Y,Z ==> Vertex 3
37.3302,0.,0.;        !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
  Internal-P3T,          !- Name
  MediumFurniture,      !- Construction Name
  PER-3T,               !- Zone Name
  137.916;              !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
  PER-3T_INFILTRATION, !- Name
  PER-3T,              !- Zone Name
  INF-SCHED,          !- Schedule Name
  AirChanges/Hour,    !- Design Flow Rate Calculation Method
  ,                  !- Design Flow Rate {m3/s}
  ,                  !- Flow per Zone Floor Area {m3/s-m2}
  ,                  !- Flow per Exterior Surface Area {m3/s-m2}
  0.3,               !- Air Changes per Hour
  0.,                !- Constant Term Coefficient
  0.,                !- Temperature Term Coefficient
  0.224,            !- Velocity Term Coefficient
  0.;               !- Velocity Squared Term Coefficient

People,
  PER-3T_PEOPLE,      !- Name
  PER-3T,            !- Zone Name
  OCC-SCHED,         !- Number of People Schedule Name
  Area/Person,       !- Number of People Calculation Method
  ,                 !- Number of People
  ,                 !- People per Zone Floor Area {person/m2}
  9.290304,         !- Zone Floor Area per Person {m2/person}
  0.3,              !- Fraction Radiant
  0.5482,          !- Sensible Heat Fraction
  ActSched;         !- Activity Level Schedule Name

Lights,
  PER-3T_LIGHTS,     !- Name
  PER-3T,           !- Zone Name
  LIT-SCHED,        !- Schedule Name
  Watts/Area,       !- Design Level Calculation Method
  ,                !- Lighting Level {W}
  13.993084,       !- Watts per Zone Floor Area {W/m2}
  ,                !- Watts per Person {W/person}
  0.55,           !- Return Air Fraction
  0.3015,        !- Fraction Radiant
  0.045,         !- Fraction Visible
  0.,            !- Fraction Replaceable
  GeneralLights; !- End-Use Subcategory

ElectricEquipment,
  PER-3T_EQUIP,      !- Name
  PER-3T,           !- Zone Name
  EQP-SCHED,        !- Schedule Name
  Watts/Area,       !- Design Level Calculation Method
  ,                !- Design Level {W}
  8.072933,        !- Watts per Zone Floor Area {W/m2}
  ,                !- Watts per Person {W/person}
  0.,              !- Fraction Latent
  0.7,            !- Fraction Radiant
  0.,             !- Fraction Lost
  0.;             !- End-Use Subcategory

!*****
****

Zone,
  PER-4T,           !- Name
  0.,              !- Direction of Relative North {deg}
  0.,              !- X Origin {m}

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0.,           !- Y Origin {m}
35.6616,     !- Z Origin {m}
1,           !- Type
1,           !- Multiplier
3.048,       !- Ceiling Height {m}
0.;          !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
PER-4TI_2,   !- Name
Ceiling,    !- Surface Type
CLG-1,      !- Construction Name
PER-4T,     !- Zone Name
Zone,       !- Outside Boundary Condition
PLE-10,     !- Outside Boundary Condition Object
NoSun,     !- Sun Exposure
NoWind,     !- Wind Exposure
0.,         !- View Factor to Ground
4,         !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
0.,37.3302,3.048,   !- X,Y,Z ==> Vertex 2
0.,0.,3.048,       !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
EW1-P4T,    !- Name
Wall,      !- Surface Type
WALL-1,    !- Construction Name
PER-4T,    !- Zone Name
Outdoors,  !- Outside Boundary Condition
,          !- Outside Boundary Condition Object
SunExposed, !- Sun Exposure
WindExposed, !- Wind Exposure
0.5,       !- View Factor to Ground
4,         !- Number of Vertices
0.,37.3302,3.048, !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,   !- X,Y,Z ==> Vertex 2
0.,0.,0.,       !- X,Y,Z ==> Vertex 3
0.,0.,3.048;    !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
EW1-P4TW_1, !- Name
Window,    !- Surface Type
COMP_NN,   !- Construction Name
EW1-P4T,   !- Building Surface Name
,          !- Outside Boundary Condition Object
0.5,       !- View Factor to Ground
,          !- Shading Control Name
,          !- Frame and Divider Name
1,         !- Multiplier
4,         !- Number of Vertices
0.,37.3302,3.048, !- X,Y,Z ==> Vertex 1
0.,37.3302,1.524, !- X,Y,Z ==> Vertex 2
0.,0.,1.524,     !- X,Y,Z ==> Vertex 3
0.,0.,3.048;    !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW41-P4T,  !- Name
Wall,     !- Surface Type
INT-WALL-1, !- Construction Name
PER-4T,   !- Zone Name
Zone,     !- Outside Boundary Condition
PER-1T,   !- Outside Boundary Condition Object
NoSun,    !- Sun Exposure
NoWind,   !- Wind Exposure
0.,       !- View Factor to Ground
4,       !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,32.7582,0.,   !- X,Y,Z ==> Vertex 2
0.,37.3302,0.,     !- X,Y,Z ==> Vertex 3
0.,37.3302,3.048; !- X,Y,Z ==> Vertex 4

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BuildingSurface:Detailed,
IW43-P4T,           !- Name
Wall,              !- Surface Type
INT-WALL-1,        !- Construction Name
PER-4T,            !- Zone Name
Zone,              !- Outside Boundary Condition
PER-3T,            !- Outside Boundary Condition Object
NoSun,             !- Sun Exposure
NoWind,            !- Wind Exposure
0.,                !- View Factor to Ground
4,                 !- Number of Vertices
0.,0.,3.048,       !- X,Y,Z ==> Vertex 1
0.,0.,0.,          !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,   !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW4C-P4T,           !- Name
Wall,              !- Surface Type
INT-WALL-1,        !- Construction Name
PER-4T,            !- Zone Name
Zone,              !- Outside Boundary Condition
COR-1T,            !- Outside Boundary Condition Object
NoSun,             !- Sun Exposure
NoWind,            !- Wind Exposure
0.,                !- View Factor to Ground
4,                 !- Number of Vertices
4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
4.572,4.572,0.,   !- X,Y,Z ==> Vertex 2
4.572,32.7582,0., !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-4TI_1,          !- Name
Floor,              !- Surface Type
FLOOR-1,            !- Construction Name
PER-4T,            !- Zone Name
Zone,              !- Outside Boundary Condition
PLE-I,             !- Outside Boundary Condition Object
NoSun,             !- Sun Exposure
NoWind,            !- Wind Exposure
0.,                !- View Factor to Ground
4,                 !- Number of Vertices
0.,37.3302,0.,     !- X,Y,Z ==> Vertex 1
4.572,32.7582,0., !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,   !- X,Y,Z ==> Vertex 3
0.,0.,0.;          !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-P4T,       !- Name
MediumFurniture,   !- Construction Name
PER-4T,            !- Zone Name
137.916;           !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
PER-4T_INFILTRATION, !- Name
PER-4T,             !- Zone Name
INF-SCHED,          !- Schedule Name
AirChanges/Hour,    !- Design Flow Rate Calculation Method
,                   !- Design Flow Rate {m3/s}
,                   !- Flow per Zone Floor Area {m3/s-m2}
,                   !- Flow per Exterior Surface Area {m3/s-m2}
0.3,                !- Air Changes per Hour
0.,                 !- Constant Term Coefficient
0.,                 !- Temperature Term Coefficient
0.224,              !- Velocity Term Coefficient
0.;                 !- Velocity Squared Term Coefficient

People,

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PER-4T_PEOPLE,      !- Name
PER-4T,             !- Zone Name
OCC-SCHED,         !- Number of People Schedule Name
Area/Person,       !- Number of People Calculation Method
,                  !- Number of People
,                  !- People per Zone Floor Area {person/m2}
9.290304,          !- Zone Floor Area per Person {m2/person}
0.3,               !- Fraction Radiant
0.5482,           !- Sensible Heat Fraction
ActSched;          !- Activity Level Schedule Name

```

```

Lights,
PER-4T_LIGHTS,     !- Name
PER-4T,            !- Zone Name
LIT-SCHED,         !- Schedule Name
Watts/Area,        !- Design Level Calculation Method
,                  !- Lighting Level {W}
13.993084,         !- Watts per Zone Floor Area {W/m2}
,                  !- Watts per Person {W/person}
0.55,             !- Return Air Fraction
0.3015,           !- Fraction Radiant
0.045,            !- Fraction Visible
0.,               !- Fraction Replaceable
GeneralLights;     !- End-Use Subcategory

```

```

ElectricEquipment,
PER-4T_EQUIP,      !- Name
PER-4T,            !- Zone Name
EQP-SCHED,         !- Schedule Name
Watts/Area,        !- Design Level Calculation Method
,                  !- Design Level {W}
8.072933,         !- Watts per Zone Floor Area {W/m2}
,                  !- Watts per Person {W/person}
0.,               !- Fraction Latent
0.7,              !- Fraction Radiant
0.,               !- Fraction Lost
0;                !- End-Use Subcategory

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!*****
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Zone,
COR-1T,            !- Name
0.,               !- Direction of Relative North {deg}
0.,               !- X Origin {m}
0.,               !- Y Origin {m}
35.6616,          !- Z Origin {m}
1,                !- Type
1,                !- Multiplier
3.048,            !- Ceiling Height {m}
0.;              !- Volume {m3} -- Zero is autocalculate

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BuildingSurface:Detailed,
COR-CLG-PI,       !- Name
Ceiling,          !- Surface Type
CLG-1,            !- Construction Name
COR-1T,           !- Zone Name
Zone,             !- Outside Boundary Condition
PLE-10,           !- Outside Boundary Condition Object
NoSun,            !- Sun Exposure
NoWind,           !- Wind Exposure
0.,               !- View Factor to Ground
4,                !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,4.572,3.048, !- X,Y,Z ==> Vertex 2
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

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BuildingSurface:Detailed,
IWC1-C1T,         !- Name
Wall,             !- Surface Type

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INT-WALL-1,           !- Construction Name
COR-1T,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-1T,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC2-C1T,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
COR-1T,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-2T,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC3-C1T,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
COR-1T,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-3T,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,4.572,3.048,  !- X,Y,Z ==> Vertex 1
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC4-C1T,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
COR-1T,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-4T,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,32.7582,0.,   !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
COR-F-P1,            !- Name
Floor,               !- Surface Type
FLOOR-1,             !- Construction Name
COR-1T,              !- Zone Name
Zone,                !- Outside Boundary Condition
PLE-I,               !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground

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4,                !- Number of Vertices
4.572,4.572,0.,   !- X,Y,Z ==> Vertex 1
4.572,32.7582,0., !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,4.572,0.; !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
  Internal-C1T,    !- Name
  MediumFurniture, !- Construction Name
  COR-1T,          !- Zone Name
  731.580;        !- Surface Area {m2}

! No INFILTRATION

People,
  COR-1T_PEOPLE,  !- Name
  COR-1T,         !- Zone Name
  OCC-SCHED,      !- Number of People Schedule Name
  Area/Person,    !- Number of People Calculation Method
  ,              !- Number of People
  ,              !- People per Zone Floor Area {person/m2}
  9.290304,      !- Zone Floor Area per Person {m2/person}
  0.3,           !- Fraction Radiant
  0.5482,        !- Sensible Heat Fraction
  ActSched;      !- Activity Level Schedule Name

Lights,
  COR-1T_LIGHTS, !- Name
  COR-1T,        !- Zone Name
  LIT-SCHED,     !- Schedule Name
  Watts/Area,    !- Design Level Calculation Method
  ,             !- Lighting Level {W}
  13.993084,    !- Watts per Zone Floor Area {W/m2}
  ,             !- Watts per Person {W/person}
  0.55,         !- Return Air Fraction
  0.3015,       !- Fraction Radiant
  0.045,        !- Fraction Visible
  0.,           !- Fraction Replaceable
  GeneralLights; !- End-Use Subcategory

ElectricEquipment,
  COR-1T_EQUIP,  !- Name
  COR-1T,        !- Zone Name
  EQP-SCHED,     !- Schedule Name
  Watts/Area,    !- Design Level Calculation Method
  ,             !- Design Level {W}
  8.072933,     !- Watts per Zone Floor Area {W/m2}
  ,             !- Watts per Person {W/person}
  0.,           !- Fraction Latent
  0.7,          !- Fraction Radiant
  0.,           !- Fraction Lost
  0;            !- End-Use Subcategory

!*****
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Zone,
  PER-1I,        !- Name
  0.,           !- Direction of Relative North {deg}
  0.,           !- X Origin {m}
  0.,           !- Y Origin {m}
  15.8496,      !- Z Origin {m}
  1,            !- Type
  1,            !- Multiplier
  3.048,        !- Ceiling Height {m}
  0.;          !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
  PER-1II_2,    !- Name

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Ceiling,                !- Surface Type
CLG-1,                  !- Construction Name
PER-1I,                 !- Zone Name
Zone,                   !- Outside Boundary Condition
PLE-I,                  !- Outside Boundary Condition Object
NoSun,                  !- Sun Exposure
NoWind,                 !- Wind Exposure
0.,                     !- View Factor to Ground
4,                       !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 2
0.,37.3302,3.048,      !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048;  !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-1IE_1,              !- Name
Wall,                   !- Surface Type
WALL-1,                 !- Construction Name
PER-1I,                 !- Zone Name
Outdoors,               !- Outside Boundary Condition
,                       !- Outside Boundary Condition Object
SunExposed,             !- Sun Exposure
WindExposed,            !- Wind Exposure
0.5,                    !- View Factor to Ground
4,                       !- Number of Vertices
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0.,    !- X,Y,Z ==> Vertex 2
0.,37.3302,0.,         !- X,Y,Z ==> Vertex 3
0.,37.3302,3.048;     !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
PER-1IE_1W_1,          !- Name
Window,                 !- Surface Type
COMP N,                 !- Construction Name
PER-1IE_1,              !- Building Surface Name
,                       !- Outside Boundary Condition Object
0.5,                    !- View Factor to Ground
,                       !- Shading Control Name
,                       !- Frame and Divider Name
1,                      !- Multiplier
4,                      !- Number of Vertices
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,1.524, !- X,Y,Z ==> Vertex 2
0.,37.3302,1.524,      !- X,Y,Z ==> Vertex 3
0.,37.3302,3.048;     !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW12-P1I,               !- Name
Wall,                   !- Surface Type
INT-WALL-1,             !- Construction Name
PER-1I,                 !- Zone Name
Zone,                   !- Outside Boundary Condition
PER-2I,                 !- Outside Boundary Condition Object
NoSun,                  !- Sun Exposure
NoWind,                 !- Wind Exposure
0.,                     !- View Factor to Ground
4,                       !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0.,    !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0.,    !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW14-P1I,               !- Name
Wall,                   !- Surface Type
INT-WALL-1,             !- Construction Name
PER-1I,                 !- Zone Name
Zone,                   !- Outside Boundary Condition
PER-4I,                 !- Outside Boundary Condition Object
NoSun,                  !- Sun Exposure
NoWind,                 !- Wind Exposure

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0.,                !- View Factor to Ground
4,                !- Number of Vertices
0.,37.3302,3.048, !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,    !- X,Y,Z ==> Vertex 2
4.572,32.7582,0., !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  IW1C-P1I,        !- Name
  Wall,           !- Surface Type
  INT-WALL-1,     !- Construction Name
  PER-1I,         !- Zone Name
  Zone,           !- Outside Boundary Condition
  COR-1I,         !- Outside Boundary Condition Object
  NoSun,         !- Sun Exposure
  NoWind,        !- Wind Exposure
  0.,            !- View Factor to Ground
  4,            !- Number of Vertices
  4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
  4.572,32.7582,0.,  !- X,Y,Z ==> Vertex 2
  32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
  32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PER-1II_1,      !- Name
  Floor,          !- Surface Type
  FLOOR-1,       !- Construction Name
  PER-1I,        !- Zone Name
  Zone,          !- Outside Boundary Condition
  PLE-1,         !- Outside Boundary Condition Object
  NoSun,        !- Sun Exposure
  NoWind,       !- Wind Exposure
  0.,           !- View Factor to Ground
  4,           !- Number of Vertices
  37.3302,37.3302,0., !- X,Y,Z ==> Vertex 1
  32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
  4.572,32.7582,0.,  !- X,Y,Z ==> Vertex 3
  0.,37.3302,0.;    !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
  Internal-P1I,   !- Name
  MediumFurniture, !- Construction Name
  PER-1I,        !- Zone Name
  137.916;       !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
  PER-1I_INFILTRATION, !- Name
  PER-1I,              !- Zone Name
  INF-SCHED,          !- Schedule Name
  AirChanges/Hour,    !- Design Flow Rate Calculation Method
  ,                   !- Design Flow Rate {m3/s}
  ,                   !- Flow per Zone Floor Area {m3/s-m2}
  ,                   !- Flow per Exterior Surface Area {m3/s-m2}
  0.3,                !- Air Changes per Hour
  0.,                 !- Constant Term Coefficient
  0.,                 !- Temperature Term Coefficient
  0.224,              !- Velocity Term Coefficient
  0.;                 !- Velocity Squared Term Coefficient

People,
  PER-1I_PEOPLE,     !- Name
  PER-1I,            !- Zone Name
  OCC-SCHED,         !- Number of People Schedule Name
  Area/Person,       !- Number of People Calculation Method
  ,                  !- Number of People
  ,                  !- People per Zone Floor Area {person/m2}
  9.290304,          !- Zone Floor Area per Person {m2/person}
  0.3,               !- Fraction Radiant
  0.5482,            !- Sensible Heat Fraction

```



```

ActSched;                !- Activity Level Schedule Name

Lights,
  PER-1I_LIGHTS,        !- Name
  PER-1I,               !- Zone Name
  LIT-SCHED,           !- Schedule Name
  Watts/Area,          !- Design Level Calculation Method
  ,                    !- Lighting Level {W}
  13.993084,           !- Watts per Zone Floor Area {W/m2}
  ,                    !- Watts per Person {W/person}
  0.55,                !- Return Air Fraction
  0.3015,              !- Fraction Radiant
  0.045,               !- Fraction Visible
  0.,                  !- Fraction Replaceable
  GeneralLights;       !- End-Use Subcategory

ElectricEquipment,
  PER-1I_EQUIP,        !- Name
  PER-1I,              !- Zone Name
  EQP-SCHED,          !- Schedule Name
  Watts/Area,         !- Design Level Calculation Method
  ,                   !- Design Level {W}
  8.072933,           !- Watts per Zone Floor Area {W/m2}
  ,                   !- Watts per Person {W/person}
  0.,                 !- Fraction Latent
  0.7,                !- Fraction Radiant
  0.,                 !- Fraction Lost
  0;                  !- End-Use Subcategory

```

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!*****
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Zone,
  PER-2I,               !- Name
  0.,                  !- Direction of Relative North {deg}
  0.,                  !- X Origin {m}
  0.,                  !- Y Origin {m}
  15.8496,             !- Z Origin {m}
  1,                   !- Type
  1,                   !- Multiplier
  3.048,               !- Ceiling Height {m}
  0.;                 !- Volume {m3} -- Zero is autocalculate

```

```

BuildingSurface:Detailed,
  PER-2II_2,           !- Name
  Ceiling,             !- Surface Type
  CLG-1,               !- Construction Name
  PER-2I,              !- Zone Name
  Zone,                !- Outside Boundary Condition
  PLE-I,               !- Outside Boundary Condition Object
  NoSun,               !- Sun Exposure
  NoWind,              !- Wind Exposure
  0.,                  !- View Factor to Ground
  4,                   !- Number of Vertices
  32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
  37.3302,0.,3.048,   !- X,Y,Z ==> Vertex 2
  37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 3
  32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

```

```

BuildingSurface:Detailed,
  PER-2IE_1,           !- Name
  Wall,                !- Surface Type
  WALL-1,              !- Construction Name
  PER-2I,              !- Zone Name
  Outdoors,            !- Outside Boundary Condition
  ,                    !- Outside Boundary Condition Object
  SunExposed,          !- Sun Exposure
  WindExposed,         !- Wind Exposure
  0.5,                 !- View Factor to Ground
  4,                   !- Number of Vertices
  37.3302,0.,3.048,   !- X,Y,Z ==> Vertex 1

```

```

37.3302,0.,0.,           !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0.,     !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048;  !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
PER-2IE_1W_1,           !- Name
Window,                 !- Surface Type
COMP_NN,                 !- Construction Name
PER-2IE_1,               !- Building Surface Name
,                         !- Outside Boundary Condition Object
0.5,                     !- View Factor to Ground
,                         !- Shading Control Name
,                         !- Frame and Divider Name
1,                       !- Multiplier
4,                       !- Number of Vertices
37.3302,0.,3.048,       !- X,Y,Z ==> Vertex 1
37.3302,0.,1.524,       !- X,Y,Z ==> Vertex 2
37.3302,37.3302,1.524, !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW23-P2I,                !- Name
Wall,                    !- Surface Type
INT-WALL-1,              !- Construction Name
PER-2I,                  !- Zone Name
Zone,                    !- Outside Boundary Condition
PER-3I,                  !- Outside Boundary Condition Object
NoSun,                   !- Sun Exposure
NoWind,                  !- Wind Exposure
0.,                       !- View Factor to Ground
4,                       !- Number of Vertices
32.7582,4.572,3.048,    !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,       !- X,Y,Z ==> Vertex 2
37.3302,0.,0.,          !- X,Y,Z ==> Vertex 3
37.3302,0.,3.048;      !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW21-P2I,                !- Name
Wall,                    !- Surface Type
INT-WALL-1,              !- Construction Name
PER-2I,                  !- Zone Name
Zone,                    !- Outside Boundary Condition
PER-1I,                  !- Outside Boundary Condition Object
NoSun,                   !- Sun Exposure
NoWind,                  !- Wind Exposure
0.,                       !- View Factor to Ground
4,                       !- Number of Vertices
37.3302,37.3302,3.048,  !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0.,     !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0.,     !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW2C-P2I,                !- Name
Wall,                    !- Surface Type
INT-WALL-1,              !- Construction Name
PER-2I,                  !- Zone Name
Zone,                    !- Outside Boundary Condition
COR-1I,                  !- Outside Boundary Condition Object
NoSun,                   !- Sun Exposure
NoWind,                  !- Wind Exposure
0.,                       !- View Factor to Ground
4,                       !- Number of Vertices
32.7582,32.7582,3.048,  !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0.,     !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,       !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048;    !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-2II_1,               !- Name
Floor,                   !- Surface Type

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FLOOR-1,           !- Construction Name
PER-2I,           !- Zone Name
Zone,             !- Outside Boundary Condition
PLE-1,           !- Outside Boundary Condition Object
NoSun,           !- Sun Exposure
NoWind,          !- Wind Exposure
0.,              !- View Factor to Ground
4,               !- Number of Vertices
37.3302,0.,0.,   !- X,Y,Z ==> Vertex 1
32.7582,4.572,0., !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
37.3302,37.3302,0.; !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
  Internal-P2I,      !- Name
  MediumFurniture,  !- Construction Name
  PER-2I,           !- Zone Name
  137.916;          !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
  PER-2I_INFILTRATION, !- Name
  PER-2I,            !- Zone Name
  INF-SCHED,        !- Schedule Name
  AirChanges/Hour,  !- Design Flow Rate Calculation Method
  ,                 !- Design Flow Rate {m3/s}
  ,                 !- Flow per Zone Floor Area {m3/s-m2}
  ,                 !- Flow per Exterior Surface Area {m3/s-m2}
  0.3,              !- Air Changes per Hour
  0.,               !- Constant Term Coefficient
  0.,               !- Temperature Term Coefficient
  0.224,            !- Velocity Term Coefficient
  0.;               !- Velocity Squared Term Coefficient

People,
  PER-2I_PEOPLE,    !- Name
  PER-2I,           !- Zone Name
  OCC-SCHED,        !- Number of People Schedule Name
  Area/Person,      !- Number of People Calculation Method
  ,                 !- Number of People
  ,                 !- People per Zone Floor Area {person/m2}
  9.290304,         !- Zone Floor Area per Person {m2/person}
  0.3,              !- Fraction Radiant
  0.5482,           !- Sensible Heat Fraction
  ActSched;         !- Activity Level Schedule Name

Lights,
  PER-2I_LIGHTS,    !- Name
  PER-2I,           !- Zone Name
  LIT-SCHED,        !- Schedule Name
  Watts/Area,       !- Design Level Calculation Method
  ,                 !- Lighting Level {W}
  13.993084,        !- Watts per Zone Floor Area {W/m2}
  ,                 !- Watts per Person {W/person}
  0.55,             !- Return Air Fraction
  0.3015,           !- Fraction Radiant
  0.045,            !- Fraction Visible
  0.,               !- Fraction Replaceable
  GeneralLights;    !- End-Use Subcategory

ElectricEquipment,
  PER-2I_EQUIP,     !- Name
  PER-2I,           !- Zone Name
  EQP-SCHED,        !- Schedule Name
  Watts/Area,       !- Design Level Calculation Method
  ,                 !- Design Level {W}
  8.072933,         !- Watts per Zone Floor Area {W/m2}
  ,                 !- Watts per Person {W/person}
  0.,               !- Fraction Latent
  0.7,              !- Fraction Radiant

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0.,          !- Fraction Lost
0;          !- End-Use Subcategory

!*****
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Zone,
  PER-3I,    !- Name
  0.,        !- Direction of Relative North {deg}
  0.,        !- X Origin {m}
  0.,        !- Y Origin {m}
  15.8496,   !- Z Origin {m}
  1,         !- Type
  1,         !- Multiplier
  3.048,     !- Ceiling Height {m}
  0.;       !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
  PER-3II_2, !- Name
  Ceiling,   !- Surface Type
  CLG-1,     !- Construction Name
  PER-3I,    !- Zone Name
  Zone,      !- Outside Boundary Condition
  PLE-I,     !- Outside Boundary Condition Object
  NoSun,     !- Sun Exposure
  NoWind,    !- Wind Exposure
  0.,        !- View Factor to Ground
  4,         !- Number of Vertices
  4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
  0.,0.,3.048, !- X,Y,Z ==> Vertex 2
  37.3302,0.,3.048, !- X,Y,Z ==> Vertex 3
  32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PER-3IE_1, !- Name
  Wall,      !- Surface Type
  WALL-1,    !- Construction Name
  PER-3I,    !- Zone Name
  Outdoors,  !- Outside Boundary Condition
  ,          !- Outside Boundary Condition Object
  SunExposed, !- Sun Exposure
  WindExposed, !- Wind Exposure
  0.5,       !- View Factor to Ground
  4,         !- Number of Vertices
  0.,0.,3.048, !- X,Y,Z ==> Vertex 1
  0.,0.,0., !- X,Y,Z ==> Vertex 2
  37.3302,0.,0., !- X,Y,Z ==> Vertex 3
  37.3302,0.,3.048; !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
  PER-3IE_1W_1, !- Name
  Window,       !- Surface Type
  COMP_NN,     !- Construction Name
  PER-3IE_1,   !- Building Surface Name
  ,            !- Outside Boundary Condition Object
  0.5,         !- View Factor to Ground
  ,            !- Shading Control Name
  ,            !- Frame and Divider Name
  1,           !- Multiplier
  4,           !- Number of Vertices
  0.,0.,3.048, !- X,Y,Z ==> Vertex 1
  0.,0.,1.524, !- X,Y,Z ==> Vertex 2
  37.3302,0.,1.524, !- X,Y,Z ==> Vertex 3
  37.3302,0.,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  IW34-P3I,    !- Name
  Wall,        !- Surface Type
  INT-WALL-1,  !- Construction Name
  PER-3I,      !- Zone Name
  Zone,        !- Outside Boundary Condition

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PER-4I,                !- Outside Boundary Condition Object
NoSun,                !- Sun Exposure
NoWind,               !- Wind Exposure
0.,                  !- View Factor to Ground
4,                    !- Number of Vertices
4.572,4.572,3.048,   !- X,Y,Z ==> Vertex 1
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 2
0.,0.,0.,           !- X,Y,Z ==> Vertex 3
0.,0.,3.048;        !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW32-P3I,             !- Name
Wall,                 !- Surface Type
INT-WALL-1,          !- Construction Name
PER-3I,              !- Zone Name
Zone,                 !- Outside Boundary Condition
PER-2I,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                    !- Number of Vertices
37.3302,0.,3.048,   !- X,Y,Z ==> Vertex 1
37.3302,0.,0.,     !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,  !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW3C-P3I,             !- Name
Wall,                 !- Surface Type
INT-WALL-1,          !- Construction Name
PER-3I,              !- Zone Name
Zone,                 !- Outside Boundary Condition
COR-1I ,             !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                    !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,  !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,    !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-3II_1,           !- Name
Floor,               !- Surface Type
FLOOR-1,             !- Construction Name
PER-3I,              !- Zone Name
Zone,                 !- Outside Boundary Condition
PLE-1,               !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                    !- Number of Vertices
0.,0.,0.,           !- X,Y,Z ==> Vertex 1
4.572,4.572,0.,    !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,  !- X,Y,Z ==> Vertex 3
37.3302,0.,0.;     !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-P3I,         !- Name
MediumFurniture,     !- Construction Name
PER-3I,              !- Zone Name
137.916;             !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
PER-3I_INFILTRATION, !- Name
PER-3I,              !- Zone Name
INF-SCHED,           !- Schedule Name
AirChanges/Hour,     !- Design Flow Rate Calculation Method

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```

,           !- Design Flow Rate {m3/s}
,           !- Flow per Zone Floor Area {m3/s-m2}
,           !- Flow per Exterior Surface Area {m3/s-m2}
0.3,       !- Air Changes per Hour
0.,        !- Constant Term Coefficient
0.,        !- Temperature Term Coefficient
0.224,    !- Velocity Term Coefficient
0.;       !- Velocity Squared Term Coefficient

People,
PER-3I_PEOPLE, !- Name
PER-3I,       !- Zone Name
OCC-SCHED,   !- Number of People Schedule Name
Area/Person, !- Number of People Calculation Method
,           !- Number of People
,           !- People per Zone Floor Area {person/m2}
9.290304,   !- Zone Floor Area per Person {m2/person}
0.3,        !- Fraction Radiant
0.5482,     !- Sensible Heat Fraction
ActSched;   !- Activity Level Schedule Name

Lights,
PER-3I_LIGHTS, !- Name
PER-3I,       !- Zone Name
LIT-SCHED,    !- Schedule Name
Watts/Area,   !- Design Level Calculation Method
,           !- Lighting Level {W}
13.993084,   !- Watts per Zone Floor Area {W/m2}
,           !- Watts per Person {W/person}
0.55,        !- Return Air Fraction
0.3015,     !- Fraction Radiant
0.045,      !- Fraction Visible
0.,         !- Fraction Replaceable
GeneralLights; !- End-Use Subcategory

ElectricEquipment,
PER-3I_EQUIP, !- Name
PER-3I,       !- Zone Name
EQP-SCHED,   !- Schedule Name
Watts/Area,   !- Design Level Calculation Method
,           !- Design Level {W}
8.072933,   !- Watts per Zone Floor Area {W/m2}
,           !- Watts per Person {W/person}
0.,         !- Fraction Latent
0.7,        !- Fraction Radiant
0.,         !- Fraction Lost
0;          !- End-Use Subcategory

!*****
****

Zone,
PER-4I,      !- Name
0.,         !- Direction of Relative North {deg}
0.,         !- X Origin {m}
0.,         !- Y Origin {m}
15.8496,    !- Z Origin {m}
1,          !- Type
1,          !- Multiplier
3.048,      !- Ceiling Height {m}
0.;        !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
PER-4II_2,  !- Name
Ceiling,   !- Surface Type
CLG-1,     !- Construction Name
PER-4I,    !- Zone Name
Zone,      !- Outside Boundary Condition
PLE-I,     !- Outside Boundary Condition Object
NoSun,     !- Sun Exposure
NoWind,    !- Wind Exposure

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0.,                               !- View Factor to Ground
4,                                 !- Number of Vertices
4.572,32.7582,3.048,             !- X,Y,Z ==> Vertex 1
0.,37.3302,3.048,                !- X,Y,Z ==> Vertex 2
0.,0.,3.048,                      !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048;              !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-4IE_1,                         !- Name
Wall,                              !- Surface Type
WALL-1,                             !- Construction Name
PER-4I,                             !- Zone Name
Outdoors,                          !- Outside Boundary Condition
,                                    !- Outside Boundary Condition Object
SunExposed,                        !- Sun Exposure
WindExposed,                      !- Wind Exposure
0.5,                               !- View Factor to Ground
4,                                 !- Number of Vertices
0.,37.3302,3.048,                !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,                  !- X,Y,Z ==> Vertex 2
0.,0.,0.,                        !- X,Y,Z ==> Vertex 3
0.,0.,3.048;                    !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
PER-4IE_1W_1,                     !- Name
Window,                           !- Surface Type
COMP_NN,                          !- Construction Name
PER-4IE_1,                         !- Building Surface Name
,                                    !- Outside Boundary Condition Object
0.5,                               !- View Factor to Ground
,                                    !- Shading Control Name
,                                    !- Frame and Divider Name
1,                                  !- Multiplier
4,                                  !- Number of Vertices
0.,37.3302,3.048,                !- X,Y,Z ==> Vertex 1
0.,37.3302,1.524,                !- X,Y,Z ==> Vertex 2
0.,0.,1.524,                      !- X,Y,Z ==> Vertex 3
0.,0.,3.048;                    !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW41-P4I,                          !- Name
Wall,                              !- Surface Type
INT-WALL-1,                       !- Construction Name
PER-4I,                             !- Zone Name
Zone,                              !- Outside Boundary Condition
PER-1I,                             !- Outside Boundary Condition Object
NoSun,                             !- Sun Exposure
NoWind,                            !- Wind Exposure
0.,                               !- View Factor to Ground
4,                                  !- Number of Vertices
4.572,32.7582,3.048,             !- X,Y,Z ==> Vertex 1
4.572,32.7582,0.,                !- X,Y,Z ==> Vertex 2
0.,37.3302,0.,                  !- X,Y,Z ==> Vertex 3
0.,37.3302,3.048;              !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW43-P4I,                          !- Name
Wall,                              !- Surface Type
INT-WALL-1,                       !- Construction Name
PER-4I,                             !- Zone Name
Zone,                              !- Outside Boundary Condition
PER-3I,                             !- Outside Boundary Condition Object
NoSun,                             !- Sun Exposure
NoWind,                            !- Wind Exposure
0.,                               !- View Factor to Ground
4,                                  !- Number of Vertices
0.,0.,3.048,                    !- X,Y,Z ==> Vertex 1
0.,0.,0.,                        !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,                !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048;            !- X,Y,Z ==> Vertex 4

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BuildingSurface:Detailed,
IW4C-P4I,           !- Name
Wall,              !- Surface Type
INT-WALL-1,        !- Construction Name
PER-4I,            !- Zone Name
Zone,              !- Outside Boundary Condition
COR-1I,            !- Outside Boundary Condition Object
NoSun,             !- Sun Exposure
NoWind,            !- Wind Exposure
0.,                !- View Factor to Ground
4,                 !- Number of Vertices
4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
4.572,4.572,0.,   !- X,Y,Z ==> Vertex 2
4.572,32.7582,0., !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-4II_1,         !- Name
Floor,             !- Surface Type
FLOOR-1,           !- Construction Name
PER-4I,            !- Zone Name
Zone,              !- Outside Boundary Condition
PLE-1,             !- Outside Boundary Condition Object
NoSun,             !- Sun Exposure
NoWind,            !- Wind Exposure
0.,                !- View Factor to Ground
4,                 !- Number of Vertices
0.,37.3302,0.,    !- X,Y,Z ==> Vertex 1
4.572,32.7582,0., !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,   !- X,Y,Z ==> Vertex 3
0.,0.,0.;         !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-P4I,      !- Name
MediumFurniture,  !- Construction Name
PER-4I,            !- Zone Name
137.916;          !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
PER-4I_INFILTRATION, !- Name
PER-4I,             !- Zone Name
INF-SCHED,          !- Schedule Name
AirChanges/Hour,    !- Design Flow Rate Calculation Method
,                   !- Design Flow Rate {m3/s}
,                   !- Flow per Zone Floor Area {m3/s-m2}
,                   !- Flow per Exterior Surface Area {m3/s-m2}
0.3,                !- Air Changes per Hour
0.,                 !- Constant Term Coefficient
0.,                 !- Temperature Term Coefficient
0.224,              !- Velocity Term Coefficient
0.;                 !- Velocity Squared Term Coefficient

People,
PER-4I_PEOPLE,     !- Name
PER-4I,            !- Zone Name
OCC-SCHED,         !- Number of People Schedule Name
Area/Person,       !- Number of People Calculation Method
,                   !- Number of People
,                   !- People per Zone Floor Area {person/m2}
9.290304,          !- Zone Floor Area per Person {m2/person}
0.3,               !- Fraction Radiant
0.5482,            !- Sensible Heat Fraction
ActSched;          !- Activity Level Schedule Name

Lights,
PER-4I_LIGHTS,    !- Name
PER-4I,            !- Zone Name
LIT-SCHED,        !- Schedule Name
Watts/Area,       !- Design Level Calculation Method

```



```

,                                     !- Lighting Level {W}
13.993084,                             !- Watts per Zone Floor Area {W/m2}
,                                     !- Watts per Person {W/person}
0.55,                                  !- Return Air Fraction
0.3015,                                !- Fraction Radiant
0.045,                                 !- Fraction Visible
0.,                                    !- Fraction Replaceable
GeneralLights;                          !- End-Use Subcategory

ElectricEquipment,
PER-4I_EQUIP,                           !- Name
PER-4I,                                 !- Zone Name
EQP-SCHED,                              !- Schedule Name
Watts/Area,                             !- Design Level Calculation Method
,                                       !- Design Level {W}
8.072933,                               !- Watts per Zone Floor Area {W/m2}
,                                       !- Watts per Person {W/person}
0.,                                    !- Fraction Latent
0.7,                                   !- Fraction Radiant
0.,                                    !- Fraction Lost
0;                                       !- End-Use Subcategory

!*****
****

Zone,
COR-1I,                                  !- Name
0.,                                    !- Direction of Relative North {deg}
0.,                                    !- X Origin {m}
0.,                                    !- Y Origin {m}
15.8496,                                !- Z Origin {m}
1,                                      !- Type
1,                                      !- Multiplier
3.048,                                  !- Ceiling Height {m}
0.;                                    !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
COR-1II_2,                              !- Name
Ceiling,                                !- Surface Type
CLG-1,                                  !- Construction Name
COR-1I,                                 !- Zone Name
Zone,                                   !- Outside Boundary Condition
PLE-I,                                  !- Outside Boundary Condition Object
NoSun,                                  !- Sun Exposure
NoWind,                                 !- Wind Exposure
0.,                                    !- View Factor to Ground
4,                                      !- Number of Vertices
4.572,32.7582,3.048,                   !- X,Y,Z ==> Vertex 1
4.572,4.572,3.048,                    !- X,Y,Z ==> Vertex 2
32.7582,4.572,3.048,                   !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048;                 !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC1-C1I,                               !- Name
Wall,                                   !- Surface Type
INT-WALL-1,                             !- Construction Name
COR-1I,                                 !- Zone Name
Zone,                                   !- Outside Boundary Condition
PER-1I,                                  !- Outside Boundary Condition Object
NoSun,                                  !- Sun Exposure
NoWind,                                 !- Wind Exposure
0.,                                    !- View Factor to Ground
4,                                      !- Number of Vertices
32.7582,32.7582,3.048,                 !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0.,                    !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,                      !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048;                   !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC2-C1I,                               !- Name
Wall,                                   !- Surface Type

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INT-WALL-1,          !- Construction Name
COR-1I,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-2I,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC3-C1I,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
COR-1I,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-3I,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,4.572,3.048,  !- X,Y,Z ==> Vertex 1
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC4-C1I,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
COR-1I,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-4I,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,32.7582,0.,   !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
COR-1II_1,           !- Name
Floor,               !- Surface Type
FLOOR-1,             !- Construction Name
COR-1I,              !- Zone Name
Zone,                !- Outside Boundary Condition
PLE-1,               !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 1
4.572,32.7582,0.,   !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,4.572,0.;   !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-C1I,         !- Name
MediumFurniture,     !- Construction Name
COR-1I,              !- Zone Name
731.580;              !- Surface Area {m2}

! No INFILTRATION

```

```

People,
COR-1I_PEOPLE,      !- Name
COR-1I,             !- Zone Name
OCC-SCHED,         !- Number of People Schedule Name
Area/Person,       !- Number of People Calculation Method
,                  !- Number of People
,                  !- People per Zone Floor Area {person/m2}
9.290304,          !- Zone Floor Area per Person {m2/person}
0.3,               !- Fraction Radiant
0.5482,           !- Sensible Heat Fraction
ActSched;          !- Activity Level Schedule Name

```

```

Lights,
COR-1I_LIGHTS,     !- Name
COR-1I,            !- Zone Name
LIT-SCHED,         !- Schedule Name
Watts/Area,        !- Design Level Calculation Method
,                  !- Lighting Level {W}
13.993084,         !- Watts per Zone Floor Area {W/m2}
,                  !- Watts per Person {W/person}
0.55,             !- Return Air Fraction
0.3015,           !- Fraction Radiant
0.045,            !- Fraction Visible
0.,               !- Fraction Replaceable
GeneralLights;     !- End-Use Subcategory

```

```

ElectricEquipment,
COR-1I_EQUIP,      !- Name
COR-1I,            !- Zone Name
EQP-SCHED,         !- Schedule Name
Watts/Area,        !- Design Level Calculation Method
,                  !- Design Level {W}
8.072933,         !- Watts per Zone Floor Area {W/m2}
,                  !- Watts per Person {W/person}
0.,               !- Fraction Latent
0.7,              !- Fraction Radiant
0.,               !- Fraction Lost
0;                !- End-Use Subcategory

```

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!*****
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Zone,
PER-1F,            !- Name
0.,               !- Direction of Relative North {deg}
0.,               !- X Origin {m}
0.,               !- Y Origin {m}
0.,               !- Z Origin {m}
1,                !- Type
1,                !- Multiplier
3.048,            !- Ceiling Height {m}
0.;              !- Volume {m3} -- Zero is autocalculate

```

```

BuildingSurface:Detailed,
PER-1FI_2,        !- Name
Ceiling,          !- Surface Type
CLG-1,            !- Construction Name
PER-1F,           !- Zone Name
Zone,             !- Outside Boundary Condition
PLE-1,            !- Outside Boundary Condition Object
NoSun,            !- Sun Exposure
NoWind,           !- Wind Exposure
0.,               !- View Factor to Ground
4,                !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 2
0.,37.3302,3.048, !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4

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```

BuildingSurface:Detailed,
PER-1FE_1,        !- Name

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```

Wall,                !- Surface Type
WALL-1,              !- Construction Name
PER-1F,              !- Zone Name
Outdoors,            !- Outside Boundary Condition
,                    !- Outside Boundary Condition Object
SunExposed,          !- Sun Exposure
WindExposed,         !- Wind Exposure
0.5,                 !- View Factor to Ground
4,                   !- Number of Vertices
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 2
0.,37.3302,0.,      !- X,Y,Z ==> Vertex 3
0.,37.3302,3.048;   !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
PER-1FE_1W_1,        !- Name
Window,              !- Surface Type
COMP N,              !- Construction Name
PER-1FE_1,           !- Building Surface Name
,                    !- Outside Boundary Condition Object
0.5,                 !- View Factor to Ground
,                    !- Shading Control Name
,                    !- Frame and Divider Name
1,                   !- Multiplier
4,                   !- Number of Vertices
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,1.524, !- X,Y,Z ==> Vertex 2
0.,37.3302,1.524,   !- X,Y,Z ==> Vertex 3
0.,37.3302,3.048;   !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW12-P1F,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
PER-1F,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-2F,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW14-P1F,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
PER-1F,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-4F,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
0.,37.3302,3.048,    !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,       !- X,Y,Z ==> Vertex 2
4.572,32.7582,0.,   !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW1C-P1F,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
PER-1F,              !- Zone Name
Zone,                !- Outside Boundary Condition
COR-1F,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure

```

```

0.,                !- View Factor to Ground
4,                !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,32.7582,0., !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PER-1FI_1,      !- Name
  Floor,         !- Surface Type
  FLOOR-1,      !- Construction Name
  PER-1F,       !- Zone Name
  Zone,         !- Outside Boundary Condition
  BASE-1,      !- Outside Boundary Condition Object
  NoSun,       !- Sun Exposure
  NoWind,      !- Wind Exposure
  0.,          !- View Factor to Ground
  4,          !- Number of Vertices
  37.3302,37.3302,0., !- X,Y,Z ==> Vertex 1
  32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
  4.572,32.7582,0., !- X,Y,Z ==> Vertex 3
  0.,37.3302,0.; !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
  Internal-P1F, !- Name
  MediumFurniture, !- Construction Name
  PER-1F,      !- Zone Name
  137.916;    !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
  PER-1F_INFILTRATION, !- Name
  PER-1F,              !- Zone Name
  INF-SCHED,          !- Schedule Name
  AirChanges/Hour,   !- Design Flow Rate Calculation Method
  ,                  !- Design Flow Rate {m3/s}
  ,                  !- Flow per Zone Floor Area {m3/s-m2}
  ,                  !- Flow per Exterior Surface Area {m3/s-m2}
  0.3,               !- Air Changes per Hour
  0.,               !- Constant Term Coefficient
  0.,               !- Temperature Term Coefficient
  0.224,            !- Velocity Term Coefficient
  0.;               !- Velocity Squared Term Coefficient

People,
  PER-1F_PEOPLE,    !- Name
  PER-1F,           !- Zone Name
  OCC-SCHED,        !- Number of People Schedule Name
  Area/Person,     !- Number of People Calculation Method
  ,                !- Number of People
  ,                !- People per Zone Floor Area {person/m2}
  9.290304,        !- Zone Floor Area per Person {m2/person}
  0.3,             !- Fraction Radiant
  0.5482,          !- Sensible Heat Fraction
  ActSched;        !- Activity Level Schedule Name

Lights,
  PER-1F_LIGHTS,   !- Name
  PER-1F,          !- Zone Name
  LIT-SCHED,       !- Schedule Name
  Watts/Area,     !- Design Level Calculation Method
  ,               !- Lighting Level {W}
  13.993084,      !- Watts per Zone Floor Area {W/m2}
  ,               !- Watts per Person {W/person}
  0.55,           !- Return Air Fraction
  0.3015,         !- Fraction Radiant
  0.045,          !- Fraction Visible
  0.,             !- Fraction Replaceable
  GeneralLights;  !- End-Use Subcategory

```

```

ElectricEquipment,
PER-1F_EQUIP,      !- Name
PER-1F,           !- Zone Name
EQP-SCHED,       !- Schedule Name
Watts/Area,      !- Design Level Calculation Method
,               !- Design Level {W}
8.072933,       !- Watts per Zone Floor Area {W/m2}
,               !- Watts per Person {W/person}
0.,             !- Fraction Latent
0.7,            !- Fraction Radiant
0.,             !- Fraction Lost
0;              !- End-Use Subcategory

```

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!*****
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```

Zone,
PER-2F,          !- Name
0.,             !- Direction of Relative North {deg}
0.,             !- X Origin {m}
0.,             !- Y Origin {m}
0.,             !- Z Origin {m}
1,              !- Type
1,              !- Multiplier
3.048,          !- Ceiling Height {m}
0.;            !- Volume {m3} -- Zero is autocalculate

```

```

BuildingSurface:Detailed,
PER-2FI_2,      !- Name
Ceiling,        !- Surface Type
CLG-1,          !- Construction Name
PER-2F,         !- Zone Name
Zone,           !- Outside Boundary Condition
PLE-1,          !- Outside Boundary Condition Object
NoSun,          !- Sun Exposure
NoWind,         !- Wind Exposure
0.,            !- View Factor to Ground
4,             !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
37.3302,0.,3.048, !- X,Y,Z ==> Vertex 2
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

```

```

BuildingSurface:Detailed,
PER-2FE_1,      !- Name
Wall,           !- Surface Type
WALL-1,         !- Construction Name
PER-2F,         !- Zone Name
Outdoors,       !- Outside Boundary Condition
,              !- Outside Boundary Condition Object
SunExposed,     !- Sun Exposure
WindExposed,    !- Wind Exposure
0.5,           !- View Factor to Ground
4,             !- Number of Vertices
37.3302,0.,3.048, !- X,Y,Z ==> Vertex 1
37.3302,0.,0., !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

```

```

FenestrationSurface:Detailed,
PER-2FE_1W_1,  !- Name
Window,        !- Surface Type
COMP NN,       !- Construction Name
PER-2FE_1,     !- Building Surface Name
,              !- Outside Boundary Condition Object
0.5,           !- View Factor to Ground
,              !- Shading Control Name
,              !- Frame and Divider Name
1,             !- Multiplier
4,             !- Number of Vertices
37.3302,0.,3.048, !- X,Y,Z ==> Vertex 1

```

```

37.3302,0.,1.524,      !- X,Y,Z ==> Vertex 2
37.3302,37.3302,1.524, !- X,Y,Z ==> Vertex 3
37.3302,37.3302,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW23-P2F,              !- Name
Wall,                  !- Surface Type
INT-WALL-1,           !- Construction Name
PER-2F,                !- Zone Name
Zone,                  !- Outside Boundary Condition
PER-3F,                !- Outside Boundary Condition Object
NoSun,                 !- Sun Exposure
NoWind,                !- Wind Exposure
0.,                    !- View Factor to Ground
4,                      !- Number of Vertices
32.7582,4.572,3.048,  !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,     !- X,Y,Z ==> Vertex 2
37.3302,0.,0.,        !- X,Y,Z ==> Vertex 3
37.3302,0.,3.048;    !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW21-P2F,              !- Name
Wall,                  !- Surface Type
INT-WALL-1,           !- Construction Name
PER-2F,                !- Zone Name
Zone,                  !- Outside Boundary Condition
PER-1F,                !- Outside Boundary Condition Object
NoSun,                 !- Sun Exposure
NoWind,                !- Wind Exposure
0.,                    !- View Factor to Ground
4,                      !- Number of Vertices
37.3302,37.3302,3.048, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0.,   !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0.,   !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW2C-P2F,              !- Name
Wall,                  !- Surface Type
INT-WALL-1,           !- Construction Name
PER-2F,                !- Zone Name
Zone,                  !- Outside Boundary Condition
COR-1F,                !- Outside Boundary Condition Object
NoSun,                 !- Sun Exposure
NoWind,                !- Wind Exposure
0.,                    !- View Factor to Ground
4,                      !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0.,   !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,     !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-2FI_1,             !- Name
Floor,                 !- Surface Type
FLOOR-1,               !- Construction Name
PER-2F,                !- Zone Name
Zone,                  !- Outside Boundary Condition
BASE-1,                !- Outside Boundary Condition Object
NoSun,                 !- Sun Exposure
NoWind,                !- Wind Exposure
0.,                    !- View Factor to Ground
4,                      !- Number of Vertices
37.3302,0.,0.,         !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,     !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0.,   !- X,Y,Z ==> Vertex 3
37.3302,37.3302,0.;   !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,

```

```

Internal-P2F,           !- Name
MediumFurniture,      !- Construction Name
PER-2F,               !- Zone Name
137.916;              !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
PER-2F_INFILTRATION,  !- Name
PER-2F,               !- Zone Name
INF-SCHED,           !- Schedule Name
AirChanges/Hour,     !- Design Flow Rate Calculation Method
,                   !- Design Flow Rate {m3/s}
,                   !- Flow per Zone Floor Area {m3/s-m2}
,                   !- Flow per Exterior Surface Area {m3/s-m2}
0.3,                 !- Air Changes per Hour
0.,                 !- Constant Term Coefficient
0.,                 !- Temperature Term Coefficient
0.224,               !- Velocity Term Coefficient
0.;                 !- Velocity Squared Term Coefficient

People,
PER-2F_PEOPLE,       !- Name
PER-2F,              !- Zone Name
OCC-SCHED,           !- Number of People Schedule Name
Area/Person,         !- Number of People Calculation Method
,                   !- Number of People
,                   !- People per Zone Floor Area {person/m2}
9.290304,            !- Zone Floor Area per Person {m2/person}
0.3,                 !- Fraction Radiant
0.5482,              !- Sensible Heat Fraction
ActSched;            !- Activity Level Schedule Name

Lights,
PER-2F_LIGHTS,      !- Name
PER-2F,              !- Zone Name
LIT-SCHED,          !- Schedule Name
Watts/Area,         !- Design Level Calculation Method
,                   !- Lighting Level {W}
13.993084,          !- Watts per Zone Floor Area {W/m2}
,                   !- Watts per Person {W/person}
0.55,               !- Return Air Fraction
0.3015,             !- Fraction Radiant
0.045,              !- Fraction Visible
0.,                 !- Fraction Replaceable
GeneralLights;      !- End-Use Subcategory

ElectricEquipment,
PER-2F_EQUIP,       !- Name
PER-2F,              !- Zone Name
EQP-SCHED,          !- Schedule Name
Watts/Area,         !- Design Level Calculation Method
,                   !- Design Level {W}
8.072933,           !- Watts per Zone Floor Area {W/m2}
,                   !- Watts per Person {W/person}
0.,                 !- Fraction Latent
0.7,                !- Fraction Radiant
0.,                 !- Fraction Lost
0;                  !- End-Use Subcategory

!*****
****

Zone,
PER-3F,             !- Name
0.,                 !- Direction of Relative North {deg}
0.,                 !- X Origin {m}
0.,                 !- Y Origin {m}
0.,                 !- Z Origin {m}
1,                  !- Type
1,                  !- Multiplier
3.048,              !- Ceiling Height {m}
0.;                 !- Volume {m3} -- Zero is autocalculate

```



```

BuildingSurface:Detailed,
  PER-3FI_2,           !- Name
  Ceiling,            !- Surface Type
  CLG-1,              !- Construction Name
  PER-3F,             !- Zone Name
  Zone,               !- Outside Boundary Condition
  PLE-1,              !- Outside Boundary Condition Object
  NoSun,              !- Sun Exposure
  NoWind,             !- Wind Exposure
  0.,                 !- View Factor to Ground
  4,                  !- Number of Vertices
  4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
  0.,0.,3.048,       !- X,Y,Z ==> Vertex 2
  37.3302,0.,3.048,  !- X,Y,Z ==> Vertex 3
  32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

```

```

BuildingSurface:Detailed,
  PER-3FE_1,          !- Name
  Wall,               !- Surface Type
  WALL-1,             !- Construction Name
  PER-3F,             !- Zone Name
  Outdoors,           !- Outside Boundary Condition
  ,                   !- Outside Boundary Condition Object
  SunExposed,         !- Sun Exposure
  WindExposed,        !- Wind Exposure
  0.5,                !- View Factor to Ground
  4,                  !- Number of Vertices
  0.,0.,3.048,       !- X,Y,Z ==> Vertex 1
  0.,0.,0.,          !- X,Y,Z ==> Vertex 2
  37.3302,0.,0.,    !- X,Y,Z ==> Vertex 3
  37.3302,0.,3.048; !- X,Y,Z ==> Vertex 4

```

```

FenestrationSurface:Detailed,
  PER-3FE_1W_1,      !- Name
  Window,            !- Surface Type
  COMP_NN,           !- Construction Name
  PER-3FE_1,         !- Building Surface Name
  ,                   !- Outside Boundary Condition Object
  0.5,                !- View Factor to Ground
  ,                   !- Shading Control Name
  ,                   !- Frame and Divider Name
  1,                  !- Multiplier
  4,                  !- Number of Vertices
  0.,0.,3.048,       !- X,Y,Z ==> Vertex 1
  0.,0.,1.524,       !- X,Y,Z ==> Vertex 2
  37.3302,0.,1.524, !- X,Y,Z ==> Vertex 3
  37.3302,0.,3.048; !- X,Y,Z ==> Vertex 4

```

```

BuildingSurface:Detailed,
  IW34-P3F,          !- Name
  Wall,               !- Surface Type
  INT-WALL-1,        !- Construction Name
  PER-3F,             !- Zone Name
  Zone,               !- Outside Boundary Condition
  PER-4F,             !- Outside Boundary Condition Object
  NoSun,              !- Sun Exposure
  NoWind,             !- Wind Exposure
  0.,                 !- View Factor to Ground
  4,                  !- Number of Vertices
  4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
  4.572,4.572,0.,    !- X,Y,Z ==> Vertex 2
  0.,0.,0.,          !- X,Y,Z ==> Vertex 3
  0.,0.,3.048;       !- X,Y,Z ==> Vertex 4

```

```

BuildingSurface:Detailed,
  IW32-P3F,          !- Name
  Wall,               !- Surface Type
  INT-WALL-1,        !- Construction Name
  PER-3F,             !- Zone Name
  Zone,               !- Outside Boundary Condition

```

```

PER-2F,           !- Outside Boundary Condition Object
NoSun,           !- Sun Exposure
NoWind,          !- Wind Exposure
0.,              !- View Factor to Ground
4,               !- Number of Vertices
37.3302,0.,3.048, !- X,Y,Z ==> Vertex 1
37.3302,0.,0.,   !- X,Y,Z ==> Vertex 2
32.7582,4.572,0., !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW3C-P3F,        !- Name
Wall,            !- Surface Type
INT-WALL-1,     !- Construction Name
PER-3F,         !- Zone Name
Zone,           !- Outside Boundary Condition
COR-1F,         !- Outside Boundary Condition Object
NoSun,          !- Sun Exposure
NoWind,         !- Wind Exposure
0.,             !- View Factor to Ground
4,              !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,    !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
PER-3FI_1,      !- Name
Floor,          !- Surface Type
FLOOR-1,       !- Construction Name
PER-3F,        !- Zone Name
Zone,          !- Outside Boundary Condition
BASE-1,        !- Outside Boundary Condition Object
NoSun,         !- Sun Exposure
NoWind,        !- Wind Exposure
0.,            !- View Factor to Ground
4,             !- Number of Vertices
0.,0.,0.,     !- X,Y,Z ==> Vertex 1
4.572,4.572,0., !- X,Y,Z ==> Vertex 2
32.7582,4.572,0., !- X,Y,Z ==> Vertex 3
37.3302,0.,0.; !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-P3F,   !- Name
MediumFurniture, !- Construction Name
PER-3F,        !- Zone Name
137.916;       !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
PER-3F_INFILTRATION, !- Name
PER-3F,              !- Zone Name
INF-SCHED,           !- Schedule Name
AirChanges/Hour,     !- Design Flow Rate Calculation Method
,                     !- Design Flow Rate {m3/s}
,                     !- Flow per Zone Floor Area {m3/s-m2}
,                     !- Flow per Exterior Surface Area {m3/s-m2}
0.3,                 !- Air Changes per Hour
0.,                  !- Constant Term Coefficient
0.,                  !- Temperature Term Coefficient
0.224,               !- Velocity Term Coefficient
0.;                  !- Velocity Squared Term Coefficient

People,
PER-3F_PEOPLE,      !- Name
PER-3F,             !- Zone Name
OCC-SCHED,          !- Number of People Schedule Name
Area/Person,        !- Number of People Calculation Method
,                   !- Number of People
,                   !- People per Zone Floor Area {person/m2}

```

```

9.290304,      !- Zone Floor Area per Person {m2/person}
0.3,          !- Fraction Radiant
0.5482,      !- Sensible Heat Fraction
ActSched;     !- Activity Level Schedule Name

Lights,
  PER-3F_LIGHTS,      !- Name
  PER-3F,             !- Zone Name
  LIT-SCHED,         !- Schedule Name
  Watts/Area,        !- Design Level Calculation Method
  ,                  !- Lighting Level {W}
  13.993084,        !- Watts per Zone Floor Area {W/m2}
  ,                  !- Watts per Person {W/person}
  0.55,             !- Return Air Fraction
  0.3015,           !- Fraction Radiant
  0.045,            !- Fraction Visible
  0.,               !- Fraction Replaceable
  GeneralLights;    !- End-Use Subcategory

ElectricEquipment,
  PER-3F_EQUIP,      !- Name
  PER-3F,            !- Zone Name
  EQP-SCHED,        !- Schedule Name
  Watts/Area,       !- Design Level Calculation Method
  ,                 !- Design Level {W}
  8.072933,        !- Watts per Zone Floor Area {W/m2}
  ,                 !- Watts per Person {W/person}
  0.,               !- Fraction Latent
  0.7,              !- Fraction Radiant
  0.,               !- Fraction Lost
  0;                !- End-Use Subcategory

!*****
****

Zone,
  PER-4F,           !- Name
  0.,               !- Direction of Relative North {deg}
  0.,               !- X Origin {m}
  0.,               !- Y Origin {m}
  0.,               !- Z Origin {m}
  1,                !- Type
  1,                !- Multiplier
  3.048,            !- Ceiling Height {m}
  0.;               !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
  PER-4FI_2,       !- Name
  Ceiling,         !- Surface Type
  CLG-1,           !- Construction Name
  PER-4F,          !- Zone Name
  Zone,            !- Outside Boundary Condition
  PLE-1,           !- Outside Boundary Condition Object
  NoSun,           !- Sun Exposure
  NoWind,          !- Wind Exposure
  0.,              !- View Factor to Ground
  4,               !- Number of Vertices
  4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
  0.,37.3302,3.048, !- X,Y,Z ==> Vertex 2
  0.,0.,3.048,    !- X,Y,Z ==> Vertex 3
  4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
  PER-4FE_1,       !- Name
  Wall,            !- Surface Type
  WALL-1,          !- Construction Name
  PER-4F,          !- Zone Name
  Outdoors,        !- Outside Boundary Condition
  ,                !- Outside Boundary Condition Object
  SunExposed,      !- Sun Exposure
  WindExposed,     !- Wind Exposure

```

```

0.5,           !- View Factor to Ground
4,            !- Number of Vertices
0.,37.3302,3.048, !- X,Y,Z ==> Vertex 1
0.,37.3302,0., !- X,Y,Z ==> Vertex 2
0.,0.,0.,     !- X,Y,Z ==> Vertex 3
0.,0.,3.048;  !- X,Y,Z ==> Vertex 4

FenestrationSurface:Detailed,
PER-4FE_1W_1,  !- Name
Window,       !- Surface Type
COMP_NN,      !- Construction Name
PER-4FE_1,    !- Building Surface Name
,             !- Outside Boundary Condition Object
0.5,         !- View Factor to Ground
,            !- Shading Control Name
,            !- Frame and Divider Name
1,           !- Multiplier
4,           !- Number of Vertices
0.,37.3302,3.048, !- X,Y,Z ==> Vertex 1
0.,37.3302,1.524, !- X,Y,Z ==> Vertex 2
0.,0.,1.524,    !- X,Y,Z ==> Vertex 3
0.,0.,3.048;   !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW41-P4F,     !- Name
Wall,        !- Surface Type
INT-WALL-1,  !- Construction Name
PER-4F,      !- Zone Name
Zone,        !- Outside Boundary Condition
PER-1F,      !- Outside Boundary Condition Object
NoSun,       !- Sun Exposure
NoWind,      !- Wind Exposure
0.,          !- View Factor to Ground
4,           !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,32.7582,0., !- X,Y,Z ==> Vertex 2
0.,37.3302,0., !- X,Y,Z ==> Vertex 3
0.,37.3302,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW43-P4F,     !- Name
Wall,        !- Surface Type
INT-WALL-1,  !- Construction Name
PER-4F,      !- Zone Name
Zone,        !- Outside Boundary Condition
PER-3F,      !- Outside Boundary Condition Object
NoSun,       !- Sun Exposure
NoWind,      !- Wind Exposure
0.,          !- View Factor to Ground
4,           !- Number of Vertices
0.,0.,3.048, !- X,Y,Z ==> Vertex 1
0.,0.,0.,    !- X,Y,Z ==> Vertex 2
4.572,4.572,0., !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IW4C-P4F,     !- Name
Wall,        !- Surface Type
INT-WALL-1,  !- Construction Name
PER-4F,      !- Zone Name
Zone,        !- Outside Boundary Condition
COR-1F,      !- Outside Boundary Condition Object
NoSun,       !- Sun Exposure
NoWind,      !- Wind Exposure
0.,          !- View Factor to Ground
4,           !- Number of Vertices
4.572,4.572,3.048, !- X,Y,Z ==> Vertex 1
4.572,4.572,0., !- X,Y,Z ==> Vertex 2
4.572,32.7582,0., !- X,Y,Z ==> Vertex 3
4.572,32.7582,3.048; !- X,Y,Z ==> Vertex 4

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BuildingSurface:Detailed,
  PER-4FI_1,           !- Name
  Floor,              !- Surface Type
  FLOOR-1,           !- Construction Name
  PER-4F,             !- Zone Name
  Zone,              !- Outside Boundary Condition
  BASE-1,            !- Outside Boundary Condition Object
  NoSun,             !- Sun Exposure
  NoWind,            !- Wind Exposure
  0.,                !- View Factor to Ground
  4,                 !- Number of Vertices
  0.,37.3302,0.,     !- X,Y,Z ==> Vertex 1
  4.572,32.7582,0., !- X,Y,Z ==> Vertex 2
  4.572,4.572,0.,   !- X,Y,Z ==> Vertex 3
  0.,0.,0.;         !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
  Internal-P4F,       !- Name
  MediumFurniture,   !- Construction Name
  PER-4F,             !- Zone Name
  137.916;           !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
  PER-4F_INFILTRATION, !- Name
  PER-4F,              !- Zone Name
  INF-SCHED,           !- Schedule Name
  AirChanges/Hour,    !- Design Flow Rate Calculation Method
  ,                   !- Design Flow Rate {m3/s}
  ,                   !- Flow per Zone Floor Area {m3/s-m2}
  ,                   !- Flow per Exterior Surface Area {m3/s-m2}
  0.3,                !- Air Changes per Hour
  0.,                 !- Constant Term Coefficient
  0.,                 !- Temperature Term Coefficient
  0.224,              !- Velocity Term Coefficient
  0.;                 !- Velocity Squared Term Coefficient

People,
  PER-4F_PEOPLE,      !- Name
  PER-4F,             !- Zone Name
  OCC-SCHED,          !- Number of People Schedule Name
  Area/Person,        !- Number of People Calculation Method
  ,                   !- Number of People
  ,                   !- People per Zone Floor Area {person/m2}
  9.290304,           !- Zone Floor Area per Person {m2/person}
  0.3,                !- Fraction Radiant
  0.5482,             !- Sensible Heat Fraction
  ActSched;           !- Activity Level Schedule Name

Lights,
  PER-4F_LIGHTS,     !- Name
  PER-4F,             !- Zone Name
  LIT-SCHED,          !- Schedule Name
  Watts/Area,         !- Design Level Calculation Method
  ,                   !- Lighting Level {W}
  13.993084,          !- Watts per Zone Floor Area {W/m2}
  ,                   !- Watts per Person {W/person}
  0.55,               !- Return Air Fraction
  0.3015,             !- Fraction Radiant
  0.045,              !- Fraction Visible
  0.,                 !- Fraction Replaceable
  GeneralLights;     !- End-Use Subcategory

ElectricEquipment,
  PER-4F_EQUIP,       !- Name
  PER-4F,             !- Zone Name
  EQP-SCHED,          !- Schedule Name
  Watts/Area,         !- Design Level Calculation Method
  ,                   !- Design Level {W}
  8.072933,          !- Watts per Zone Floor Area {W/m2}

```

```

,                !- Watts per Person {W/person}
0.,             !- Fraction Latent
0.7,           !- Fraction Radiant
0.,            !- Fraction Lost
0;             !- End-Use Subcategory

!*****
****

Zone,
COR-1F,        !- Name
0.,           !- Direction of Relative North {deg}
0.,           !- X Origin {m}
0.,           !- Y Origin {m}
0.,           !- Z Origin {m}
1,            !- Type
1,            !- Multiplier
3.048,        !- Ceiling Height {m}
0.;          !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
COR-1FI_2,    !- Name
Ceiling,     !- Surface Type
CLG-1,       !- Construction Name
COR-1F,      !- Zone Name
Zone,        !- Outside Boundary Condition
PLE-1,       !- Outside Boundary Condition Object
NoSun,       !- Sun Exposure
NoWind,      !- Wind Exposure
0.,          !- View Factor to Ground
4,           !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,4.572,3.048, !- X,Y,Z ==> Vertex 2
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWCL-C1F,    !- Name
Wall,        !- Surface Type
INT-WALL-1,  !- Construction Name
COR-1F,      !- Zone Name
Zone,        !- Outside Boundary Condition
PER-1F,      !- Outside Boundary Condition Object
NoSun,       !- Sun Exposure
NoWind,      !- Wind Exposure
0.,          !- View Factor to Ground
4,           !- Number of Vertices
32.7582,32.7582,3.048, !- X,Y,Z ==> Vertex 1
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 2
32.7582,4.572,0., !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC2-C1F,    !- Name
Wall,        !- Surface Type
INT-WALL-1,  !- Construction Name
COR-1F,      !- Zone Name
Zone,        !- Outside Boundary Condition
PER-2F,      !- Outside Boundary Condition Object
NoSun,       !- Sun Exposure
NoWind,      !- Wind Exposure
0.,          !- View Factor to Ground
4,           !- Number of Vertices
32.7582,4.572,3.048, !- X,Y,Z ==> Vertex 1
32.7582,4.572,0., !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,32.7582,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC3-C1F,    !- Name
Wall,        !- Surface Type

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INT-WALL-1,           !- Construction Name
COR-1F,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-3F,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,4.572,3.048,   !- X,Y,Z ==> Vertex 1
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 2
32.7582,4.572,0.,   !- X,Y,Z ==> Vertex 3
32.7582,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
IWC4-C1F,            !- Name
Wall,                !- Surface Type
INT-WALL-1,          !- Construction Name
COR-1F,              !- Zone Name
Zone,                !- Outside Boundary Condition
PER-4F,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,32.7582,3.048, !- X,Y,Z ==> Vertex 1
4.572,32.7582,0.,   !- X,Y,Z ==> Vertex 2
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 3
4.572,4.572,3.048; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
COR-1FI_1,           !- Name
Floor,               !- Surface Type
FLOOR-1,             !- Construction Name
COR-1F,              !- Zone Name
Zone,                !- Outside Boundary Condition
BASE-1,              !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
4.572,4.572,0.,     !- X,Y,Z ==> Vertex 1
4.572,32.7582,0.,   !- X,Y,Z ==> Vertex 2
32.7582,32.7582,0., !- X,Y,Z ==> Vertex 3
32.7582,4.572,0.;   !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 70 lb/ft2 (341.77 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-C1F,         !- Name
MediumFurniture,     !- Construction Name
COR-1F,              !- Zone Name
731.580;              !- Surface Area {m2}

! No INFILTRATION

People,
COR-1F_PEOPLE,       !- Name
COR-1F,              !- Zone Name
OCC-SCHED,           !- Number of People Schedule Name
Area/Person,         !- Number of People Calculation Method
,                    !- Number of People
,                    !- People per Zone Floor Area {person/m2}
9.290304,            !- Zone Floor Area per Person {m2/person}
0.3,                 !- Fraction Radiant
0.5482,              !- Sensible Heat Fraction
ActSched;            !- Activity Level Schedule Name

Lights,
COR-1F_LIGHTS,       !- Name
COR-1F,              !- Zone Name
LIT-SCHED,           !- Schedule Name

```

```

Watts/Area,          !- Design Level Calculation Method
,                   !- Lighting Level {W}
13.993084,          !- Watts per Zone Floor Area {W/m2}
,                   !- Watts per Person {W/person}
0.55,              !- Return Air Fraction
0.3015,            !- Fraction Radiant
0.045,             !- Fraction Visible
0.,                !- Fraction Replaceable
GeneralLights;     !- End-Use Subcategory

ElectricEquipment,
COR-1F_EQUIP,      !- Name
COR-1F,            !- Zone Name
EQP-SCHED,         !- Schedule Name
Watts/Area,        !- Design Level Calculation Method
,                   !- Design Level {W}
8.072933,          !- Watts per Zone Floor Area {W/m2}
,                   !- Watts per Person {W/person}
0.,                !- Fraction Latent
0.7,               !- Fraction Radiant
0.,                !- Fraction Lost
0;                 !- End-Use Subcategory

!*****
****

Zone,
BASE-1,            !- Name
0.,                !- Direction of Relative North {deg}
0.,                !- X Origin {m}
0.,                !- Y Origin {m}
-2.4384,           !- Z Origin {m}
1,                 !- Type
1,                 !- Multiplier
2.4384,            !- Ceiling Height {m}
0.;                !- Volume {m3} -- Zero is autocalculate

BuildingSurface:Detailed,
BASE-1W,           !- Name
Wall,              !- Surface Type
SLAB-1,            !- Construction Name
BASE-1,            !- Zone Name
Ground,            !- Outside Boundary Condition
,                  !- Outside Boundary Condition Object
NoSun,             !- Sun Exposure
NoWind,            !- Wind Exposure
1.00,              !- View Factor to Ground
4,                 !- Number of Vertices
37.3302,37.3302,2.4384, !- X,Y,Z ==> Vertex 1
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 2
0.,37.3302,0.,    !- X,Y,Z ==> Vertex 3
0.,37.3302,2.4384; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
BASE-2W,           !- Name
Wall,              !- Surface Type
SLAB-1,            !- Construction Name
BASE-1,            !- Zone Name
Ground,            !- Outside Boundary Condition
,                  !- Outside Boundary Condition Object
NoSun,             !- Sun Exposure
NoWind,            !- Wind Exposure
1.00,              !- View Factor to Ground
4,                 !- Number of Vertices
37.3302,0.,2.4384, !- X,Y,Z ==> Vertex 1
37.3302,0.,0.,    !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 3
37.3302,37.3302,2.4384; !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
BASE-3W,           !- Name

```



```

Wall,                !- Surface Type
SLAB-1,              !- Construction Name
BASE-1,              !- Zone Name
Ground,              !- Outside Boundary Condition
,                    !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
1.00,                !- View Factor to Ground
4,                   !- Number of Vertices
0.,0.,2.4384,        !- X,Y,Z ==> Vertex 1
0.,0.,0.,            !- X,Y,Z ==> Vertex 2
37.3302,0.,0.,       !- X,Y,Z ==> Vertex 3
37.3302,0.,2.4384;  !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
BASE-4W,              !- Name
Wall,                 !- Surface Type
SLAB-1,              !- Construction Name
BASE-1,              !- Zone Name
Ground,              !- Outside Boundary Condition
,                    !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
1.00,                !- View Factor to Ground
4,                   !- Number of Vertices
0.,37.3302,2.4384,   !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,       !- X,Y,Z ==> Vertex 2
0.,0.,0.,            !- X,Y,Z ==> Vertex 3
0.,0.,2.4384;       !- X,Y,Z ==> Vertex 4

BuildingSurface:Detailed,
SLB-1,               !- Name
Floor,               !- Surface Type
SLAB-1,              !- Construction Name
BASE-1,              !- Zone Name
Ground,              !- Outside Boundary Condition
,                    !- Outside Boundary Condition Object
NoSun,               !- Sun Exposure
NoWind,              !- Wind Exposure
0.,                  !- View Factor to Ground
4,                   !- Number of Vertices
0.,0.,0.,            !- X,Y,Z ==> Vertex 1
0.,37.3302,0.,       !- X,Y,Z ==> Vertex 2
37.3302,37.3302,0., !- X,Y,Z ==> Vertex 3
37.3302,0.,0.;      !- X,Y,Z ==> Vertex 4

! DOE-2 FLOOR-WEIGHT = 130 lb/ft2 (634.72 kg/m2); Area = Internal Mass/(Density x Mass_Thickness)
! Internal mass corresponds to FLOOR_WEIGHT mass minus mass of floor slab
InternalMass,
Internal-B1,         !- Name
MediumFurniture_Base, !- Construction Name
BASE-1,              !- Zone Name
1435.018;           !- Surface Area {m2}

ZoneInfiltration:DesignFlowRate,
BASE-1_INFILTRATION, !- Name
BASE-1,              !- Zone Name
ALLWAYSON,           !- Schedule Name
AirChanges/Hour,     !- Design Flow Rate Calculation Method
,                    !- Design Flow Rate {m3/s}
,                    !- Flow per Zone Floor Area {m3/s-m2}
,                    !- Flow per Exterior Surface Area {m3/s-m2}
2.0,                 !- Air Changes per Hour -- combustion + ventilation air for boiler
1.,                  !- Constant Term Coefficient
0.,                  !- Temperature Term Coefficient
0.,                  !- Velocity Term Coefficient
0.;                  !- Velocity Squared Term Coefficient

! Boiler jacket loss, Btu/h = (Boiler output capacity/input capacity) {79%} x (Floor area served)
{150,000 ft2} x Loss Factor

```

! Loss factor of 0.0057 corresponds to (boiler input capacity)/(ft2 floor area) {nominally 35 Btu/(h ft2)} x

! (Jacket loss)/(Boiler output capacity) {1.3%}

```
OtherEquipment,
  BASE-1_SOURCE,      !- Name (boiler jacket heat loss into basement)
  BASE-1,             !- Zone Name
  ALLWAYSON,          !- Schedule Name
  EquipmentLevel,    !- Design Level Calculation Method
  19795,              !- Design Level {W} -- [67,545 BTU/h]
  ,                   !- Watts per Zone Floor Area {W/m2}
  ,                   !- Watts per Person {W/Person}
  0.,                 !- Fraction Latent
  0.7,                !- Fraction Radiant
  0.;                 !- Fraction Lost
```

! Use sizing parameters to account for pull-up loads and duct leakage
! (increase oversizing factor if needed to reduce "too many iterations" warnings)
! Global sizing ratio is applied to all zone design loads and supply/return airflow rates
! Zone airflows correspond to cooling design condition
! System airflows correspond to coincident cooling design condition
! Humidity ratio 0.008 corresponds to supply air at 53F, 90% RH

```
Sizing:Parameters,
  1.0,                !- Sizing Factor
  1;                  !- Timesteps in Averaging Window
```

```
Sizing:Zone,
  PER-1T,              !- Zone Name
  11.667,              !- Zone Cooling Design Supply Air Temperature 53F {C}
  32.222,              !- Zone Heating Design Supply Air Temperature 90F {C}
  0.008,              !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
  0.008,              !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
  Flow/Person,        !- Outdoor Air Method
  0.007079,           !- Outdoor Air Flow per Person 15 cfm {m3/s}
  0.0,                 !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
  0.0,                 !- Outdoor Air Flow per Zone {m3/s}
  0.0,                 !- Zone Sizing Factor
  Flow/Zone,          !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
  0.61779,            !- Cooling Design Air Flow Rate {m3/s}
  ,                    !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
  ,                    !- Cooling Minimum Air Flow {m3/s}
  ,                    !- Cooling Minimum Air Flow Fraction
  Flow/Zone,          !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
  1.00402,            !- Heating Design Air Flow Rate {m3/s}
  ,                    !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
  ,                    !- Heating Maximum Air Flow {m3/s}
  ;                    !- Heating Maximum Air Flow Fraction
```

```
Sizing:Zone,
  PER-2T,              !- Zone Name
  11.667,              !- Zone Cooling Design Supply Air Temperature 53F {C}
  32.222,              !- Zone Heating Design Supply Air Temperature 90F {C}
  0.008,              !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
  0.008,              !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
  Flow/Person,        !- Outdoor Air Method
  0.007079,           !- Outdoor Air Flow per Person 15 cfm {m3/s}
  0.0,                 !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
  0.0,                 !- Outdoor Air Flow per Zone {m3/s}
  0.0,                 !- Zone Sizing Factor
  Flow/Zone,          !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
  1.295,              !- Cooling Design Air Flow Rate {m3/s}
  ,                    !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
  ,                    !- Cooling Minimum Air Flow {m3/s}
  ,                    !- Cooling Minimum Air Flow Fraction
  Flow/Zone,          !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
  1.00912,            !- Heating Design Air Flow Rate {m3/s}
```

```

,           !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,           !- Heating Maximum Air Flow {m3/s}
;           !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-3T,     !- Zone Name
11.667,    !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,    !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,     !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,     !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person, !- Outdoor Air Method
0.007079,  !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,       !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,       !- Outdoor Air Flow per Zone {m3/s}
0.0,       !- Zone Sizing Factor
Flow/Zone, !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
0.86914,   !- Cooling Design Air Flow Rate {m3/s}
,          !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,          !- Cooling Minimum Air Flow {m3/s}
,          !- Cooling Minimum Air Flow Fraction
Flow/Zone, !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
1.00983,   !- Heating Design Air Flow Rate {m3/s}
,          !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,          !- Heating Maximum Air Flow {m3/s}
;          !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-4T,     !- Zone Name
11.667,    !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,    !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,     !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,     !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person, !- Outdoor Air Method
0.007079,  !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,       !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,       !- Outdoor Air Flow per Zone {m3/s}
0.0,       !- Zone Sizing Factor
Flow/Zone, !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
1.72447,   !- Cooling Design Air Flow Rate {m3/s}
,          !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,          !- Cooling Minimum Air Flow {m3/s}
,          !- Cooling Minimum Air Flow Fraction
Flow/Zone, !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
1.00451,   !- Heating Design Air Flow Rate {m3/s}
,          !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,          !- Heating Maximum Air Flow {m3/s}
;          !- Heating Maximum Air Flow Fraction

Sizing:Zone,
COR-1T,     !- Zone Name
11.667,    !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,    !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,     !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,     !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person, !- Outdoor Air Method
0.007079,  !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,       !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,       !- Outdoor Air Flow per Zone {m3/s}
0.0,       !- Zone Sizing Factor
Flow/Zone, !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
2.03576,   !- Cooling Design Air Flow Rate {m3/s}
,          !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,          !- Cooling Minimum Air Flow {m3/s}
,          !- Cooling Minimum Air Flow Fraction
Flow/Zone, !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)

```

```

3.08779,          !- Heating Design Air Flow Rate {m3/s}
,                !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,                !- Heating Maximum Air Flow {m3/s}
;                !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-1I,          !- Zone Name
11.667,         !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,         !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,         !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,         !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,    !- Outdoor Air Method
0.007079,      !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,           !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,           !- Outdoor Air Flow per Zone {m3/s}
0.0,           !- Zone Sizing Factor
Flow/Zone,      !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
0.58547,       !- Cooling Design Air Flow Rate {m3/s}
,              !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,              !- Cooling Minimum Air Flow {m3/s}
,              !- Cooling Minimum Air Flow Fraction
Flow/Zone,      !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
0.91192,       !- Heating Design Air Flow Rate {m3/s}
,              !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,              !- Heating Maximum Air Flow {m3/s}
;              !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-2I,          !- Zone Name
11.667,         !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,         !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,         !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,         !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,    !- Outdoor Air Method
0.007079,      !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,           !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,           !- Outdoor Air Flow per Zone {m3/s}
0.0,           !- Zone Sizing Factor
Flow/Zone,      !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
1.32963,       !- Cooling Design Air Flow Rate {m3/s}
,              !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,              !- Cooling Minimum Air Flow {m3/s}
,              !- Cooling Minimum Air Flow Fraction
Flow/Zone,      !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
0.91583,       !- Heating Design Air Flow Rate {m3/s}
,              !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,              !- Heating Maximum Air Flow {m3/s}
;              !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-3I,          !- Zone Name
11.667,         !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,         !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,         !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,         !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,    !- Outdoor Air Method
0.007079,      !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,           !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,           !- Outdoor Air Flow per Zone {m3/s}
0.0,           !- Zone Sizing Factor
Flow/Zone,      !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
0.867,         !- Cooling Design Air Flow Rate {m3/s}
,              !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,              !- Cooling Minimum Air Flow {m3/s}
,              !- Cooling Minimum Air Flow Fraction

```

```

Flow/Zone,           !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
0.91642,
,
,
;
                    !- Heating Design Air Flow Rate {m3/s}
                    !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
                    !- Heating Maximum Air Flow {m3/s}
                    !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-4I,              !- Zone Name
11.667,              !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,              !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,              !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,              !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,        !- Outdoor Air Method
0.007079,           !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,                !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,                !- Outdoor Air Flow per Zone {m3/s}
0.0,                !- Zone Sizing Factor
Flow/Zone,          !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
1.70296,
,
,
,
                    !- Cooling Design Air Flow Rate {m3/s}
                    !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
                    !- Cooling Minimum Air Flow {m3/s}
                    !- Cooling Minimum Air Flow Fraction
Flow/Zone,          !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
0.91261,
,
,
;
                    !- Heating Design Air Flow Rate {m3/s}
                    !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
                    !- Heating Maximum Air Flow {m3/s}
                    !- Heating Maximum Air Flow Fraction

Sizing:Zone,
COR-1I,             !- Zone Name
11.667,              !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,              !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,              !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,              !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,        !- Outdoor Air Method
0.007079,           !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,                !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,                !- Outdoor Air Flow per Zone {m3/s}
0.0,                !- Zone Sizing Factor
Flow/Zone,          !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
1.83857,
,
,
,
                    !- Cooling Design Air Flow Rate {m3/s}
                    !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
                    !- Cooling Minimum Air Flow {m3/s}
                    !- Cooling Minimum Air Flow Fraction
Flow/Zone,          !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
2.59897,
,
,
;
                    !- Heating Design Air Flow Rate {m3/s}
                    !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
                    !- Heating Maximum Air Flow {m3/s}
                    !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-1F,             !- Zone Name
11.667,              !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,              !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,              !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,              !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,        !- Outdoor Air Method
0.007079,           !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,                !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,                !- Outdoor Air Flow per Zone {m3/s}
0.0,                !- Zone Sizing Factor
Flow/Zone,          !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
0.60836,
,
,
                    !- Cooling Design Air Flow Rate {m3/s}
                    !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
                    !- Cooling Minimum Air Flow {m3/s}

```

```

,                                     !- Cooling Minimum Air Flow Fraction
Flow/Zone,                             !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
0.90058,                                !- Heating Design Air Flow Rate {m3/s}
,                                         !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,                                         !- Heating Maximum Air Flow {m3/s}
;                                         !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-2F,                                  !- Zone Name
11.667,                                  !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,                                  !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,                                   !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,                                   !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,                             !- Outdoor Air Method
0.007079,                                !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,                                     !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,                                     !- Outdoor Air Flow per Zone {m3/s}
0.0,                                     !- Zone Sizing Factor
Flow/Zone,                             !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
1.39579,                                !- Cooling Design Air Flow Rate {m3/s}
,                                         !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,                                         !- Cooling Minimum Air Flow {m3/s}
,                                         !- Cooling Minimum Air Flow Fraction
Flow/Zone,                             !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
0.90071,                                !- Heating Design Air Flow Rate {m3/s}
,                                         !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,                                         !- Heating Maximum Air Flow {m3/s}
;                                         !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-3F,                                  !- Zone Name
11.667,                                  !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,                                  !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,                                   !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,                                   !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,                             !- Outdoor Air Method
0.007079,                                !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,                                     !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,                                     !- Outdoor Air Flow per Zone {m3/s}
0.0,                                     !- Zone Sizing Factor
Flow/Zone,                             !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
0.91028,                                !- Cooling Design Air Flow Rate {m3/s}
,                                         !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
,                                         !- Cooling Minimum Air Flow {m3/s}
,                                         !- Cooling Minimum Air Flow Fraction
Flow/Zone,                             !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
0.90123,                                !- Heating Design Air Flow Rate {m3/s}
,                                         !- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
,                                         !- Heating Maximum Air Flow {m3/s}
;                                         !- Heating Maximum Air Flow Fraction

Sizing:Zone,
PER-4F,                                  !- Zone Name
11.667,                                  !- Zone Cooling Design Supply Air Temperature 53F {C}
32.222,                                  !- Zone Heating Design Supply Air Temperature 90F {C}
0.008,                                   !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
0.008,                                   !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
Flow/Person,                             !- Outdoor Air Method
0.007079,                                !- Outdoor Air Flow per Person 15 cfm {m3/s}
0.0,                                     !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
0.0,                                     !- Outdoor Air Flow per Zone {m3/s}
0.0,                                     !- Zone Sizing Factor
Flow/Zone,                             !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
1.79735,                                !- Cooling Design Air Flow Rate {m3/s}
,                                         !- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}

```

```

,
,
Flow/Zone,
value 0)
0.90116,
,
,
;
!- Cooling Minimum Air Flow {m3/s}
!- Cooling Minimum Air Flow Fraction
!- Heating Design Air Flow Method (DesignDay if autosize with next
!- Heating Design Air Flow Rate {m3/s}
!- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
!- Heating Maximum Air Flow {m3/s}
!- Heating Maximum Air Flow Fraction

```

```

Sizing:Zone,
COR-1F,
11.667,
32.222,
0.008,
0.008,
Flow/Person,
0.007079,
0.0,
0.0,
0.0,
Flow/Zone,
value 0)
2.35805,
,
,
,
Flow/Zone,
value 0)
2.58111,
,
,
;
!- Zone Name
!- Zone Cooling Design Supply Air Temperature 53F {C}
!- Zone Heating Design Supply Air Temperature 90F {C}
!- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
!- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
!- Outdoor Air Method
!- Outdoor Air Flow per Person 15 cfm {m3/s}
!- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
!- Outdoor Air Flow per Zone {m3/s}
!- Zone Sizing Factor
!- Cooling Design Air Flow Method (DesignDay if autosize with next
!- Cooling Design Air Flow Rate {m3/s}
!- Cooling Minimum Air Flow per Zone Floor Area {m3/s-m2}
!- Cooling Minimum Air Flow {m3/s}
!- Cooling Minimum Air Flow Fraction
!- Heating Design Air Flow Method (DesignDay if autosize with next
!- Heating Design Air Flow Rate {m3/s}
!- Heating Maximum Air Flow per Zone Floor Area {m3/s-m2}
!- Heating Maximum Air Flow {m3/s}
!- Heating Maximum Air Flow Fraction

```

! Each VAV box damper is held at 40% of box design flow when there is a zone heating demand,
! so minimum SYSTEM air flow ratio is set to this minimum flow ratio.
! If the zone VAV dampers were reverse action and could open to full flow to meet heating demand,
! this ratio should be set to 1.

```

Sizing:System,
SYS10,
Sensible,
1.06188,
0.4,
7.0,
.008,
11.0,
.008,
11.667,
16.7,
Coincident,
No,
No,
0.008,
0.008,
Flow/System,
value 0)
5.10205,
Flow/System,
value 0)
7.11526;
!- AirLoop Name
!- Type of Load to Size On
!- Design Outdoor Air Flow Rate {m3/s}
!- Minimum System Air Flow Ratio
!- Preheat Design Temperature {C} - no coil
!- Preheat Design Humidity Ratio {kg-H2O/kg-Air} - no coil
!- Precool Design Temperature {C} - no coil
!- Precool Design Humidity Ratio {kg-H2O/kg-Air} - no coil
!- Central Cooling Design Supply Air Temperature {C}
!- Central Heating Design Supply Air Temperature {C} - no coil
!- Sizing Option
!- 100% Outdoor Air in Cooling
!- 100% Outdoor Air in Heating
!- Central Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-Air}
!- Central Heating Design Supply Air Humidity Ratio {kg-H2O/kg-Air}
!- Cooling Design Air Flow Method (DesignDay if autosize with next
!- Cooling Design Air Flow Rate {m3/s}
!- Heating Design Air Flow Method (DesignDay if autosize with next
!- Heating Design Air Flow Rate {m3/s}

```

```

Sizing:System,
SYS2,
Sensible,
1.06188,
0.4,
7.0,
.008,
11.0,
.008,
11.667,
!- AirLoop Name
!- Type of Load to Size On
!- Design Outdoor Air Flow Rate {m3/s}
!- Minimum System Air Flow Ratio
!- Preheat Design Temperature {C} - no coil
!- Preheat Design Humidity Ratio {kg-H2O/kg-Air} - no coil
!- Precool Design Temperature {C} - no coil
!- Precool Design Humidity Ratio {kg-H2O/kg-Air} - no coil
!- Central Cooling Design Supply Air Temperature {C}

```

```

16.7,           !- Central Heating Design Supply Air Temperature {C} - no coil
Coincident,    !- Sizing Option
No,            !- 100% Outdoor Air in Cooling
No,            !- 100% Outdoor Air in Heating
0.008,        !- Central Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-Air}
0.008,        !- Central Heating Design Supply Air Humidity Ratio {kg-H2O/kg-Air}
Flow/System,   !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
4.75404,      !- Cooling Design Air Flow Rate {m3/s}
Flow/System,   !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
6.25575;      !- Heating Design Air Flow Rate {m3/s}

Sizing:System,
SYS1,         !- AirLoop Name
Sensible,     !- Type of Load to Size On
1.06188,     !- Design Outdoor Air Flow Rate {m3/s}
0.4,         !- Minimum System Air Flow Ratio
7.0,         !- Preheat Design Temperature {C} - no coil
.008,        !- Preheat Design Humidity Ratio {kg-H2O/kg-Air} - no coil
11.0,        !- Precool Design Temperature {C} - no coil
.008,        !- Precool Design Humidity Ratio {kg-H2O/kg-Air} - no coil
11.667,      !- Central Cooling Design Supply Air Temperature {C}
16.7,        !- Central Heating Design Supply Air Temperature {C} - no coil
Coincident,   !- Sizing Option
No,           !- 100% Outdoor Air in Cooling
No,           !- 100% Outdoor Air in Heating
0.008,       !- Central Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-Air}
0.008,       !- Central Heating Design Supply Air Humidity Ratio {kg-H2O/kg-Air}
Flow/System,  !- Cooling Design Air Flow Method (DesignDay if autosize with next
value 0)
5.04494,     !- Cooling Design Air Flow Rate {m3/s}
Flow/System,  !- Heating Design Air Flow Method (DesignDay if autosize with next
value 0)
6.18478;     !- Heating Design Air Flow Rate {m3/s}

Sizing:Plant,
BoilerPlant, !- Plant or Condenser Loop Name
Heating,     !- Loop Type
82.222,     !- Design Loop Exit Temperature 180F {C}
16.667;     !- Loop Design Temperature Difference 30F {deltaC}

Sizing:Plant,
CHWPlant,    !- Plant or Condenser Loop Name
Cooling,     !- Loop Type
6.667,      !- Design Loop Exit Temperature 44F {C}
6.667;      !- Loop Design Temperature Difference 12F {deltaC}

Sizing:Plant,
CHWPlant Condenser Loop, !- Plant or Condenser Loop Name
Condenser,   !- Loop Type
29.444,     !- Design Loop Exit Temperature 85F {C}
5.556;      !- Loop Design Temperature Difference 10F {deltaC}

```

```

!===== file: HVACScheds.inc =====Start=====
! Zone air heating setpoint temperature {C} schedule

```

```

Schedule:Compact,
HTG-SCHED,   !- Name
sctTemperature, !- Schedule Type Limits Name
Through: 12/31, !- Field 1
For: Weekdays WinterDesignDay SummerDesignDay, !- Field 2
Until: 5:00, !- Field 3
15.55557, !- Field 4 [60F]
Until: 7:00, !- Field 5
18.33335, !- Field 6 [65F]
Until: 18:00, !- Field 7
21.11113, !- Field 8 [70F]
Until: 19:00, !- Field 9
18.33335, !- Field 10 [65F]
Until: 24:00, !- Field 11

```



```

15.55557,           !- Field 12 [60F]
For: Weekends Holidays, !- Field 13
Until: 5:00,        !- Field 14
15.55557,           !- Field 15 [60F]
Until: 16:00,       !- Field 16
18.33335,           !- Field 17 [65F]
Until: 24:00,       !- Field 18
15.55557,           !- Field 19 [60F]
For: AllOtherDays,  !- Field 20
Until: 24:00,       !- Field 21
15.55557;           !- Field 22 [60F]

! Zone air cooling setpoint temperature {C} schedule

Schedule:Compact,
  CLG-SCHED,         !- Name
  sctTemperature,    !- Schedule Type Limits Name
  Through: 12/31,    !- Field 1
  For: AllDays,      !- Field 2
  Until: 5:00,       !- Field 3
  25.00002,          !- Field 4 [77F]
  Until: 18:00,      !- Field 5
  22.7778,           !- Field 6 [73F]
  Until: 24:00,      !- Field 7
  25.00002;          !- Field 8 [77F]

!Valid Control Types are:
! 0 - Uncontrolled (No specification or default)
! 1 - Single Heating Setpoint
! 2 - Single Cooling SetPoint
! 3 - Single Heating/Cooling Setpoint
! 4 - Dual Setpoint (Heating and Cooling) with deadband

Schedule:Compact,
  Zone-Control-Type-Sched, !- Name
  Control TypeHV,         !- Schedule Type Limits Name
  Through: 12/31,         !- Field 1
  For: AllDays,           !- Field 2
  Until: 24:00,           !- Field 3
  4;                       !- Field 4

! MinOA schedule same as FAN-SCHED

Schedule:Compact,
  FAN-SCHED,             !- Name
  sctOnOff,              !- Schedule Type Limits Name
  Through: 12/31,        !- Field 1
  For: Weekdays WinterDesignDay SummerDesignDay, !- Field 2
  Until: 5:00,           !- Field 3
  0.,                    !- Field 4
  Until: 20:00,          !- Field 5
  1.,                    !- Field 6
  Until: 24:00,          !- Field 7
  0.,                    !- Field 8
  For: Saturdays,       !- Field 9
  Until: 5:00,           !- Field 10
  0.,                    !- Field 11
  Until: 15:00,          !- Field 12
  1.,                    !- Field 13
  Until: 24:00,          !- Field 14
  0.,                    !- Field 15
  For: Sundays Holidays, !- Field 16
  Until: 24:00,          !- Field 17
  0.,                    !- Field 18
  For: AllOtherDays,     !- Field 19
  Until: 24:00,          !- Field 20
  0.;                    !- Field 21

Schedule:Day:Hourly,
  CHWPlant ChW Temp Schedule Daily, !- Name
  sctAnyNumber,          !- Schedule Type Limits Name

```

```

6.667,           !- Hour 1
6.667,           !- Hour 2
6.667,           !- Hour 3
6.667,           !- Hour 4
6.667,           !- Hour 5
6.667,           !- Hour 6
6.667,           !- Hour 7
6.667,           !- Hour 8
6.667,           !- Hour 9
6.667,           !- Hour 10
6.667,          !- Hour 11
6.667,          !- Hour 12
6.667,          !- Hour 13
6.667,          !- Hour 14
6.667,          !- Hour 15
6.667,          !- Hour 16
6.667,          !- Hour 17
6.667,          !- Hour 18
6.667,          !- Hour 19
6.667,          !- Hour 20
6.667,          !- Hour 21
6.667,          !- Hour 22
6.667,          !- Hour 23
6.667;          !- Hour 24

```

```

Schedule:Week:Daily,
  CHWPlant ChW Temp Schedule Weekly, !- Name
  CHWPlant ChW Temp Schedule Daily,  !- Sunday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- Monday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- Tuesday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- Wednesday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- Thursday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- Friday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- Saturday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- Holiday Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- SummerDesignDay Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- WinterDesignDay Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily,  !- CustomDay1 Schedule:Day Name
  CHWPlant ChW Temp Schedule Daily;  !- CustomDay2 Schedule:Day Name

```

```

Schedule:Year,
  CHWPlant ChW Temp Schedule,        !- Name
  sctAnyNumber,                      !- Schedule Type Limits Name
  CHWPlant ChW Temp Schedule Weekly, !- Schedule:Week Name 1
  1,                                  !- Start Month 1
  1,                                  !- Start Day 1
  12,                                 !- End Month 1
  31;                                 !- End Day 1

```

```

Schedule:Compact,
  ConstSetSched82.2,                !- Name
  sctAnyNumber,                    !- Schedule Type Limits Name
  Through: 12/31,                  !- Field 1
  For: AllDays,                    !- Field 2
  Until: 24:00,                    !- Field 3
  82.222;                          !- Field 4

```

```

Schedule:Compact,
  ConstSetSched11.7,               !- Name
  sctTemperature,                  !- Schedule Type Limits Name
  Through: 12/31,                  !- Field 1
  For: AllDays,                    !- Field 2
  Until: 24:00,                    !- Field 3
  11.667;                          !- Field 4

```

```

Schedule:Compact,
  RPT-SCHED,                       !- Name
  sctOnOff,                        !- Schedule Type Limits Name
  Through: 12/31,                  !- Field 1
  For: Weekdays WinterDesignDay SummerDesignDay, !- Field 2
  Until: 5:00,                    !- Field 3

```

```

0.,                !- Field 4
Until: 20:00,      !- Field 5
1.,                !- Field 6
Until: 24:00,      !- Field 7
0.,                !- Field 8
For: Saturdays,    !- Field 9
Until: 5:00,       !- Field 10
0.,                !- Field 11
Until: 15:00,      !- Field 12
1.,                !- Field 13
Until: 24:00,      !- Field 14
0.,                !- Field 15
For: Sundays Holidays, !- Field 16
Until: 24:00,      !- Field 17
0.,                !- Field 18
For: AllOtherDays, !- Field 19
Until: 24:00,      !- Field 20
0.;                !- Field 21
!===== file: HVACScheds.inc ====End=====

!===== file: PerfCurves.inc ====Start=====
! DOE-2.1E HERM-CENT-CAP-FT (CCAPT3) and OPEN-CENT-CAP-FT (CCAPT1) Curves (3):
!
! Cooling Capacity Function of Temperature Curve
! for open or hermetic water-cooled centrifugal chillers
! x = Leaving Chilled Water Temperature and y = Entering Condenser Water Temperature

Curve:Biquadratic,
  HERM-CENT-CAP-FT,      !- Name
  0.2578959,            !- Coefficient1 Constant
  0.0389016,            !- Coefficient2 x
  -0.00021708,          !- Coefficient3 x**2
  0.0468684,            !- Coefficient4 y
  -0.0009428399,        !- Coefficient5 y**2
  -0.00034344,          !- Coefficient6 x*y
  5.,                   !- Minimum Value of x
  10.,                  !- Maximum Value of x
  24.,                  !- Minimum Value of y
  35.;                  !- Maximum Value of y

! Energy Input to Cooling Output Ratio Function of Temperature Curve
! for open or hermetic water-cooled centrifugal chillers
! x = Leaving Chilled Water Temperature and y = Entering Condenser Water Temperature

Curve:Biquadratic,
  HERM-CENT-EIR-FT,     !- Name
  0.933884,             !- Coefficient1 Constant
  -0.058212,            !- Coefficient2 x
  0.00450036,           !- Coefficient3 x**2
  0.00243,              !- Coefficient4 y
  0.000486,             !- Coefficient5 y**2
  -0.001215,           !- Coefficient6 x*y
  5.,                   !- Minimum Value of x
  10.,                  !- Maximum Value of x
  24.,                  !- Minimum Value of y
  35.;                  !- Maximum Value of y

! Energy Input to Cooling Output Ratio Function of Part Load Ratio Curve
! for open or hermetic water-cooled centrifugal chillers
! x = Part Load Ratio (load/capacity)

Curve:Quadratic,
  HERM-CENT-EIR-FP,     !- Name
  0.222903,             !- Coefficient1 Constant
  0.313387,             !- Coefficient2 x
  0.46371,              !- Coefficient3 x**2
  0.,                   !- Minimum Value of x
  1.;                   !- Maximum Value of x

!===== file: PerfCurves.inc ====End=====

```

```

!---- System: VAVS ---Begin---

OutdoorAir:NodeList,
  SYS10 Outside Air Inlet; !- Node or NodeList Name 1

OutdoorAir:NodeList,
  SYS2 Outside Air Inlet; !- Node or NodeList Name 1

OutdoorAir:NodeList,
  SYS1 Outside Air Inlet; !- Node or NodeList Name 1

NodeList,
  PER-1T Inlets,          !- Name
  PER-1T Supply Inlet;   !- Node 1 Name

NodeList,
  PER-2T Inlets,          !- Name
  PER-2T Supply Inlet;   !- Node 1 Name

NodeList,
  PER-3T Inlets,          !- Name
  PER-3T Supply Inlet;   !- Node 1 Name

NodeList,
  PER-4T Inlets,          !- Name
  PER-4T Supply Inlet;   !- Node 1 Name

NodeList,
  COR-1T Inlets,          !- Name
  COR-1T Supply Inlet;   !- Node 1 Name

NodeList,
  PER-1I Inlets,          !- Name
  PER-1I Supply Inlet;   !- Node 1 Name

NodeList,
  PER-2I Inlets,          !- Name
  PER-2I Supply Inlet;   !- Node 1 Name

NodeList,
  PER-3I Inlets,          !- Name
  PER-3I Supply Inlet;   !- Node 1 Name

NodeList,
  PER-4I Inlets,          !- Name
  PER-4I Supply Inlet;   !- Node 1 Name

NodeList,
  COR-1I Inlets,          !- Name
  COR-1I Supply Inlet;   !- Node 1 Name

NodeList,
  PER-1F Inlets,          !- Name
  PER-1F Supply Inlet;   !- Node 1 Name

NodeList,
  PER-2F Inlets,          !- Name
  PER-2F Supply Inlet;   !- Node 1 Name

NodeList,
  PER-3F Inlets,          !- Name
  PER-3F Supply Inlet;   !- Node 1 Name

NodeList,
  PER-4F Inlets,          !- Name
  PER-4F Supply Inlet;   !- Node 1 Name

NodeList,
  COR-1F Inlets,          !- Name
  COR-1F Supply Inlet;   !- Node 1 Name

```

```

ZoneHVAC:EquipmentConnections,
  PER-1T,                !- Zone Name
  PER-1T Equipment,      !- Zone Conditioning Equipment List Name
  PER-1T Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-1T Zone Air Node,  !- Zone Air Node Name
  PER-1T Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  PER-2T,                !- Zone Name
  PER-2T Equipment,      !- Zone Conditioning Equipment List Name
  PER-2T Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-2T Zone Air Node,  !- Zone Air Node Name
  PER-2T Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  PER-3T,                !- Zone Name
  PER-3T Equipment,      !- Zone Conditioning Equipment List Name
  PER-3T Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-3T Zone Air Node,  !- Zone Air Node Name
  PER-3T Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  PER-4T,                !- Zone Name
  PER-4T Equipment,      !- Zone Conditioning Equipment List Name
  PER-4T Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-4T Zone Air Node,  !- Zone Air Node Name
  PER-4T Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  COR-1T,                !- Zone Name
  COR-1T Equipment,      !- Zone Conditioning Equipment List Name
  COR-1T Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  COR-1T Zone Air Node,  !- Zone Air Node Name
  COR-1T Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  PER-1I,                !- Zone Name
  PER-1I Equipment,      !- Zone Conditioning Equipment List Name
  PER-1I Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-1I Zone Air Node,  !- Zone Air Node Name
  PER-1I Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  PER-2I,                !- Zone Name
  PER-2I Equipment,      !- Zone Conditioning Equipment List Name
  PER-2I Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-2I Zone Air Node,  !- Zone Air Node Name
  PER-2I Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  PER-3I,                !- Zone Name
  PER-3I Equipment,      !- Zone Conditioning Equipment List Name
  PER-3I Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-3I Zone Air Node,  !- Zone Air Node Name
  PER-3I Return Outlet;  !- Zone Return Air Node Name

ZoneHVAC:EquipmentConnections,
  PER-4I,                !- Zone Name
  PER-4I Equipment,      !- Zone Conditioning Equipment List Name
  PER-4I Inlets,         !- Zone Air Inlet Node or NodeList Name
  ,                      !- Zone Air Exhaust Node or NodeList Name
  PER-4I Zone Air Node,  !- Zone Air Node Name
  PER-4I Return Outlet;  !- Zone Return Air Node Name

```

```

ZoneHVAC:EquipmentConnections,
COR-1I,                !- Zone Name
COR-1I Equipment,      !- Zone Conditioning Equipment List Name
COR-1I Inlets,         !- Zone Air Inlet Node or NodeList Name
,                       !- Zone Air Exhaust Node or NodeList Name
COR-1I Zone Air Node,  !- Zone Air Node Name
COR-1I Return Outlet;  !- Zone Return Air Node Name

```

```

ZoneHVAC:EquipmentConnections,
PER-1F,                !- Zone Name
PER-1F Equipment,      !- Zone Conditioning Equipment List Name
PER-1F Inlets,         !- Zone Air Inlet Node or NodeList Name
,                       !- Zone Air Exhaust Node or NodeList Name
PER-1F Zone Air Node,  !- Zone Air Node Name
PER-1F Return Outlet;  !- Zone Return Air Node Name

```

```

ZoneHVAC:EquipmentConnections,
PER-2F,                !- Zone Name
PER-2F Equipment,      !- Zone Conditioning Equipment List Name
PER-2F Inlets,         !- Zone Air Inlet Node or NodeList Name
,                       !- Zone Air Exhaust Node or NodeList Name
PER-2F Zone Air Node,  !- Zone Air Node Name
PER-2F Return Outlet;  !- Zone Return Air Node Name

```

```

ZoneHVAC:EquipmentConnections,
PER-3F,                !- Zone Name
PER-3F Equipment,      !- Zone Conditioning Equipment List Name
PER-3F Inlets,         !- Zone Air Inlet Node or NodeList Name
,                       !- Zone Air Exhaust Node or NodeList Name
PER-3F Zone Air Node,  !- Zone Air Node Name
PER-3F Return Outlet;  !- Zone Return Air Node Name

```

```

ZoneHVAC:EquipmentConnections,
PER-4F,                !- Zone Name
PER-4F Equipment,      !- Zone Conditioning Equipment List Name
PER-4F Inlets,         !- Zone Air Inlet Node or NodeList Name
,                       !- Zone Air Exhaust Node or NodeList Name
PER-4F Zone Air Node,  !- Zone Air Node Name
PER-4F Return Outlet;  !- Zone Return Air Node Name

```

```

ZoneHVAC:EquipmentConnections,
COR-1F,                !- Zone Name
COR-1F Equipment,      !- Zone Conditioning Equipment List Name
COR-1F Inlets,         !- Zone Air Inlet Node or NodeList Name
,                       !- Zone Air Exhaust Node or NodeList Name
COR-1F Zone Air Node,  !- Zone Air Node Name
COR-1F Return Outlet;  !- Zone Return Air Node Name

```

```

ZoneControl:Thermostat,
PER-1T Thermostat,     !- Name
PER-1T,                !- Zone Name
Zone-Control-Type-Sched, !- Control Type Schedule Name
ThermostatSetpoint: DualSetpoint, !- Control 1 Object Type
PER-1T DualSPSched;    !- Control 1 Name

```

```

ZoneControl:Thermostat,
PER-2T Thermostat,     !- Name
PER-2T,                !- Zone Name
Zone-Control-Type-Sched, !- Control Type Schedule Name
ThermostatSetpoint: DualSetpoint, !- Control 1 Object Type
PER-2T DualSPSched;    !- Control 1 Name

```

```

ZoneControl:Thermostat,
PER-3T Thermostat,     !- Name
PER-3T,                !- Zone Name
Zone-Control-Type-Sched, !- Control Type Schedule Name
ThermostatSetpoint: DualSetpoint, !- Control 1 Object Type
PER-3T DualSPSched;    !- Control 1 Name

```

```

ZoneControl:Thermostat,

```

```

PER-4T Thermostat,           !- Name
PER-4T,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-4T DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
COR-1T Thermostat,           !- Name
COR-1T,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
COR-1T DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-1I Thermostat,           !- Name
PER-1I,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-1I DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-2I Thermostat,           !- Name
PER-2I,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-2I DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-3I Thermostat,           !- Name
PER-3I,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-3I DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-4I Thermostat,           !- Name
PER-4I,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-4I DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
COR-1I Thermostat,           !- Name
COR-1I,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
COR-1I DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-1F Thermostat,           !- Name
PER-1F,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-1F DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-2F Thermostat,           !- Name
PER-2F,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-2F DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-3F Thermostat,           !- Name
PER-3F,                       !- Zone Name
Zone-Control-Type-Sched,     !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint, !- Control 1 Object Type
PER-3F DualSPSched;         !- Control 1 Name

ZoneControl:Thermostat,
PER-4F Thermostat,           !- Name

```

```

PER-4F,                                !- Zone Name
Zone-Control-Type-Sched,                !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint,      !- Control 1 Object Type
PER-4F DualSPSched;                    !- Control 1 Name

ZoneControl:Thermostat,
COR-1F Thermostat,                     !- Name
COR-1F,                                 !- Zone Name
Zone-Control-Type-Sched,                !- Control Type Schedule Name
ThermostatSetpoint:DualSetpoint,      !- Control 1 Object Type
COR-1F DualSPSched;                    !- Control 1 Name

ThermostatSetpoint:DualSetpoint,
PER-1T DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-2T DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-3T DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-4T DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
COR-1T DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-1I DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-2I DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-3I DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-4I DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
COR-1I DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-1F DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint:DualSetpoint,
PER-2F DualSPSched,                    !- Name
HTG-SCHED,                              !- Heating Setpoint Temperature Schedule Name
CLG-SCHED;                              !- Cooling Setpoint Temperature Schedule Name

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ThermostatSetpoint: DualSetpoint,
  PER-3F DualSPSched,      !- Name
  HTG-SCHED,              !- Heating Setpoint Temperature Schedule Name
  CLG-SCHED;              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint: DualSetpoint,
  PER-4F DualSPSched,      !- Name
  HTG-SCHED,              !- Heating Setpoint Temperature Schedule Name
  CLG-SCHED;              !- Cooling Setpoint Temperature Schedule Name

ThermostatSetpoint: DualSetpoint,
  COR-1F DualSPSched,      !- Name
  HTG-SCHED,              !- Heating Setpoint Temperature Schedule Name
  CLG-SCHED;              !- Cooling Setpoint Temperature Schedule Name

ZoneHVAC: EquipmentList,
  PER-1T Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-1T ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

ZoneHVAC: EquipmentList,
  PER-2T Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-2T ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

ZoneHVAC: EquipmentList,
  PER-3T Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-3T ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

ZoneHVAC: EquipmentList,
  PER-4T Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-4T ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

ZoneHVAC: EquipmentList,
  COR-1T Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  COR-1T ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

ZoneHVAC: EquipmentList,
  PER-1I Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-1I ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

ZoneHVAC: EquipmentList,
  PER-2I Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-2I ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

ZoneHVAC: EquipmentList,
  PER-3I Equipment,        !- Name
  ZoneHVAC: AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-3I ATU,              !- Zone Equipment 1 Name
  1,                       !- Zone Equipment 1 Cooling Priority
  1;                       !- Zone Equipment 1 Heating Priority

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ZoneHVAC:EquipmentList,
  PER-4I Equipment,           !- Name
  ZoneHVAC:AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-4I ATU,                 !- Zone Equipment 1 Name
  1,                           !- Zone Equipment 1 Cooling Priority
  1;                            !- Zone Equipment 1 Heating Priority

ZoneHVAC:EquipmentList,
  COR-1I Equipment,          !- Name
  ZoneHVAC:AirDistributionUnit, !- Zone Equipment 1 Object Type
  COR-1I ATU,                !- Zone Equipment 1 Name
  1,                           !- Zone Equipment 1 Cooling Priority
  1;                            !- Zone Equipment 1 Heating Priority

ZoneHVAC:EquipmentList,
  PER-1F Equipment,          !- Name
  ZoneHVAC:AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-1F ATU,                !- Zone Equipment 1 Name
  1,                           !- Zone Equipment 1 Cooling Priority
  1;                            !- Zone Equipment 1 Heating Priority

ZoneHVAC:EquipmentList,
  PER-2F Equipment,          !- Name
  ZoneHVAC:AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-2F ATU,                !- Zone Equipment 1 Name
  1,                           !- Zone Equipment 1 Cooling Priority
  1;                            !- Zone Equipment 1 Heating Priority

ZoneHVAC:EquipmentList,
  PER-3F Equipment,          !- Name
  ZoneHVAC:AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-3F ATU,                !- Zone Equipment 1 Name
  1,                           !- Zone Equipment 1 Cooling Priority
  1;                            !- Zone Equipment 1 Heating Priority

ZoneHVAC:EquipmentList,
  PER-4F Equipment,          !- Name
  ZoneHVAC:AirDistributionUnit, !- Zone Equipment 1 Object Type
  PER-4F ATU,                !- Zone Equipment 1 Name
  1,                           !- Zone Equipment 1 Cooling Priority
  1;                            !- Zone Equipment 1 Heating Priority

ZoneHVAC:EquipmentList,
  COR-1F Equipment,          !- Name
  ZoneHVAC:AirDistributionUnit, !- Zone Equipment 1 Object Type
  COR-1F ATU,                !- Zone Equipment 1 Name
  1,                           !- Zone Equipment 1 Cooling Priority
  1;                            !- Zone Equipment 1 Heating Priority

ZoneHVAC:AirDistributionUnit,
  PER-1T ATU,                 !- Name
  PER-1T Supply Inlet,        !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-1T VAV Reheat,          !- Air Terminal Name
  0.1,                        !- Nominal Upstream Leakage Fraction
  0.1;                         !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-2T ATU,                 !- Name
  PER-2T Supply Inlet,        !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-2T VAV Reheat,          !- Air Terminal Name
  0.1,                        !- Nominal Upstream Leakage Fraction
  0.1;                         !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-3T ATU,                 !- Name
  PER-3T Supply Inlet,        !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-3T VAV Reheat,          !- Air Terminal Name

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0.1,                !- Nominal Upstream Leakage Fraction
0.1;                !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-4T ATU,                !- Name
  PER-4T Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-4T VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  COR-1T ATU,                !- Name
  COR-1T Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  COR-1T VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-1I ATU,                !- Name
  PER-1I Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-1I VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-2I ATU,                !- Name
  PER-2I Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-2I VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-3I ATU,                !- Name
  PER-3I Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-3I VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-4I ATU,                !- Name
  PER-4I Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-4I VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  COR-1I ATU,                !- Name
  COR-1I Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  COR-1I VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-1F ATU,                !- Name
  PER-1F Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
  PER-1F VAV Reheat,        !- Air Terminal Name
  0.1,                      !- Nominal Upstream Leakage Fraction
  0.1;                      !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
  PER-2F ATU,                !- Name
  PER-2F Supply Inlet,      !- Air Distribution Unit Outlet Node Name
  AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type

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PER-2F VAV Reheat,          !- Air Terminal Name
0.1,                       !- Nominal Upstream Leakage Fraction
0.1;                       !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
PER-3F ATU,                !- Name
PER-3F Supply Inlet,      !- Air Distribution Unit Outlet Node Name
AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
PER-3F VAV Reheat,       !- Air Terminal Name
0.1,                     !- Nominal Upstream Leakage Fraction
0.1;                     !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
PER-4F ATU,                !- Name
PER-4F Supply Inlet,      !- Air Distribution Unit Outlet Node Name
AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
PER-4F VAV Reheat,       !- Air Terminal Name
0.1,                     !- Nominal Upstream Leakage Fraction
0.1;                     !- Constant Downstream Leakage Fraction

ZoneHVAC:AirDistributionUnit,
COR-1F ATU,                !- Name
COR-1F Supply Inlet,      !- Air Distribution Unit Outlet Node Name
AirTerminal:SingleDuct:VAV:Reheat, !- Air Terminal Object Type
COR-1F VAV Reheat,       !- Air Terminal Name
0.1,                     !- Nominal Upstream Leakage Fraction
0.1;                     !- Constant Downstream Leakage Fraction

AirTerminal:SingleDuct:VAV:Reheat,
PER-1T VAV Reheat,        !- Name
FAN-SCHED,                !- Availability Schedule Name
PER-1T Damper Outlet,     !- Damper Air Outlet Node Name
PER-1T Damper Inlet,     !- Air Inlet Node Name
1.00402,                  !- Maximum Air Flow Rate {m3/s}
Constant,                 !- Zone Minimum Air Flow Input Method
0.4,                     !- Zone Minimum Air Flow Fraction
,                          !- Minimum Air Flow Fraction Schedule Name
PER-1T Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water,      !- Reheat Coil Object Type
PER-1T Reheat Coil,      !- Reheat Coil Name
0.000109883,             !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                     !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-1T Supply Inlet,     !- Air Outlet Node Name
0.001,                   !- Convergence Tolerance
Normal;                   !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-2T VAV Reheat,        !- Name
FAN-SCHED,                !- Availability Schedule Name
PER-2T Damper Outlet,     !- Damper Air Outlet Node Name
PER-2T Damper Inlet,     !- Air Inlet Node Name
1.295,                    !- Maximum Air Flow Rate {m3/s}
Constant,                 !- Zone Minimum Air Flow Input Method
0.4,                     !- Zone Minimum Air Flow Fraction
,                          !- Minimum Air Flow Fraction Schedule Name
PER-2T Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water,      !- Reheat Coil Object Type
PER-2T Reheat Coil,      !- Reheat Coil Name
0.000141729,             !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                     !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-2T Supply Inlet,     !- Air Outlet Node Name
0.001,                   !- Convergence Tolerance
Normal;                   !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-3T VAV Reheat,        !- Name
FAN-SCHED,                !- Availability Schedule Name
PER-3T Damper Outlet,     !- Damper Air Outlet Node Name
PER-3T Damper Inlet,     !- Air Inlet Node Name
1.00983,                  !- Maximum Air Flow Rate {m3/s}
Constant,                 !- Zone Minimum Air Flow Input Method

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0.4,                !- Zone Minimum Air Flow Fraction
,                  !- Minimum Air Flow Fraction Schedule Name
PER-3T Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
PER-3T Reheat Coil,  !- Reheat Coil Name
0.000110519,        !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-3T Supply Inlet, !- Air Outlet Node Name
0.001,              !- Convergence Tolerance
Normal;             !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-4T VAV Reheat,  !- Name
FAN-SCHED,          !- Availability Schedule Name
PER-4T Damper Outlet, !- Damper Air Outlet Node Name
PER-4T Damper Inlet, !- Air Inlet Node Name
1.72447,            !- Maximum Air Flow Rate {m3/s}
Constant,           !- Zone Minimum Air Flow Input Method
0.4,                !- Zone Minimum Air Flow Fraction
,                  !- Minimum Air Flow Fraction Schedule Name
PER-4T Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
PER-4T Reheat Coil,  !- Reheat Coil Name
0.000188732,        !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-4T Supply Inlet, !- Air Outlet Node Name
0.001,              !- Convergence Tolerance
Normal;             !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
COR-1T VAV Reheat,  !- Name
FAN-SCHED,          !- Availability Schedule Name
COR-1T Damper Outlet, !- Damper Air Outlet Node Name
COR-1T Damper Inlet, !- Air Inlet Node Name
3.08779,            !- Maximum Air Flow Rate {m3/s}
Constant,           !- Zone Minimum Air Flow Input Method
0.4,                !- Zone Minimum Air Flow Fraction
,                  !- Minimum Air Flow Fraction Schedule Name
COR-1T Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
COR-1T Reheat Coil,  !- Reheat Coil Name
0.000337938,        !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                !- Minimum Hot Water or Steam Flow Rate {m3/s}
COR-1T Supply Inlet, !- Air Outlet Node Name
0.001,              !- Convergence Tolerance
Normal;             !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-1I VAV Reheat,  !- Name
FAN-SCHED,          !- Availability Schedule Name
PER-1I Damper Outlet, !- Damper Air Outlet Node Name
PER-1I Damper Inlet, !- Air Inlet Node Name
0.91192,            !- Maximum Air Flow Rate {m3/s}
Constant,           !- Zone Minimum Air Flow Input Method
0.4,                !- Zone Minimum Air Flow Fraction
,                  !- Minimum Air Flow Fraction Schedule Name
PER-1I Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
PER-1I Reheat Coil,  !- Reheat Coil Name
0.0000998038,       !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-1I Supply Inlet, !- Air Outlet Node Name
0.001,              !- Convergence Tolerance
Normal;             !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-2I VAV Reheat,  !- Name
FAN-SCHED,          !- Availability Schedule Name
PER-2I Damper Outlet, !- Damper Air Outlet Node Name
PER-2I Damper Inlet, !- Air Inlet Node Name
1.32963,            !- Maximum Air Flow Rate {m3/s}

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Constant,                !- Zone Minimum Air Flow Input Method
0.4,                    !- Zone Minimum Air Flow Fraction
,                        !- Minimum Air Flow Fraction Schedule Name
PER-2I Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water,     !- Reheat Coil Object Type
PER-2I Reheat Coil,     !- Reheat Coil Name
0.000145519,           !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                    !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-2I Supply Inlet,    !- Air Outlet Node Name
0.001,                  !- Convergence Tolerance
Normal;                 !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-3I VAV Reheat,      !- Name
FAN-SCHED,              !- Availability Schedule Name
PER-3I Damper Outlet,   !- Damper Air Outlet Node Name
PER-3I Damper Inlet,    !- Air Inlet Node Name
0.91642,                !- Maximum Air Flow Rate {m3/s}
Constant,               !- Zone Minimum Air Flow Input Method
0.4,                    !- Zone Minimum Air Flow Fraction
,                        !- Minimum Air Flow Fraction Schedule Name
PER-3I Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water,     !- Reheat Coil Object Type
PER-3I Reheat Coil,     !- Reheat Coil Name
0.000100296,           !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                    !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-3I Supply Inlet,    !- Air Outlet Node Name
0.001,                  !- Convergence Tolerance
Normal;                 !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-4I VAV Reheat,      !- Name
FAN-SCHED,              !- Availability Schedule Name
PER-4I Damper Outlet,   !- Damper Air Outlet Node Name
PER-4I Damper Inlet,    !- Air Inlet Node Name
1.70296,                !- Maximum Air Flow Rate {m3/s}
Constant,               !- Zone Minimum Air Flow Input Method
0.4,                    !- Zone Minimum Air Flow Fraction
,                        !- Minimum Air Flow Fraction Schedule Name
PER-4I Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water,     !- Reheat Coil Object Type
PER-4I Reheat Coil,     !- Reheat Coil Name
0.000186378,           !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                    !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-4I Supply Inlet,    !- Air Outlet Node Name
0.001,                  !- Convergence Tolerance
Normal;                 !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
COR-1I VAV Reheat,      !- Name
FAN-SCHED,              !- Availability Schedule Name
COR-1I Damper Outlet,   !- Damper Air Outlet Node Name
COR-1I Damper Inlet,    !- Air Inlet Node Name
2.59897,                !- Maximum Air Flow Rate {m3/s}
Constant,               !- Zone Minimum Air Flow Input Method
0.4,                    !- Zone Minimum Air Flow Fraction
,                        !- Minimum Air Flow Fraction Schedule Name
COR-1I Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water,     !- Reheat Coil Object Type
COR-1I Reheat Coil,     !- Reheat Coil Name
0.000284439,           !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                    !- Minimum Hot Water or Steam Flow Rate {m3/s}
COR-1I Supply Inlet,    !- Air Outlet Node Name
0.001,                  !- Convergence Tolerance
Normal;                 !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-1F VAV Reheat,      !- Name
FAN-SCHED,              !- Availability Schedule Name
PER-1F Damper Outlet,   !- Damper Air Outlet Node Name
PER-1F Damper Inlet,    !- Air Inlet Node Name

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0.90058,           !- Maximum Air Flow Rate {m3/s}
Constant,          !- Zone Minimum Air Flow Input Method
0.4,              !- Zone Minimum Air Flow Fraction
,                 !- Minimum Air Flow Fraction Schedule Name
PER-1F Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
PER-1F Reheat Coil, !- Reheat Coil Name
0.000098562,      !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,              !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-1F Supply Inlet, !- Air Outlet Node Name
0.001,            !- Convergence Tolerance
Normal;           !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-2F VAV Reheat, !- Name
FAN-SCHED,         !- Availability Schedule Name
PER-2F Damper Outlet, !- Damper Air Outlet Node Name
PER-2F Damper Inlet, !- Air Inlet Node Name
1.39579,          !- Maximum Air Flow Rate {m3/s}
Constant,          !- Zone Minimum Air Flow Input Method
0.4,              !- Zone Minimum Air Flow Fraction
,                 !- Minimum Air Flow Fraction Schedule Name
PER-2F Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
PER-2F Reheat Coil, !- Reheat Coil Name
0.00015276,       !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,              !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-2F Supply Inlet, !- Air Outlet Node Name
0.001,            !- Convergence Tolerance
Normal;           !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-3F VAV Reheat, !- Name
FAN-SCHED,         !- Availability Schedule Name
PER-3F Damper Outlet, !- Damper Air Outlet Node Name
PER-3F Damper Inlet, !- Air Inlet Node Name
0.91028,          !- Maximum Air Flow Rate {m3/s}
Constant,          !- Zone Minimum Air Flow Input Method
0.4,              !- Zone Minimum Air Flow Fraction
,                 !- Minimum Air Flow Fraction Schedule Name
PER-3F Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
PER-3F Reheat Coil, !- Reheat Coil Name
0.0000996239,     !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,              !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-3F Supply Inlet, !- Air Outlet Node Name
0.001,            !- Convergence Tolerance
Normal;           !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
PER-4F VAV Reheat, !- Name
FAN-SCHED,         !- Availability Schedule Name
PER-4F Damper Outlet, !- Damper Air Outlet Node Name
PER-4F Damper Inlet, !- Air Inlet Node Name
1.79735,          !- Maximum Air Flow Rate {m3/s}
Constant,          !- Zone Minimum Air Flow Input Method
0.4,              !- Zone Minimum Air Flow Fraction
,                 !- Minimum Air Flow Fraction Schedule Name
PER-4F Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water, !- Reheat Coil Object Type
PER-4F Reheat Coil, !- Reheat Coil Name
0.000196708,      !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,              !- Minimum Hot Water or Steam Flow Rate {m3/s}
PER-4F Supply Inlet, !- Air Outlet Node Name
0.001,            !- Convergence Tolerance
Normal;           !- Damper Heating Action

AirTerminal:SingleDuct:VAV:Reheat,
COR-1F VAV Reheat, !- Name
FAN-SCHED,         !- Availability Schedule Name
COR-1F Damper Outlet, !- Damper Air Outlet Node Name

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COR-1F Damper Inlet,          !- Air Inlet Node Name
2.58111,                    !- Maximum Air Flow Rate {m3/s}
Constant,                   !- Zone Minimum Air Flow Input Method
0.4,                        !- Zone Minimum Air Flow Fraction
,                             !- Minimum Air Flow Fraction Schedule Name
COR-1F Reheat Coil HW Inlet, !- Hot Water or Steam Inlet Node Name
Coil:Heating:Water,        !- Reheat Coil Object Type
COR-1F Reheat Coil,        !- Reheat Coil Name
0.000282485,              !- Maximum Hot Water or Steam Flow Rate {m3/s}
0.0,                       !- Minimum Hot Water or Steam Flow Rate {m3/s}
COR-1F Supply Inlet,      !- Air Outlet Node Name
0.001,                    !- Convergence Tolerance
Normal;                   !- Damper Heating Action

Coil:Heating:Water,
PER-1T Reheat Coil,          !- Name
FAN-SCHED,                 !- Availability Schedule Name
165.05486,                 !- U-Factor Times Area Value {W/K}
0.000109883,              !- Maximum Water Flow Rate {m3/s}
PER-1T Reheat Coil HW Inlet, !- Water Inlet Node Name
PER-1T Reheat Coil HW Outlet, !- Water Outlet Node Name
PER-1T Damper Outlet,      !- Air Inlet Node Name
PER-1T Supply Inlet,       !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate, !- Performance Input Method
7655.33141,               !- Nominal Capacity {W}
82.222,                   !- Design Inlet Water Temperature (180F) {C}
11.667,                   !- Design Inlet Air Temperature (53F) {C}
65.556,                   !- Design Outlet Water Temperature (150F) {C}
32.222;                   !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
PER-2T Reheat Coil,          !- Name
FAN-SCHED,                 !- Availability Schedule Name
212.89084,                 !- U-Factor Times Area Value {W/K}
0.000141729,              !- Maximum Water Flow Rate {m3/s}
PER-2T Reheat Coil HW Inlet, !- Water Inlet Node Name
PER-2T Reheat Coil HW Outlet, !- Water Outlet Node Name
PER-2T Damper Outlet,      !- Air Inlet Node Name
PER-2T Supply Inlet,       !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate, !- Performance Input Method
9873.9892,                !- Nominal Capacity {W}
82.222,                   !- Design Inlet Water Temperature (180F) {C}
11.667,                   !- Design Inlet Air Temperature (53F) {C}
65.556,                   !- Design Outlet Water Temperature (150F) {C}
32.222;                   !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
PER-3T Reheat Coil,          !- Name
FAN-SCHED,                 !- Availability Schedule Name
166.00977,                 !- U-Factor Times Area Value {W/K}
0.000110519,              !- Maximum Water Flow Rate {m3/s}
PER-3T Reheat Coil HW Inlet, !- Water Inlet Node Name
PER-3T Reheat Coil HW Outlet, !- Water Outlet Node Name
PER-3T Damper Outlet,      !- Air Inlet Node Name
PER-3T Supply Inlet,       !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate, !- Performance Input Method
7699.62069,               !- Nominal Capacity {W}
82.222,                   !- Design Inlet Water Temperature (180F) {C}
11.667,                   !- Design Inlet Air Temperature (53F) {C}
65.556,                   !- Design Outlet Water Temperature (150F) {C}
32.222;                   !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
PER-4T Reheat Coil,          !- Name
FAN-SCHED,                 !- Availability Schedule Name
283.49344,                 !- U-Factor Times Area Value {W/K}
0.000188732,              !- Maximum Water Flow Rate {m3/s}
PER-4T Reheat Coil HW Inlet, !- Water Inlet Node Name
PER-4T Reheat Coil HW Outlet, !- Water Outlet Node Name
PER-4T Damper Outlet,      !- Air Inlet Node Name
PER-4T Supply Inlet,       !- Air Outlet Node Name

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UFactorTimesAreaAndDesignWaterFlowRate,  !- Performance Input Method
13148.57507,                               !- Nominal Capacity {W}
82.222,                                     !- Design Inlet Water Temperature (180F) {C}
11.667,                                     !- Design Inlet Air Temperature (53F) {C}
65.556,                                     !- Design Outlet Water Temperature (150F) {C}
32.222;                                     !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
COR-1T Reheat Coil,                        !- Name
FAN-SCHED,                                  !- Availability Schedule Name
507.61557,                                  !- U-Factor Times Area Value {W/K}
0.000337938,                                !- Maximum Water Flow Rate {m3/s}
COR-1T Reheat Coil HW Inlet,                !- Water Inlet Node Name
COR-1T Reheat Coil HW Outlet,               !- Water Outlet Node Name
COR-1T Damper Outlet,                       !- Air Inlet Node Name
COR-1T Supply Inlet,                       !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate,    !- Performance Input Method
23543.47739,                                !- Nominal Capacity {W}
82.222,                                     !- Design Inlet Water Temperature (180F) {C}
11.667,                                     !- Design Inlet Air Temperature (53F) {C}
65.556,                                     !- Design Outlet Water Temperature (150F) {C}
32.222;                                     !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
PER-1I Reheat Coil,                        !- Name
FAN-SCHED,                                  !- Availability Schedule Name
149.91506,                                  !- U-Factor Times Area Value {W/K}
0.0000998038,                              !- Maximum Water Flow Rate {m3/s}
PER-1I Reheat Coil HW Inlet,                !- Water Inlet Node Name
PER-1I Reheat Coil HW Outlet,               !- Water Outlet Node Name
PER-1I Damper Outlet,                       !- Air Inlet Node Name
PER-1I Supply Inlet,                       !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate,    !- Performance Input Method
6953.1394,                                  !- Nominal Capacity {W}
82.222,                                     !- Design Inlet Water Temperature (180F) {C}
11.667,                                     !- Design Inlet Air Temperature (53F) {C}
65.556,                                     !- Design Outlet Water Temperature (150F) {C}
32.222;                                     !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
PER-2I Reheat Coil,                        !- Name
FAN-SCHED,                                  !- Availability Schedule Name
218.5841,                                   !- U-Factor Times Area Value {W/K}
0.000145519,                               !- Maximum Water Flow Rate {m3/s}
PER-2I Reheat Coil HW Inlet,                !- Water Inlet Node Name
PER-2I Reheat Coil HW Outlet,               !- Water Outlet Node Name
PER-2I Damper Outlet,                       !- Air Inlet Node Name
PER-2I Supply Inlet,                       !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate,    !- Performance Input Method
10138.04548,                                !- Nominal Capacity {W}
82.222,                                     !- Design Inlet Water Temperature (180F) {C}
11.667,                                     !- Design Inlet Air Temperature (53F) {C}
65.556,                                     !- Design Outlet Water Temperature (150F) {C}
32.222;                                     !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
PER-3I Reheat Coil,                        !- Name
FAN-SCHED,                                  !- Availability Schedule Name
150.65398,                                  !- U-Factor Times Area Value {W/K}
0.000100296,                              !- Maximum Water Flow Rate {m3/s}
PER-3I Reheat Coil HW Inlet,                !- Water Inlet Node Name
PER-3I Reheat Coil HW Outlet,               !- Water Outlet Node Name
PER-3I Damper Outlet,                       !- Air Inlet Node Name
PER-3I Supply Inlet,                       !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate,    !- Performance Input Method
6987.41073,                                  !- Nominal Capacity {W}
82.222,                                     !- Design Inlet Water Temperature (180F) {C}
11.667,                                     !- Design Inlet Air Temperature (53F) {C}
65.556,                                     !- Design Outlet Water Temperature (150F) {C}
32.222;                                     !- Design Outlet Air Temperature (90F) {C}

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Coil:Heating:Water,
  PER-4I Reheat Coil,
  FAN-SCHED,
  279.95764,
  0.000186378,
  PER-4I Reheat Coil HW Inlet,
  PER-4I Reheat Coil HW Outlet,
  PER-4I Damper Outlet,
  PER-4I Supply Inlet,
  UFactorTimesAreaAndDesignWaterFlowRate,
  12984.58301,
  82.222,
  11.667,
  65.556,
  32.222;

Coil:Heating:Water,
  COR-1I Reheat Coil,
  FAN-SCHED,
  427.25546,
  0.000284439,
  COR-1I Reheat Coil HW Inlet,
  COR-1I Reheat Coil HW Outlet,
  COR-1I Damper Outlet,
  COR-1I Supply Inlet,
  UFactorTimesAreaAndDesignWaterFlowRate,
  19816.33326,
  82.222,
  11.667,
  65.556,
  32.222;

Coil:Heating:Water,
  PER-1F Reheat Coil,
  FAN-SCHED,
  148.04967,
  0.000098562,
  PER-1F Reheat Coil HW Inlet,
  PER-1F Reheat Coil HW Outlet,
  PER-1F Damper Outlet,
  PER-1F Supply Inlet,
  UFactorTimesAreaAndDesignWaterFlowRate,
  6866.62176,
  82.222,
  11.667,
  65.556,
  32.222;

Coil:Heating:Water,
  PER-2F Reheat Coil,
  FAN-SCHED,
  229.46094,
  0.00015276,
  PER-2F Reheat Coil HW Inlet,
  PER-2F Reheat Coil HW Outlet,
  PER-2F Damper Outlet,
  PER-2F Supply Inlet,
  UFactorTimesAreaAndDesignWaterFlowRate,
  10642.51911,
  82.222,
  11.667,
  65.556,
  32.222;

Coil:Heating:Water,
  PER-3F Reheat Coil,
  FAN-SCHED,
  149.64484,
  0.0000996239,
  PER-3F Reheat Coil HW Inlet,
  PER-3F Reheat Coil HW Outlet,

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!- Name
!- Availability Schedule Name
!- U-Factor Times Area Value {W/K}
!- Maximum Water Flow Rate {m3/s}
!- Water Inlet Node Name
!- Water Outlet Node Name
!- Air Inlet Node Name
!- Air Outlet Node Name
!- Performance Input Method
!- Nominal Capacity {W}
!- Design Inlet Water Temperature (180F) {C}
!- Design Inlet Air Temperature (53F) {C}
!- Design Outlet Water Temperature (150F) {C}
!- Design Outlet Air Temperature (90F) {C}

!- Name
!- Availability Schedule Name
!- U-Factor Times Area Value {W/K}
!- Maximum Water Flow Rate {m3/s}
!- Water Inlet Node Name
!- Water Outlet Node Name
!- Air Inlet Node Name
!- Air Outlet Node Name
!- Performance Input Method
!- Nominal Capacity {W}
!- Design Inlet Water Temperature (180F) {C}
!- Design Inlet Air Temperature (53F) {C}
!- Design Outlet Water Temperature (150F) {C}
!- Design Outlet Air Temperature (90F) {C}

!- Name
!- Availability Schedule Name
!- U-Factor Times Area Value {W/K}
!- Maximum Water Flow Rate {m3/s}
!- Water Inlet Node Name
!- Water Outlet Node Name
!- Air Inlet Node Name
!- Air Outlet Node Name
!- Performance Input Method
!- Nominal Capacity {W}
!- Design Inlet Water Temperature (180F) {C}
!- Design Inlet Air Temperature (53F) {C}
!- Design Outlet Water Temperature (150F) {C}
!- Design Outlet Air Temperature (90F) {C}

!- Name
!- Availability Schedule Name
!- U-Factor Times Area Value {W/K}
!- Maximum Water Flow Rate {m3/s}
!- Water Inlet Node Name
!- Water Outlet Node Name
!- Air Inlet Node Name
!- Air Outlet Node Name
!- Performance Input Method
!- Nominal Capacity {W}
!- Design Inlet Water Temperature (180F) {C}
!- Design Inlet Air Temperature (53F) {C}
!- Design Outlet Water Temperature (150F) {C}
!- Design Outlet Air Temperature (90F) {C}

!- Name
!- Availability Schedule Name
!- U-Factor Times Area Value {W/K}
!- Maximum Water Flow Rate {m3/s}
!- Water Inlet Node Name
!- Water Outlet Node Name

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PER-3F Damper Outlet,           !- Air Inlet Node Name
PER-3F Supply Inlet,           !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate, !- Performance Input Method
6940.60661,                    !- Nominal Capacity {W}
82.222,                        !- Design Inlet Water Temperature (180F) {C}
11.667,                        !- Design Inlet Air Temperature (53F) {C}
65.556,                        !- Design Outlet Water Temperature (150F) {C}
32.222;                         !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
PER-4F Reheat Coil,           !- Name
FAN-SCHED,                    !- Availability Schedule Name
295.4752,                     !- U-Factor Times Area Value {W/K}
0.000196708,                  !- Maximum Water Flow Rate {m3/s}
PER-4F Reheat Coil HW Inlet,  !- Water Inlet Node Name
PER-4F Reheat Coil HW Outlet, !- Water Outlet Node Name
PER-4F Damper Outlet,         !- Air Inlet Node Name
PER-4F Supply Inlet,         !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate, !- Performance Input Method
13704.29517,                  !- Nominal Capacity {W}
82.222,                        !- Design Inlet Water Temperature (180F) {C}
11.667,                        !- Design Inlet Air Temperature (53F) {C}
65.556,                        !- Design Outlet Water Temperature (150F) {C}
32.222;                         !- Design Outlet Air Temperature (90F) {C}

Coil:Heating:Water,
COR-1F Reheat Coil,           !- Name
FAN-SCHED,                    !- Availability Schedule Name
424.32002,                    !- U-Factor Times Area Value {W/K}
0.000282485,                  !- Maximum Water Flow Rate {m3/s}
COR-1F Reheat Coil HW Inlet,  !- Water Inlet Node Name
COR-1F Reheat Coil HW Outlet, !- Water Outlet Node Name
COR-1F Damper Outlet,         !- Air Inlet Node Name
COR-1F Supply Inlet,         !- Air Outlet Node Name
UFactorTimesAreaAndDesignWaterFlowRate, !- Performance Input Method
19680.18599,                  !- Nominal Capacity {W}
82.222,                        !- Design Inlet Water Temperature (180F) {C}
11.667,                        !- Design Inlet Air Temperature (53F) {C}
65.556,                        !- Design Outlet Water Temperature (150F) {C}
32.222;                         !- Design Outlet Air Temperature (90F) {C}

AirLoopHVAC:ReturnPath,
SYS10 Return Path,           !- Name
SYS10 Return Air Outlet,     !- Return Air Path Outlet Node Name
AirLoopHVAC:ReturnPlenum,   !- Component 1 Object Type
Return-Plenum-10;           !- Component 1 Name

AirLoopHVAC:ReturnPath,
SYS2 Return Path,           !- Name
SYS2 Return Air Outlet,     !- Return Air Path Outlet Node Name
AirLoopHVAC:ReturnPlenum,   !- Component 1 Object Type
Return-Plenum-2;           !- Component 1 Name

AirLoopHVAC:ReturnPath,
SYS1 Return Path,           !- Name
SYS1 Return Air Outlet,     !- Return Air Path Outlet Node Name
AirLoopHVAC:ReturnPlenum,   !- Component 1 Object Type
Return-Plenum-1;           !- Component 1 Name

AirLoopHVAC:ReturnPlenum,
Return-Plenum-10,          !- Name
PLE-10,                    !- Zone Name
PLE-10 Zone Air Node,      !- Zone Node Name
SYS10 Return Air Outlet,   !- Outlet Node Name
COR-1T Return Outlet,     !- Inlet 1 Node Name
PER-1T Return Outlet,     !- Inlet 2 Node Name
PER-2T Return Outlet,     !- Inlet 3 Node Name
PER-3T Return Outlet,     !- Inlet 4 Node Name
PER-4T Return Outlet;     !- Inlet 5 Node Name

AirLoopHVAC:ReturnPlenum,

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Return-Plenum-2,      !- Name
PLE-I,                !- Zone Name
PLE-I Zone Air Node,  !- Zone Node Name
SYS2 Return Air Outlet, !- Outlet Node Name
COR-1I Return Outlet, !- Inlet 1 Node Name
PER-1I Return Outlet, !- Inlet 2 Node Name
PER-2I Return Outlet, !- Inlet 3 Node Name
PER-3I Return Outlet, !- Inlet 4 Node Name
PER-4I Return Outlet; !- Inlet 5 Node Name

AirLoopHVAC:ReturnPlenum,
Return-Plenum-1,      !- Name
PLE-1,                !- Zone Name
PLE-1 Zone Air Node,  !- Zone Node Name
SYS1 Return Air Outlet, !- Outlet Node Name
COR-1F Return Outlet, !- Inlet 1 Node Name
PER-1F Return Outlet, !- Inlet 2 Node Name
PER-2F Return Outlet, !- Inlet 3 Node Name
PER-3F Return Outlet, !- Inlet 4 Node Name
PER-4F Return Outlet; !- Inlet 5 Node Name

AirLoopHVAC:SupplyPath,
SYS10 Supply Path,    !- Name
SYS10 Zone Equip Inlet, !- Supply Air Path Inlet Node Name
AirLoopHVAC:ZoneSplitter, !- Component 1 Object Type
SYS10 Zone Splitter;  !- Component 1 Name

AirLoopHVAC:SupplyPath,
SYS2 Supply Path,     !- Name
SYS2 Zone Equip Inlet, !- Supply Air Path Inlet Node Name
AirLoopHVAC:ZoneSplitter, !- Component 1 Object Type
SYS2 Zone Splitter;   !- Component 1 Name

AirLoopHVAC:SupplyPath,
SYS1 Supply Path,     !- Name
SYS1 Zone Equip Inlet, !- Supply Air Path Inlet Node Name
AirLoopHVAC:ZoneSplitter, !- Component 1 Object Type
SYS1 Zone Splitter;   !- Component 1 Name

AirLoopHVAC:ZoneSplitter,
SYS10 Zone Splitter,  !- Name
SYS10 Zone Equip Inlet, !- Inlet Node Name
COR-1T Damper Inlet,  !- Outlet 1 Node Name
PER-1T Damper Inlet,  !- Outlet 2 Node Name
PER-2T Damper Inlet,  !- Outlet 3 Node Name
PER-3T Damper Inlet,  !- Outlet 4 Node Name
PER-4T Damper Inlet;  !- Outlet 5 Node Name

AirLoopHVAC:ZoneSplitter,
SYS2 Zone Splitter,   !- Name
SYS2 Zone Equip Inlet, !- Inlet Node Name
COR-1I Damper Inlet,  !- Outlet 1 Node Name
PER-1I Damper Inlet,  !- Outlet 2 Node Name
PER-2I Damper Inlet,  !- Outlet 3 Node Name
PER-3I Damper Inlet,  !- Outlet 4 Node Name
PER-4I Damper Inlet;  !- Outlet 5 Node Name

AirLoopHVAC:ZoneSplitter,
SYS1 Zone Splitter,   !- Name
SYS1 Zone Equip Inlet, !- Inlet Node Name
COR-1F Damper Inlet,  !- Outlet 1 Node Name
PER-1F Damper Inlet,  !- Outlet 2 Node Name
PER-2F Damper Inlet,  !- Outlet 3 Node Name
PER-3F Damper Inlet,  !- Outlet 4 Node Name
PER-4F Damper Inlet;  !- Outlet 5 Node Name

AirLoopHVAC,
SYS10,                !- Name
SYS10 Controllers,    !- Controller List Name
SYS10 Availability Managers, !- Availability Manager List Name
7.11526,              !- Design Supply Air Flow Rate {m3/s}

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SYS10 Branches,          !- Branch List Name
,                        !- Connector List Name
SYS10 Air Loop Inlet,   !- Supply Side Inlet Node Name
SYS10 Return Air Outlet, !- Demand Side Outlet Node Name
SYS10 Zone Equip Inlet, !- Demand Side Inlet Node Names
SYS10 Fan Outlet;       !- Supply Side Outlet Node Names

AirLoopHVAC,
  SYS2,                  !- Name
  SYS2 Controllers,     !- Controller List Name
  SYS2 Availability Managers, !- Availability Manager List Name
  6.25575,               !- Design Supply Air Flow Rate {m3/s}
  SYS2 Branches,       !- Branch List Name
  ,                      !- Connector List Name
  SYS2 Air Loop Inlet,  !- Supply Side Inlet Node Name
  SYS2 Return Air Outlet, !- Demand Side Outlet Node Name
  SYS2 Zone Equip Inlet, !- Demand Side Inlet Node Names
  SYS2 Fan Outlet;     !- Supply Side Outlet Node Names

AirLoopHVAC,
  SYS1,                  !- Name
  SYS1 Controllers,     !- Controller List Name
  SYS1 Availability Managers, !- Availability Manager List Name
  6.18478,               !- Design Supply Air Flow Rate {m3/s}
  SYS1 Branches,       !- Branch List Name
  ,                      !- Connector List Name
  SYS1 Air Loop Inlet,  !- Supply Side Inlet Node Name
  SYS1 Return Air Outlet, !- Demand Side Outlet Node Name
  SYS1 Zone Equip Inlet, !- Demand Side Inlet Node Names
  SYS1 Fan Outlet;     !- Supply Side Outlet Node Names

AirLoopHVAC:ControllerList,
  SYS10 Controllers,    !- Name
  Controller:WaterCoil, !- Controller 1 Object Type
  SYS10 Cooling Coil Controller; !- Controller 1 Name

AirLoopHVAC:ControllerList,
  SYS2 Controllers,    !- Name
  Controller:WaterCoil, !- Controller 1 Object Type
  SYS2 Cooling Coil Controller; !- Controller 1 Name

AirLoopHVAC:ControllerList,
  SYS1 Controllers,    !- Name
  Controller:WaterCoil, !- Controller 1 Object Type
  SYS1 Cooling Coil Controller; !- Controller 1 Name

AvailabilityManagerAssignmentList,
  SYS10 Availability Managers, !- Name
  AvailabilityManager:Scheduled, !- Availability Manager 1 Object Type
  SYS10 Availability 1;       !- Availability Manager 1 Name

AvailabilityManagerAssignmentList,
  SYS2 Availability Managers, !- Name
  AvailabilityManager:Scheduled, !- Availability Manager 1 Object Type
  SYS2 Availability 1;       !- Availability Manager 1 Name

AvailabilityManagerAssignmentList,
  SYS1 Availability Managers, !- Name
  AvailabilityManager:Scheduled, !- Availability Manager 1 Object Type
  SYS1 Availability 1;       !- Availability Manager 1 Name

AvailabilityManager:Scheduled,
  SYS10 Availability 1, !- Name
  FAN-SCHED;          !- Schedule Name

AvailabilityManager:Scheduled,
  SYS2 Availability 1, !- Name
  FAN-SCHED;          !- Schedule Name

AvailabilityManager:Scheduled,
  SYS1 Availability 1, !- Name

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FAN-SCHED;                !- Schedule Name

BranchList,
  SYS10 Branches,        !- Name
  SYS10 Main Branch;     !- Branch 1 Name

BranchList,
  SYS2 Branches,        !- Name
  SYS2 Main Branch;     !- Branch 1 Name

BranchList,
  SYS1 Branches,        !- Name
  SYS1 Main Branch;     !- Branch 1 Name

! Use return fan (Comp1) for each main branch
! No main heating coil

Branch,
  SYS10 Main Branch,      !- Name
  7.11526,                !- Maximum Flow Rate {m3/s}
  Fan:VariableVolume,    !- Component 1 Object Type
  SYS10 Return Fan,      !- Component 1 Name
  SYS10 Air Loop Inlet,  !- Component 1 Inlet Node Name
  SYS10 Return Fan Outlet, !- Component 1 Outlet Node Name
  Passive,               !- Component 1 Branch Control Type
  AirLoopHVAC:OutdoorAirSystem, !- Component 2 Object Type
  SYS10 OA System,      !- Component 2 Name
  SYS10 Return Fan Outlet, !- Component 2 Inlet Node Name
  SYS10 Mixed Air Outlet, !- Component 2 Outlet Node Name
  Passive,               !- Component 2 Branch Control Type
  Coil:Cooling:Water,    !- Component 3 Object Type
  SYS10 Cooling Coil,    !- Component 3 Name
  SYS10 Mixed Air Outlet, !- Component 3 Inlet Node Name
  SYS10 Cooling Coil Outlet, !- Component 3 Outlet Node Name
  Passive,               !- Component 3 Branch Control Type
  Fan:VariableVolume,    !- Component 4 Object Type
  SYS10 Supply Fan,      !- Component 4 Name
  SYS10 Cooling Coil Outlet, !- Component 4 Inlet Node Name
  SYS10 Fan Outlet,      !- Component 4 Outlet Node Name
  Active;                !- Component 4 Branch Control Type

Branch,
  SYS2 Main Branch,      !- Name
  6.25575,                !- Maximum Flow Rate {m3/s}
  Fan:VariableVolume,    !- Component 1 Object Type
  SYS2 Return Fan,      !- Component 1 Name
  SYS2 Air Loop Inlet,  !- Component 1 Inlet Node Name
  SYS2 Return Fan Outlet, !- Component 1 Outlet Node Name
  Passive,               !- Component 1 Branch Control Type
  AirLoopHVAC:OutdoorAirSystem, !- Component 2 Object Type
  SYS2 OA System,      !- Component 2 Name
  SYS2 Return Fan Outlet, !- Component 2 Inlet Node Name
  SYS2 Mixed Air Outlet, !- Component 2 Outlet Node Name
  Passive,               !- Component 2 Branch Control Type
  Coil:Cooling:Water,    !- Component 3 Object Type
  SYS2 Cooling Coil,    !- Component 3 Name
  SYS2 Mixed Air Outlet, !- Component 3 Inlet Node Name
  SYS2 Cooling Coil Outlet, !- Component 3 Outlet Node Name
  Passive,               !- Component 3 Branch Control Type
  Fan:VariableVolume,    !- Component 4 Object Type
  SYS2 Supply Fan,      !- Component 4 Name
  SYS2 Cooling Coil Outlet, !- Component 4 Inlet Node Name
  SYS2 Fan Outlet,      !- Component 4 Outlet Node Name
  Active;                !- Component 4 Branch Control Type

Branch,
  SYS1 Main Branch,      !- Name
  6.18478,                !- Maximum Flow Rate {m3/s}
  Fan:VariableVolume,    !- Component 1 Object Type
  SYS1 Return Fan,      !- Component 1 Name
  SYS1 Air Loop Inlet,  !- Component 1 Inlet Node Name

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SYS1 Return Fan Outlet,      !- Component 1 Outlet Node Name
Passive,                    !- Component 1 Branch Control Type
AirLoopHVAC:OutdoorAirSystem, !- Component 2 Object Type
SYS1 OA System,             !- Component 2 Name
SYS1 Return Fan Outlet,     !- Component 2 Inlet Node Name
SYS1 Mixed Air Outlet,     !- Component 2 Outlet Node Name
Passive,                    !- Component 2 Branch Control Type
Coil:Cooling:Water,        !- Component 3 Object Type
SYS1 Cooling Coil,         !- Component 3 Name
SYS1 Mixed Air Outlet,     !- Component 3 Inlet Node Name
SYS1 Cooling Coil Outlet,  !- Component 3 Outlet Node Name
Passive,                    !- Component 3 Branch Control Type
Fan:VariableVolume,        !- Component 4 Object Type
SYS1 Supply Fan,           !- Component 4 Name
SYS1 Cooling Coil Outlet,  !- Component 4 Inlet Node Name
SYS1 Fan Outlet,           !- Component 4 Outlet Node Name
Active;                     !- Component 4 Branch Control Type

AirLoopHVAC:OutdoorAirSystem,
SYS10 OA System,           !- Name
SYS10 OA System Controllers, !- Controller List Name
SYS10 OA System Equipment, !- Outdoor Air Equipment List Name
SYS10 Availability Managers; !- Availability Manager List Name

AirLoopHVAC:OutdoorAirSystem,
SYS2 OA System,           !- Name
SYS2 OA System Controllers, !- Controller List Name
SYS2 OA System Equipment, !- Outdoor Air Equipment List Name
SYS2 Availability Managers; !- Availability Manager List Name

AirLoopHVAC:OutdoorAirSystem,
SYS1 OA System,           !- Name
SYS1 OA System Controllers, !- Controller List Name
SYS1 OA System Equipment, !- Outdoor Air Equipment List Name
SYS1 Availability Managers; !- Availability Manager List Name

AirLoopHVAC:ControllerList,
SYS10 OA System Controllers, !- Name
Controller:OutdoorAir,      !- Controller 1 Object Type
SYS10 OA Controller;        !- Controller 1 Name

AirLoopHVAC:ControllerList,
SYS2 OA System Controllers, !- Name
Controller:OutdoorAir,      !- Controller 1 Object Type
SYS2 OA Controller;         !- Controller 1 Name

AirLoopHVAC:ControllerList,
SYS1 OA System Controllers, !- Name
Controller:OutdoorAir,      !- Controller 1 Object Type
SYS1 OA Controller;         !- Controller 1 Name

AirLoopHVAC:OutdoorAirSystem:EquipmentList,
SYS10 OA System Equipment, !- Name
OutdoorAir:Mixer,          !- Component 1 Object Type
SYS10 OA Mixing Box;       !- Component 1 Name

AirLoopHVAC:OutdoorAirSystem:EquipmentList,
SYS2 OA System Equipment, !- Name
OutdoorAir:Mixer,          !- Component 1 Object Type
SYS2 OA Mixing Box;       !- Component 1 Name

AirLoopHVAC:OutdoorAirSystem:EquipmentList,
SYS1 OA System Equipment, !- Name
OutdoorAir:Mixer,          !- Component 1 Object Type
SYS1 OA Mixing Box;       !- Component 1 Name

OutdoorAir:Mixer,
SYS10 OA Mixing Box,       !- Name
SYS10 Mixed Air Outlet,   !- Mixed Air Node Name
SYS10 Outside Air Inlet, !- Outdoor Air Stream Node Name
SYS10 Relief Air Outlet, !- Relief Air Stream Node Name

```

```

SYS10 Return Fan Outlet; !- Return Air Stream Node Name

OutdoorAir:Mixer,
  SYS2 OA Mixing Box,      !- Name
  SYS2 Mixed Air Outlet,   !- Mixed Air Node Name
  SYS2 Outside Air Inlet,  !- Outdoor Air Stream Node Name
  SYS2 Relief Air Outlet,  !- Relief Air Stream Node Name
  SYS2 Return Fan Outlet;  !- Return Air Stream Node Name

OutdoorAir:Mixer,
  SYS1 OA Mixing Box,      !- Name
  SYS1 Mixed Air Outlet,   !- Mixed Air Node Name
  SYS1 Outside Air Inlet,  !- Outdoor Air Stream Node Name
  SYS1 Relief Air Outlet,  !- Relief Air Stream Node Name
  SYS1 Return Fan Outlet;  !- Return Air Stream Node Name

Coil:Cooling:Water,
  SYS10 Cooling Coil,      !- Name
  FAN-SCHED,               !- Availability Schedule Name
  0.00503356,              !- Design Water Flow Rate {m3/s}
  7.11526,                 !- Design Air Flow Rate {m3/s}
  6.667,                   !- Design Inlet Water Temperature {C}
  26.72184,                !- Design Inlet Air Temperature {C}
  11.667,                  !- Design Outlet Air Temperature {C}
  0.00839934,              !- Design Inlet Air Humidity Ratio {kg-H2O/kg-air}
  0.008,                   !- Design Outlet Air Humidity Ratio {kg-H2O/kg-air}
  SYS10 Cooling Coil Water Inlet Node, !- Water Inlet Node Name
  SYS10 Cooling Coil Water Outlet Node, !- Water Outlet Node Name
  SYS10 Mixed Air Outlet,   !- Air Inlet Node Name
  SYS10 Cooling Coil Outlet, !- Air Outlet Node Name
  SimpleAnalysis,          !- Type of Analysis
  CrossFlow;               !- Heat Exchanger Configuration

Coil:Cooling:Water,
  SYS2 Cooling Coil,      !- Name
  FAN-SCHED,               !- Availability Schedule Name
  0.00450484,              !- Design Water Flow Rate {m3/s}
  6.25575,                 !- Design Air Flow Rate {m3/s}
  6.667,                   !- Design Inlet Water Temperature {C}
  26.96755,                !- Design Inlet Air Temperature {C}
  11.667,                  !- Design Outlet Air Temperature {C}
  0.00841609,              !- Design Inlet Air Humidity Ratio {kg-H2O/kg-air}
  0.008,                   !- Design Outlet Air Humidity Ratio {kg-H2O/kg-air}
  SYS2 Cooling Coil Water Inlet Node, !- Water Inlet Node Name
  SYS2 Cooling Coil Water Outlet Node, !- Water Outlet Node Name
  SYS2 Mixed Air Outlet,   !- Air Inlet Node Name
  SYS2 Cooling Coil Outlet, !- Air Outlet Node Name
  SimpleAnalysis,          !- Type of Analysis
  CrossFlow;               !- Heat Exchanger Configuration

Coil:Cooling:Water,
  SYS1 Cooling Coil,      !- Name
  FAN-SCHED,               !- Availability Schedule Name
  0.00438031,              !- Design Water Flow Rate {m3/s}
  6.18478,                 !- Design Air Flow Rate {m3/s}
  6.667,                   !- Design Inlet Water Temperature {C}
  26.74489,                !- Design Inlet Air Temperature {C}
  11.667,                  !- Design Outlet Air Temperature {C}
  0.00839745,              !- Design Inlet Air Humidity Ratio {kg-H2O/kg-air}
  0.008,                   !- Design Outlet Air Humidity Ratio {kg-H2O/kg-air}
  SYS1 Cooling Coil Water Inlet Node, !- Water Inlet Node Name
  SYS1 Cooling Coil Water Outlet Node, !- Water Outlet Node Name
  SYS1 Mixed Air Outlet,   !- Air Inlet Node Name
  SYS1 Cooling Coil Outlet, !- Air Outlet Node Name
  SimpleAnalysis,          !- Type of Analysis
  CrossFlow;               !- Heat Exchanger Configuration

! Variable-speed supply fans
! Coeffs from Title 24
! PLF = C1 + C2xFF + C3xFF^2 + C4xFF^3 + C5xFF^4

```



```

Fan:VariableVolume,
  SYS10 Supply Fan,      !- Name
  FAN-SCHED,            !- Availability Schedule Name
  0.65,                 !- Fan Efficiency
  746.4,                !- Pressure Rise {Pa}
  7.11526,              !- Maximum Flow Rate {m3/s}
  1.06188,              !- Minimum Flow Rate {m3/s}
  0.9,                  !- Motor Efficiency
  1.,                    !- Motor In Airstream Fraction
  0.1021,               !- Fan Coefficient 1
  -0.1177,              !- Fan Coefficient 2
  0.2647,               !- Fan Coefficient 3
  0.7600,               !- Fan Coefficient 4
  0.,                    !- Fan Coefficient 5
  SYS10 Cooling Coil Outlet, !- Air Inlet Node Name
  SYS10 Fan Outlet;     !- Air Outlet Node Name

Fan:VariableVolume,
  SYS2 Supply Fan,      !- Name
  FAN-SCHED,            !- Availability Schedule Name
  0.65,                 !- Fan Efficiency
  746.4,                !- Pressure Rise {Pa}
  6.25575,              !- Maximum Flow Rate {m3/s}
  1.06188,              !- Minimum Flow Rate {m3/s}
  0.9,                  !- Motor Efficiency
  1.,                    !- Motor In Airstream Fraction
  0.1021,               !- Fan Coefficient 1
  -0.1177,              !- Fan Coefficient 2
  0.2647,               !- Fan Coefficient 3
  0.7600,               !- Fan Coefficient 4
  0.,                    !- Fan Coefficient 5
  SYS2 Cooling Coil Outlet, !- Air Inlet Node Name
  SYS2 Fan Outlet;     !- Air Outlet Node Name

Fan:VariableVolume,
  SYS1 Supply Fan,      !- Name
  FAN-SCHED,            !- Availability Schedule Name
  0.65,                 !- Fan Efficiency
  746.4,                !- Pressure Rise {Pa}
  6.18478,              !- Maximum Flow Rate {m3/s}
  1.06188,              !- Minimum Flow Rate {m3/s}
  0.9,                  !- Motor Efficiency
  1.,                    !- Motor In Airstream Fraction
  0.1021,               !- Fan Coefficient 1
  -0.1177,              !- Fan Coefficient 2
  0.2647,               !- Fan Coefficient 3
  0.7600,               !- Fan Coefficient 4
  0.,                    !- Fan Coefficient 5
  SYS1 Cooling Coil Outlet, !- Air Inlet Node Name
  SYS1 Fan Outlet;     !- Air Outlet Node Name

! Variable-speed return fans
! Coeffs from Title 24
! PLF = C1 + C2xFF + C3xFF^2 + C4xFF^3 + C5xFF^4

Fan:VariableVolume,
  SYS10 Return Fan,    !- Name
  FAN-SCHED,            !- Availability Schedule Name
  0.65,                 !- Fan Efficiency
  248.8,                !- Pressure Rise {Pa}
  7.11526,              !- Maximum Flow Rate {m3/s}
  1.06188,              !- Minimum Flow Rate {m3/s}
  0.88,                 !- Motor Efficiency
  1.0,                   !- Motor In Airstream Fraction
  0.1021,               !- Fan Coefficient 1
  -0.1177,              !- Fan Coefficient 2
  0.2647,               !- Fan Coefficient 3
  0.7600,               !- Fan Coefficient 4
  0.,                    !- Fan Coefficient 5
  SYS10 Air Loop Inlet, !- Air Inlet Node Name
  SYS10 Return Fan Outlet; !- Air Outlet Node Name

```

```

Fan:VariableVolume,
  SYS2 Return Fan,          !- Name
  FAN-SCHEM,               !- Availability Schedule Name
  0.65,                    !- Fan Efficiency
  248.8,                    !- Pressure Rise {Pa}
  6.25575,                 !- Maximum Flow Rate {m3/s}
  1.06188,                 !- Minimum Flow Rate {m3/s}
  0.88,                    !- Motor Efficiency
  1.0,                      !- Motor In Airstream Fraction
  0.1021,                  !- Fan Coefficient 1
  -0.1177,                 !- Fan Coefficient 2
  0.2647,                  !- Fan Coefficient 3
  0.7600,                  !- Fan Coefficient 4
  0.,                      !- Fan Coefficient 5
  SYS2 Air Loop Inlet,     !- Air Inlet Node Name
  SYS2 Return Fan Outlet;  !- Air Outlet Node Name

Fan:VariableVolume,
  SYS1 Return Fan,          !- Name
  FAN-SCHEM,               !- Availability Schedule Name
  0.65,                    !- Fan Efficiency
  248.8,                    !- Pressure Rise {Pa}
  6.18478,                 !- Maximum Flow Rate {m3/s}
  1.06188,                 !- Minimum Flow Rate {m3/s}
  0.88,                    !- Motor Efficiency
  1.0,                      !- Motor In Airstream Fraction
  0.1021,                  !- Fan Coefficient 1
  -0.1177,                 !- Fan Coefficient 2
  0.2647,                  !- Fan Coefficient 3
  0.7600,                  !- Fan Coefficient 4
  0.,                      !- Fan Coefficient 5
  SYS1 Air Loop Inlet,     !- Air Inlet Node Name
  SYS1 Return Fan Outlet;  !- Air Outlet Node Name

Controller:WaterCoil,
  SYS10 Cooling Coil Controller, !- Name
  Temperature,                !- Control Variable
  REVERSE,                    !- Action
  FLOW,                        !- Actuator Variable
  SYS10 Fan Outlet,           !- Sensor Node Name
  SYS10 Cooling Coil Water Inlet Node, !- Actuator Node Name
  0.002,                       !- Controller Convergence Tolerance {deltaC}
  0.00503356,                 !- Maximum Actuated Flow {m3/s}
  0.0;                          !- Minimum Actuated Flow {m3/s}

Controller:WaterCoil,
  SYS2 Cooling Coil Controller, !- Name
  Temperature,                !- Control Variable
  REVERSE,                    !- Action
  FLOW,                        !- Actuator Variable
  SYS2 Fan Outlet,           !- Sensor Node Name
  SYS2 Cooling Coil Water Inlet Node, !- Actuator Node Name
  0.002,                       !- Controller Convergence Tolerance {deltaC}
  0.00450484,                 !- Maximum Actuated Flow {m3/s}
  0.0;                          !- Minimum Actuated Flow {m3/s}

Controller:WaterCoil,
  SYS1 Cooling Coil Controller, !- Name
  Temperature,                !- Control Variable
  REVERSE,                    !- Action
  FLOW,                        !- Actuator Variable
  SYS1 Fan Outlet,           !- Sensor Node Name
  SYS1 Cooling Coil Water Inlet Node, !- Actuator Node Name
  0.002,                       !- Controller Convergence Tolerance {deltaC}
  0.00438031,                 !- Maximum Actuated Flow {m3/s}
  0.0;                          !- Minimum Actuated Flow {m3/s}

Controller:OutdoorAir,
  SYS10 OA Controller,        !- Name
  SYS10 Relief Air Outlet,    !- Relief Air Outlet Node Name

```

```

SYS10 Return Fan Outlet,  !- Return Air Node Name
SYS10 Mixed Air Outlet,  !- Mixed Air Node Name
SYS10 Outside Air Inlet, !- Actuator Node Name
1.06185,                  !- Minimum Outdoor Air Flow Rate {m3/s}
7.11526,                  !- Maximum Outdoor Air Flow Rate {m3/s}
DifferentialDryBulb,      !- Economizer Control Type (OAmin for Toa,db>Tra,db)
ModulateFlow,            !- Economizer Control Action Type
21.111,                   !- Economizer Maximum Limit Dry-Bulb Temperature 70F {C} (OAmin for
Toa,db>lim)
,                           !- Economizer Maximum Limit Enthalpy {J/kg}
,                           !- Economizer Maximum Limit Dewpoint Temperature {C}
,                           !- Electronic Enthalpy Limit Curve Name
,                           !- Economizer Minimum Limit Dry-Bulb Temperature {C}
NoLockout,                !- Lockout Type
FixedMinimum,              !- Minimum Limit Type
FAN-SCHED;                 !- Minimum Outdoor Air Schedule Name

```

```

Controller:OutdoorAir,
SYS2 OA Controller,       !- Name
SYS2 Relief Air Outlet,   !- Relief Air Outlet Node Name
SYS2 Return Fan Outlet,   !- Return Air Node Name
SYS2 Mixed Air Outlet,    !- Mixed Air Node Name
SYS2 Outside Air Inlet,   !- Actuator Node Name
1.06185,                  !- Minimum Outdoor Air Flow Rate {m3/s}
6.25575,                  !- Maximum Outdoor Air Flow Rate {m3/s}
DifferentialDryBulb,      !- Economizer Control Type (OAmin for Toa,db>Tra,db)
ModulateFlow,            !- Economizer Control Action Type
21.111,                   !- Economizer Maximum Limit Dry-Bulb Temperature 70F {C} (OAmin for
Toa,db>lim)
,                           !- Economizer Maximum Limit Enthalpy {J/kg}
,                           !- Economizer Maximum Limit Dewpoint Temperature {C}
,                           !- Electronic Enthalpy Limit Curve Name
,                           !- Economizer Minimum Limit Dry-Bulb Temperature {C}
NoLockout,                !- Lockout Type
FixedMinimum,              !- Minimum Limit Type
FAN-SCHED;                 !- Minimum Outdoor Air Schedule Name

```

```

Controller:OutdoorAir,
SYS1 OA Controller,       !- Name
SYS1 Relief Air Outlet,   !- Relief Air Outlet Node Name
SYS1 Return Fan Outlet,   !- Return Air Node Name
SYS1 Mixed Air Outlet,    !- Mixed Air Node Name
SYS1 Outside Air Inlet,   !- Actuator Node Name
1.06185,                  !- Minimum Outdoor Air Flow Rate {m3/s}
6.18478,                  !- Maximum Outdoor Air Flow Rate {m3/s}
DifferentialDryBulb,      !- Economizer Control Type (OAmin for Toa,db>Tra,db)
ModulateFlow,            !- Economizer Control Action Type
21.111,                   !- Economizer Maximum Limit Dry-Bulb Temperature 70F {C} (OAmin for
Toa,db>lim)
,                           !- Economizer Maximum Limit Enthalpy {J/kg}
,                           !- Economizer Maximum Limit Dewpoint Temperature {C}
,                           !- Electronic Enthalpy Limit Curve Name
,                           !- Economizer Minimum Limit Dry-Bulb Temperature {C}
NoLockout,                !- Lockout Type
FixedMinimum,              !- Minimum Limit Type
FAN-SCHED;                 !- Minimum Outdoor Air Schedule Name

```

! No main heating coil so no associated main heating coil controller

```

SetpointManager:Scheduled,
SYS10 Setpoint Manager 1, !- Name
Temperature,              !- Control Variable
ConstSetSched11.7,       !- Schedule Name
SYS10 Sup Air Temp Nodes; !- Setpoint Node or NodeList Name

```

```

SetpointManager:Scheduled,
SYS2 Setpoint Manager 1, !- Name
Temperature,              !- Control Variable
ConstSetSched11.7,       !- Schedule Name
SYS2 Sup Air Temp Nodes; !- Setpoint Node or NodeList Name

```

```

SetpointManager:Scheduled,
SYS1 Setpoint Manager 1,  !- Name
Temperature,             !- Control Variable
ConstSetSched11.7,      !- Schedule Name
SYS1 Sup Air Temp Nodes; !- Setpoint Node or NodeList Name

SetpointManager:MixedAir,
SYS2 Setpoint Manager 2,  !- Name
Temperature,             !- Control Variable
SYS2 Fan Outlet,         !- Reference Setpoint Node Name
SYS2 Cooling Coil Outlet, !- Fan Inlet Node Name
SYS2 Fan Outlet,         !- Fan Outlet Node Name
SYS2 Supply Fan Upstream Nodes; !- Setpoint Node or NodeList Name

SetpointManager:MixedAir,
SYS10 Setpoint Manager 2, !- Name
Temperature,             !- Control Variable
SYS10 Fan Outlet,        !- Reference Setpoint Node Name
SYS10 Cooling Coil Outlet, !- Fan Inlet Node Name
SYS10 Fan Outlet,        !- Fan Outlet Node Name
SYS10 Supply Fan Upstream Nodes; !- Setpoint Node or NodeList Name

SetpointManager:MixedAir,
SYS1 Setpoint Manager 2,  !- Name
Temperature,             !- Control Variable
SYS1 Fan Outlet,         !- Reference Setpoint Node Name
SYS1 Cooling Coil Outlet, !- Fan Inlet Node Name
SYS1 Fan Outlet,         !- Fan Outlet Node Name
SYS1 Supply Fan Upstream Nodes; !- Setpoint Node or NodeList Name

NodeList,
SYS10 Sup Air Temp Nodes, !- Name
SYS10 Fan Outlet;        !- Node 1 Name

NodeList,
SYS2 Sup Air Temp Nodes,  !- Name
SYS2 Fan Outlet;         !- Node 1 Name

NodeList,
SYS1 Sup Air Temp Nodes,  !- Name
SYS1 Fan Outlet;         !- Node 1 Name

NodeList,
SYS10 Supply Fan Upstream Nodes, !- Name
SYS10 Mixed Air Outlet;        !- Node 1 Name

NodeList,
SYS2 Supply Fan Upstream Nodes, !- Name
SYS2 Mixed Air Outlet;         !- Node 1 Name

NodeList,
SYS1 Supply Fan Upstream Nodes, !- Name
SYS1 Mixed Air Outlet;         !- Node 1 Name

!-----
! Single Boiler Supply

PlantLoop,
BoilerPlant,             !- Name
Water,                   !- Fluid Type
BoilerPlant Operation,   !- Plant Equipment Operation Scheme Name
BoilerPlant HW Supply Outlet Node, !- Loop Temperature Setpoint Node Name
100,                     !- Maximum Loop Temperature {C}
10,                      !- Minimum Loop Temperature {C}
0.00253538,             !- Maximum Loop Flow Rate {m3/s}
0.0,                    !- Minimum Loop Flow Rate {m3/s}
2.8523,                 !- Plant Loop Volume {m3}
BoilerPlant HW Supply Inlet Node, !- Plant Side Inlet Node Name
BoilerPlant HW Supply Outlet Node, !- Plant Side Outlet Node Name
BoilerPlant HW Supply Side Branches, !- Plant Side Branch List Name
BoilerPlant HW Supply Side Connectors, !- Plant Side Connector List Name

```

```

HWdemand1 HW Demand Inlet Node,           !- Demand Side Inlet Node Name
HWdemand1 HW Demand Outlet Node,          !- Demand Side Outlet Node Name
HWdemand1 HW Demand Side Branches,        !- Demand Side Branch List Name
HWdemand1 HW Demand Side Connectors,      !- Demand Side Connector List Name
Optimal;                                  !- Load Distribution Scheme

SetpointManager:Scheduled,
  BoilerPlant HW Temp Manager,             !- Name
  Temperature,                             !- Control Variable
  ConstSetSched82.2,                       !- Schedule Name
  BoilerPlant HW Supply Outlet Node;       !- Setpoint Node or NodeList Name

BranchList,
  BoilerPlant HW Supply Side Branches,     !- Name
  BoilerPlant HW Supply Inlet Branch,      !- Branch 1 Name
  BoilerPlant Boiler Branch,              !- Branch 2 Name
  BoilerPlant HW Supply Bypass Branch,     !- Branch 3 Name
  BoilerPlant HW Supply Outlet Branch;     !- Branch 4 Name

ConnectorList,
  BoilerPlant HW Supply Side Connectors,   !- Name
  Connector:Splitter,                     !- Connector 1 Object Type
  BoilerPlant HW Supply Splitter,         !- Connector 1 Name
  Connector:Mixer,                         !- Connector 2 Object Type
  BoilerPlant HW Supply Mixer;            !- Connector 2 Name

! Use variable speed pump

Branch,
  BoilerPlant HW Supply Inlet Branch,      !- Name
  ,                                         !- Maximum Flow Rate {m3/s}
  Pump:VariableSpeed,                     !- Component 1 Object Type
  BoilerPlant HW Circ Pump,                !- Component 1 Name
  BoilerPlant HW Supply Inlet Node,        !- Component 1 Inlet Node Name
  BoilerPlant HW Pump Outlet Node,         !- Component 1 Outlet Node Name
  Active;                                  !- Component 1 Branch Control Type

Branch,
  BoilerPlant Boiler Branch,               !- Name
  ,                                         !- Maximum Flow Rate {m3/s}
  Boiler:HotWater,                         !- Component 1 Object Type
  BoilerPlant Boiler,                      !- Component 1 Name
  BoilerPlant Boiler Inlet Node,           !- Component 1 Inlet Node Name
  BoilerPlant Boiler Outlet Node,         !- Component 1 Outlet Node Name
  Active;                                  !- Component 1 Branch Control Type

Branch,
  BoilerPlant HW Supply Bypass Branch,     !- Name
  ,                                         !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                          !- Component 1 Object Type
  BoilerPlant HW Supply Side Bypass,       !- Component 1 Name
  BoilerPlant HW Supply Bypass Inlet Node, !- Component 1 Inlet Node Name
  BoilerPlant HW Supply Bypass Outlet Node, !- Component 1 Outlet Node Name
  Bypass;                                  !- Component 1 Branch Control Type

Pipe:Adiabatic,
  BoilerPlant HW Supply Side Bypass,       !- Name
  BoilerPlant HW Supply Bypass Inlet Node, !- Inlet Node Name
  BoilerPlant HW Supply Bypass Outlet Node; !- Outlet Node Name

Branch,
  BoilerPlant HW Supply Outlet Branch,     !- Name
  ,                                         !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                          !- Component 1 Object Type
  BoilerPlant HW Supply Outlet,            !- Component 1 Name
  BoilerPlant HW Supply Exit Pipe Inlet Node, !- Component 1 Inlet Node Name
  BoilerPlant HW Supply Outlet Node,       !- Component 1 Outlet Node Name
  Passive;                                  !- Component 1 Branch Control Type

Pipe:Adiabatic,
  BoilerPlant HW Supply Outlet,            !- Name

```

```

BoilerPlant HW Supply Exit Pipe Inlet Node,      !- Inlet Node Name
BoilerPlant HW Supply Outlet Node;              !- Outlet Node Name

BranchList,
  HWdemand1 HW Demand Side Branches,            !- Name
  HWdemand1 HW Inlet Branch,                    !- Branch 1 Name
  PER-1T HW-Branch,                             !- Branch 2 Name
  PER-2T HW-Branch,                             !- Branch 3 Name
  PER-3T HW-Branch,                             !- Branch 4 Name
  PER-4T HW-Branch,                             !- Branch 5 Name
  COR-1T HW-Branch,                             !- Branch 6 Name
  PER-1I HW-Branch,                             !- Branch 7 Name
  PER-2I HW-Branch,                             !- Branch 8 Name
  PER-3I HW-Branch,                             !- Branch 9 Name
  PER-4I HW-Branch,                             !- Branch 10 Name
  COR-1I HW-Branch,                             !- Branch 11 Name
  PER-1F HW-Branch,                             !- Branch 12 Name
  PER-2F HW-Branch,                             !- Branch 13 Name
  PER-3F HW-Branch,                             !- Branch 14 Name
  PER-4F HW-Branch,                             !- Branch 15 Name
  COR-1F HW-Branch,                             !- Branch 16 Name
  HWdemand1 HW Bypass Branch,                   !- Branch 17 Name
  HWdemand1 HW Outlet Branch;                   !- Branch 18 Name

ConnectorList,
  HWdemand1 HW Demand Side Connectors,          !- Name
  Connector:Splitter,                           !- Connector 1 Object Type
  HWdemand1 HW Splitter,                       !- Connector 1 Name
  Connector:Mixer,                              !- Connector 2 Object Type
  HWdemand1 HW Mixer;                          !- Connector 2 Name

Branch,
  HWdemand1 HW Inlet Branch,                    !- Name
  ,                                              !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                              !- Component 1 Object Type
  HWdemand1 HW Inlet Pipe,                     !- Component 1 Name
  HWdemand1 HW Demand Inlet Node,              !- Component 1 Inlet Node Name
  HWdemand1 HW Demand Entrance Pipe Outlet Node, !- Component 1 Outlet Node Name
  Passive;                                     !- Component 1 Branch Control Type

Pipe:Adiabatic,
  HWdemand1 HW Inlet Pipe,                     !- Name
  HWdemand1 HW Demand Inlet Node,              !- Inlet Node Name
  HWdemand1 HW Demand Entrance Pipe Outlet Node; !- Outlet Node Name

Branch,
  HWdemand1 HW Outlet Branch,                  !- Name
  ,                                              !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                              !- Component 1 Object Type
  HWdemand1 HW Outlet Pipe,                   !- Component 1 Name
  HWdemand1 HW Demand Exit Pipe Inlet Node,   !- Component 1 Inlet Node Name
  HWdemand1 HW Demand Outlet Node,            !- Component 1 Outlet Node Name
  Passive;                                     !- Component 1 Branch Control Type

Pipe:Adiabatic,
  HWdemand1 HW Outlet Pipe,                   !- Name
  HWdemand1 HW Demand Exit Pipe Inlet Node,   !- Inlet Node Name
  HWdemand1 HW Demand Outlet Node;            !- Outlet Node Name

Branch,
  PER-1T HW-Branch,                            !- Name
  ,                                              !- Maximum Flow Rate {m3/s}
  Coil:Heating:Water,                          !- Component 1 Object Type
  PER-1T Reheat Coil,                          !- Component 1 Name
  PER-1T Reheat Coil HW Inlet,                 !- Component 1 Inlet Node Name
  PER-1T Reheat Coil HW Outlet,               !- Component 1 Outlet Node Name
  Active;                                     !- Component 1 Branch Control Type

Branch,
  PER-2T HW-Branch,                            !- Name
  ,                                              !- Maximum Flow Rate {m3/s}

```

```

Coil:Heating:Water,
PER-2T Reheat Coil,
PER-2T Reheat Coil HW Inlet,
PER-2T Reheat Coil HW Outlet,
Active;
Branch,
  PER-3T HW-Branch,
  ,
  Coil:Heating:Water,
  PER-3T Reheat Coil,
  PER-3T Reheat Coil HW Inlet,
  PER-3T Reheat Coil HW Outlet,
  Active;
Branch,
  PER-4T HW-Branch,
  ,
  Coil:Heating:Water,
  PER-4T Reheat Coil,
  PER-4T Reheat Coil HW Inlet,
  PER-4T Reheat Coil HW Outlet,
  Active;
Branch,
  COR-1T HW-Branch,
  ,
  Coil:Heating:Water,
  COR-1T Reheat Coil,
  COR-1T Reheat Coil HW Inlet,
  COR-1T Reheat Coil HW Outlet,
  Active;
Branch,
  PER-1I HW-Branch,
  ,
  Coil:Heating:Water,
  PER-1I Reheat Coil,
  PER-1I Reheat Coil HW Inlet,
  PER-1I Reheat Coil HW Outlet,
  Active;
Branch,
  PER-2I HW-Branch,
  ,
  Coil:Heating:Water,
  PER-2I Reheat Coil,
  PER-2I Reheat Coil HW Inlet,
  PER-2I Reheat Coil HW Outlet,
  Active;
Branch,
  PER-3I HW-Branch,
  ,
  Coil:Heating:Water,
  PER-3I Reheat Coil,
  PER-3I Reheat Coil HW Inlet,
  PER-3I Reheat Coil HW Outlet,
  Active;
Branch,
  PER-4I HW-Branch,
  ,
  Coil:Heating:Water,
  PER-4I Reheat Coil,
  PER-4I Reheat Coil HW Inlet,
  PER-4I Reheat Coil HW Outlet,
  Active;
Branch,
  COR-1I HW-Branch,
  ,
  Coil:Heating:Water,
  COR-1I Reheat Coil,
  COR-1I Reheat Coil HW Inlet,
  COR-1I Reheat Coil HW Outlet,
  Active;

```

```

!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

!- Name

```

```

,
Coil:Heating:Water,
COR-1I Reheat Coil,
COR-1I Reheat Coil HW Inlet,
COR-1I Reheat Coil HW Outlet,
Active;
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

Branch,
PER-1F HW-Branch,
,
Coil:Heating:Water,
PER-1F Reheat Coil,
PER-1F Reheat Coil HW Inlet,
PER-1F Reheat Coil HW Outlet,
Active;
!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

Branch,
PER-2F HW-Branch,
,
Coil:Heating:Water,
PER-2F Reheat Coil,
PER-2F Reheat Coil HW Inlet,
PER-2F Reheat Coil HW Outlet,
Active;
!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

Branch,
PER-3F HW-Branch,
,
Coil:Heating:Water,
PER-3F Reheat Coil,
PER-3F Reheat Coil HW Inlet,
PER-3F Reheat Coil HW Outlet,
Active;
!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

Branch,
PER-4F HW-Branch,
,
Coil:Heating:Water,
PER-4F Reheat Coil,
PER-4F Reheat Coil HW Inlet,
PER-4F Reheat Coil HW Outlet,
Active;
!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

Branch,
COR-1F HW-Branch,
,
Coil:Heating:Water,
COR-1F Reheat Coil,
COR-1F Reheat Coil HW Inlet,
COR-1F Reheat Coil HW Outlet,
Active;
!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

! no main heating coil (so no associated coil branch)

Branch,
HWdemand1 HW Bypass Branch,
,
Pipe:Adiabatic,
HWdemand1 HW Bypass Pipe,
HWdemand1 HW Bypass Inlet Node,
HWdemand1 HW Bypass Outlet Node,
Bypass;
!- Name
!- Maximum Flow Rate {m3/s}
!- Component 1 Object Type
!- Component 1 Name
!- Component 1 Inlet Node Name
!- Component 1 Outlet Node Name
!- Component 1 Branch Control Type

Pipe:Adiabatic,
HWdemand1 HW Bypass Pipe,
HWdemand1 HW Bypass Inlet Node,
HWdemand1 HW Bypass Outlet Node;
!- Name
!- Inlet Node Name
!- Outlet Node Name

Connector:Splitter,
HWdemand1 HW Splitter,
HWdemand1 HW Inlet Branch,
!- Name
!- Inlet Branch Name

```



```

PER-1T HW-Branch,                !- Outlet Branch 1 Name
PER-2T HW-Branch,                !- Outlet Branch 2 Name
PER-3T HW-Branch,                !- Outlet Branch 3 Name
PER-4T HW-Branch,                !- Outlet Branch 4 Name
COR-1T HW-Branch,                !- Outlet Branch 5 Name
PER-1I HW-Branch,                !- Outlet Branch 6 Name
PER-2I HW-Branch,                !- Outlet Branch 7 Name
PER-3I HW-Branch,                !- Outlet Branch 8 Name
PER-4I HW-Branch,                !- Outlet Branch 9 Name
COR-1I HW-Branch,                !- Outlet Branch 10 Name
PER-1F HW-Branch,                !- Outlet Branch 11 Name
PER-2F HW-Branch,                !- Outlet Branch 12 Name
PER-3F HW-Branch,                !- Outlet Branch 13 Name
PER-4F HW-Branch,                !- Outlet Branch 14 Name
COR-1F HW-Branch,                !- Outlet Branch 15 Name
HWdemand1 HW Bypass Branch;      !- Outlet Branch 16 Name

Connector:Mixer,
  HWdemand1 HW Mixer,            !- Name
  HWdemand1 HW Outlet Branch,    !- Outlet Branch Name
  PER-1T HW-Branch,              !- Inlet Branch 1 Name
  PER-2T HW-Branch,              !- Inlet Branch 2 Name
  PER-3T HW-Branch,              !- Inlet Branch 3 Name
  PER-4T HW-Branch,              !- Inlet Branch 4 Name
  COR-1T HW-Branch,              !- Inlet Branch 5 Name
  PER-1I HW-Branch,              !- Inlet Branch 6 Name
  PER-2I HW-Branch,              !- Inlet Branch 7 Name
  PER-3I HW-Branch,              !- Inlet Branch 8 Name
  PER-4I HW-Branch,              !- Inlet Branch 9 Name
  COR-1I HW-Branch,              !- Inlet Branch 10 Name
  PER-1F HW-Branch,              !- Inlet Branch 11 Name
  PER-2F HW-Branch,              !- Inlet Branch 12 Name
  PER-3F HW-Branch,              !- Inlet Branch 13 Name
  PER-4F HW-Branch,              !- Inlet Branch 14 Name
  COR-1F HW-Branch,              !- Inlet Branch 15 Name
  HWdemand1 HW Bypass Branch;    !- Inlet Branch 16 Name

Connector:Splitter,
  BoilerPlant HW Supply Splitter, !- Name
  BoilerPlant HW Supply Inlet Branch, !- Inlet Branch Name
  BoilerPlant Boiler Branch,        !- Outlet Branch 1 Name
  BoilerPlant HW Supply Bypass Branch; !- Outlet Branch 2 Name

Connector:Mixer,
  BoilerPlant HW Supply Mixer,      !- Name
  BoilerPlant HW Supply Outlet Branch, !- Outlet Branch Name
  BoilerPlant Boiler Branch,        !- Inlet Branch 1 Name
  BoilerPlant HW Supply Bypass Branch; !- Inlet Branch 2 Name

PlantEquipmentOperationSchemes,
  BoilerPlant Operation,            !- Name
  PlantEquipmentOperation:HeatingLoad, !- Control Scheme 1 Object Type
  BoilerPlant Heat Supply,          !- Control Scheme 1 Name
  FAN-SCHED;                        !- Control Scheme 1 Schedule Name

PlantEquipmentOperation:HeatingLoad,
  BoilerPlant Heat Supply,          !- Name
  0,                                !- Load Range 1 Lower Limit {W}
  10000000000000000,               !- Load Range 1 Upper Limit {W}
  BoilerPlant heating plant;        !- Priority Control 1 Equipment List Name

PlantEquipmentList,
  BoilerPlant heating plant,        !- Name
  Boiler:HotWater,                  !- Equipment 1 Object Type
  BoilerPlant Boiler;               !- Equipment 1 Name

! Coefficients below are curve fit to DOE-2 fuel use vs PLR default curve for HW boiler

Boiler:HotWater,
  BoilerPlant Boiler,              !- Name
  NaturalGas,                       !- Fuel Type

```

```

176634.73428,
0.79,
BoilerPlant Boiler Efficiency Curve,
82.222,
0.00253538,
0.0,
1.2,
1.0,
BoilerPlant Boiler Inlet Node,
BoilerPlant Boiler Outlet Node,
100.0,
VariableFlow;
!- Nominal Capacity {W}
!- Nominal Thermal Efficiency
!- Normalized Boiler Efficiency Curve Name
!- Design Water Outlet Temperature {C}
!- Design Water Flow Rate {m3/s}
!- Minimum Part Load Ratio
!- Maximum Part Load Ratio
!- Optimum Part Load Ratio
!- Boiler Water Inlet Node Name
!- Boiler Water Outlet Node Name
!- Water Outlet Upper Temperature Limit {C}
!- Boiler Flow Mode

Curve:Quadratic,
BoilerPlant Boiler Efficiency Curve,
0.5887682,
0.7888184,
-0.3862498,
0,
1;
!- Name
!- Coefficient1 Constant
!- Coefficient2 x
!- Coefficient3 x**2
!- Minimum Value of x
!- Maximum Value of x

Pump:VariableSpeed,
BoilerPlant HW Circ Pump,
BoilerPlant HW Supply Inlet Node,
BoilerPlant HW Pump Outlet Node,
0.00253538,
179344.,
647.72702,
0.9,
0.,
Stream
0.,
Performance Curve
1.,
Performance Curve
0.,
Performance Curve
0.,
Performance Curve
0,
Intermittent;
!- Name
!- Inlet Node Name
!- Outlet Node Name
!- Rated Flow Rate {m3/s}
!- Rated Pump Head {Pa}
!- Rated Power Consumption {W}
!- Motor Efficiency
!- Fraction of Motor Inefficiencies to Fluid
!- Coefficient 1 of the Part Load
!- Coefficient 2 of the Part Load
!- Coefficient 3 of the Part Load
!- Coefficient 4 of the Part Load
!- Minimum Flow Rate {m3/s}
!- Pump Control Type

!-----
! Chilled Water Demand Side
! Single Chiller Supply

PlantLoop,
CHWPlant,
Water,
CHWPlant Operation,
CHWPlant ChW Supply Outlet Node,
98,
1,
0.0139187,
0.0,
15.65855,
CHWPlant ChW Supply Inlet Node,
CHWPlant ChW Supply Outlet Node,
CHWPlant ChW Supply Side Branches,
CHWPlant ChW Supply Side Connectors,
CHWdemand1 ChW Demand Inlet Node,
CHWdemand1 ChW Demand Outlet Node,
CHWdemand1 ChW Demand Side Branches,
CHWdemand1 ChW Demand Side Connectors,
Optimal;
!- Name
!- Fluid Type
!- Plant Equipment Operation Scheme Name
!- Loop Temperature Setpoint Node Name
!- Maximum Loop Temperature {C}
!- Minimum Loop Temperature {C}
!- Maximum Loop Flow Rate {m3/s}
!- Minimum Loop Flow Rate {m3/s}
!- Plant Loop Volume {m3}
!- Plant Side Inlet Node Name
!- Plant Side Outlet Node Name
!- Plant Side Branch List Name
!- Plant Side Connector List Name
!- Demand Side Inlet Node Name
!- Demand Side Outlet Node Name
!- Demand Side Branch List Name
!- Demand Side Connector List Name
!- Load Distribution Scheme

SetpointManager:Scheduled,
CHWPlant ChW Temp Manager,
Temperature,
CHWPlant ChW Temp Schedule,
CHWPlant ChW Supply Outlet Node;
!- Name
!- Control Variable
!- Schedule Name
!- Setpoint Node or NodeList Name

```

```

BranchList,
  CHWPlant ChW Supply Side Branches,      !- Name
  CHWPlant ChW Supply Inlet Branch,       !- Branch 1 Name
  CHWPlant Chiller Branch,                !- Branch 2 Name
  CHWPlant ChW Supply Bypass Branch,      !- Branch 3 Name
  CHWPlant ChW Supply Outlet Branch;      !- Branch 4 Name

BranchList,
  CHWdemand1 ChW Demand Side Branches,   !- Name
  CHWdemand1 ChW Inlet Branch,            !- Branch 1 Name
  SYS1 ChW-Branch,                       !- Branch 2 Name
  SYS2 ChW-Branch,                       !- Branch 3 Name
  SYS10 ChW-Branch,                      !- Branch 4 Name
  CHWdemand1 ChW Bypass Branch,          !- Branch 5 Name
  CHWdemand1 ChW Outlet Branch;          !- Branch 6 Name

ConnectorList,
  CHWPlant ChW Supply Side Connectors,    !- Name
  Connector:Splitter,                    !- Connector 1 Object Type
  CHWPlant ChW Supply Splitter,          !- Connector 1 Name
  Connector:Mixer,                       !- Connector 2 Object Type
  CHWPlant ChW Supply Mixer;             !- Connector 2 Name

ConnectorList,
  CHWdemand1 ChW Demand Side Connectors,  !- Name
  Connector:Splitter,                    !- Connector 1 Object Type
  CHWdemand1 ChW Splitter,              !- Connector 1 Name
  Connector:Mixer,                       !- Connector 2 Object Type
  CHWdemand1 ChW Mixer;                 !- Connector 2 Name

Branch,
  CHWdemand1 ChW Inlet Branch,            !- Name
  ,                                       !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                       !- Component 1 Object Type
  CHWdemand1 ChW Inlet Pipe,             !- Component 1 Name
  CHWdemand1 ChW Demand Inlet Node,      !- Component 1 Inlet Node Name
  CHWdemand1 ChW Demand Entrance Pipe Outlet Node, !- Component 1 Outlet Node Name
  Passive;                               !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWdemand1 ChW Inlet Pipe,             !- Name
  CHWdemand1 ChW Demand Inlet Node,      !- Inlet Node Name
  CHWdemand1 ChW Demand Entrance Pipe Outlet Node; !- Outlet Node Name

Branch,
  SYS10 ChW-Branch,                      !- Name
  ,                                       !- Maximum Flow Rate {m3/s}
  Coil:Cooling:Water,                   !- Component 1 Object Type
  SYS10 Cooling Coil,                   !- Component 1 Name
  SYS10 Cooling Coil Water Inlet Node,   !- Component 1 Inlet Node Name
  SYS10 Cooling Coil Water Outlet Node,  !- Component 1 Outlet Node Name
  Active;                                !- Component 1 Branch Control Type

Branch,
  SYS2 ChW-Branch,                       !- Name
  ,                                       !- Maximum Flow Rate {m3/s}
  Coil:Cooling:Water,                   !- Component 1 Object Type
  SYS2 Cooling Coil,                   !- Component 1 Name
  SYS2 Cooling Coil Water Inlet Node,    !- Component 1 Inlet Node Name
  SYS2 Cooling Coil Water Outlet Node,   !- Component 1 Outlet Node Name
  Active;                                !- Component 1 Branch Control Type

Branch,
  SYS1 ChW-Branch,                       !- Name
  ,                                       !- Maximum Flow Rate {m3/s}
  Coil:Cooling:Water,                   !- Component 1 Object Type
  SYS1 Cooling Coil,                   !- Component 1 Name
  SYS1 Cooling Coil Water Inlet Node,    !- Component 1 Inlet Node Name
  SYS1 Cooling Coil Water Outlet Node,   !- Component 1 Outlet Node Name
  Active;                                !- Component 1 Branch Control Type

```

```

Branch,
  CHWdemand1 ChW Bypass Branch,
  ,
  Pipe:Adiabatic,
  CHWdemand1 ChW Bypass Pipe,
  CHWdemand1 ChW Bypass Inlet Node,
  CHWdemand1 ChW Bypass Outlet Node,
  Bypass;
  !- Name
  !- Maximum Flow Rate {m3/s}
  !- Component 1 Object Type
  !- Component 1 Name
  !- Component 1 Inlet Node Name
  !- Component 1 Outlet Node Name
  !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWdemand1 ChW Bypass Pipe,
  CHWdemand1 ChW Bypass Inlet Node,
  CHWdemand1 ChW Bypass Outlet Node;
  !- Name
  !- Inlet Node Name
  !- Outlet Node Name

Branch,
  CHWdemand1 ChW Outlet Branch,
  ,
  Pipe:Adiabatic,
  CHWdemand1 ChW Outlet Pipe,
  CHWdemand1 ChW Demand Exit Pipe Inlet Node,
  CHWdemand1 ChW Demand Outlet Node,
  Passive;
  !- Name
  !- Maximum Flow Rate {m3/s}
  !- Component 1 Object Type
  !- Component 1 Name
  !- Component 1 Inlet Node Name
  !- Component 1 Outlet Node Name
  !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWdemand1 ChW Outlet Pipe,
  CHWdemand1 ChW Demand Exit Pipe Inlet Node,
  CHWdemand1 ChW Demand Outlet Node;
  !- Name
  !- Inlet Node Name
  !- Outlet Node Name

Branch,
  CHWPlant ChW Supply Outlet Branch,
  ,
  Pipe:Adiabatic,
  CHWPlant ChW Supply Outlet,
  CHWPlant ChW Supply Exit Pipe Inlet Node,
  CHWPlant ChW Supply Outlet Node,
  Passive;
  !- Name
  !- Maximum Flow Rate {m3/s}
  !- Component 1 Object Type
  !- Component 1 Name
  !- Component 1 Inlet Node Name
  !- Component 1 Outlet Node Name
  !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWPlant ChW Supply Outlet,
  CHWPlant ChW Supply Exit Pipe Inlet Node,
  CHWPlant ChW Supply Outlet Node;
  !- Name
  !- Inlet Node Name
  !- Outlet Node Name

Branch,
  CHWPlant ChW Supply Inlet Branch,
  ,
  Pump:VariableSpeed,
  CHWPlant ChW Circ Pump,
  CHWPlant ChW Supply Inlet Node,
  CHWPlant ChW Pump Outlet Node,
  Active;
  !- Name
  !- Maximum Flow Rate {m3/s}
  !- Component 1 Object Type
  !- Component 1 Name
  !- Component 1 Inlet Node Name
  !- Component 1 Outlet Node Name
  !- Component 1 Branch Control Type

Branch,
  CHWPlant Chiller Branch,
  ,
  Chiller:Electric:EIR,
  CHWPlant Chiller,
  CHWPlant Chiller Inlet Node,
  CHWPlant Chiller Outlet Node,
  Active;
  !- Name
  !- Maximum Flow Rate {m3/s}
  !- Component 1 Object Type
  !- Component 1 Name
  !- Component 1 Inlet Node Name
  !- Component 1 Outlet Node Name
  !- Component 1 Branch Control Type

Branch,
  CHWPlant ChW Supply Bypass Branch,
  ,
  Pipe:Adiabatic,
  CHWPlant ChW Supply Side Bypass,
  CHWPlant ChW Supply Bypass Inlet Node,
  CHWPlant ChW Supply Bypass Outlet Node,
  Bypass;
  !- Name
  !- Maximum Flow Rate {m3/s}
  !- Component 1 Object Type
  !- Component 1 Name
  !- Component 1 Inlet Node Name
  !- Component 1 Outlet Node Name
  !- Component 1 Branch Control Type

Pipe:Adiabatic,

```

```

CHWPlant ChW Supply Side Bypass,           !- Name
CHWPlant ChW Supply Bypass Inlet Node,     !- Inlet Node Name
CHWPlant ChW Supply Bypass Outlet Node;    !- Outlet Node Name

Connector:Splitter,
  CHWPlant ChW Supply Splitter,           !- Name
  CHWPlant ChW Supply Inlet Branch,       !- Inlet Branch Name
  CHWPlant Chiller Branch,               !- Outlet Branch 1 Name
  CHWPlant ChW Supply Bypass Branch;      !- Outlet Branch 2 Name

Connector:Mixer,
  CHWPlant ChW Supply Mixer,              !- Name
  CHWPlant ChW Supply Outlet Branch,      !- Outlet Branch Name
  CHWPlant Chiller Branch,               !- Inlet Branch 1 Name
  CHWPlant ChW Supply Bypass Branch;      !- Inlet Branch 2 Name

Connector:Splitter,
  CHWdemand1 ChW Splitter,                !- Name
  CHWdemand1 ChW Inlet Branch,            !- Inlet Branch Name
  SYS10 ChW-Branch,                       !- Outlet Branch 1 Name
  SYS2 ChW-Branch,                        !- Outlet Branch 2 Name
  SYS1 ChW-Branch,                        !- Outlet Branch 3 Name
  CHWdemand1 ChW Bypass Branch;           !- Outlet Branch 4 Name

Connector:Mixer,
  CHWdemand1 ChW Mixer,                   !- Name
  CHWdemand1 ChW Outlet Branch,           !- Outlet Branch Name
  SYS10 ChW-Branch,                       !- Inlet Branch 1 Name
  SYS2 ChW-Branch,                        !- Inlet Branch 2 Name
  SYS1 ChW-Branch,                        !- Inlet Branch 3 Name
  CHWdemand1 ChW Bypass Branch;           !- Inlet Branch 4 Name

PlantEquipmentOperationSchemes,
  CHWPlant Operation,                     !- Name
  PlantEquipmentOperation:CoolingLoad,    !- Control Scheme 1 Object Type
  CHWPlant ChW Supply,                    !- Control Scheme 1 Name
  FAN-SCHED;                              !- Control Scheme 1 Schedule Name

PlantEquipmentOperation:CoolingLoad,
  CHWPlant ChW Supply,                     !- Name
  0,                                        !- Load Range 1 Lower Limit {W}
  1000000000000000,                       !- Load Range 1 Upper Limit {W}
  CHWPlant ChW Plant;                      !- Priority Control 1 Equipment List Name

PlantEquipmentList,
  CHWPlant ChW Plant,                       !- Name
  Chiller:Electric:EIR,                    !- Equipment 1 Object Type
  CHWPlant Chiller;                        !- Equipment 1 Name

! Generic hermetic centrifugal chiller from DOE-2.1E

Chiller:Electric:EIR,
  CHWPlant Chiller,                         !- Name
  387887.48643,                             !- Reference Capacity {W}
  5.5,                                       !- Reference COP {W/W}
  6.667,                                     !- Reference Leaving Chilled Water
  Temperature (44F) {C}                      !- Reference Entering Condenser Fluid
  29.444,
  Temperature (85F) {C}                      !- Reference Chilled Water Flow Rate {m3/s}
  0.0139187,                                !- Reference Condenser Water Flow Rate
  0.0197387,
  {m3/s}
  HERM-CENT-CAP-FT,                          !- Cooling Capacity Function of Temperature
  Curve Name
  HERM-CENT-EIR-FT,                          !- Electric Input/Cooling Output Function of
  Temperature Curve Name
  HERM-CENT-EIR-FP,                          !- Electric Input/Cooling Output Function of
  PLR Curve Name
  0.1,                                       !- Minimum Part Load Ratio
  1.0,                                       !- Maximum Part Load Ratio
  1.0,                                       !- Optimum Part Load Ratio

```

```

0.2,
CHWPlant Chiller Inlet Node,
CHWPlant Chiller Outlet Node,
CHWPlant Chiller Cond Inlet Node,
CHWPlant Chiller Cond Outlet Node,
WaterCooled,
,
1.0,
2.0,
Limit {C}
    VariableFlow;

Pump:VariableSpeed,
    CHWPlant ChW Circ Pump,
    CHWPlant ChW Supply Inlet Node,
    CHWPlant ChW Pump Outlet Node,
    0.0139187,
    179344.,
    3555.89277,
    0.9,
    0.,
Stream
    0.,
Performance Curve
    1.,
Performance Curve
    0.,
Performance Curve
    0.,
Performance Curve
    0,
    Intermittent;

!-----
! Single Tower Supply

CondenserLoop,
    CHWPlant Condenser Loop,
    Water,
    CHWPlant Condenser Loop Operation,
    AIR,
Name/Ref
    80,
    5,
    0.0197387,
    0.0,
    22.206,
    CHWPlant Cnd Supply Inlet Node,
    CHWPlant Cnd Supply Outlet Node,
    CHWPlant Condenser Supply Side Branches,
    CHWPlant Condenser Supply Side Connectors,
    CHWPlant Cnd Demand Inlet Node,
    CHWPlant Cnd Demand Outlet Node,
    CHWPlant Cnd Demand Side Branches,
    CHWPlant Cnd Demand Side Connectors,
    Sequential;

BranchList,
    CHWPlant Condenser Supply Side Branches,
    CHWPlant Condenser Supply Inlet Branch,
    CHWPlant Tower Branch,
    CHWPlant Condenser Supply Bypass Branch,
    CHWPlant Condenser Supply Outlet Branch;

ConnectorList,
    CHWPlant Condenser Supply Side Connectors,
    Connector:Splitter,
    CHWPlant Condenser Supply Splitter,
    Connector:Mixer,
    CHWPlant Condenser Supply Mixer;

!- Minimum Unloading Ratio
!- Chilled Water Inlet Node Name
!- Chilled Water Outlet Node Name
!- Condenser Inlet Node Name
!- Condenser Outlet Node Name
!- Condenser Type
!- Condenser Fan Power Ratio {W/W}
!- Compressor Motor Efficiency
!- Leaving Chilled Water Lower Temperature

!- Chiller Flow Mode

!- Name
!- Inlet Node Name
!- Outlet Node Name
!- Rated Flow Rate {m3/s}
!- Rated Pump Head {Pa}
!- Rated Power Consumption {W}
!- Motor Efficiency
!- Fraction of Motor Inefficiencies to Fluid

!- Coefficient 1 of the Part Load
!- Coefficient 2 of the Part Load
!- Coefficient 3 of the Part Load
!- Coefficient 4 of the Part Load

!- Minimum Flow Rate {m3/s}
!- Pump Control Type

!- Name
!- Fluid Type
!- Condenser Equipment Operation Scheme Name
!- Condenser Loop Temperature Setpoint Node

!- Maximum Loop Temperature {C}
!- Minimum Loop Temperature {C}
!- Maximum Loop Flow Rate {m3/s}
!- Minimum Loop Flow Rate {m3/s}
!- Condenser Loop Volume {m3}

!- Condenser Side Inlet Node Name
!- Condenser Side Outlet Node Name
!- Condenser Side Branch List Name
!- Condenser Side Connector List Name
!- Demand Side Inlet Node Name
!- Demand Side Outlet Node Name
!- Condenser Demand Side Branch List Name
!- Condenser Demand Side Connector List Name
!- Load Distribution Scheme

!- Name
!- Branch 1 Name
!- Branch 2 Name
!- Branch 3 Name
!- Branch 4 Name

!- Name
!- Connector 1 Object Type
!- Connector 1 Name
!- Connector 2 Object Type
!- Connector 2 Name

```

```

Branch,
  CHWPlant Condenser Supply Inlet Branch,      !- Name
  ,                                             !- Maximum Flow Rate {m3/s}
  Pump:VariableSpeed,                          !- Component 1 Object Type
  CHWPlant Cnd Circ Pump,                      !- Component 1 Name
  CHWPlant Cnd Supply Inlet Node,             !- Component 1 Inlet Node Name
  CHWPlant Cnd Pump Outlet Node,              !- Component 1 Outlet Node Name
  Active;                                       !- Component 1 Branch Control Type

Branch,
  CHWPlant Tower Branch,                       !- Name
  ,                                             !- Maximum Flow Rate {m3/s}
  CoolingTower:SingleSpeed,                   !- Component 1 Object Type
  CHWPlant Tower,                             !- Component 1 Name
  CHWPlant Tower Inlet Node,                  !- Component 1 Inlet Node Name
  CHWPlant Tower Outlet Node,                 !- Component 1 Outlet Node Name
  Active;                                       !- Component 1 Branch Control Type

Branch,
  CHWPlant Condenser Supply Bypass Branch,     !- Name
  ,                                             !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                             !- Component 1 Object Type
  CHWPlant Condenser Supply Side Bypass,      !- Component 1 Name
  CHWPlant Condenser Supply Bypass Inlet Node, !- Component 1 Inlet Node Name
  CHWPlant Condenser Supply Bypass Outlet Node, !- Component 1 Outlet Node Name
  Bypass;                                       !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWPlant Condenser Supply Side Bypass,      !- Name
  CHWPlant Condenser Supply Bypass Inlet Node, !- Inlet Node Name
  CHWPlant Condenser Supply Bypass Outlet Node; !- Outlet Node Name

Branch,
  CHWPlant Condenser Supply Outlet Branch,     !- Name
  ,                                             !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                             !- Component 1 Object Type
  CHWPlant Condenser Supply Outlet,           !- Component 1 Name
  CHWPlant Condenser Supply Exit Pipe Inlet Node, !- Component 1 Inlet Node Name
  CHWPlant Cnd Supply Outlet Node,            !- Component 1 Outlet Node Name
  Passive;                                       !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWPlant Condenser Supply Outlet,           !- Name
  CHWPlant Condenser Supply Exit Pipe Inlet Node, !- Inlet Node Name
  CHWPlant Cnd Supply Outlet Node;            !- Outlet Node Name

BranchList,
  CHWPlant Cnd Demand Side Branches,          !- Name
  CHWPlant Condenser Demand Inlet Branch,     !- Branch 1 Name
  CHWPlant Chiller Condenser Branch,         !- Branch 2 Name
  CHWPlant Condenser Demand Bypass Branch,   !- Branch 3 Name
  CHWPlant Condenser Demand Outlet Branch;   !- Branch 4 Name

ConnectorList,
  CHWPlant Cnd Demand Side Connectors,       !- Name
  Connector:Splitter,                         !- Connector 1 Object Type
  CHWPlant Condenser Demand Splitter,       !- Connector 1 Name
  Connector:Mixer,                           !- Connector 2 Object Type
  CHWPlant Condenser Demand Mixer;          !- Connector 2 Name

Branch,
  CHWPlant Condenser Demand Inlet Branch,     !- Name
  ,                                             !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                             !- Component 1 Object Type
  CHWPlant Cnd Demand Inlet Pipe,            !- Component 1 Name
  CHWPlant Cnd Demand Inlet Node,            !- Component 1 Inlet Node Name
  CHWPlant Cnd Demand In Pipe Outlet Node,   !- Component 1 Outlet Node Name
  Passive;                                       !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWPlant Cnd Demand Inlet Pipe,            !- Name

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CHWPlant Cnd Demand Inlet Node,           !- Inlet Node Name
CHWPlant Cnd Demand In Pipe Outlet Node;  !- Outlet Node Name

Branch,
  CHWPlant Chiller Condenser Branch,      !- Name
  ,                                       !- Maximum Flow Rate {m3/s}
  Chiller:Electric:EIR,                  !- Component 1 Object Type
  CHWPlant Chiller,                       !- Component 1 Name
  CHWPlant Chiller Cond Inlet Node,       !- Component 1 Inlet Node Name
  CHWPlant Chiller Cond Outlet Node,     !- Component 1 Outlet Node Name
  Active;                                 !- Component 1 Branch Control Type

Branch,
  CHWPlant Condenser Demand Bypass Branch, !- Name
  ,                                       !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                        !- Component 1 Object Type
  CHWPlant Condenser Demand Side Bypass, !- Component 1 Name
  CHWPlant Condenser Demand Bypass Inlet Node, !- Component 1 Inlet Node Name
  CHWPlant Condenser Demand Bypass Outlet Node, !- Component 1 Outlet Node Name
  Bypass;                                 !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWPlant Condenser Demand Side Bypass,  !- Name
  CHWPlant Condenser Demand Bypass Inlet Node, !- Inlet Node Name
  CHWPlant Condenser Demand Bypass Outlet Node; !- Outlet Node Name

Branch,
  CHWPlant Condenser Demand Outlet Branch, !- Name
  ,                                       !- Maximum Flow Rate {m3/s}
  Pipe:Adiabatic,                        !- Component 1 Object Type
  CHWPlant Condenser Demand Outlet,       !- Component 1 Name
  CHWPlant Condenser Demand Exit Pipe Inlet Node, !- Component 1 Inlet Node Name
  CHWPlant Cnd Demand Outlet Node,       !- Component 1 Outlet Node Name
  Passive;                                !- Component 1 Branch Control Type

Pipe:Adiabatic,
  CHWPlant Condenser Demand Outlet,       !- Name
  CHWPlant Condenser Demand Exit Pipe Inlet Node, !- Inlet Node Name
  CHWPlant Cnd Demand Outlet Node;       !- Outlet Node Name

Connector:Splitter,
  CHWPlant Condenser Demand Splitter,     !- Name
  CHWPlant Condenser Demand Inlet Branch, !- Inlet Branch Name
  CHWPlant Chiller Condenser Branch,     !- Outlet Branch 1 Name
  CHWPlant Condenser Demand Bypass Branch; !- Outlet Branch 2 Name

Connector:Mixer,
  CHWPlant Condenser Demand Mixer,       !- Name
  CHWPlant Condenser Demand Outlet Branch, !- Outlet Branch Name
  CHWPlant Chiller Condenser Branch,     !- Inlet Branch 1 Name
  CHWPlant Condenser Demand Bypass Branch; !- Inlet Branch 2 Name

Connector:Splitter,
  CHWPlant Condenser Supply Splitter,    !- Name
  CHWPlant Condenser Supply Inlet Branch, !- Inlet Branch Name
  CHWPlant Tower Branch,                 !- Outlet Branch 1 Name
  CHWPlant Condenser Supply Bypass Branch; !- Outlet Branch 2 Name

Connector:Mixer,
  CHWPlant Condenser Supply Mixer,       !- Name
  CHWPlant Condenser Supply Outlet Branch, !- Outlet Branch Name
  CHWPlant Tower Branch,                 !- Inlet Branch 1 Name
  CHWPlant Condenser Supply Bypass Branch; !- Inlet Branch 2 Name

CondenserEquipmentOperationSchemes,
  CHWPlant Condenser Loop Operation,     !- Name
  PlantEquipmentOperation:CoolingLoad,   !- Control Scheme 1 Object Type
  CHWPlant Condenser Only,               !- Control Scheme 1 Name
  FAN-SCHED;                             !- Control Scheme 1 Schedule Name

PlantEquipmentOperation:CoolingLoad,

```



```

CHWPlant Condenser Only,
0,
10000000000000,
CHWPlant Condenser plant;
!- Name
!- Load Range 1 Lower Limit {W}
!- Load Range 1 Upper Limit {W}
!- Priority Control 1 Equipment List Name

CondenserEquipmentList,
CHWPlant Condenser plant,
CoolingTower:SingleSpeed,
CHWPlant Tower;
!- Name
!- Equipment 1 Object Type
!- Equipment 1 Name

CoolingTower:SingleSpeed,
CHWPlant Tower,
CHWPlant Tower Inlet Node,
CHWPlant Tower Outlet Node,
0.0197387,
12.66666,
4813.33108,
28519.42459,
Air Flow Rate {W/K}
0.0,
{m3/s}
0.0;
!- Air Flow Rate in Free Convection Regime
!- U-Factor Times Area Value at Free
Convection Air Flow Rate {W/K}

Pump:VariableSpeed,
CHWPlant Cnd Circ Pump,
CHWPlant Cnd Supply Inlet Node,
CHWPlant Cnd Pump Outlet Node,
0.0197387,
179344.,
5042.75119,
0.9,
0.,
Stream
0.,
Performance Curve
1.,
Performance Curve
0.,
Performance Curve
0.,
Performance Curve
0.,
Performance Curve
0.,
Intermittent;
!- Name
!- Inlet Node Name
!- Outlet Node Name
!- Rated Flow Rate {m3/s}
!- Rated Pump Head {Pa}
!- Rated Power Consumption {W}
!- Motor Efficiency
!- Fraction of Motor Inefficiencies to Fluid
!- Coefficient 1 of the Part Load
!- Coefficient 2 of the Part Load
!- Coefficient 3 of the Part Load
!- Coefficient 4 of the Part Load
!- Minimum Flow Rate {m3/s}
!- Pump Control Type

!-----
!==== file: report.inc ====Start====

Output:VariableDictionary,
regular,
Unsorted;
Output:Surfaces:Drawing,
DXF;
Output:Constructions,
Construction;
!- Type of Report
!- Key Field
!- Sort Option
!- Type of Report
!- Report Name
!- Type of Report

! Output:Diagnostics,
! DisplayExtraWarnings;
!- Type of Report

!***** REPORT VARIABLES *****
Output:Variable,
*,
Outdoor Dry Bulb,
Hourly,
RPT-SCHED;
!- Key_Value
!- Variable_Name {C}
!- Reporting_Frequency
!- Schedule_Name

Output:Variable,
PER-1I,
Zone/Sys Air Temperature,
Hourly,
RPT-SCHED;
!- Key_Value
!- Variable_Name {C}
!- Reporting_Frequency
!- Schedule_Name

```

```

Output:Variable,
  PER-1I,                                     !- Key_Value
  Zone/Sys Thermostat Cooling Setpoint,      !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  PER-1I,                                     !- Key_Value
  Zone/Sys Thermostat Heating Setpoint,      !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name

Output:Variable,
  PER-2I,                                     !- Key_Value
  Zone/Sys Air Temperature,                  !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  PER-3I,                                     !- Key_Value
  Zone/Sys Air Temperature,                  !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  PER-4I,                                     !- Key_Value
  Zone/Sys Air Temperature,                  !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name

Output:Variable,
  COR-1I,                                     !- Key_Value
  Zone/Sys Air Temperature,                  !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  COR-1I,                                     !- Key_Value
  Zone/Sys Thermostat Cooling Setpoint,      !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  COR-1I,                                     !- Key_Value
  Zone/Sys Thermostat Heating Setpoint,      !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name

Output:Variable,
  PLE-I,                                     !- Key_Value
  Zone/Sys Air Temperature,                  !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name

Output:Variable,
  SYS2 Return Fan Outlet,                    !- Key_Value
  System Node Temp,                          !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  SYS2 Mixed Air Outlet,                     !- Key_Value
  System Node Temp,                          !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  SYS2 Mixed Air Outlet,                     !- Key_Value
  System Node Setpoint Temp,                 !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name
Output:Variable,
  SYS2 Fan Outlet,                           !- Key_Value
  System Node Temp,                          !- Variable_Name {C}
  Hourly,                                     !- Reporting_Frequency
  RPT-SCHED;                                  !- Schedule_Name

Output:Variable,

```

```

PER-1I SUPPLY INLET,                !- Key_Value
System Node Temp,                   !- Variable_Name {C}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
PER-2I SUPPLY INLET,                !- Key_Value
System Node Temp,                   !- Variable_Name {C}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
PER-3I SUPPLY INLET,                !- Key_Value
System Node Temp,                   !- Variable_Name {C}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
PER-4I SUPPLY INLET,                !- Key_Value
System Node Temp,                   !- Variable_Name {C}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
COR-1I SUPPLY INLET,                !- Key_Value
System Node Temp,                   !- Variable_Name {C}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name

!*****
Output:Variable,
PER-1I,                              !- Key_Value
Zone/Sys Sensible Cooling Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
PER-1I,                              !- Key_Value
Zone/Sys Sensible Heating Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name

Output:Variable,
PER-2I,                              !- Key_Value
Zone/Sys Sensible Cooling Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
PER-2I,                              !- Key_Value
Zone/Sys Sensible Heating Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name

Output:Variable,
PER-3I,                              !- Key_Value
Zone/Sys Sensible Cooling Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
PER-3I,                              !- Key_Value
Zone/Sys Sensible Heating Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name

Output:Variable,
PER-4I,                              !- Key_Value
Zone/Sys Sensible Cooling Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name
Output:Variable,
PER-4I,                              !- Key_Value
Zone/Sys Sensible Heating Rate,     !- Variable_Name {W}
Hourly,                              !- Reporting_Frequency
RPT-SCHED;                           !- Schedule_Name

Output:Variable,

```

```

COR-1I,                                !- Key_Value
Zone/Sys Sensible Cooling Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
COR-1I,                                !- Key_Value
Zone/Sys Sensible Heating Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name

Output:Variable,
PER-1I REHEAT COIL,                    !- Key_Value
Total Water Heating Coil Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
PER-2I REHEAT COIL,                    !- Key_Value
Total Water Heating Coil Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
PER-3I REHEAT COIL,                    !- Key_Value
Total Water Heating Coil Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
PER-4I REHEAT COIL,                    !- Key_Value
Total Water Heating Coil Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
COR-1I REHEAT COIL,                    !- Key_Value
Total Water Heating Coil Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name

Output:Variable,
SYS2 COOLING COIL,                    !- Key_Value
Total Water Cooling Coil Rate,        !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
SYS2 COOLING COIL,                    !- Key_Value
Sensible Water Cooling Coil Rate,    !- Variable_Name {W}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
!*****
Output:Variable,
PER-1I,                                !- Key_Value
Zone Total Internal Total Heat Gain,  !- Variable_Name {J}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
PER-1I,                                !- Key_Value
Zone People Number Of Occupants,     !- Variable_Name {}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
PER-1I,                                !- Key_Value
Zone People Total Heat Gain,         !- Variable_Name {J}
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
PER-1I,                                !- Key_Value
Zone Lights Electric Power,          !- Variable_Name {W} total including fraction
to return
Hourly,                                !- Reporting_Frequency
RPT-SCHED;                              !- Schedule_Name
Output:Variable,
PER-1I,                                !- Key_Value
Zone Electric Equipment Electric Power, !- Variable_Name {W}

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```

Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name

Output:Variable,
COR-1I,                                     !- Key_Value
Zone Total Internal Total Heat Gain,       !- Variable_Name {J}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
COR-1I,                                     !- Key_Value
Zone People Number Of Occupants,          !- Variable_Name {}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
COR-1I,                                     !- Key_Value
Zone People Total Heat Gain,              !- Variable_Name {J}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
COR-1I,                                     !- Key_Value
Zone Lights Electric Power,               !- Variable_Name {W} total including fraction
to return
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
COR-1I,                                     !- Key_Value
Zone Electric Equipment Electric Power,   !- Variable_Name {W}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
!*****
Output:Variable,
PER-1I,                                     !- Key_Value
Zone Transmitted Solar,                   !- Variable_Name {W}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
PER-1I,                                     !- Key_Value
Zone Window Heat Gain,                   !- Variable_Name {W}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
PER-1I,                                     !- Key_Value
Zone Window Heat Loss,                   !- Variable_Name {W}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name

Output:Variable,
COR-1I,                                     !- Key_Value
Zone Transmitted Solar,                   !- Variable_Name {W}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
COR-1I,                                     !- Key_Value
Zone Window Heat Gain,                   !- Variable_Name {W}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
COR-1I,                                     !- Key_Value
Zone Window Heat Loss,                   !- Variable_Name {W}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
!*****
Output:Variable,
PER-1I,                                     !- Key_Value
Zone Infiltration Total Heat Loss,        !- Variable_Name {J}
Hourly,                                     !- Reporting_Frequency
RPT-SCHED;                                 !- Schedule_Name
Output:Variable,
PER-1I,                                     !- Key_Value
Zone Infiltration Total Heat Gain,        !- Variable_Name {J}
Hourly,                                     !- Reporting_Frequency

```

```

RPT-SCHED;                                !- Schedule_Name

!*****
! Reports intermediate storey plenum "floor" surface temperatures
! "Inside" is occupied zone side; "outside" is plenum side

Output:Variable,
  PER-1II_2,                                !- Key_Value
  Surface Inside Temperature,               !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  PER-1II_2,                                !- Key_Value
  Surface Outside Temperature,              !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  PER-2II_2,                                !- Key_Value
  Surface Inside Temperature,               !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  PER-2II_2,                                !- Key_Value
  Surface Outside Temperature,              !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  PER-3II_2,                                !- Key_Value
  Surface Inside Temperature,               !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  PER-3II_2,                                !- Key_Value
  Surface Outside Temperature,              !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  PER-4II_2,                                !- Key_Value
  Surface Inside Temperature,               !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  PER-4II_2,                                !- Key_Value
  Surface Outside Temperature,              !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  COR-1II_2,                                !- Key_Value
  Surface Inside Temperature,               !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  COR-1II_2,                                !- Key_Value
  Surface Outside Temperature,              !- Variable_Name {C}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name

!*****
Output:Variable,
  SYS2 Fan Outlet,                          !- Key Value
  System Node MassFlowRate,                 !- Variable Name {kg/s}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name
Output:Variable,
  SYS2 Fan Outlet,                          !- Key Value
  System Node VolFlowRate,                  !- Variable Name {m3/s}
  Hourly,                                   !- Reporting_Frequency
  RPT-SCHED;                                !- Schedule_Name

Output:Variable,
  SYS2 Outside Air Inlet,                   !- Key Value

```

```

System Node MassFlowRate,           !- Variable Name {kg/s}
Hourly,                             !- Reporting_Frequency
RPT-SCHED;                          !- Schedule_Name

!*****
! Fan outlet flow - sum of damper outlet flows = upstream duct leakage flow
! Sum of damper outlet flows - sum of supply inlet flows = downstream duct leakage flow

Output:Variable,
  PER-1I Damper Outlet,              !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  PER-2I Damper Outlet,              !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  PER-3I Damper Outlet,              !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  PER-4I Damper Outlet,              !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  COR-1I Damper Outlet,              !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name

Output:Variable,
  PER-1I Supply Inlet,               !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  PER-2I Supply Inlet,               !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  PER-3I Supply Inlet,               !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  PER-4I Supply Inlet,               !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  COR-1I Supply Inlet,               !- Key Value
  System Node MassFlowRate,         !- Variable Name
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name

!*****
! Intermediate storey AHU fans
Output:Variable,
  SYS2 Supply Fan,                  !- Key Value
  Fan Electric Power,               !- Variable Name {W}
  Hourly,                           !- Reporting_Frequency
  RPT-SCHED;                        !- Schedule_Name
Output:Variable,
  SYS2 Return Fan,                  !- Key Value
  Fan Electric Power,               !- Variable Name {W}
  Hourly,                           !- Reporting_Frequency

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RPT-SCHED;                                !- Schedule_Name

! Chilled water circ, condenser water circ, and hot water circ pumps
Output:Variable,
*,                                          !- Key_Value
  Pump Electric Power,                    !- Variable_Name {W}
  Hourly,                                  !- Reporting_Frequency
  RPT-SCHED;                              !- Schedule_Name

Output:Variable,
*,                                          !- Key_Value
  Chiller Electric Power,                 !- Variable_Name {W}
  Hourly,                                  !- Reporting_Frequency
  RPT-SCHED;                              !- Schedule_Name

Output:Variable,
*,                                          !- Key_Value
  Tower Fan Electric Power,              !- Variable_Name {W}
  Hourly,                                  !- Reporting_Frequency
  RPT-SCHED;                              !- Schedule_Name

Output:Variable,
*,                                          !- Key_Value
  Boiler Gas Consumption Rate,           !- Variable_Name {W}
  Hourly,                                  !- Reporting_Frequency
  RPT-SCHED;                              !- Schedule_Name

Output:Variable,
*,                                          !- Key_Value
  Total HVAC Electric Demand,           !- Variable_Name {W}
  Hourly,                                  !- Reporting_Frequency
  RPT-SCHED;                              !- Schedule_Name
Output:Variable,
*,                                          !- Key_Value
  Total Building Electric Demand,       !- Variable_Name {W}
  Hourly,                                  !- Reporting_Frequency
  RPT-SCHED;                              !- Schedule_Name

!***** REPORT TABLES *****
OutputControl:Table:Style,
  comma;                                   !- Column Separator

Output:Table:Monthly,
  Zone Cooling Summary,                   !- Name
  2,                                       !- Digits After Decimal
  Zone Mean Air Temperature, SumOrAverage, !- Variable or Meter Name + Aggregation Type
  Zone/Sys Sensible Cooling Energy, SumOrAverage, !- Variable or Meter Name + Aggregation Type
  Zone/Sys Sensible Cooling Rate, Maximum, !- Variable or Meter Name + Aggregation Type
  Outdoor Dry Bulb, ValueWhenMaximumOrMinimum, !- Variable or Meter Name + Aggregation Type
  Outdoor Wet Bulb, ValueWhenMaximumOrMinimum, !- Variable or Meter Name + Aggregation Type
  Zone Total Internal Latent Gain, SumOrAverage, !- Variable or Meter Name + Aggregation Type
  Zone Total Internal Latent Gain, Maximum, !- Variable or Meter Name + Aggregation Type
  Outdoor Dry Bulb, ValueWhenMaximumOrMinimum, !- Variable or Meter Name + Aggregation Type
  Outdoor Wet Bulb, ValueWhenMaximumOrMinimum; !- Variable or Meter Name + Aggregation Type

Output:Table:Monthly,
  Building Loads - Heating,               !- Name
  2,                                       !- Digits After Decimal
  Zone/Sys Sensible Heating Energy, SumOrAverage, !- Variable or Meter Name + Aggregation Type
  Zone/Sys Sensible Heating Rate, Maximum, !- Variable or Meter Name + Aggregation Type
  Outdoor Dry Bulb, ValueWhenMaximumOrMinimum; !- Variable or Meter Name + Aggregation Type

Output:Table:Monthly,
  Zone Electric Summary,                  !- Name
  2,                                       !- Digits After Decimal
  Zone Lights Electric Consumption, SumOrAverage, !- Variable or Meter Name +
Aggregation Type
  Zone Lights Electric Consumption, Maximum, !- Variable or Meter Name +
Aggregation Type
  Zone Electric Equipment Electric Consumption, SumOrAverage, !- Variable or Meter Name +
Aggregation Type

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Zone Electric Equipment Electric Consumption, Maximum;      !- Variable or Meter Name +
Aggregation Type

Output:Table:Monthly,
  Energy Consumption - Electricity & Natural Gas,      !- Name
  2,                                                    !- Digits After Decimal
  Electricity:Building, SumOrAverage,                  !- Variable or Meter Name + Aggregation Type
  Electricity:Building, Maximum,                       !- Variable or Meter Name + Aggregation Type
  Gas:Facility, SumOrAverage,                          !- Variable or Meter Name + Aggregation Type
  Gas:Facility, Maximum;                               !- Variable or Meter Name + Aggregation Type

Output:Table:Monthly,
  Building Energy Consumption - Electricity,           !- Name
  2,                                                    !- Digits After Decimal
  Fans:Electricity, SumOrAverage,                      !- Variable or Meter Name + Aggregation Type
  Pumps:Electricity, SumOrAverage,                    !- Variable or Meter Name + Aggregation Type
  Cooling:Electricity, SumOrAverage,                  !- Variable or Meter Name + Aggregation Type
  HeatRejection:Electricity, SumOrAverage,            !- Variable or Meter Name + Aggregation Type
  Heating:Electricity, SumOrAverage,                  !- Variable or Meter Name + Aggregation Type
  InteriorLights:Electricity, SumOrAverage,           !- Variable or Meter Name + Aggregation Type
  InteriorEquipment:Electricity, SumOrAverage;        !- Variable or Meter Name + Aggregation Type

Output:Table:Monthly,
  Peak Energy End-Use - Electricity,                  !- Name
  2,                                                    !- Digits After Decimal
  Fans:Electricity, Maximum,                          !- Variable or Meter Name + Aggregation Type
  Pumps:Electricity, Maximum,                        !- Variable or Meter Name + Aggregation Type
  Cooling:Electricity, Maximum,                      !- Variable or Meter Name + Aggregation Type
  HeatRejection:Electricity, Maximum,                !- Variable or Meter Name + Aggregation Type
  Heating:Electricity, Maximum,                      !- Variable or Meter Name + Aggregation Type
  InteriorLights:Electricity, Maximum,               !- Variable or Meter Name + Aggregation Type
  InteriorEquipment:Electricity, Maximum;            !- Variable or Meter Name + Aggregation Type

Output:Table:Monthly,
  Building Energy Performance - Natural Gas,          !- Name
  2,                                                    !- Digits After Decimal
  Heating:Gas, SumOrAverage;                          !- Variable or Meter Name + Aggregation Type

Output:Table:Monthly,
  Peak Energy End-Use - Natural Gas,                  !- Name
  4,                                                    !- Digits After Decimal
  Heating:Gas, Maximum;                               !- Variable or Meter Name + Aggregation Type

!==== file: report.inc ====End====

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