

Simulation Diagnostics | Hacking Simulation CIBSE simulation Group

Annie Marston Ph.D., BEMP, LEED AP | 20th March 2018



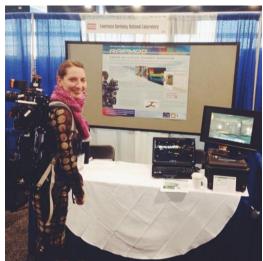
Don't Compromise -- Simulate







About Me



Ph.D. in Renewable Energy and Architecture

Worked on mostly American and German buildings

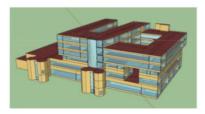
Simulation Specialist

Over 10 years of experience

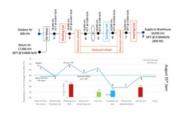
My work Includes:

- Over 75 LEED projects (8 Platinum)
- 2 net zero buildings
- Research projects for American government
- 10 IEMPs
- CFD studies, thermal comfort studies, daylighting studies, optimization studies.

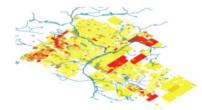
Services



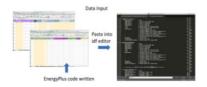
Energy modelling for LEED



Complex HVAC and controls

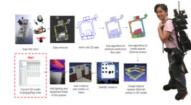


IEMP and community co-ops



Teaching and online courses

Simulation beyond certification and compliance



Automatic Energy Model



Post Occupancy Controls



Integrated Energy Master Plans



OD for Energy Models



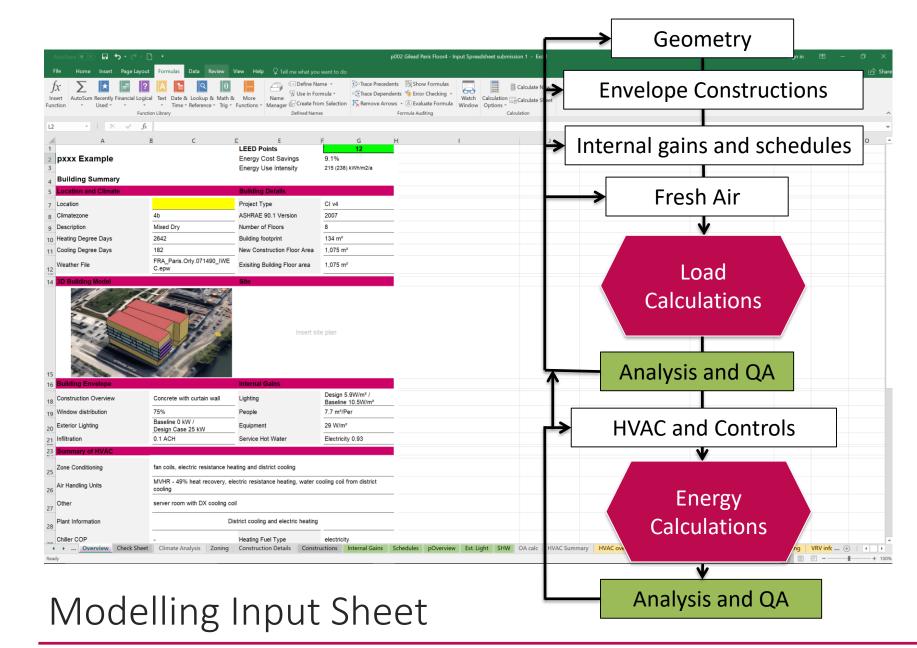


PROBLEM 1: Inputting data into a simulation engine GUI takes lots of time, is complicated and prone to errors

PROBLEM 2: Input errors and misunderstanding outputs leads to poor results, lack of confidence in modelling and, at worse, incorrect analysis and advice to the client

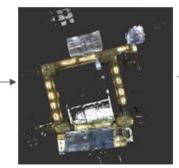


"The first principle is you must not fool yourself – and you are the easiest person to fool" Richard Feynman*

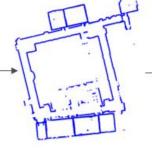




Scan the room

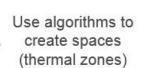


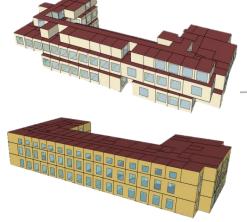
Data removal



Work with 2D data Use algorithms to produce continuous

floor plan





Area 95.0 Celler 0.0 CFLIR 76.3 CFLIR 076.3 CFLIR 076.3 CFLIR 076.3

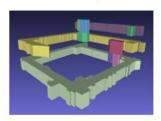
Add lighting and equipment loads to the spaces



Add windows and window U-Value



Identify windows



Create distinct spaces (thermal zones) in 3D model

Data Input - Geometry

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sign Case Construction	on (SI)					200F 1		ENERGYPLUS code	Baseline Case Construction (SI Roof - Gilead							ENERGYPLUS code
Name of Assembly:	Roof with e	external Insulation unde	ter sealing	Residential?		ode in documenation		ENERGTPLUS code	Name of Assembly:	Roof (Insulatio	on Entirely Above Deck)		Residential? no			ENERGTPLUS code
ver Material	Count for R- d				at Heat Capacity	U-Value (W/mªK)	no fiim	(Construction	Layer Material	Count for R-d			Specific Heat Capacity	/alue (W/m2K)	no film	Construction
	value? y/n [mm]	[m] (W/mK)	()λ (m^aK/W) R 0.03	(kg/m³) (J/kg.k)	(Wh/mª.K)			Construction,Roof - Gilead,Roof - Gilear,		value? [mm] [r	m] (W/mK)λ (m2	2K/W) R (kg/m [#]) He	at(J/kg.k) (Wh/mª.K)			Construction Roof - Gilead Roof -
e Outside Air Film 1 Insulation	y 132	0.13	0.04 3	256 8	37 7,857	0.30	0.27 W/m2K	Material, Roof - Gilead - Insulation 132m -	a e Outside Air Film 1 Rigid Insulation (baseline)	y 132	0.132 0.04	3.29 256	837 7838	0.30	0.27 W/m2K	Material,Roof - Gilead - Rigid Insu
2 Concrete	n 230	0.23	0.62 0	2243 8	119,944	2.70		Material,Roof - Gilead - Concrete 230mr.	2 Concrete (baseline) g i Inside Air Film	n 230	0.230 0.62	0.37 2243	837 119944	2.70	230	Material, Roof - Gilead - Concrete
	ess of the construction	0.36		U	Value Assembly 0.	0.26 W/m ³ K	****				0.36 m	0.12	U Value Assembly 0.27		0.048 Btu/(h'ft"F)	
	R-value Insulation	3.30	19		Heat Capacity 1	28				R-value Insulation	3.29 m²/K/W		Heat Capacity 128			
terior Wall - Gilead Cur				and the second se		Ext Wall 1			Exterior Wall - Gilead Curtain w	all				1		
Name of Assembly:		all (see glazing) d Conducti		Residential?		ode in documenation			Name of Assembly:		d Conductivity R		Residential? no			
iyer Material	Count for R- d value? yin [mm]	[m] (W/mK)		Density Specific Hea (kg/m ^a) (J/kg.k)	(Wh/m ^a .K)	U-Value (W/mªK)	no film	!Construction	Layer Material		m] (W/mK) λ (m2	R-Value Density 1 (2K/W) R (kg/m ^e) He	Specific Heat Capacity at(J/kg.k) (Wh/m ² .K)	/alue (W/m2K)	no film	Construction
e Outside Air Film			0.03				0.33 W/m2K	Construction,Exterior Wall - Gilead Curti				0.03			0.36 W/m2K	Construction, Exterior Wall - Gilea
1 Insulation 2 Concrete	n 100 n 300		0.04 3	2243 8 256 8	37 52,150 37 17,856	0.40		Material, Exterior Wall - Gliead Curtain w . Material, Exterior Wall - Gliead Curtain w .	1 Concrete (baseline) 2 Cavity Wall Insulation (Bas		0.100 0.620	0.16 256 2.54 2243	837 5952 837 52922	6.20 0.39		Material, Exterior Wall - Gilead Cu Material, Exterior Wall - Gilead Cu
3 Plaster Board	n 13		0.23 0.06		00 5,200	17.69		Material, Exterior Wall - Gilead Curtain w .	3 Gypsum Board (Baseline)		0.013 0.230	0.06 1800	800 5200	17.69		Material, Exterior Wall - Gilead Cu
Inside Air Film Thickne	ess of the construction	0.41	0.12	v	Value Assembly 0.	8.29 0.31 W/m²K			a i Inside Air Film Thickness	of the construction	0.21 m	0.12	U Value Assembly 0.36	8.29 3 W/m ² K	0.064 Btu/(h'ftº'F)	
	R-value Insulation	0.00	0		Heat Capacity 7	5				R-value Insulation	2.54 m²/K/W		Heat Capacity 64		. ,	
terior Wall - Gilead Con						Ext Wall 1			Exterior Wall - Gilead Concrete					1		
Name of Assembly:	Concrete p			Residential?		ode in documenation			Name of Assembly:		d Conductivity R		Residential? no			
ayer Material	R-value (mm) insulation?	d Conducti [m] (W/mK)		Density Specific Hea (kg/m ^a) (J/kg.k)	at Heat Capacity (Wh/m ² .K)	U-Value (W/mªK)	no film	!Construction	Layer Material		m] (W/mK) λ (m2	R-Value Density 1 (2K/W) R (kg/m ^e) He	Specific Heat Capacity at(J/kg.k) (Wh/m ² .K)	/alue (W/m2K)	no film	Construction
e Outside Air Film			0.03				0.33 W/m2K	Construction,Exterior Wall - Gilead Conc.				0.03			0.36 W/m2K	Construction, Exterior Wall - Gilead
1 Concrete 2 Insulation	n 300 n 100		0.62 0.48	2243 8 256 8	37 156,449 37 5,952	2.07		Material, Exterior Wall - Gliead Concrete . Material, Exterior Wall - Gliead Concrete .	1 Concrete (baseline) 2 Cavity Wall Insulation (Bas		0.100 0.620	0.16 256	837 5952 837 52922	6.20		Material, Exterior Wall - Gilead Cor Material, Exterior Wall - Gilead Cor
3 Plaster Board	n 13		0.23 0.06		00 5,200	17.69		Material, Exterior Wall - Gilead Concrete .	3 Gypsum Board (Baseline)		0.013 0.230	0.06 1800	800 5200	17.69		Material, Exterior Wall - Gilead Cor
Inside Air Film Thickne	ess of the construction	0.41	0.12	v	Value Assembly 0.	8.29 0.31 W/m²K		-	a i Inside Air Film Thickness	of the construction	0.21 m	0.12	U Value Assembly 0.36	8.29 3 W/m ³ K	0.064 Btu/(h'ftº'F)	
	R-value Insulation	0.00			Heat Capacity 1	68				R-value Insulation	2.54 mª/K/W		Heat Capacity 64			
erior Wall - Gilead Con			-			nt Wall 1			Interior Wall - Gilead Concrete	· · · ·	1					
Name of Assembly:	Count for R- d			Residential?	NO C	Code in Documentation										
		d Conducti	huby D Malue	Density Specific Hea	1 Heat Canacity				Name of Assembly:	Concrete	d Conductivity R	Value Density	Roscific Heat Capacity			
iyer Material	value? y/n [mm]	d Conducti [m] (W/mK)		Density Specific Hea (kg/m²) (J/kg.k)	at Heat Capacity (Wh/m ² .K)	U-Value (W/mªK)	no fim	!Construction		Count for R- d		R-Value Density : (kg/m [®]) He	Specific Heat Capacity U-V at(J/Kg.k) (Wh/m².K)	/alue (W/m2K)	no fiim	Construction
e Outside Air Film	value? y/n [mm]	[m] (W/mK)	() λ (m ^q K/W) R 0.03	(kg/m²) (J/kg.k)	(Wh/m².K)	U-Value (W/mªK) 33.33	no fim 3.10 W/m2K	Construction,Interior Wall - Gilead Concre	Name of Assembly: Layer Material α e Outside Air Film	Count for R- d value? [mm] [r	m] (W/mK) λ (m2	2K/W) R (kg/m ^e) He 0.03	at(J/kg.k) (Wh/m².K)	33.33	no film	Construction, Interior Wall - Gilead
		[m] (W/mK)	()λ (m ^a K/W) R	(kg/m²) (J/kg.k)		U-Value (W/mªK)			Name of Assembly: Layer Material α e Outside Air Film	Count for R- d		(kg/m ^e) He				Construction, Interior Wall - Gilead
Outside Air Film Concrete Conc	value? y/n [mm]	[m] (W/mK)	()λ (m ^q KW) R 0.03 0.62 0.32	(kg/m²) (J/kg.k)	(Wh/m².K)	U-Value (W/m ^a K) 33.33 3.10		Construction,Interior Wall - Gilead Concre	Name of Assembly: Layer Material a e Outside Air Film 1 concrete (Baseline) 2 3 3	Count for R- d value? [mm] [r n 200	m] (W/mK) λ (m2 0.2 0.62 0 0	2K/W) R (kg/m ⁴) He 0.03 0.32 2243 #DIV/01 0 #DIV/01 0	at(J/kg.k) (Wh/m².K)	33.33 3.10		Construction, Interior Wall - Gilead
e Outside Air Film 1 concrete 2 3 Inside Air Film Thickne	value? y/n [mm]	[m] (W/mK)	() λ (m ^q K/W) R 0.03	(kg/m ⁴) (J/kg.k) 2243 8:	(Wh/m².K)	U-Value (W/m²K) 33.33 3.10 8.29		Construction,Interior Wall - Gilead Concre	Name of Assembly: Layer Material α e Outside Air Film 1 concrete (Baseline) 2 3 ai nside Air Film 1	Count for R- value? d (mm) [m n 200 0 0 0 0 0 0 of the construction 0 0 0	m] (W/mK) λ (m2 0.2 0.62 0 0 0 0 0.20 m	2K/W) R (kg/m ⁴) He 0.03 0.32 2243 #DIV/01 0	ati(J/kg.k) (Wh/m ² .K) U.X 837 104300 0 0 0 0 0 0 0 0 0 0 U Value Assembly "IDIV	33.33 3.10 8.33		Construction Construction, Interior Wall - Gilead Material, Interior Wall - Gilead Con
Outside Air Film Concrete Con	value? yin (mm) n 200	[m] (W/mK)	()λ (m ^q KW) R 0.03 0.62 0.32	(kg/m ⁴) (J/kg.k) 2243 8:	(Wh/m ² .K) 104300 0 0	U-Value (Wim*K) 33.33 3.10 8.29 2.11 Wim*K		Construction,Interior Wall - Gilead Concre	Name of Assembly: Layer Material α e Outside Air Film 1 concrete (Baseline) 2 3 ai nside Air Film 1	Count for R- value? d (mm) [m n 200 0 0 0 0 0 0 of the construction 0 0 0	m] (W/mK) λ (m2 0.2 0.62 0 0 0 0	2K/W) R (kg/m ⁴) He 0.03 0.32 2243 #DIV/01 0 #DIV/01 0	837 104300 0 0	33.33 3.10 8.33	#DIV/0!	Construction, Interior Wall - Gilead
Outside Air Film Concrete Z Inside Air Film Thickne	value? yin [mm] n 200 ess of the construction R-value insulation e in EnergyPlus	[m] (W/mK)	() Å (m ⁴ K/W) R 0.62 0.32 0.12 0	(kgim ⁴) (Jikg.k) 2243 8:	(Wh/m ² .K) 137 104300 0 1 Value Assembly 2. Heat Capacity 10 B	U-Value (Wilm ² K) 33.33 3.10 8.29 2.11 Wim ² K 104 Selow Grade Wall 1		Construction Interior Wall - Gilead Concret Material,Interior Wall - Gilead Concrete - c	Name of Assembly: Layer Material 0 Outside Air Film 1 concrete (Baseline) 2 3 Inside Air Film 1 inside Air Film Thickness	Count for R- d value? (mm) [r n 200 0 0 of the construction R-value Insulation	m] (W/mK) λ (m2 0.2 0.62 0 0 0 0 0 0.20 m 0.00 m ² /K/W	2K/W) R (kg/m ⁴) He 0.03 0.32 2243 #DIV/01 0 #DIV/01 0	at(J/kg.k) (Wh/m ⁴ /K) U.3 837 104300 0 0 0 U Value Assembly // 014 Heat Capacity 104	33.33 3.10 8.33	#DIV/0!	Construction, Interior Wall - Gilead
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Outside Air Film Concrete Outside Air Film Concrete S Inside Air Film Thickne Name of Assembly: yer Material	value? yin [mm] n 200 ess of the construction R-value insulation in EnergyPlus Concrete t	(m) (Wimk) 0.20 	() Å (m ^B K/W) R 0.62 0.32 0.62 0.32 0.12 0 0 0 0 0 0 0 0 0 0 0	(kg/m ²) (Jkg.k) 2243 8: V Residential?	(Wh/m ² .K) I37 104300 0 1 Value Assembly 2. Heat Capacity 10 No C at Heat Capacity	U-Value (Wilm ² K) 33.33 3.10 8.29 2.11 Wim ² K 104 Selow Grade Wall 1	3.10 W/m2K	Construction,Interior Wall - Gilead Concret Material.Interior Wall - Gilead Concrete - c	Name of Assembly Layer Material o Outside Air Film 1 concrete (Baselme) 2 3 oi Inside Air Film Clow Ortsde Wolfer Manne In Entrime Thickness Name of Assembly Layer Material Material	Count for R- d value? [mm] [r n 200 0 0 of the construction R-value insulation rgyPlus d	m] (W/mk) Å (m2 0.2 0.62 0 0 0 0 0.20 m 0.00 m ⁴ /K/W	2KWV) R (kg/m ²) He 0.03 0.32 2243 #DIV/01 0 #DIV/01 0 0.12	at(JRg IX) ((Whm*K) (J-X) 837 104300 0 0 0 U Value Assembly #DIV Heat Capacity 104 Residentia? No Specific	33.33 3.10 8.33 701 7alue (W/m2K)	februer	Construction, Interior Wall - Gilead
Outside Air Film	value? yin [mm] n 200 ess of the construction R-value Insulation in EnergyPlus Concrete t Count for R- d value? yin [mm]	(m) (Wimk) 0.20 0.20 0.20 0.20 0.00 below grade wall not pa d Conduct [m] (Wimk)	G Å (mRKW) R 0.62 0.33 0.62 0.32 0.12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(kg/m ²) (Jkg k) 2243 8: 2243 8: VU Residential? Density (kg/m ²) (Jkg k)	(V/h/m²-K) I37 104300 0 0 J Value Assembly 2. 1000000000000000000000000000000000000	U-Value (Wim%) 33.33 3.10 8.29 2.11 Wim% Io4 Below Grade Wall 1 Dede in doc umentation U-Value (Wim%)	3.10 W/m2K	Construction Interior Wal - Glead Concre Material Interior Wal - Glead Concrete - c Construction Construction Construction	Name of Assemby Layer Material d International c. Cottode AF Film Concrete (Baseline) 2 3 a Inticke AF Film Head of AF Film Thickness Laber Material Mane of Assemby Material Laber Material a Used AF Film	Count for R- d value? (mm) [r n 200 0 0 0 of the construction R-value insulation rgyPlus Walls, Below- d (mm) [r	m] (Wimk) Å (m2 0.2 0.62 0 0 0 0.00 m 0.00 m KGW d d d Conductivity R mj	2KVV) R (kg/m ²) He 0.03 0.32 2243 #DIV/01 0 #DIV/01 0 0.12 	at(J/kg k) (Vh/m ² k) U-3 857 104300 0 0 0 0 U Value Assembly FOIV Heat Capacity 104 Specific No At(J/kg k) Heat Capacity U-3	33.33 3.10 70! 70!	adivio:	Construction.Interior Wall - Glead Con Material/Interior Wall - Gilead Con IConstruction Construction Below Grade Wall -
Outside Air Film Concrete Outside Air Film Isole Air Film Thickne Name of Assembly: Were Mail - Name Outside Air Film Concrete Outside Air Film	value? yin (mm) n 200 ess of the construction R-value Insulation in EnergyPlus Concrete te Count for R- d	(m) (Wimk) 0.20 0.20 0.20 0.20 0.00 below grade wall not pa d Conduct [m] (Wimk)	0) Å (mROW) R 0.03 0.62 0.32 0.12 0 0 2 2 0.12 0 0 2 2 0.12 0 0 2 2 0.12 0 0 2 2 0.12 0 0 0 2 0.12 0 0 0 2 0.12	(kg/m ²) (Jkg,k) 2243 8: 2243 U Residential? Density Specific Hea	(V/h/m²-K) I37 104300 0 0 J Value Assembly 2. 1000000000000000000000000000000000000	U-Value (Wim*K) 33.33 3.10 8.29 2.11 Wim*K 04 Below Grade Wall 1 05 in documentation U-Value (Wim*K) 2.07	3.10 W/m2K	Construction,Interior Wall - Gilead Concret Material.Interior Wall - Gilead Concrete - c	Name of Assembly. Layer Material a Conceller a Concrete (Baseline) a Inside Air Film b Inside Air Film b Inside Air Film b Material c Concrete (Baseline) 2 Thickness b Inside Air Film Material Caserbity Alayer Material a Outside Air Film 1 CAUL (Concrete Bock) do Air Film 2 Carely Wall Insiden (bar	Count for R- value? d (mm) (r n 200 0 0 0 0 o 0 0 of the construction R-value insulation regriptus Walls, Below- d (mm) [r d 0 [r	m] (W/mk) Å (m2 0.2 0.62 0 0 0 0 0.20 m 0.00 m ⁴ /K/W	2KW0 R (kg/m ²) He 0.03 3.2 2243 #DW/01 0 #DW/01 0 #DW/01 0 4.Value Density He 2KW0 R (kg/m ²) He 0.26 2300 0.21 256	at(JRg IX) ((Whm*K) (J-X) 837 104300 0 0 0 U Value Assembly #DIV Heat Capacity 104 Residentia? No Specific	33.33 3.10 8.33 701 701 701 701 701 701 701 701 701 701	februer	Construction.Interior Wall - Gliead Con Material,Interior Wall - Gliead Con IConstruction Construction Below Grade Wall - Material,Below Grade Wall -
Outside Air Film Concrete Outside Air Film Isoide Air Film Thickne Name of Assembly: wyer Material Outside Air Film Isoide Air Film Isoide Air Film	value? yin [mm] n 200 ess of the construction R-value insulation Concrete to Concrete to value? yin Count for R- value? yin 0 (mm)	[m] (Wimk) 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 - 0.20 -	G Å (mRKW) R 0.62 0.33 0.62 0.32 0.12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(kgm) (kgk) 2243 8: Residential? Dentity Specific Hea (kgm) (kgk)	(Wh/m ² K) 37 104300 0 1 Value Assembly 2 Heat Capacity 11 No B (Wh/m ² K) Heat Capacity 14 Heat Capacity 156449 0	U-Value (VIIII*K) 33.33 3.10 8.29 11 Wim*K 104 U-Value (VIII*K) U-Value (VIII*K) 2.07 8.29	3.10 W/m2K	Construction Interior Wal - Glead Concre Material Interior Wal - Glead Concrete - c Construction Construction Construction	Name of Assembly. Layer Material a Odstde AF Film 1 concrete (Baseline) 2 3 1 inside AF Film	Count bor R. d value? (mm) [r n 200 0 0 0 of the construction R-value insulation rg:pPlus d [rm] [r seline) 203 0 vy (10) (0	mj (W/mK) Å (md 0.2 0.62 0 0.20 0 0 0.20 m 0 0.00 mH/K/W M Grade 0 0 d Conductivity R (W/mK) Å (md 0.20 0.778 0.050	22KW) R (kg/m ²) He 0.03 0.32 2243 #DI//01 0 #DI//01 0 0.12 	at(Jing x) (Vithim* x) U-3 857 104300 0 0 0 0 0 U Value Assembly #DIV Heat Capacity 164 164 Residentia? No 164 164 Residentia? No 164 164 164 Residentia? No 164	33.33 3.10 8.33 70! 1 Value (W/m2K) #DIV/0! 3.83 -4.84 10.00	februio: februio: no film 18.35 Wim2K	Construction.Interior Wall - Glead Con Material/Interior Wall - Glead Con IConstruction Construction Below Grade Wall - Material,Below Grade Wall -
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2 Outside Air Film 1 concrete 2 3 Inside Air Film Thickne Name of Assembly: yer Outside Air Film 1 concrete 2 Outside Air Film 1 concrete 2 Inside Air Film Thickne	value? ym [mm] n 200 ess of the construction R-value Insulation Concrete Concrete In Concrete Insulation n 300 n 300 ess of the construction R-value Insulation Revalue Insulation	[m] (WimK) 0.20 0.20 0.20 0.00 below grade wall not pz d Conducti [m] (WimK) 0.50 0.00	0) Å (mROW) R 0.03 0.62 0.32 0.12 0 0 2 2 0.12 0 0 2 2 0.12 0 0 2 2 0.12 0 0 2 2 0.12 0 0 0 2 0.12 0 0 0 2 0.12	(kgm) (kgk) 2243 8: Residential? Dentity Specific Hea (kgm) (kgk)	(Wh/m ² K) IO4300 0 0 JValue Assembly 2. Heat Capacity 11 No Cat Heat Capacity IVexture Assembly 2. Value Assembly 2. Value Assembly 2. Value Assembly 3. IVexture Assembly 3. IVexture Assembly 4. Value Assembly 5. Heat Capacity 10	U-Value (WIII"K) 33.53 3.10 8.29 64 164 1646 Killst 5 1506 in documentation U-Value (WIII"K) 2.07 8.29 5.58 WIII"K	3.10 W/m2K	Construction Interior Wal - Glead Concre Material Interior Wal - Glead Concrete - c Construction Construction Construction	Name of Assembly. Layer Material a Odstde AF Film 1 concrete (Baseline) 2 3 1 inside AF Film	Count to: R. d value? [mm] [r n 200 0 0 0 0 of the construction R-value insulation rg:Plus Walls, Berow- d_mm_l [r geline) 203 0 y (105) 0 of the construction of the construction	mil (Wink) A (m2 0.2 0.62, for the second seco	2KW0 R (kg/m ²) He 0.03 3.2 2243 #DW/01 0 #DW/01 0 #DW/01 0 4.Value Density He 2KW0 R (kg/m ²) He 0.26 2300 0.21 256	at(Jrg.x) (VIII'm* Ix) ² U-J 8537 104300 0 0 0 0 0 U Value Assembly FOIV Heat Capacity 104 Heat Capacity 104 Residential? No 10 10 Specific at(Jkg.x) Heat Capacity U-J L-J 10 B37 300.705 B37 (2.212) U Value Assembly K47	33.33 3.10 8.33 70! 1 Value (W/m2K) #DIV/0! 3.83 -4.84 10.00	februio: februio: no film 18.35 Wim2K	Construction.Interior Wall - Glead Material,Interior Wall - Glead Cor IConstruction Construction Below Grade Wall - Mam Material,Below Grade Wall - Nam
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Data Input – Envelope Constructions

m²/Person			Schedules
	ft²/Person	TOTAL	Occupancy
13.7 m²/person	147.1 ft ² /person	18	Office
6.5 m²/person	70.3 ft²/person	66	Office
m²/person	ft²/person	-	Storage
m²/person	ft²/person	-	Office
15.4 m²/person	165.2 ft²/person	2	MeetingRoom
2.3 m²/person	24.9 ft ² /person	44	MeetingRoom
m²/person	ft²/person	-	MeetingRoom
4.7 m²/person	50.6 ft²/person	2	MeetingRoom
m²/person	ft²/person	-	Office
m²/person	ft²/person	-	Storage
	6.5 m²/person m²/person 15.4 m²/person 2.3 m²/person m²/person 4.7 m²/person	6.5 m²/person 70.3 ft²/person m²/person ft²/person m²/person ft²/person 15.4 m²/person 165.2 ft²/person 2.3 m²/person 24.9 ft²/person m²/person ft²/person m²/person 50.6 ft²/person m²/person ft²/person m²/person ft²/person	6.5 m²/person 70.3 ft²/person 66 m²/person ft²/person - m²/person ft²/person - 15.4 m²/person 165.2 ft²/person 2 2.3 m²/person 24.9 ft²/person 44 m²/person 50.6 ft²/person - 4.7 m²/person 50.6 ft²/person 2 m²/person ft²/person -

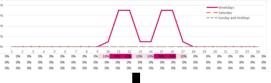
Table 8 Equipment Load Densities by Space Use														
Equipment		1	Equipment		Schedules									
Equipment	W/m ²		W/ft ²	TOTAL	Equipment									
Office	35	W/m²	3.3 W/ft ²	8,610	Office									
OpenOffice	35	W/m ²	3.3 W/ft ²	15,094	Office									
Storage	-	W/m ²	0.0 W/ft ²		Office									
Corridor	-	W/m ²	0.0 W/ft ²	-	Office									
TeaRoom	-	W/m ²	0.0 W/ft ²	-	Office									
MeetingRoom	22	W/m ²	2.0 W/ft ²	2,199	MeetingRoom									
CopyRoom	10	W/m ²	0.9 W/ft ²	180	Office									
PhoneBooth	-	W/m ²	0.0 W/ft ²	-	Office									
Shower	-	W/m ²	0.0 W/ft ²	-	Office									
AV	10	W/m ²	0.9 W/ft ²	73	Mechnical									
Average				29.0 W/m ²										

Lighting	D	esign Case		В		Schedule	
	W/ft ²	W/m ²	Total (W)	W/ft ²	W/m ²	Total (W)	
Office	0.51 W/ft ²	5.5 W/m ²	1,361	1.11 W/ft ²	11.9 W/m ²	2,939	Office
OpenOffice	0.56 W/ft ²	6.0 W/m ²	2,608	0.98 W/ft ²	10.5 W/m ²	4,549	Office
Storage	0.44 W/ft ²	4.7 W/m ²	252	0.63 W/ft ²	6.8 W/m ²	361	Storage
Corridor	0.64 W/ft ²	6.8 W/m ²	1,172	0.66 W/ft ²	7.1 W/m ²	1,215	Office
TeaRoom	0.38 W/ft ²	4.1 W/m ²	126	1.11 W/ft ²	11.9 W/m ²	367	Office
MeetingRoom	0.50 W/ft ²	5.4 W/m ²	546	1.23 W/ft ²	13.2 W/m ²	1,348	MeetingRoom
CopyRoom	0.43 W/ft ²	4.7 W/m ²	84	1.11 W/ft ²	11.9 W/m ²	214	Office
PhoneBooth	0.83 W/ft ²	8.9 W/m ²	84	1.11 W/ft ²	11.9 W/m ²	112	Office
Shower	0.64 W/ft ²	6.9 W/m ²	42	0.98 W/ft ²	10.5 W/m ²	65	Office
AV	0.54 W/ft ²	5.8 W/m ²	42	1.11 W/ft ²	11.9 W/m ²	87	Storage
Average			5.9 W/m ²			10.5 W/m ²	





Meeting Rooms - Occupancy and Equipment Profile



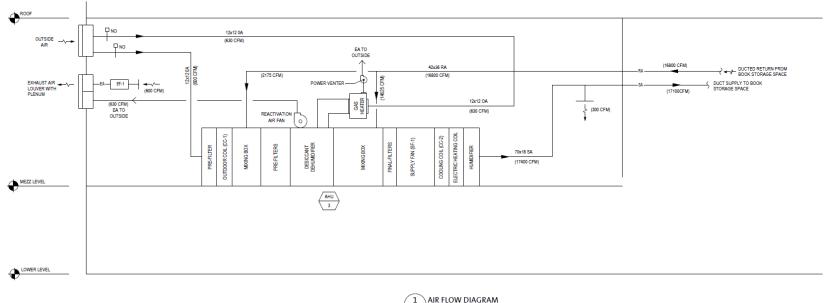
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thermostat	at Zone Name	Zone Type	m ² #	Area	y/n	ACH	m²/ner	Occupani		W/m²		Design W/m ²	Design		Summer setpoint setba		ter schedule	Schedule	Temp schedule	62.1 B	aseline Base	V CTS IN CLASS:2oneInfiltration:0		DOTE IN CLASS. D. DOTE:		
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×	04 CopyRoom2	CopyRoom				0.1			MeetingRoom-OCCUPANCY	10.0	81 Office-EQUIPMENT	5.2		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.002 1		96 ZoneInfiltration:DesignFlow		ElectricEquipment.04		
Y	04 Corridor1	Corridor	18 1	18	0	0.0			Office-OCCUPANCY	0.0	Office-EQUIPMENT	8.6		Office-LIGHTING	50.0 50		14.0 16-Heating 14-Setbac			0.005		125		eree o reesportprise riço 4		or1-Ligi HVACTemplat
Y	04 Corridor2	Corridor	74 1	74	v	0.1			Office-OCCUPANCY	0.0	Office-EQUIPMENT	8.1		Office-LIGHTING	50.0 50		14.0 16-Heating 14-Setbac			0.022		529 ZoneInfiltration:DesignFlow	đ			or2-Ligi HVACTemplat
Y	04 Corridor3	Corridor	55 1	55	n	0.0			Office-OCCUPANCY	0.0	Office-EQUIPMENT	4.8		Office-LIGHTING	50.0 50					0.016		388				or3-Ligi HVACTemplat
Y	04 Corridor4	Corridor	24 1	24	¥.	0.1			Office-OCCUPANCY	0.0	Office-EQUIPMENT	6.2	151	Office-LIGHTING	50.0 50	10 16.	14.0 16-Heating 14-Setbac			0.007	7.1	173 ZoneInfiltration:DesignFlow	4			or4-Ligi HVACTempla
Y	04 MeetingRoom1	MeetingRoom	19 1	19	v	0.1	2.4	8	MeetingRoom-OCCUPANCY	21.6	420 MeetingRoom-EQUIPMENT	6.5	126	MeetingRoom-LIGHTING	24.0 21	.0 20.0	18.0 20-Heating 18-Setbac	k 24-Cooling 26-Setbac	k 24/20Thermostat	0.027 1	3.2	257 ZoneInfiltration:DesignFlow	People,04 MeetingRoom	ElectricEquipment,04	Mr Lights,04 Meetin	gRoom HVACTempla
Y	04 MeetingRoom2	MeetingRoom	15 1	15	y .	0.1	3.9	4	MeetingRoom-OCCUPANCY	21.6	334 MeetingRoom-EQUIPMENT	2.7	42	MeetingRoom-LIGHTING	24.0 26	.0 20.0	18.0 20-Heating 18-Setbac	k 24-Cooling 26-Setbac	k 24/20Thermostat	0.021 1	3.2	205 ZoneInfiltration:DesignFlow	F People,04 MeetingRoom	ElectricEquipment,04	Me Lights,04 Meetin	gRoom HVACTempla
Y	04 MeetingRoom3	MeetingRoom	60 1	60	y .	0.1	1.9	32	MeetingRoom-OCCUPANCY	21.6	1,287 MeetingRoom-EQUIPMENT	5.6	336	MeetingRoom-LIGHTING	24.0 21	1.0 20.1	18.0 20-Heating 18-Setbac	k 24-Cooling 26-Setbac	k 24/20Thermostat	0.082 1	3.2	790 ZoneInfiltration:DesignFlow	People,04 MeetingRoom	ElectricEquipment,04	Me Lights,04 Meetin	gRoom HVACTemplat
Y	04 MeetingRoom4	MeetingRoom	7 1	7	n	0.0	2.4	3	MeetingRoom-OCCUPANCY	21.6	157 MeetingRoom-EQUIPMENT	5.8	42	MeetingRoom-LIGHTING	24.0 21	i.0 20.1	18.0 20-Heating 18-Setbac	k 24-Cooling 26-Setbac	k 24/20Thermostat	0.01 1	3.2	96	People,04 MeetingRoom	ElectricEquipment,04	Mr Lights,04 Meetir	gRoom HVACTemplat
Y	04 Office1	Office	54 1	54	y .	0.1	13.4	4	Office-OCCUPANCY	35.0	1,877 Office-EQUIPMENT	5.6	302	Office-LIGHTING	24.0 21	1.0 20.0	18.0 20-Heating 18-Setbac	k 24-Cooling 26-Setbac	k 24/20Thermostat	0.026 1	1.9	641 ZoneInfiltration:DesignFlow	People,04 Office1-Occup	ElectricEquipment,04	Of Lights,04 Office:	-Lights HVACTemplat
Y	04 Office2	Office	35 1	35	y .	0.1	11.7	3	Office-OCCUPANCY	35.0	1,226 Office-EQUIPMENT	6.5	227	Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac	k 24-Cooling 26-Setbac	k 24/20Thermostat	0.017 1		418 ZoneInfiltration:DesignFlow				
Y	04 Office3	Office	44 1	44	y .	0.1	14.6	3	Office-OCCUPANCY	35.0	1,537 Office-EQUIPMENT	5.2			24.0 21		18.0 20-Heating 18-Setbac			0.021 1		525 ZoneInfiltration:DesignFlow				
Y	04 Office4	Office	37 1	37	n	0.0	12.2	3	Office-OCCUPANCY	35.0	1,283 Office-EQUIPMENT	6.2		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.018 1		438	People,04 Office4-Occup			
Y	04 Office5	Office	11 1	11	n	0.0	10.8		Office-OCCUPANCY	35.0	378 Office-EQUIPMENT	7.0		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.005 1		129	People,04 Office5-Occup			
Y	04 Office6	Office	66 1	66	n	0.0	16.5		Office-OCCUPANCY	35.0	2,310 Office-EQUIPMENT	4.6		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.032 1		789	People,04 Office6-Occup			
Y	04 OpenOffice1	OpenOffice	182 1	182	Y	0.1	7.9		Office-OCCUPANCY	35.0	6,374 Office-EQUIPMENT	5.0	907	Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.124 1		1921 ZoneInfiltration:DesignFlow				
Y	04 OpenOffice2	OpenOffice	77 1	77		0.1	6.4		Office-OCCUPANCY	35.0	2,686 Office-EQUIPMENT	5.9		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.052 1		809 ZoneInfiltration:DesignFlow				
Y	04 OpenOffice3	OpenOffice	54 1 118 1	54		0.1	6.0		Office-OCCUPANCY	35.0	1,890 Office-EQUIPMENT	5.6		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.037 1		570 ZoneInfiltration:DesignFlow				
	04 OpenOffice4 04 PhoneBooth1	OpenOffice PhoneBooth	118 1	118	Y	0.1	5.4		Office-OCCUPANCY	35.0	4,144 Office-EQUIPMENT Office-EQUIPMENT	8.0		Office-LIGHTING Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac			0.081 1		1249 ZoneInfiltration:DesignFlow	People.04 OpenOffice4-0 People.04 PhoneBooth1-	ElectricEquipment,04		
¥	04 PhoneBooth1 04 PhoneBooth2	PhoneBooth	5 1	5	n	0.0	4.9		MeetingRoom-OCCUPANCY MeetingRoom-OCCUPANCY	0.0	Office-EQUIPMENT Office-EQUIPMENT	9.2		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac 18.0 20-Heating 18-Setbac			0.005 1		58 54 ZoneInfiltration:DesignFlow				Booth 1- HVACTemplat Booth 2- HVACTemplat
Y Y	04 PhoneBooth2 04 Shower	Shower	6 1	6		0.1	4.0	1	Office-OCCUPANCY	0.0	Office-EQUIPMENT	6.9		Office-LIGHTING	24.0 21		18.0 20-Heating 18-Setbac					54 ZoneInfiltration:DesignFlow				r-Lights HVACTemplat
Y Y	04 Storage1	Storage	14 1	14	1	0.0		1.1	Storage-OCCUPANCY	0.0	Office-EQUIPMENT	6.2		Storage-LIGHTING	50.0 5					0		93				e1-Light HVACTemplat
Y Y	04 Storage1 04 Storage2	Storage	11 1	11		0.0			Storage-OCCUPANCY	0.0	Office-EQUIPMENT	3.8		Storage-LIGHTING	50.0 5		14.0 16-Heating 14-Setbac			0		74				e2-Light HVACTemplat
Y	04 Storage3	Storage	15 1	15		0.1			Storage-OCCUPANCY	0.0	Office-EQUIPMENT	2.8		Storage-LIGHTING	50.0 50					0		102 ZoneInfiltration:DesignFlow	4			e3-Light HVACTemplat
Y Y	04 TeaRoom	TeaRoom	31 1	31		0.0	15.4	2	MeetingRoom-OCCUPANCY	0.0	Office-EQUIPMENT	41		Office-LIGHTING	24.0 21					0.014 1		367	People 04 TeaRoom-Occ			om-Ligh HVACTemplate
<i>s</i>	a constant					0.0	20.4		and a second second	0.0	2		110		2.00 2.		and an intering to octobe									

Data Input - Ideal Loads

All zone names and zone types to be Automatically entered in this sheet generated Information edited **Simulation Code** over formulas File age Layout A Shar Ho Inser Σ × Define Name Trace Precedents 5 Show Form fx -Calculate Now 60 ℜ Use in Formula * Trace Dependents 1 Error Check Watch Calculation Calculate Sheet Insert Auto cial Logical Text Date & Lookup & Math & More Name lecent Time * Reference * Trig * Functions * Manager 🔐 Create from Selection 💦 Remove Arrows 🔹 🛞 Evaluate Fo Function Used Window Options * Function Library Defined Name Formula Auditing Calculation AC55 Lighting Design W/m² Setpoint heating schedule Setpoint Cooling Schedule Area m² Temp Zone Type No. Stories Rate ACH Area m¹ ","Ligh ="HVACTemplate: -" HVAC overv 04 AV FERROR VLOOK 1 FERRORIDA*E = IFERRORI I EIVI = IFIG4=*** ".IF(=IFERROR(D4/J=SUMIF('DA ca =IFERROR(VLO(=IFERROR(IF(VL=IF(VLOOKUP((=IFERROR(VLO(=P4/D4 =IFERRORI/VLO=IF(VLOOKUP(C=IF(VLOOKUP(C=IF(VLOOKUP(C=IF(VLOOKUP(C=IF(AND(T4 ERROR(ROU =VLOOKUP(C4, =Z4*F4 =IE(OR(14=** 14 = Ligh ="HVACTemplate: -"HVACTemplat HVAC ove FERROR/VLOOK IEERDORIDS*I -IEERRORIIE/VI -IE/CS-* .if(=iFERRORID5/J=SUMIFCOA ca =iFERRORIVLOC=iFERRORIIF(VI=iF(VLOOKUP(C=iFERRORIVLOC=P5/D5 IFERRORIVLO IFIVLOOKUP(CIFIVLOOKUP(CIFIVLOOKUP(CIFIVLOOKUP(CIFIAND(TSI", IFAND(TSI", HE/TS-RO =IFERROR(ROU =VLOOKUP(CS. =Z5*F Ligh ="WVACTemplate -"WVACT =IFERROR/VLOOK IFERRORID6*1=IFERRORIIF(VI=IFIG6=" IF(=IFERRORID6/J=SUMIF('OA ca =IFERRORIVLO(=IFERROR(IFIVL=IF(VLOOKUP((=IFERRORIVLO(=P6/D6 FERRORI(VLD =:F(VLDOKUP(C =:F(VLOOKUP(C =:F(VLOOKUP(C =:F(ADDKUP(C =:F(ADDKUP(C =:F(ADDKUP(C =:F(ADDKUP(C =:F(VLOOKUP(C =:F(VLOKUP(C =:F BO -IEEBBORIBOU -IA OOKUBICE -76*5 =SUMIF('OA ca =IF HVAC overv D4 Corridor2 FERROR VLOOK IFERROR/D8*(=IFERROR(IF(VI=IF(G8=""", IF(=IFERROR(D8/J=SUMIF("DA ca =IFERROR(VLO(=IFERROR(IF(VI=IF(VLOOKUP(C=IFERROR(VLO(=P8/D8 IFERROR((VLD =IF(VLOOKUP(C =IF(VLOOKUP(C =IF(VLOOKUP(C =IF(AND(TB= RO =IFERROR(ROU =VLOOKUP(CB, =Z8*F8 +1F(G8-") HVAC overv 04 Corridor3 FERRORIVLOOK 1 FERRORID9*1=IFERRORI/F/V =IF(G9=""" IF =IFERRORID9/I =SUMIFI'OA ca =IFERRORI/VLOX =IFERRORI/IF/V =IF/VLOXVPIX =IFERRORIVLOX =P9/D9 =FERROR(/VLO =IF/VLOOKUPIX =IF/VLOOKUPIX =IF/VLOOKUPIX =IF/VLOOKUPIX =IF/AND/T9="" =IF/AND/R9="" =IF/T9="" RO =IFERROR/ROU =VLOOKUP(C9. =Z9*F Corridor HVAC overy D4 Corridor4 Corridor FERRORIVLOOK FERRORIDIO SFERRORIFIVI SFERRORIDIO SUMIFICA CE SFERRORIVIO SFERRORIFIVI SFUNDOKUPIC SFERRORIVIO SP10/01 TERORIVUD UFVLOOKUPIC UFVLOOKUPIC UFVLOOKUPIC UFVLOOKUPIC UFVLOOKUPIC UFVLOOKUPIC UFVLOOKUPIC 12 10*F III =FERROR[D11, =SUMIF['D4:c6 =FERROR[VDC =FERROR[IF[V] =F(VDOKUP[(=FERROR[VDC =F20) III =FERROR[D11, =SUMIF['D4:c6 =FERROR[VDC =FERROR[IF[V] =F(VDOKUP[(=FERROR[VDC =F21) III =FERROR[D12, =SUMIF['D4:c6 =FERROR[VDC =FERROR[VDC =F20] III =FERROR[D13, =SUMIF['D4:c6 =FERROR[VDC =FERROR[VDC =FERROR[VDC =F20] III =FERROR[D13, =SUMIF['D4:c6 =FERROR[VDC =FE HVAC overv 04 MeetingRoom Meeting DRI/VLO =IF/VLOOKUPIC =IF/VLOOKUPIC =IF/VLOOKUPIC =IF/VLOOKUPIC =IF/AND/T13= FANDIR13=" =IF(T13=" ".R =IFERROR(ROU =VLOOKUP(C11=Z15 HVAC overv 04 MeetingRoom Meeting II =IFERROR(D14, =SUMIF("OA ca =IFERROR(VLO(=IFERROR(IF(VI =IF(VLOOKUP((=IFERROR(VLO(=P14/D14 FERROR VLOOK ROR[D14 = IFERROR[IF[VI = IF(G14=""," RROR((VLD=IF(VLOOKUP(C=IF(VLOOKUP(C=IF(VLOOKUP(C=IF(VLOOKUP(C=IFAND(T14=""=IF(AND(R14=""=IF(T14="",",R=IFERROR(ROU=VLOOKUP(C14=Z14*F1 "HVAC overv 04 Office1 "HVAC overv 04 Office2 "HVAC overv 04 Office3 FERROR VLOOK ERRORID15 =IFERROR(IF(VI=IF(G15="." 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Data Input - Ideal Loads

Translating a mechanical drawing to energy component drawings

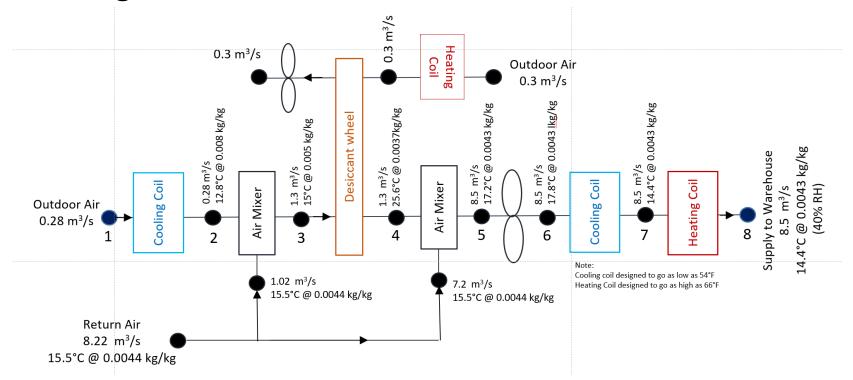




SIV

Data Input – HVAC and Controls

Translating a mechanical drawings to energy component drawings



Data Input – HVAC and Controls

Translating mechanical information to simple table to record inputs and generate mechanical system for simulation.

	CTA 3	
	Position des centrales : Superposées	
	1 CAISSON DE TRAITEM	ENT D'AIR TYPE CCM170
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	 Etanchéité : classe B Transmittance Thermique : classe T3 	PORTE SUR CHARNIERS SECTION DETENTE
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Prog. Nº : 06/150.7836/PB Progr 3/ 5

Table 21 Specifications for proposed AHU

		General Information				
AHU Nr.	System description	Areas that the system feeds	Max Air Flow rate	Min Air Flow rate	Outdoor Air Flow Rate	Exhaust Air Flow rate
	repeat description where possible, ie dedicated outdoor air system, AHU VAV, etc.	name zone types that the system feeds	m³/s	m³/s	m³/s	m³/s
СТАЗ	Dedicated outdoor air system	west side of the building offices	0.364	0.36	0.36	0.364
CTA4	Dedicated outdoor air system	east side of the building offices	0.666	0.67	0.67	0.67

	Supp	ly Fan				Retu	Heat Ex	changer		
Filter	Supply fan Pressure Drop	Fan Power Supply/Extract	Efficiency	Fresh Air/Fan Schedule	Filter	Return Fan Pressure Drop	Fan Power Supply/Extract	Efficiency	Туре	Efficiency
Category	PA	[kW]	[%]		Category	PA	[kW]	[%]		
F8	379	8.5 kW	81%	MVHR-CTA3 - Fresh Air Schedule	F5	592	6.2 kW	80%	Flat Plate	47%
F8	624	16.0 kW	81%	MVHR-CTA4 - Fresh Air Schedule	F5	782	11.8 kW	82%	Flat Plate	47%

		Heating Coil		Cooling Coil									
AHU Nr.	Heating Coil	Entering Air Temperature	Leaving Air Temperature	Cooling Coil Total	Water temp. in	Water temp. out	Flow Rate	Entering Air Temperature DB	Leaving Air Temperature DB				
	[kW]	[°C]	[°C]	[kW]	[°C]	[°C]	[m ^s /s]	[°C]	[°C]				
CTA3	82.5	5.7°C	20.8°C	120	6°C	16°C	4.57	32°C	15°C				
CTA4	144	5.6°C	22.1°C	193	6°C	16°C	16.54	32°C	15°C				

Data Input – Automation Process

Translating mechanical information to simple table to record inputs and generate mechanical system for simulation.

				Proposed De	sign						
Space Use		one ating	Zone Cooling	Mechanical Ventilation	Cor	nnection	to zo		cooling Supply		leat upply
Office	Fa	nCoil	FanCoil	MVHR	Sing	leDuctUr	contro	lled	Water	EI	ectric
OpenOffice	Fa	nCoil	FanCoil	MVHR	Sing	leDuctUr	contro	lled	Water	EI	ectric
Storage	Fa	nCoil	FanCoil						Water	EI	ectric
Corridor	Fa	nCoil	FanCoil	MVHR	Sing	leDuctUr	contro	lled	Water	EI	ectric
TeaRoom	Fa	nCoil	FanCoil	MVHR	Sing	leDuctUr	contro	lled	Water	EI	ectric
MeetingRoon	n Fa	nCoil	FanCoil	MVHR	Sing	leDuctUr	contro	lled	Water	EI	ectric
CopyRoom	Fa	nCoil	FanCoil	MVHR	Sing	leDuctUr	contro	lled	Water	EI	ectric
PhoneBooth	Fa	nCoil	FanCoil	MVHR	Sing	leDuctUr	contro	lled	Water	EI	ectric
Shower	Fa	nCoil	FanCoil						Water	EI	ectric
AV			FanCoil						Water	EI	ectric
			Number of	Outdo	or Air - A	ASHRAE 62	.1 2010	Calculatio	n		
Fresh Air Calculation	~	ea	people	ASHRAE 62.1 TV		cfm	cfm/ft°	TOTAL	l/s .	Vs.m*	TOTA
	m2	ft2		Addition 2 02.11 Ty	~	/person	Cambrid	cfm	Person	v.a	Vs/.m2
Office	246.0	2,648	18	Office Building - office	pace	5.0	0.1	248.9	2.5	0.3	0.48
OpenOffice	431.3	4,642	66	Office Building - office	pace	5.0	0.1	608.5	2.5	0.3	0.68
Storage	53.3	573									
Corridor	171.1	1,841	-	General - Corridors		-	0.1	110.5	-	0.3	0.30
TeaRoom	30.7	330	2	Office Building - office	pace	5.0	0.1	29.8	2.5	0.3	0.40
MeetingRoom	101.8	1,096	44	General - Confernce M	eeting	5.0	0.1	285.7	2.5	0.3	1.38
CopyRoom	18.0	194		Office Building - office	pace	5.0	0.1	11.6	2.5	0.3	0.30
PhoneBooth	9.4	101	2	Office Building - Break	ooms	5.0	0.1	22.2	2.5	0.6	1.13
Shower	6.1	66								-	

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ne Type	Storeys	Area	Tota	l Area	Volume	Exhaust		or Air / Fre		Flow rates fro	m FCU			With			Additional	Additional			Conditioned	d
		m'	m'	ft"	[m']	(m?/b)	From	[Vs]		rom Max	Min	AHU		Reheat? leave baink	Zone Cooling Equipment 1	Zone Heating Equipment 1	Cooling Equipment 2	Heating Equipment 2	If there is a fan coil what is the Fan Type?	If there is a fan coil what is the HC type?		
Q.9	1	13.7	14	147	49	for our	AHU?	feal	- FC	fui.va	[m ³ /s]			if no reheat)							N	_
•	1	7.3	7	78	26		0		- FC	58 Autosize					FanCoil	FanCoil			Variable Volume	Electricity	Y	
oom	1	10.0	10	107	36		0		- FC						FanCoil	FanCoil			Variable Volume	Electricity	Y	
oom	1	8.1 17.6	8 18	87 190	29		CTA4 CTA3	4	0.004 FC			MVHR-CTA4 MVHR-CTA3	SingleDuctUncontrolled SingleDuctUncontrolled		FanColl	FanCoil			Variable Volume	Electricity	Y	
or or	1	74.4	74	801	268		CTA3	34	0.008 FC			MVHR-CTA3 MVHR-CTA3	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
or	1	54.7	55	588	197		CTA4	82	0.082 FC			MVHR-CTA4	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
or	1	24.4	24	263	88		CTA3	11	0.011 FC			MVHR-CTA3	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
ingRoom	1	19.4 15.5	19 15	209 167	70 56		CTA3 CTA4	43 21	0.043 FC 0.021 FC			MVHR-CTA3 MVHR-CTA4	SingleDuctUncontrolled SingleDuctUncontrolled		FanCoil FanCoil	FanCoil FanCoil			Variable Volume Variable Volume	Electricity	Y	
Room	1	15.5	15 60	642	215		CTA4 CTA4	156	0.021 FC			MVHR-CTA4 MVHR-CTA4	SingleDuctUncontrolled		FanColl	FanCoil			Variable Volume Variable Volume	Electricity	Y	
gRoom	1	7.3	7	78	26		CTA4	15	0.015 FC			MVHR-CTA4	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
	1	53.6	54	577	193		CTA3	42	0.042 FC	89 Autosize		MVHR-CTA3	SingleDuctUncontrolled		FanColl	FanCoil			Variable Volume	Electricity	Y	
e	1	35.0	35	377	126		CTA3	21	0.021 FC			MVHR-CTA3	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
•	1	43.9 36.7	44 37	473 395	158 132		CTA4 CTA4	31 31	0.031 FC			MVHR-CTA4 MVHR-CTA4	SingleDuctUncontrolled SingleDuctUncontrolled		FanCoil FanCoil	FanCoil			Variable Volume Variable Volume	Electricity	Y U	
0	1	10.8	11	116	39		CTA4	10	0.010 FC			MVHR-CTA4	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Ý	
	1	66.0	66	710	238		CTA4	51	0.051 FC			MVHR-CTA4	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
Office	1	182.1	182	1,960	656		CTA3	161	0.161 FC			MVHR-CTA3	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
nOffice	1	76.7	77	826	276		CTA3	38	0.038 FC			MVHR-CTA3	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
nOffice nOffice	1	54.0 118.4	54 118	581	194 426		CTA4 CTA4	95 148	0.095 FC			MVHR-CTA4 MVHR-CTA4	SingleDuctUncontrolled SingleDuctUncontrolled		FanCol	FanCoil			Variable Volume Variable Volume	Electricity	Y V	
neBooth	1	4.9	5	52	17		CTA3	6	0.006 FC			MVHR-CTA3	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Ý	
neBooth	1	4.6	5	49	16		CTA4	6	0.006 FC			MVHR-CTA4	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
wer	1	6.1	6	66	22		0	-	- FC						FanCoil	FanCoil			Variable Volume	Electricity	Y	
age soe	1	13.7	14	147	49 39		0		- FC						FanCoil FanCoil	FanCoil FanCoil			Variable Volume Variable Volume	Electricity	Y U	
896 896	1	15.1	15	162	54		0	1	. FC						FanCoil	FanCoil			Variable Volume	Electricity	Ý	
Room	1	30.7	31	330	111		CTA4	16	0.016 FC			MVHR-CTA4	SingleDuctUncontrolled		FanCoil	FanCoil			Variable Volume	Electricity	Y	
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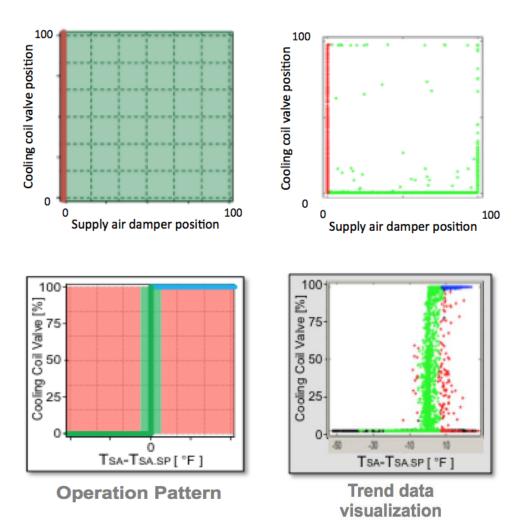
Data Input – HVAC and Controls

Problem 1: Inputting data into a simulation engine GUI takes lots of time, is complicated and prone to errors

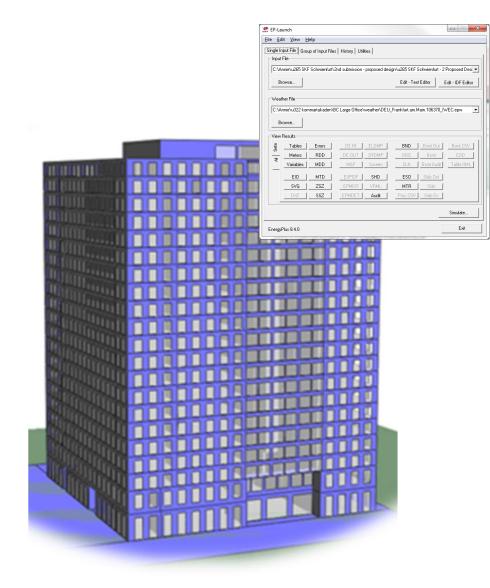
Solution 1: Excel GUI, utilize the power of excel and its formulas to record all inputs, do the necessary calculations, automatically generate simulation code and provide neat information for the client report. Use excel to QA your inputs

Model control "If you can't draw it, you can't build it"

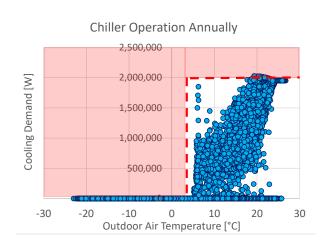




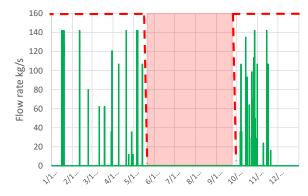
Operation Diagnostics - Commissioning

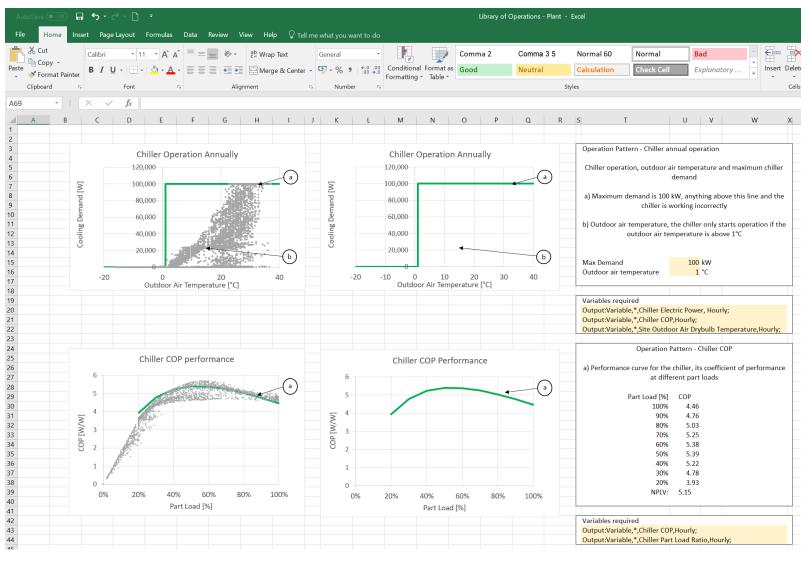


Simulation Diagnostics

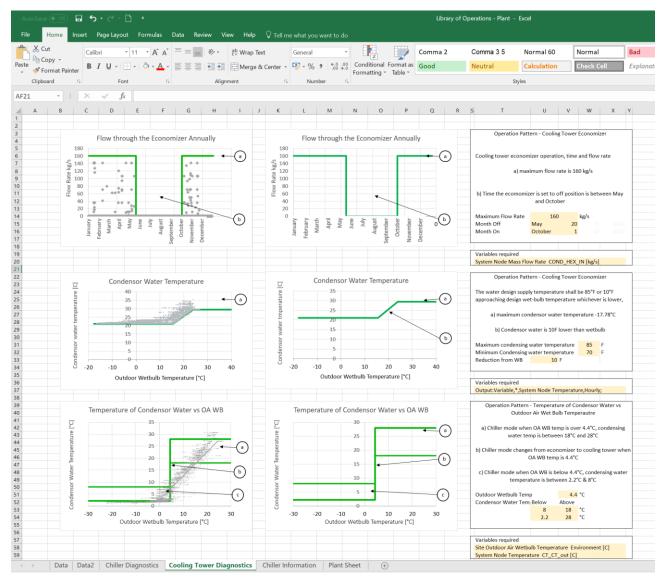


Flow through the Economizer Annually





Output Data – Scripting Process



Output Data – Scripting Process

4.11.1.2 Fans and Pumps

The fan power calculation for the baseline building design is based on G3.1.2.9 of ASHRAE Standard 90.1 2010 Appendix G and 6.5.3.1 of ASHRAE Standard 90.1 2010. The fan supply volume was calculated using 20°F difference between the supply air and the room air temperature according to G3.1.2.8.

The minimum outdoor air flow into each zone is identical to the outdoor air flow for the design case. The minimum outdoor air flow into the zones in the baseline case will never drop below that required for the design case. The peak fan power supply flow was calculated for the baseline case using Table G3.1.2.10 – System 3 through 8:

Fan power = bhp x 746 / fan motor efficiency

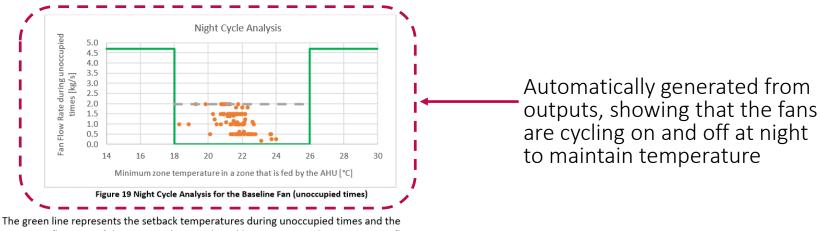
			Baseline	FanPower	11.8	kW							
		В	aseline outdoor ai	r flow rate	1.03	m³/s							
			Baseline tota	l flow rate	5.21	m³/s							
Fan Name	Variable / Constant	AHU or Terminal Box?	Supply/ Return/ Exhaust (AHU) / unconditioned (exhaust fan)	Outdoor Air Flow rate [m³/s]	Peak flow rate [m³/s]	flow rate [I/s]		ЬНР	Motor Efficiency	cfm	Pressure Drop	BASELINE system	Fan Efficienc
BASELINE				1.0	5.2		11848			11044			
HU04	Variable	AHU	Supply	0.9	5.0	4971	11414	13.7	89.5%	10,534	1,492	8	0.65
4 Corridor1	Constant	AHU	Supply	0.0	0.0	8	14	0.0	82.5%	17	1,171	4	0.65
4 Corridor2	Constant	AHU	Supply	0.0	0.1	73	131	0.1	82.5%	154	1,171	4	0.65
4 Corridor3	Constant	AHU	Supply	0.1	0.1	82	148	0.2	82.5%	174	1,171	4	0.65
4 Corridor4	Constant	AHU	Supply	0.0	0.0	11	20	0.0	82.5%	23	1,171	4	0.65
)4 Storage3	Constant	AHU	Supply	0.0	0.0	11	19	0.0	82.5%	23	1,171	4	0.65
M TopRoom	Constant	AHU	Supply	0.0	0.1	56	101	0.1	82.5%	119	1,171	4	0.65

Fan calculations from the modelling input master file

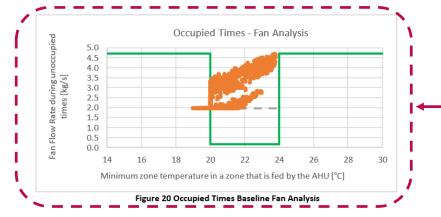
The fans were modelled with a night cycle which was put on during unoccupied times. The fans cycle on and off during this time when temperature of the space is required to be met. An analysis of the fan operation in the model is detailed below:

The total number of hours the fan is operating for is 4088 The total number of hours the fan is operating during unoccupied times is 87 The peak fan power is 5.9kW Operating hours during occupied and unoccupied times and peak fan power, all automatically generated from the output file

Output Data – Night Cycle Analysis Project Example



The green line represents the setback temperatures during unoccupied times and the maximum flow rate of the system. The grey dotted line represents the minimum air flow rate during occupied times. During unoccupied times the night cycle comes on to maintain the setback temperatures and is between 0 kg/s and 1.97kg/s flow rate.



Automatically generated showing how the fan is operating during occupied hours and that the zone is reaching temperature during those times

The graph above shows the fan operation during occupied times. The orange dots represent the flow rate and the minimum zone temperature fed by the AHU. The fan operation is always above the minimum flow rate of 1.97 kg/s and ramps up during the cooling season. The dots fall below the set temperature of 20C as this includes zones which have a lower setpoint such as the corridors and storage rooms.

Output Data – Night Cycle Analysis Project Example

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How this works – Output data from Software

Calculations

Generating the correct data output names

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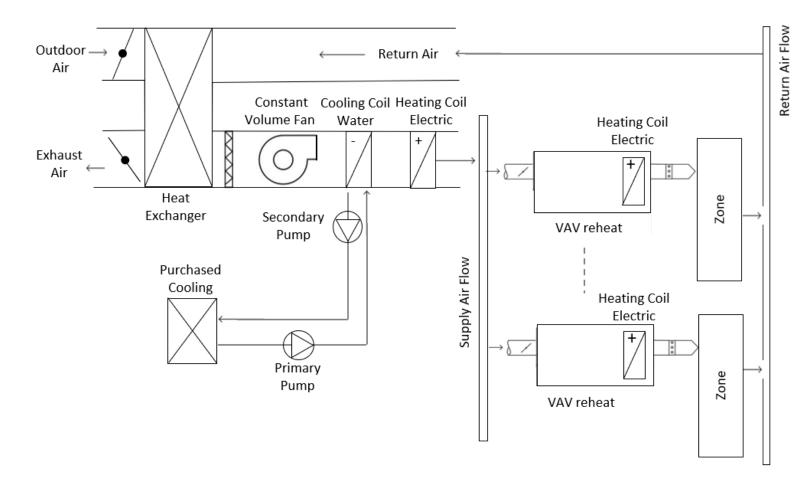
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	04 CopyRoom1	10	20	11.1		0.23	0.4	0.02	8	AHU04	36	67 r		AHU04	8	04 CopyRoom1:Zone Air Temperature [C](AHU04_zoneTemp	AHU01
	04 CopyRoom2	8	20	11.1		0.24	0.3	0.02	8	AHU04	38	67 r		AHU04	8	04 CopyRoom2:Zone Air Temperature [C](AHU04_zoneTemp	AHU02
	04 Corridor1	18	20	11.1		0.02	0.0	0.00	4	04 Corridor1		1		04 Corridor1	4	04 Corridor1:Zone Air Temperature [C](ho		04 Corridor1_zoneTemp	AHU03
	04 Corridor2	74	20	11.1		0.97	1.0	0.07	4	04 Corridor2		13 1		04 Corridor2	4	04 Corridor2:Zone Air Temperature [C](ho		04 Corridor2_zoneTemp	AHU04
	04 Corridor3	55	20	11.1		0.34	0.3	0.03	4	04 Corridor3		6 1		04 Corridor3	4	04 Corridor3:Zone Air Temperature [C](ho		04 Corridor3_zoneTemp	AHU05
	04 Corridor4	24	20	11.1		0.08	0.1	0.01	4	04 Corridor4		3 r		04 Corridor4	4	04 Corridor4:Zone Air Temperature [C](ho		04 Corridor4_zoneTemp	AHU06
	04 MeetingRoom1	19	20	11.1	1.44	0.51	1.4	0.11	8	AHU04	74	67 г		AHU04	8	04 MeetingRoom1:Zone Air Temperature [AHU04 zoneTemp	AHU07
	04 MeetingRoom2	15	20	11.1		0.44	1.1	0.08	8	AHU04	68	67 r		AHU04	8	04 MeetingRoom2:Zone Air Temperature		AHU04_zoneTemp	AHU08
	04 MeetingRoom3	60	20	11.1	5.61	1.94	5.6	0.42	8	AHU04	94	67 r		AHU04	8	04 MeetingRoom3:Zone Air Temperature		AHU04 zoneTemp	AHUU01
	04 MeetingRoom4	7	20	11.1	0.54	0.15	0.5	0.04	8	AHU04	74	67 r		AHU04	8	04 MeetingRoom4:Zone Air Temperature		AHU04_zoneTemp	AHUU02
	04 Office1	54	20	11.1		1.83	4.5	0.33	8	AHU04	83	67 r		AHU04	8	04 Office1:Zone Air Temperature [C](hour		AHU04_zoneTemp	EB.00 ITRoom
	04 Office2	35	20	11.1		1.34	3.0	0.23	8	AHU04	86	67 r		AHU04	8	04 Office2:Zone Air Temperature [C](hour		AHU04 zoneTemp	EB.00 Kitchen
	04 Office3	44	20	11.1	3.71	1.68	3.7	0.28	8	AHU04	84	67 r		AHU04	8	04 Office3:Zone Air Temperature [C](hourl		AHU04 zoneTemp	EB.01 Kitchen
04	04 Office4	37	20	11.1	2.39	1.31	2.4	0.18	8	AHU04	65	67 r		AHU04	8	04 Office4:Zone Air Temperature [C](hour		AHU04 zoneTemp	EB.02 ITRoom
	04 Office5	11	20	11.1	0.82	0.66	0.8	0.06	8	AHU04	76	67 r		AHU04	8	04 Office5:Zone Air Temperature [C](hour		AHU04_zoneTemp	EB.02 Kitchen
	04 Office6	66	20	11.1	4.05	1.90	4.1	0.30	8	AHU04	61	67 r		AHU04	8	04 Office6:Zone Air Temperature [C](hourl		AHU04 zoneTemp	EB.03 ITRoom
	04 OpenOffice1	182	20	11.1	16.30	5.95	16.3	1.22	8	AHU04	90	67 r		AHU04	8	04 OpenOffice1:Zone Air Temperature [C](AHU04_zoneTemp	EB.03_Kitchen
	04 OpenOffice2	77	20	11.1	6.29	2.34	6.3	0.47	8	AHU04	82	67 r		AHU04	8	04 OpenOffice2:Zone Air Temperature [C](AHU04_zoneTemp	EB.04_ITRoom
	04 OpenOffice3	54	20	11.1		1.66	4.4	0.33	8	AHU04	82	67 r		AHU04	8	04 OpenOffice3:Zone Air Temperature [C](AHU04 zoneTemp	EB.04 Kitchen
04	04 OpenOffice4	118	20	11.1	10.61	3.86	10.6	0.80	8	AHU04	90	67 r		AHU04	8	04 OpenOffice4:Zone Air Temperature [C](AHU04 zoneTemp	EB.05 ITRoom
	04 PhoneBooth1	5	20	11.1		0.13	0.2	0.02	8	AHU04	41	67 r		AHU04	8	04 PhoneBooth1:Zone Air Temperature [C		AHU04 zoneTemp	EB.05 Kitchen
	04 PhoneBooth2	5	20	11.1	0.21	0.17	0.2	0.02	8	AHU04	45	67 r		AHU04	8	04 PhoneBooth2:Zone Air Temperature [C		AHU04 zoneTemp	EB.06 ITRoom
	04 Shower	6	20	11.1	0.20	0.24	0.2	0.02	8	AHU04	39	67 r		AHU04	8	04 Shower:Zone Air Temperature [C](hour		AHU04_zoneTemp	EB.06 Kitchen
	(0.0					-			_	0:Zone Air Temperature [C](hourly)		zoneTemp	EB.07 Confere
	()					0.0					-				0:Zone Air Temperature [C](hourly)		_zoneTemp	EB.07_ITRoom
04	04 Storage3	15	20	11.1	-	0.14	0.1	0.01	4	04 Storage3	9	9 r		04 Storage3	4	04 Storage3:Zone Air Temperature [C](hou	rly)	04 Storage3_zoneTemp	EB.07_Kitchen
	04 TeaRoom	31	20	11.1	0.75	0.44	0.8	0.06	4	04 TeaRoom	24	24 r		04 TeaRoom	4	04 TeaRoom:Zone Air Temperature [C](ho		04 TeaRoom_zoneTemp	EB.07_OpenOf
																:Zone Air Temperature [C](timestep)		_zoneTemp	EB.07_OpenOf
																:Zone Air Temperature [C](timestep)		_zoneTemp	EB.07_OpenOf
																:Zone Air Temperature [C](timestep)		_zoneTemp	EB.U01_Entrar
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.00_Entrand
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.01_ITRoom
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.01_OfficeSe
											1					:Zone Air Temperature [C](timestep)		_zoneTemp	NB.02_ITRoom
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.02_OfficeSo
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.02_Recepti
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.03_ITRoom
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.03_OfficeS
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.03_Recepti
																:Zone Air Temperature [C](timestep)		_zoneTemp	NB.04_ITRoom
																:Zone Air Temperature [C](timestep)		zoneTemp	NB.04 OfficeSo

How this works – Scripting what data needs to be called

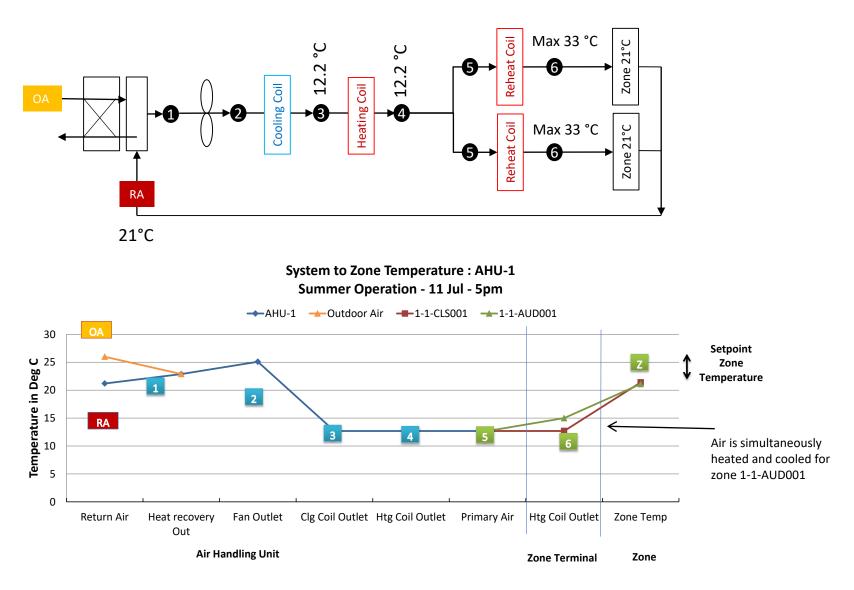
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L21 - :	× ×	<i>f</i> x Tota	I Number of h	nours Fan is c	n																
A	В	с	D	E	F	G	н	1	J K	L	М	N C)	Р	Q	R	S	т	U	v	w
1	FAN SCHEDULE:Sched	Minumum	Maximum	If in setback,	AHU04 FAN OUT-Syste	AHU04_FAN_OUT:Syst	Fan Night Cycl	e Fan on during													
2 Date/Time	ule Value [](Hourly)	AHU04 zonetem	AHU04_zonetem	cooling or heating	m Node Mass Flow Rate [kg/s](hourly)	em Node Mass Flow Rate [kg/s](hourly)	Analysis	occupied times	All Fan operation	AHU04							Night Cy	cle Analysis			
3 01/01 01:00:00	0	18.0	18.0	18.0	-		#N/A	#N/A	#N/A	Max Flow rate	4.70	kg/s a					Night Cy	cie Analysis)		
4 01/01 02:00:00	0	18.0	18.0	18.0	-		#N/A	#N/A	#N/A	Min Flow Rate	0.16	kg/s kg/s kg/s	5	5.0						_	
5 01/01 03:00:00	0	18.0	18.0	18.0	-		#N/A	#N/A	#N/A	Min AHU flow rate	1.97	kg/s o	4	4.0							
6 01/01 04:00:00	0	18.0	18.0	18.0			#N/A	#N/A	#N/A			ů,									
7 01/01 05:00:00	0			18.0	-		#N/A	#N/A	#N/A	Winter		50 C	[kg/s]	3.0							
8 01/01 06:00:00	0	18.0	18.0	18.0	-		#N/A	#N/A	#N/A	Setback Temperature	18	°C in		2.0							
9 01/01 07:00:00	0			18.0	-		#N/A	#N/A	#N/A	Setpoint temperature	20	ດໍ ດໍ Rate during	am a	2.0							
10 01/01 08:00:00	0			18.0	-		#N/A	#N/A	#N/A	Summer			°₽ 1	1.0					- A		
11 01/01 09:00:00	0			18.0	-		#N/A	#N/A	#N/A	Setback Temperature		°C ∧o						-			
2 01/01 10:00:00	0			18.0	-		#N/A	#N/A	#N/A	Setpoint temperature	24	°C 11	U	0.0							
3 01/01 11:00:00	0			18.0	-		#N/A	#N/A	#N/A			Fan		14	16	18	20	22 24	26	28	30
4 01/01 12:00:00	0			18.0	-		#N/A	#N/A	#N/A	X Axis Temp Limits		°C		M	inimum zo	one tem	perature in	n a zone that	is fed by the	AHU [°C	.]
5 01/01 13:00:00	0			18.0	-		#N/A	#N/A	#N/A	Y Axis Temp Limits	30	°C									
6 01/01 14:00:00	0			18.0	-		#N/A	#N/A	#N/A												
7 01/01 15:00:00	0			18.0	-		#N/A	#N/A	#N/A							Ann	ual Fan O	peration A	nalvsis		
8 01/01 16:00:00	0			18.0	-		#N/A	#N/A	#N/A	Number of hours fan		unoccupied		5.0					'		
9 01/01 17:00:00	0			18.0	-		#N/A	#N/A	#N/A	on in unoccupied time	es	3		5.0							_
0 01/01 18:00:00	0			18.0	-		#N/A	#N/A	#N/A			Ŭ O	4	4.0				_			
1 01/01 19:00:00	0			18.0	-		#N/A	#N/A	#N/A	Total Number of hou	rs 4088		S]								
2 01/01 20:00:00	0			18.0	-		#N/A	#N/A	#N/A	Fan is on	_	during	[kg/s]	3.0							
3 01/01 21:00:00	0			18.0	-		#N/A	#N/A	#N/A			du	es []	2.0							
4 01/01 22:00:00	0			18.0	-		#N/A	#N/A	#N/A			Rate	time ,	2.0							
25 01/01 23:00:00	0			18.0	-		#N/A	#N/A	#N/A			Ra	÷ :	1.0							
6 01/01 24:00:00	0			18.0	-		#N/A	#N/A	#N/A			Š						-	•••••		
7 01/02 01:00:00	0			18.0	-		#N/A	#N/A	#N/A			Fan Flow	(0.0							
8 01/02 02:00:00 9 01/02 03:00:00	0			18.0 18.0	-		#N/A #N/A	#N/A #N/A	#N/A #N/A			Fai		14	16	18	20	22 24		28	30
01/02 03:00:00 0 01/02 04:00:00	0			18.0	-		#N/A #N/A	#N/A #N/A	#N/A #N/A					Min	imum zor	ne temp	erature in a	a zone that is	fed by the A	HU [°C]	
30 01/02 04:00:00 31 01/02 05:00:00	0			18.0	-		#N/A #N/A	#N/A #N/A	#N/A #N/A												
31 01/02 05:00:00 32 01/02 06:00:00	0			18.0	-		#N/A #N/A	#N/A	#N/A #N/A												
3 01/02 07:00:00	1			19.9		1.97	#N/A	1.97	1.97			<u> </u>				00	cupied Tin	nes - Fan An	alvsis		
4 01/02 08:00:00	1			20.0		1.97	#N/A	1.97	1.97			Died		5.0		50			,		
5 01/02 09:00:00	1			21.5	-	1.97	#N/A	1.97	1.97			occupi		4.5			_			_	-
6 01/02 10:00:00	1			22.0		1.97	#N/A	1.97	1.97			Doun		4.0							
7 01/02 11:00:00	1			22.2	-	1.97	#N/A	1.97	1.97				[s/s]	3.5				15			
8 01/02 12:00:00	1			22.5	-	1.97	#N/A	1.97	1.97			during	[kg/	3.0 2.5			r. 1-				
9 01/02 13:00:00	1			20.4	-	1.97	#N/A	1.97	1.97				nes	2.0			- Mari				
0 01/02 14:00:00	1			22.0	-	1.97		1.97	1.97			Rate	tiu	1.5							
1 01/02 15:00:00	1			22.6	-	1.97	#N/A	1.97	1.97			Flow		1.0							
2 01/02 16:00:00	1			22.7	-	1.97	#N/A	1.97	1.97			E		0.5							
3 01/02 17:00:00	1			22.8		1.97	#N/A	1.97	1.97			Fan		0.0	16	18	20	22 24	26	28	30
4 01/02 18:00:00	1			20.2	-	1.97	#N/A	1.97	1.97												50
45 01/02 19:00:00	1			20.0	-	1.97	#N/A	1.97	1.97					Min	imum zone	e tempe	rature in a zo	one that is fed	by the AHU ['C]	
· · · · · · · · · · · · · · · · · · ·		20.0	20.0	20.0		4.07		4.07	4.07												

How the works – Data analysis and quality control

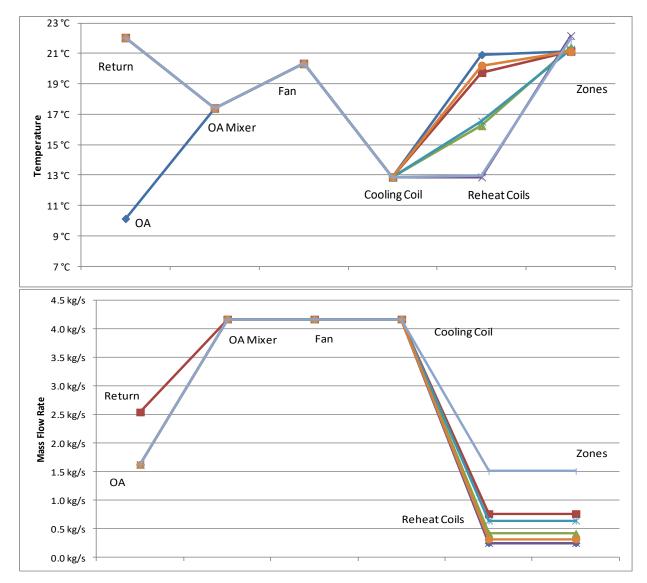
Energy Component Diagram



AHU Analysis – VAV reheat example



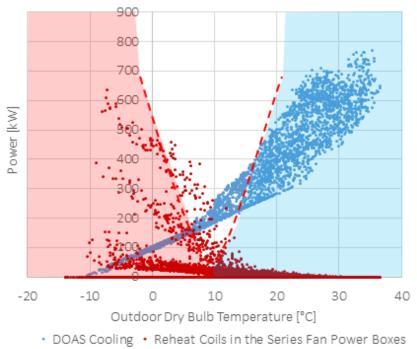
AHU Analysis – Simultaneous Heating and Cooling



AHU Analysis – Heat Exchanger and Cooling Coil

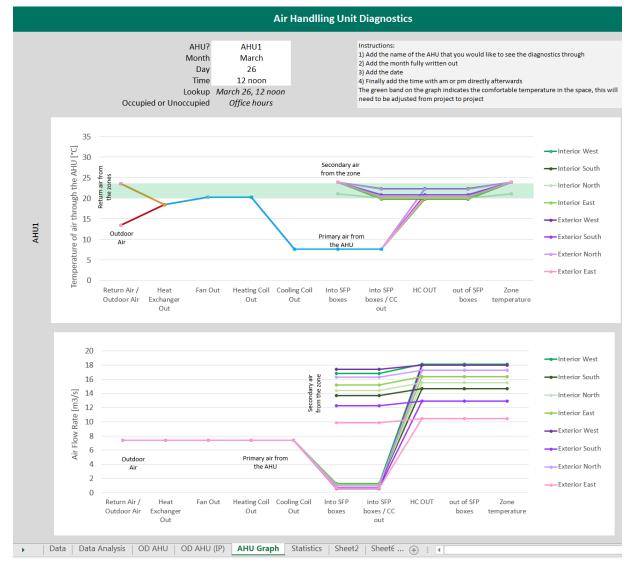
Statistics and Heating Cooling Analysis (SI)

	Hours in the	
	year these	
	conditions apply	
Heat Exchanger exchanging heat	2,630	
Heat Exchanger exchanging cool	733	
AHU Heating Coil ON	-	
AHU Cooling Coil ON	3,333	
AHU heating and cooling on at the same time	-	
Heat Exchanger exchanging Heat and Cooling Coil ON	2,655	
Heat Exchanger exchanging Cool and heating Coil ON	-	
······································		
Total number of hours system is on	3,413	
Hours heat exchanger should be bypassed in the summer		

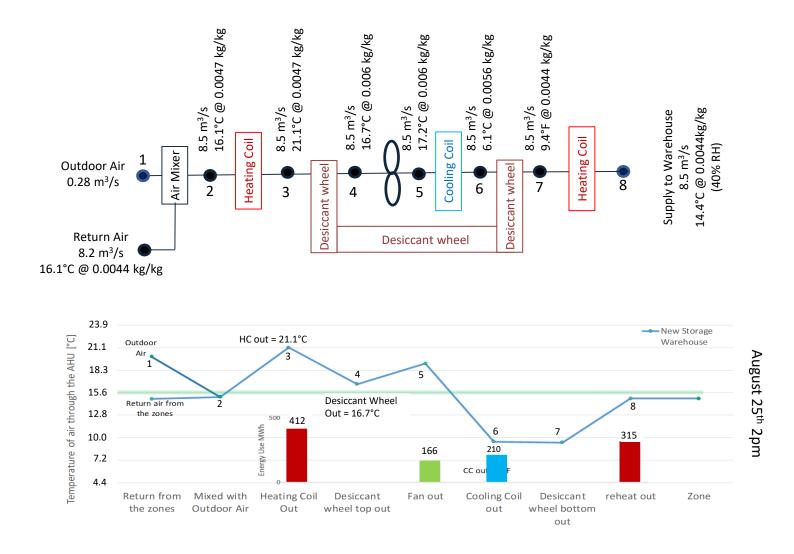


SIM²

AHU Analysis – Heat Exchanger and Cooling Coil



AHU and Controls Analysis Tool



AHU Analysis – Case study

- Unclear controls can easily lead to simultaneous heating and cooling.
- Heat exchangers can be added to systems thinking they will save energy but in fact cause the system to use more energy.
- Lack of analysis, misunderstanding how a systems actually works and business as usual leads to poor performance of building systems.
- Energy modellers can model and give extremely valuable feedback on controls for the building saving thousands of pounds of operational energy costs.

AHU and Controls Modelling and Analysis

PROBLEM 2: Input errors and misunderstanding outputs leads to poor results, lack of confidence in modelling and, at worse, incorrect analysis and advice to the client

SOLUTION 2: Simulation diagnostics!



Annie Marston Ph.D., BEMP, LEED AP Building Performance Analyst

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