[EnergyPlus_Support] Zone Level Airflows

6 messages

Celia King-Scott <celiakingscott@yahoo.com>   Wed, Jun 26, 2013 at 11:17 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

Hi,

I was wondering if any can help me with an issue I am experiencing in EnergyPlus.
Initially when we looked at the User Design Airflow column under Zone Cooling Loads in the output I saw that the supply air-to-room air temperature was much less than 20F even though the room setpoint was at 75 and supply temperature was 55F. (Following ASHRAE 90.1 2007 Appendix G requirements for Baseline model). We corrected this by adjusting the design outside air at the zone level sizing parameter however now the undercooled hours are about 1000 (much more than allowed). This tells that without taking the outside air into account for zone sizing, there isn't enough airflow to cool the space during the year. The outside air zone sizing parameter isn't used for calculating the cooling capacity, only the airflow, which is what I think is causing difference in temperature differences in the zone. However how do we meet the supply air-to-room air temperature delta T requirement and have less than 300 unmet load hours as also required?

I have attached the Baseline idf and output for your review.
Thank you for your time on this. Any help is greatly appreciated.

Celia

__._,_.___

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2 attachments

□ **Baseline.idf**
   835K

□ **BaselineTable.csv**
   105K

Jim Dirkes <jim@buildingperformanceteam.com>   Thu, Jun 27, 2013 at 12:53 AM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

Dear Celia,

The "Central Cooling Design Supply Temperature" must be 11.1C below the zone cooling setpoint in order to achieve your goal. Since you supply the air at 13.3C and serve 20 zones, ALL of the zone setpoints must be ~24.4   – and they are not.

Similarly, the zone heating setpoints must be 11.1C lower than, in this case, the Zone Heating Design Supply Air Temperature (35C) in Sizing:Zone – and they are not.

For an ASHRAE 90.1 energy model, each zone <u>on a particular system</u> must use a uniform setpoint for heating or cooling! The fact that the actual design may use somewhat different zone setpoints is not relevant, although I suppose that you are allowed to specify a delta T <u>larger</u> than 11.1C. The purpose of the Baseline – Proposed model is … the comparison between a "fictitious" Baseline system and an almost-true Proposed system. In order to make the comparison consistent and understandable, some variables (like setpoints and schedules) must be regulated.

I looked very quickly at your IDF and may have missed some things, but I think that you will see an improvement if you change these setpoints.

Obj15	Obj16	Obj17	Obj18	Obj19
SuperMarket_HTG SETP_SCH_24/7	SuperMarket_CLG SETP_SCH_24/7	UPC/Pharmacy_CL GSETP_SCH_24/7	Tenant_HTGSETP _SCH_6-10	Tenant_CLGSETP _SCH_6-10
Temperature	Temperature	Temperature	Temperature	Temperature
Through: 12/31	Through: 12/31	Through: 12/31	Through: 12/31	Through: 12/31
For SummerDesignDay	For WinterDesignDay	For WinterDesignDay	For SummerDesignDay	For WinterDesignDay
Until: 24:00	Until: 24:00	Until: 24:00	Until: 24:00	Until: 24:00
19.44	24.4	22.78	15.56	25.56
For: AllOtherDays	For: AllOtherDays	For: AllOtherDays	For: AllOtherDays	For: AllOtherDays
Until: 6:00	Until: 6:00	Until: 6:00	Until: 6:00	Until: 6:00
19.44	24.4	22.78	15.56	25.56
Until: 22:00	Until: 22:00	Until: 22:00	Until: 22:00	Until: 22:00
19.44	24.4	22.78	19.44	24.4
Until: 24:00	Until: 24:00	Until: 24:00	Until: 24:00	Until: 24:00
19.44	24.4	22.78	15.56	25.56

James V Dirkes II, PE, BEMP, LEED AP
www.buildingperformanceteam.com
Energy Analysis, Commissioning & Training Services
1631 Acacia Drive, Grand Rapids, MI 49504 USA
616 450 8653

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matthewrlarson@eaton.com <matthewrlarson@eaton.com>   Fri, Jun 28, 2013 at 7:31 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: EnergyPlus_Support@yahoogroups.com

I've worked on this model some as well and wanted to expand on this discussion. In order to zone the capacities at the zone level, the sizing:zone object was used with the TemperatureDifference Zone Cooling Design Supply Air Temperature Method using 20F dT shown below. You can see this from looking at the HVAC Sizing Summary Report for Zone Cooling under the Calculated dT determined from the Calculated Design Load and Air Flow. The User Design Load is then 1.15 times the Calculated which makes sense since I have a 1.15 sizing factor. The interesting part comes in when looking at the User Design Air Flow. This was increased past the 1.15 sizing factor for a number of the zones which resulted in a lower User Design dT shown in the below table. I determined this was from specifying design outdoor air conditions per person and per square foot. When I removed the design OA conditions, the User Design dT matched the Calculated dT. The problem now is that the total airflow reduced significantly so the undercooled hours is now about 1,000, which tells me that without taking the outside air into account for zone sizing, there isn't enough airflow to cool the space during the year. My takeaway is that the outside air zone sizing parameter isn't used for calculating the cooling capacity, only the airflow, which is what I think is causing difference in temperature differences between the zones. My thinking is that to satisfy the baseline requirements for 90.1, the temperature difference should be specified at 20F which will properly size the cooling capacity and then the airflow can be increased if required based on the OA design specifications. ASHRAE 90.1 App G Section G3.1.2.8 specifies the airflow be based on a 20F dT but I see no other way to do this than let the airflow be adjusted based on design OA even though it may reduce the design temperature difference. I should also note that the required

ventilation air is less than the User Design Air Flow for all the zones. The OA is just being accounted for after the cooling capacity is calculated instead of before. If I am missing anything or if anyone has any thoughts on this, I'd love to get some feedback. Below are some screenshots showing the sizing:zone object and the HVAC Sizing Summary Report for Zone Cooling.

```
Sizing:Zone,
    Sales,                      !- Zone Name
    TemperatureDifference,       !- Zone Cooling Design Supply Air Temperature Method
    ,                           !- Zone Cooling Design Supply Air Temperature {C}
    11.1,                        !- Zone Cooling Design Supply Air Temperature Difference {C}
    SupplyAirTemperature,        !- Zone Heating Design Supply Air Temperature Method
    35.0,                        !- Zone Heating Design Supply Air Temperature {C}
    ,                           !- Zone Heating Design Supply Air Temperature Difference {C}
    0.0085,                      !- Zone Cooling Design Supply Air Humidity Ratio {kg-H2O/kg-air}
    0.0080,                      !- Zone Heating Design Supply Air Humidity Ratio {kg-H2O/kg-air}
    Sales OA Design,             !- Design Specification Outdoor Air Object Name
    ,                           !- Zone Heating Sizing Factor
    ,                           !- Zone Cooling Sizing Factor
    DesignDay,                   !- Cooling Design Air Flow Method
    ,                           !- 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
    DesignDay,                   !- Heating Design Air Flow Method
    ,                           !- 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
    ;                           !- Design Specification Zone Air Distribution Object Name
 DesignSpecification:OutdoorAir,
    Sales OA Design,             !- Name
    Sum,                        !- Outdoor Air Method
    0.47194744E-02,                  !- Outdoor Air Flow per Person {m3/s-person}
    0.91440004E-03,              !- Outdoor Air Flow per Zone Floor Area {m3/s-m2}
    ;                           !- Outdoor Air Flow per Zone {m3/s}
```

REPORT:	HVAC Sizing Summary						
FOR:	Entire Facility						
Zone Cooling							
		Calculated Design Load [Btu/h]	User Design Load [Btu/h]	Calculated Design Air Flow [ft3/min]	User Design Air Flow [ft3/min]	Calculated dT	User Design dT
	OPTICALS.	2703.27	3108.77	128.063	198.374	19.54528457	14.51042345
	BREAKRO(	19012.39	21864.25	900.68	1352.369	19.54530445	14.96978704
	UPC	1574.43	1810.6	74.586	85.774	19.54529745	19.54533403
	BAKERY	34648.97	39846.31	1641.436	1887.651	19.54531254	19.54531398
	FRONTOFI	1901.2	2186.38	90.066	133.126	19.54533753	15.20684108
	CUSTOME	2430.31	2794.86	115.132	165.399	19.54527878	15.6460035
	STOCKRO(	30692.66	35296.56	1454.012	3255.522	19.54531987	10.03894306
	GRVESTIB|	15858.72	18237.53	751.28	863.972	19.54530934	19.54531148
	FOODTEN.	11897.65	13682.3	563.631	648.176	19.54530995	19.54530297
	HALLWAY	1871.6	2152.34	88.664	199.224	19.5452829	10.00335004
	OPTICALE:	2434.15	2799.27	115.314	175.485	19.54526417	14.77001833
	SALES	0	0	0	28158.07	#DIV/0!	0
	FOODTEN.	15005.29	17256.09	710.85	817.478	19.54531482	19.54531022
	PHARMAC	3154.97	3628.22	149.462	171.881	19.54522567	19.54528402
	APOFFICE	2964.86	3409.58	140.455	368.575	19.54534008	8.565471121
	GMVESTIE	15079.74	17341.7	714.377	821.533	19.54531322	19.54532518
	MEATUTIL	0	0	0	371.052	#DIV/0!	0
	TRAINING	5509.4	6335.81	260.999	300.148	19.54527142	19.54532677
	DELI	51298.15	58992.87	2430.162	2794.687	19.54531716	19.54531143
	BANKTEN.	2767.94	3183.13	131.126	150.795	19.54537931	19.54536021

Thanks,

Matthew Larson, PE, CEM, BEMP, LEED AP BD+C
Project Engineer

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MatthewRLarson@Eaton.com
www.eaton.com/energysolutions

From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] **On Behalf Of** Jim Dirkes
Sent: Wednesday, June 26, 2013 4:54 PM
To: EnergyPlus_Support@yahoogroups.com
Subject: RE: [EnergyPlus_Support] Zone Level Airflows

[Quoted text hidden]

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2 attachments

> **image004.jpg**
> 1K

image007.jpg
1K

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jeannieboef@gmail.com <jeannieboef@gmail.com>   Fri, Jun 28, 2013 at 8:27 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>
Cc: "<EnergyPlus_Support@yahoogroups.com>" <EnergyPlus_Support@yahoogroups.com>

Sizing:zone object you specify the air temperature and humidity with which the air should enter the zone (it doesn't matter where the air comes from or what amount of it is ODA). This air's energy (enthalpy and moisture) is added to the zones energy and moisture balance equations. In effect the volume airflow to meet the load at specified supply temp is calculated...sizing factor is included.

This is how the load is deturmined for the zone. The equipment is then sized (sizing:system object) to meet this load (air flow at specified temp). It may be specified that the equipment must supply a minimum ODA amount (and the equipment looks up this value from the sizing:zone object). If the value of the minimum ODA flowrate exceeds the total needed for cooling, the ODA rate will be used (100% ODA) and conditioned to the setpoints. The setpoint manager assigned air

setpoint temps should be setup to deliver at least the air at the same
setpoints as the design air setpoints that you put in the sizing:zone
object.
>

__._,_.___

Jim Dirkes <jim@buildingperformanceteam.com>   Fri, Jun 28, 2013 at 8:37 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

In addition to Jean's comments…..

I have not looked into it in detail, but every so often an auto-sized zone will not meet all of the loads (i.e., there will be lot of unmet load hours).

ASHRAE 90.1 anticipates this and allows the modeler to increase the sizing factor as needed to get the unmet loads under control.

If this situation occurs, I check my inputs for the problem zone(s) and if they look OK, I try raising the zone sizing factor. That normally helps.

James V Dirkes II, PE, BEMP, LEED AP
www.buildingperformanceteam.com
Energy Analysis, Commissioning & Training Services
1631 Acacia Drive, Grand Rapids, MI 49504 USA
616 450 8653

From: EnergyPlus_Support@yahoogroups.com [mailto:EnergyPlus_Support@yahoogroups.com] **On Behalf Of** jeannieboef@gmail.com
Sent: Friday, June 28, 2013 2:28 PM
To: EnergyPlus_Support@yahoogroups.com
Cc: <EnergyPlus_Support@yahoogroups.com>
Subject: Re: [EnergyPlus_Support] Zone Level Airflows

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>

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Jim Dirkes <jim@buildingperformanceteam.com>   Fri, Jun 28, 2013 at 9:22 PM
Reply-To: EnergyPlus_Support@yahoogroups.com
To: "EnergyPlus_Support@yahoogroups.com" <EnergyPlus_Support@yahoogroups.com>

p.s., Just in case it escaped your notice, the "SystemSummary" report provides a very nice summary, <u>zone by zone</u>, of unmet load hours for each month.

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