How-to Non-Res

Greenbuild: Phius Summit November 2025

Getting Started

Phius Certification Guidebook

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- Section 0.5.4 Non-Residential Projects
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Mixed-Use Projects

2024 Guidebook Section 0.5.3

Mixed-Use Projects (Section 0.5.3)

Mixed-use projects come in two basic variants.

1. Usage types of all spaces are known at the time of design

OR

1. Part of the building is designed and finished for known usage types, and part of it is designed for an unknown future tenant who is responsible for completing construction in terms of plumbing, HVAC systems, interior finishes, insulation, etc. (aka “shell-lease”)

Finished (“F”) vs Unfinished (“UF”)

Finished (“F”):

Refers to spaces whose occupancy / tenant is known at the time of design.

Unfinished (“UF”):

Refers to spaces intended for an unknown non-residential shell-lease.

Phius' Mixed-Use Approach (Section 0.5.3.2)

Phius encourages the entire building to be Certified, but…

- Partial Certification may be sought so long as >50% of the building floor area is included.
- If there are a mix of "F" and "UF" spaces planned and being certified, each must be separately metered and have its own mechanical systems. The predicted energy use can then be compared to actual usage.
  - For "UF" Spaces: If, between design certification and final certification, prospective tenants are found to occupy the UF space who are able and willing to meet the constraints of whole-building certification in their build-out plans, the tenant fit-out must be certified under its planned function rather than as an unfinished space.

Four Paths (Section 0.5.3.2)

Whole Building Certification

Separate energy models are created for residential and non-residential areas.
100% of the iCFA.

A. Combined
   a. Overall source energy limit
   b. Overall space conditioning targets
   c. “UF” spaces may be Certified
B. Separate
   a. Individual source energy limit
   b. Individual space conditioning targets
   c. “UF” space may not be Certified

Partial Building Certification

Separate energy models are created for residential and non-residential areas.
>50% of the iCFA.

C. Combined
   a. Overall source energy limit
   b. Overall space conditioning targets
   c. “UF” spaces may be Certified
D. Separate
   a. Individual source energy limit
   b. Individual space conditioning targets
   c. “UF” space may not be Certified

Table 0.5.3.2.0

Table 0.5.3.2.0 Mixed-Use Certification Matrix					
Mixed-Use Certification Paths		Whole Building Certification		Partial Building Certification	
		A	B	C	D
Modeling & Certification	Separate energy models for residential & non-residential.	☑	☑	☑	☑
	100% of the building floor area is modeled / certified.	☑	☑		
	≥ 50% of the building floor area must be modeled / certified.			☑	☑
	Unknown non-residential spaces may not be certified alone.		☑		☑
	Follows UF Protocol outlined in Phius Mixed-Use Approach.	☑	☑	☑	☑
Source Energy Allowance	Determined for building by applying a mix of residential and non-residential allowances to certified spaces.	☑		☑	
	Determined for building by applying a mix of residential and non-residential allowances to certified spaces.		☑		☑
Space Conditioning Targets	Apply to the whole / certified portion of the building.	☑		☑	
	Apply to partial building and must be met in each energy model.		☑		☑

Non-Residential Projects

2024 Guidebook Section 0.5.4

Non-Residential Projects (Section 0.5.4)

Things to keep in mind

- Space conditioning targets still apply
- Airtightness requirement still apply
- Source Energy limit is proportional to floor area
- More detailed information is required for:
  a. Occupancy patterns
  b. Plug loads
  c. Lighting
  d. Process loads
  e. Ventilation patterns

Dormitories & Hotels (Section 0.5.4.1)

Follow modeling protocol and on-site requirements based on whether the occupancy is assumed to be “Transient” or “Long-Term”.

Transient Occupancy:

- Occupant stays < 30 days = Non-Residential

Long-Term Occupancy:

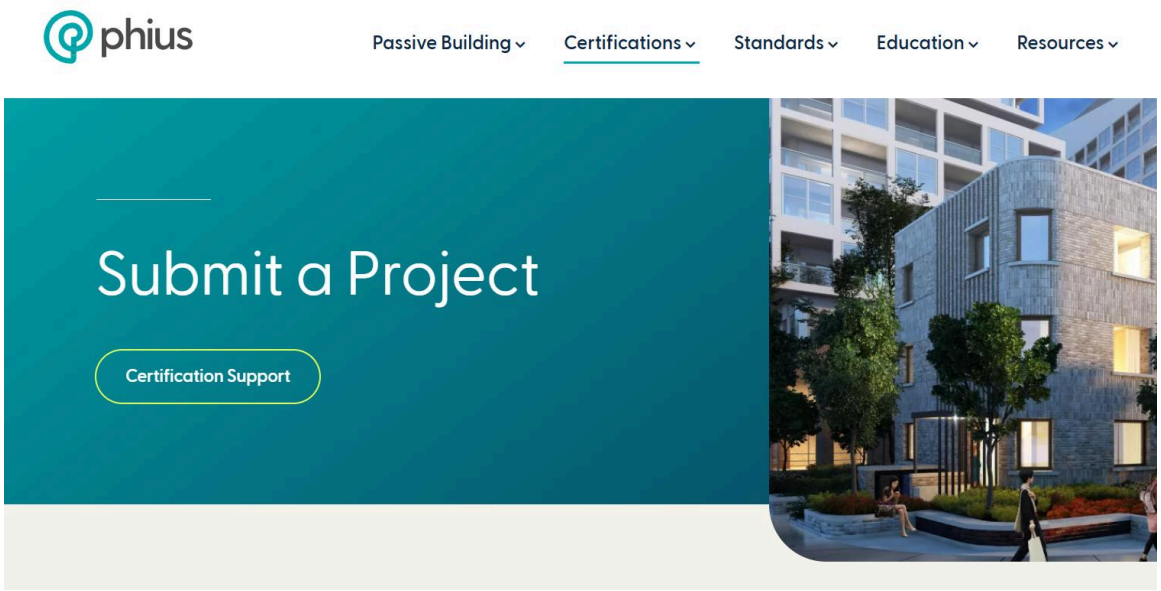
- Occupant stays ≥ 30 days = Residential

Registering a Project

2024 Guidebook Section 1.1.2

Registering a Project

- Inquiry - Submit a Project Page
  - Phase 1: Paperwork - Request a Contract



Providing Project Information

- Things to keep in mind
  - Registration quotes require information about each unique building or energy model.
  - Discrete use types and volumes require separate energy models.
  - Separate models or cases require individual line items in the

Description about each of the Certification paths can be found below.

Phius Standards

Project Information

Building Name	Quantity *	iCFA *	Number of Dwelling Units *
Residential	1	301559	331
Retail A	1	4946	0
Retail B	1	3826	0
Retail C/D	1	2508	0

Enter each unique building (or energy model) in the rows above. For non-residential buildings, input 0 for the number of dwelling units. For mixed-use, include each model and include the dwelling unit quantity for residential portions.

Software & Performance Target Introduction

WUFI & METr

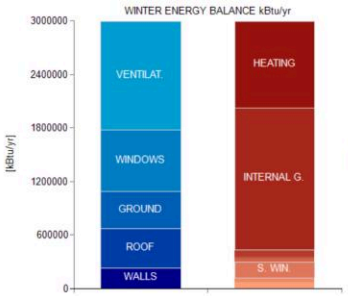
- All Certification is done via modeling compliance
  - WUFI Passive
  - METr
- Monthly Modeling tool
- Single Zone
- Supports residential and non-residential buildings
- More flexibility on non-res cases

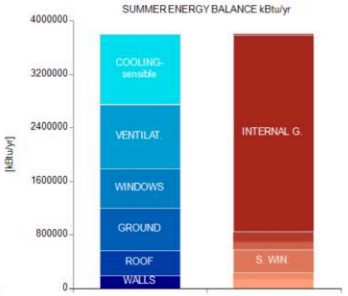
WUFI & METr

- Limitations:
  - Single Zone
  - Averaged annual internal gains
    - Not able to account for seasonal use
  - Simplified mechanical systems
    - Must calculate COPs externally
    - Cannot account for controls / BAS
  - **Not a load sizing tool**
    - Single Zone
    - Design Temps are not 99.6% & 0.4%
    - No latent load in peak cooling
      - Covered in crossover modeling
    - Loads are *ideal air loads*

ANNUAL HEAT DEMAND		
Transmission losses :	1,779,354	kBtu/yr
Ventilation losses:	1,216,175	kBtu/yr
Total heat losses:	2,995,529	kBtu/yr
Solar heat gains:	724,579	kBtu/yr
Internal heat gains:	2,649,458	kBtu/yr
Total heat gains:	3,374,036	kBtu/yr
Utilization factor:	59.9	%
Useful heat gains:	2,020,543	kBtu/yr
Annual heat demand:	974,986	kBtu/yr
Specific annual heat demand:	13,182.8	Btu/ft²yr

ANNUAL COOLING DEMAND		
Solar heat gains:	852,212	kBtu/yr
Internal heat gains:	2,931,660	kBtu/yr
Total heat gains:	3,783,872	kBtu/yr
Transmission losses :	3,102,183	kBtu/yr
Ventilation losses:	1,652,330	kBtu/yr
Total heat losses:	4,754,514	kBtu/yr
Utilization factor:	57.6	%
Useful heat losses:	2,739,798	kBtu/yr
Cooling demand - sensible:	1,044,074	kBtu/yr
Cooling demand - latent:	12,714	kBtu/yr
Annual cooling demand:	1,056,788	kBtu/yr
Specific annual cooling demand:	14.3	kBtu/ft²yr





Target Calculation

Visualized components

Nr	Name	Type	Attachment outside	Area [ft²]	Orientation	Inclination [°]	R [hr ft² °F/Btu]
1	Roof	Opaque	Outer air	73813.22	Horizontal (100 %)	0	30.182
2	Slab	Opaque	Ground	73957.22	Horizontal (100 %)	180	5.007
3	Cafeteria Skylight	Transparent	Outer air	144	Horizontal (100 %)	0	1.9
4	Exterior Windows	Transparent	Outer air	9462.66	S (37 %), E (13 %), W (13 %	90	2.523
5	Exterior Walls	Opaque	Outer air	17050.7	S (37 %), E (13 %), W (13 %	90	14.918
6	Exterior Door	Opaque	Outer air	524.99	S (44 %), E (12 %), W (4 %)	90	2.702

Total area of envelope components (interior components excluded) 174952.79

Project information

Name	Zone1
Type	Simulated zone
PH case	Passive house: School

Geometry / Specific heat capacity

Setting	Setting way	Value
Visualized volume [ft³]	From visualized geometry	970556.51
Gross volume [ft³]	From visualized volume and components	970556.51
Net volume [ft³]	Estimated from gross volume	[illegible]
Interior conditioned floor area [ft²]	User defined	73966.05
Specific heat capacity [Btu/ft²F]	Lightweight	11

Additional data

Humidity capacity [lb/(lbw/lbda) ft³]	143.3713

Phius 2024

New Construction*

Performance Criteria Calculator v24.1

UNITS:	IMPERIAL (IP)
BUILDING FUNCTION:	NON-RESIDENTIAL
STATE / PROVINCE	ILLINOIS
CITY	CHICAGO MIDWAY AP
ASHRAE 169 Climate Zone	5A
Envelope Area (ft²)	174,952.8
iCFA (ft²)	73,966.1
Average Occupancy	300
Design (Max) Occupancy	1,478

Space Conditioning Criteria

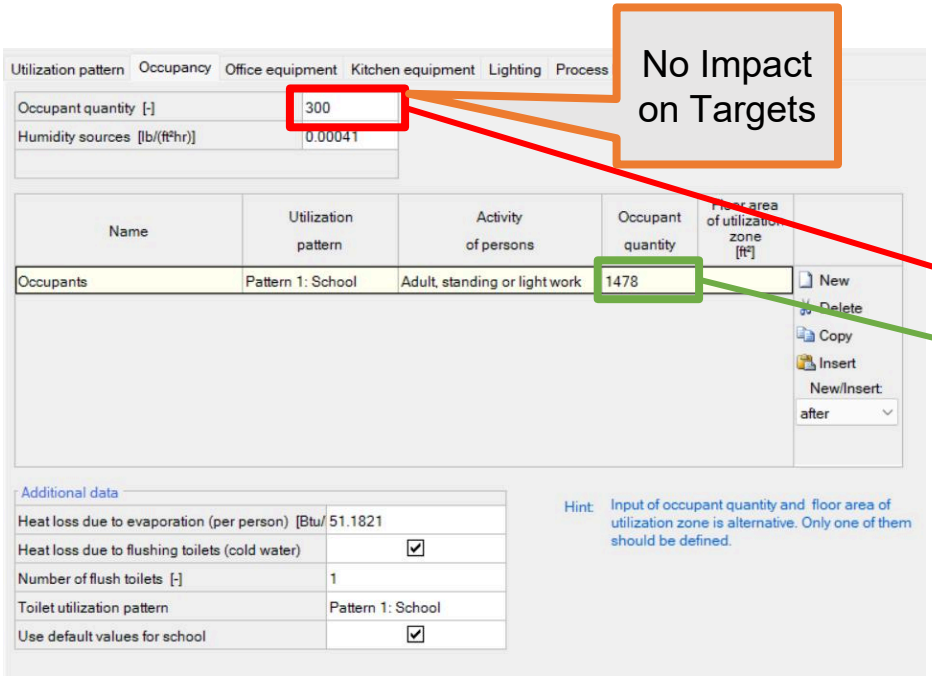
Annual Heating Demand	9.6	kBtu/ft²yr
Annual Cooling Demand	6.5	kBtu/ft²yr
Peak Heating Load	8.3	Btu/ft²hr
Peak Cooling Load	4.0	Btu/ft²hr

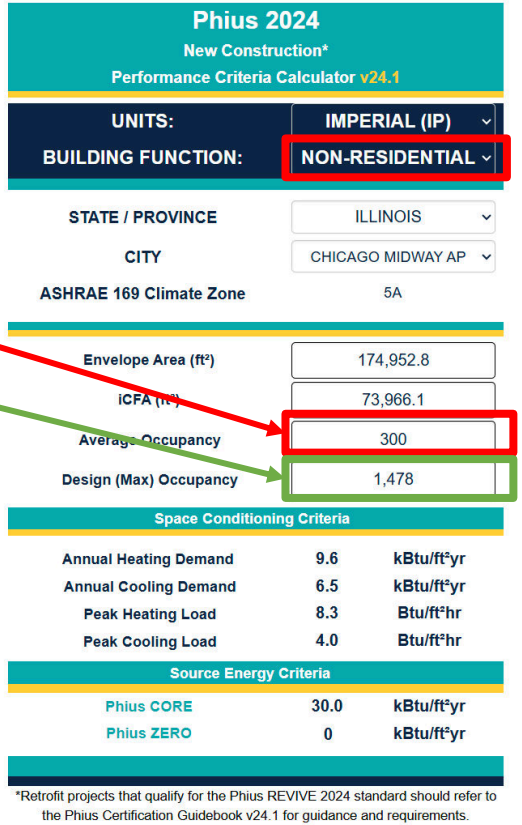
Source Energy Criteria

Phius CORE	30.0	kBtu/ft²yr
Phius ZERO	0	kBtu/ft²yr

*Retrofit projects that qualify for the Phius REVIVE 2024 standard should refer to the Phius Certification Guidebook v24.1 for guidance and requirements.

Target Calculation

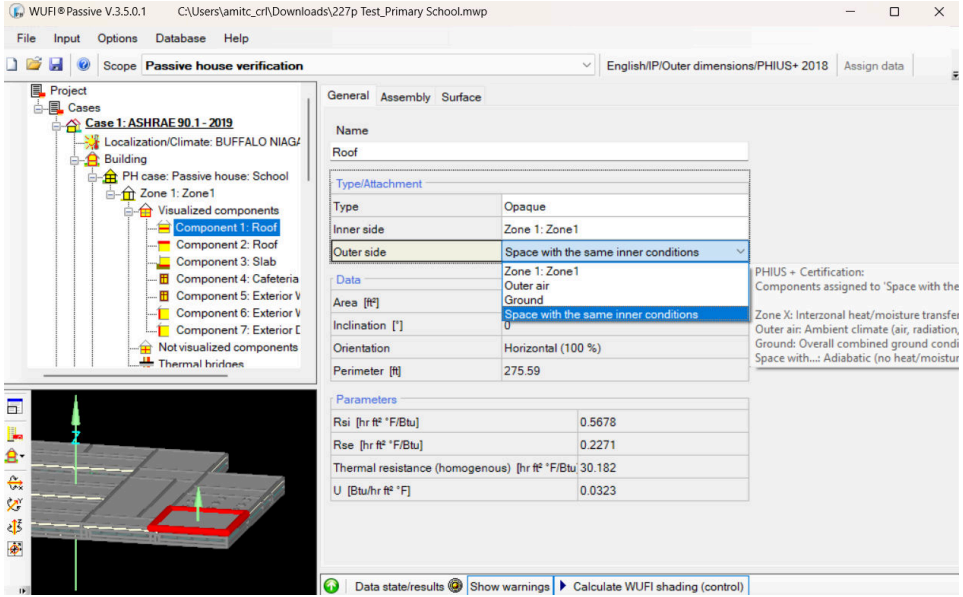




Envelope Area

Different Boundary Conditions:

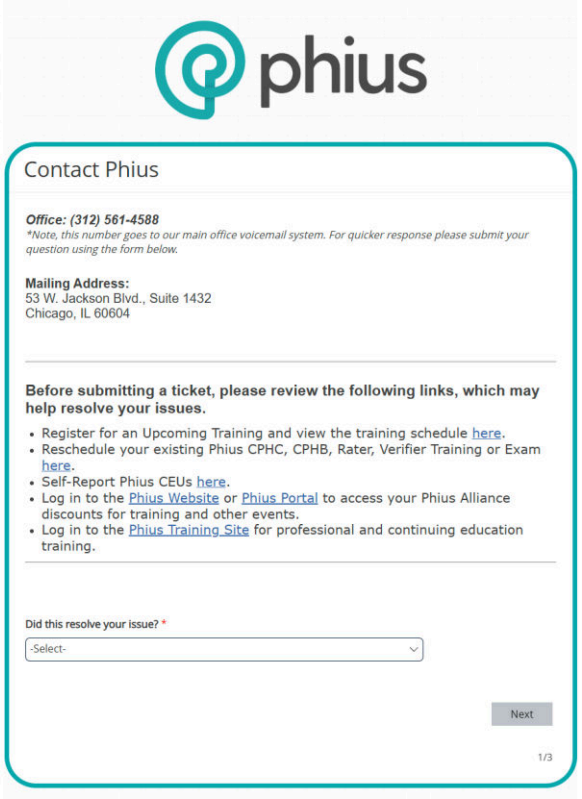
- Space with same inner conditions
  - Attached, conditioned, non-certified space
  - Small load from infiltration
  - **Does count towards envelope area**
- Zone 1:
  - Attached, conditioned, certified space
  - No loads
  - **Does NOT count towards envelope area**



Custom Targets

Contact Us!

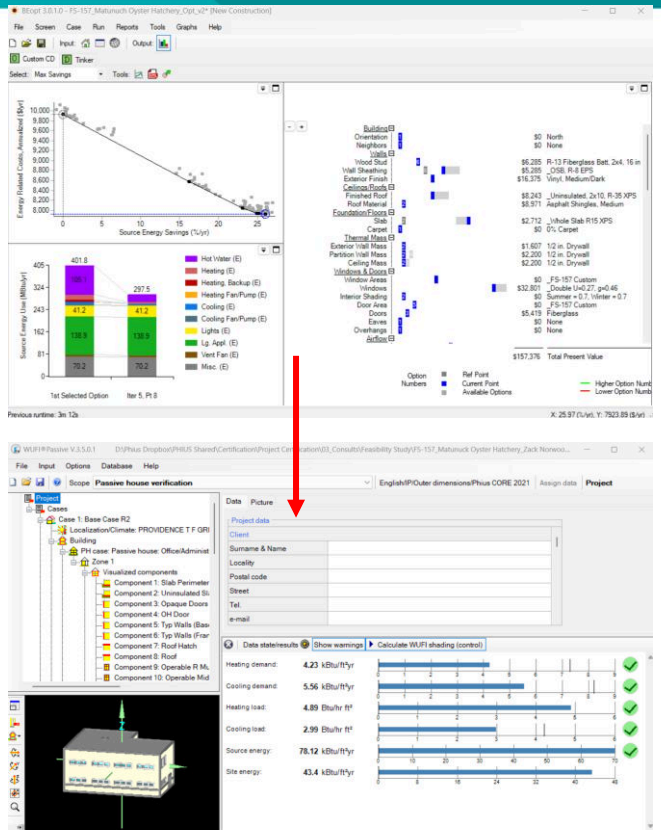
- Buildings that may require custom targets:
  - High ventilation loads
    - > 1.0 ACH
  - High Internal Gains
    - Hospitals
    - Laboratories
    - Food processing
    - Oyster hatchery
    - Factory
    - etc



Custom Targets

Process

- Follows target setting process
  - Use optimization to determine ideal envelope package for internal conditions
  - Crossover modeling in WUFI
  - WUFI space conditioning results become targets
- Needs:
  - Geometry
  - Internal gains
  - Occupancy schedule

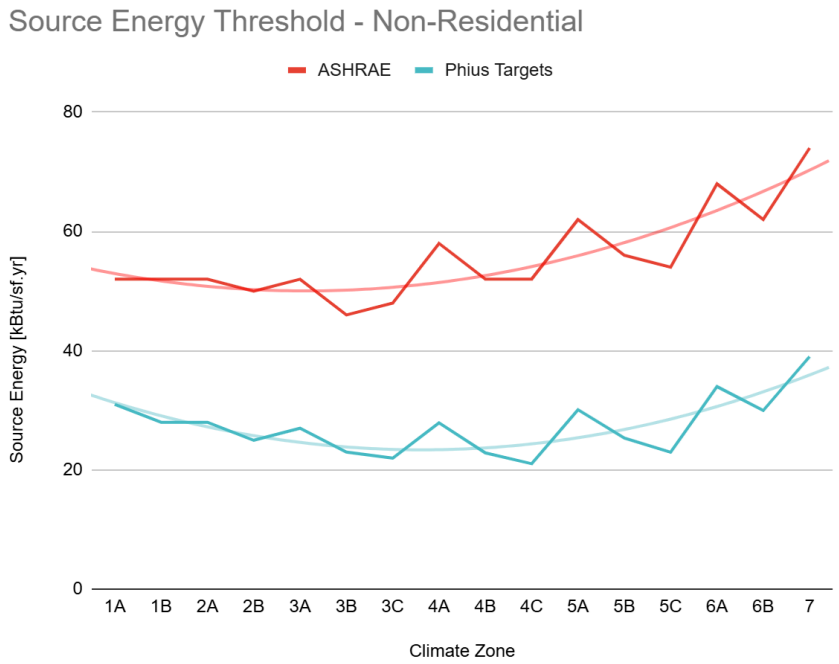


Non-Residential Source Energy Limits

2024 Guidebook Table 1.3.4.1.1

Non-Residential Source Energy Limits

- Improved source energy target for climate sensitivity and non-residential loads
  - Previous target was 24.5 kBtu/sf yr for all buildings
- Utilized ASHRAE 100 data
  - Reduced existing building usage by Phius median source energy savings
  - “Allowance” for humid climates for dehumidification



Non-Residential Source Energy Limits

(Table 1.3.4.1.1)

- Limit varies by climate zone
- Process load source energy allowances are added on to this ‘base’ limit
- There is no target for Unfinished Spaces

Table 1.3.4.1.1 Non-Residential Base Source Energy Limits	
ASHRAE 169 Climate Zone	**Source Energy Limit** [kBtu/ft^2.yr]
1A	31.0
1B	28.0
2A	28.0
2B	25.0
3A	27.0
3B	23.0
3C	22.0
4A	28.0
4B	23.0
4C	21.0
5A	30.0
5B	25.0
5C	23.0
6A	34.0
6B	30.0
7	39.0
8	46.0

Non-Res Modeling: Setting up → PH Case

2024 Guidebook Section 1.4.4.4

Typ. Non-Res Modeling Protocol

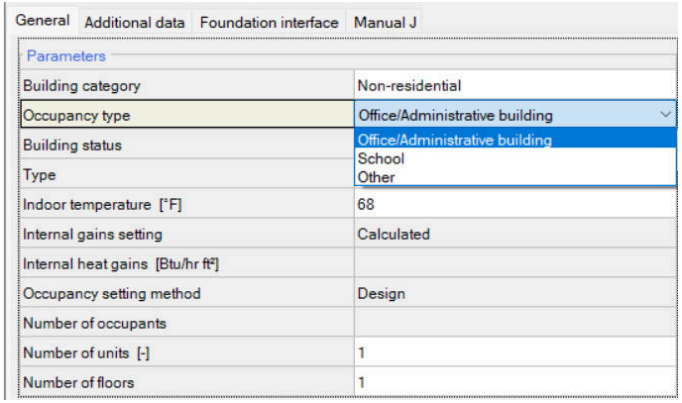
1. PH Case > Set ‘Building category’ to Non-residential

> Set ‘Occupancy type’

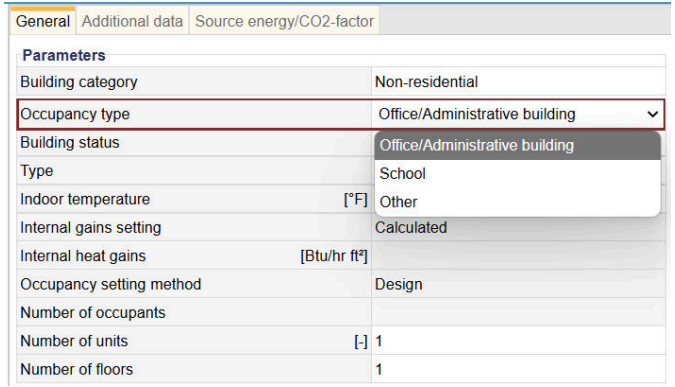
> Office/Admin: Use for all non-res projects that have a defined program that do not fall under the category of school

> School: Use for schools

> Other: Never use



WUFI



METr

Unfinished (“UF”) Modeling Protocol

Finished (“F”):
Refers to spaces whose occupancy / tenant is known at the time of design.

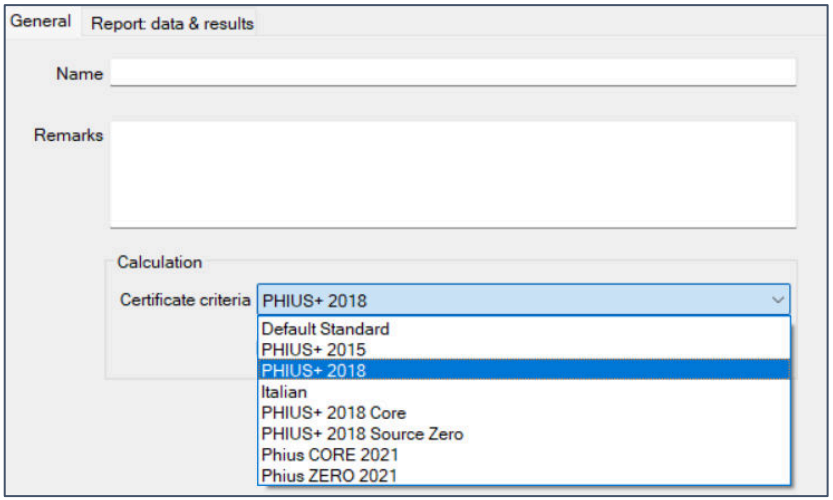
Unfinished (“UF”):
Refers to spaces intended for an unknown non-residential shell-lease.

1.4.4.9 Non-Residential Internal Loads / Occupancy

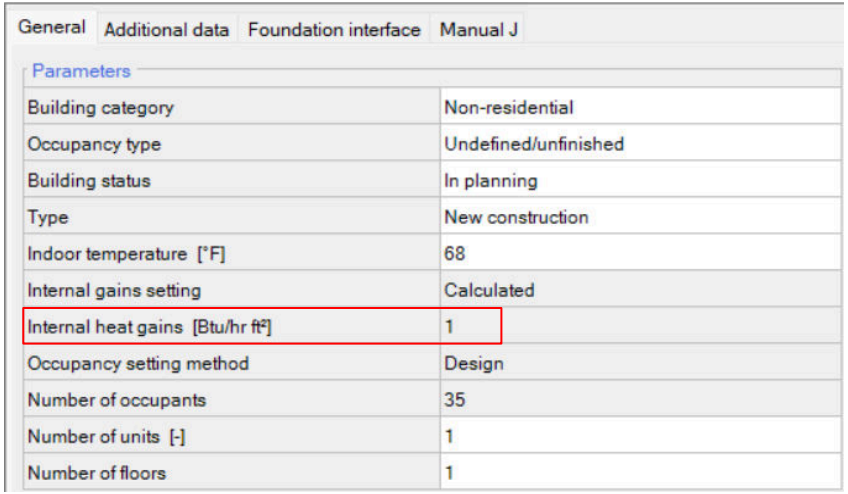
Unfinished (UF) Spaces:
It is necessary to assume a scenario to apply the certification criteria in regards to calculating the heating and cooling loads and demands of Unfinished spaces (UF). For the source energy criterion, there is no additional source energy allowance for unfinished spaces and therefore no assumption about their energy use.

Unfinished (“UF”) Modeling Protocol

1. Case 1 > Set ‘Certificate criteria’ to PHIUS+ 2018’



2. PH Case > Set ‘Building category’ to Non-residential
> Set ‘Occupancy type’ to Undefined/unfinished*

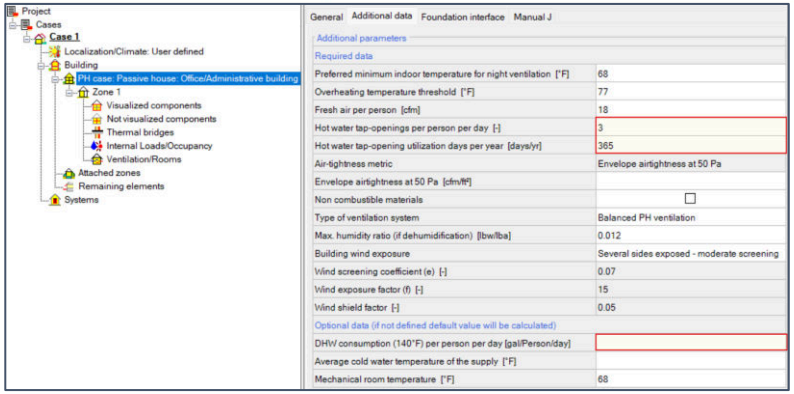


*This option will ONLY be available when the ‘Certificate criteria’ is correctly set in Step 1.

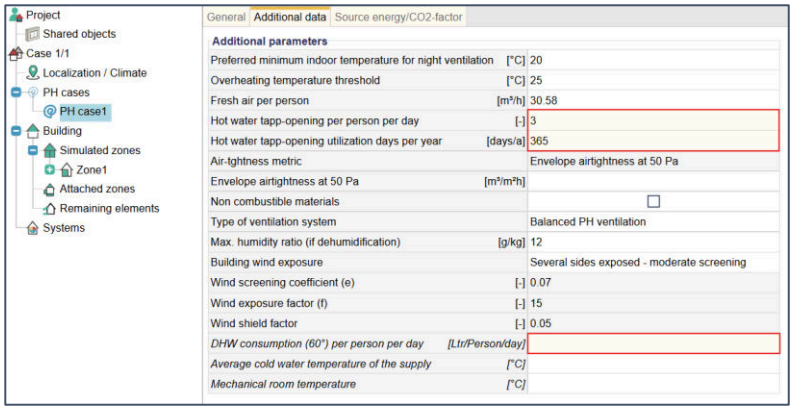
(Not currently available in METr)

Non-Res DHW Usage

- Hot water tap-openings per person per day
  - Assumes *every* occupant opens *every* tap in the building this number of times
- Hot water tap opening utilization days per year
  - Number of days the building is open per year
- DHW consumption (140F) per person per day
  - Default: 3.2 gal



WUFI



METr

Non-Res DHW Usage **Calculator**

- DHW consumption (140F)
  - Realistically, DHW consumed is not 140F
  - To calculate effective gal/p.day for WUFI based on 110F, enter occupant quantities per group, and estimated DHW consumption per person
    - Use default 3.2 or provide a narrative to support using a lower value for Certification
- Hot water tap-openings per person per day
  - Enter quantity of DHW taps in the building
  - Enter the # of HW taps opened per person per day
    - Use 3 or provide a narrative to support using a lower value for Certification

v25.0 - 2025.05

Phius Non-Residential Effective DHW Usage Calculator

Required inputs | Calculated cells | Results | Constants & Instructions

Type of Occupant	# ppl	gal/person/day (@110F)	gal/day	Notes	Instructions
Students	200	3.2	640	DHW at 110F (60 F delta from 50F)	Input high-level occupancy groups & quantities of people within that group. Then, input estimated gal/person/day (@110F, typ). Use 3.2 gallons as a default if unknown.
Teachers	20	3.2	64		
Office/Admin	10	3.2	32		
			0		
			0		
			0		
		Summed Total	736		
		Calculated Total	491	DHW at 140F (90 F delta from 50F)	-
Kitchen Staff / Janitors	10	3.2	32	DHW at 140F (90 F delta from 50F)	Input any occupants that may use 3.2 gallons/day of 140F water
Total	240		523	DHW at 140F (90 F delta from 50F)	-
			2.2	effective gal/p.day for WP model (at 140F)	Enter the calculated value to the left in WUFI Passive under: PH Case > Additional Data > ***DHW Consumption (140F) per person per day***

Total DHW taps in the building
30

Type of Occupant	# ppl	# HW taps opened/person/day	WUFI - Tap openings/person.day	Notes	Instructions
Students	200	3	0.083	averages per occupancy group	Fist, input the total number of DHW taps in the building in cell B19. Then, input the total estimated # of taps opened by each occupant on a daily basis. Use 3 taps (or less, if <3 total taps) as a default if unknown.
Teachers	20	3	0.008		
Office/Admin	10	3	0.004		
0	0		0.000		
0	0		0.000		
0	0		0.000		
Kitchen Staff / Janitors	10	3	0.004		
Total	240		0.10	effective hot water-tap openings/p.day for WP model	Enter the calculated value to the left in WUFI Passive under: PH Case > Additional Data > ***Hot water tap-openings per person per day***

Phius Non-Res Effective DHW Usage Calculator

Non-Res DHW Usage **Inputs for WUFI**

v25.0 - 2025.05

Phius Non-Residential Effective DHW Usage Calculator

Required inputs | **Results**
Calculated cells | Constants & Instructions

Type of Occupant	# ppl	gal/person/day (@110F)	gal/day	Notes	Instructions
Students	200	3.2	640	DHW at 110F (60 F delta from 50F)	Input high-level occupancy groups & quantities of people within that group. Then, input estimated gal/person/day (@110F, typ). Use 3.2 gallons as a default if unknown.
Teachers	20	3.2	64		
Office/Admin	10	3.2	32		
			0		
			0		
			0		
		Summed Total	**736**		
		Calculated Total	**491**	DHW at 140F (90 F delta from 50F)	-
Kitchen Staff/Janitors	10	3.2	32	DHW at 140F (90 F delta from 50F)	Input any occupants that may use 3.2 gallons/day of 140F water
Total	**240**		**523**	DHW at 140F (90 F delta from 50F)	-
			2.2	**effective gal/p.day for WP model (at 140F)**	Enter the calculated value to the left in WUFI Passive under: PH Case > Additional Data > ***DHW Consumption (140F) per person per day***

Total DHW taps in the building
30

Type of Occupant	# ppl	# HW taps opened/person/day	WUFI - Tap openings/person.day	Notes	Instructions
Students	200	3	0.083	averages per occupancy group	Fist, input the total number of DHW taps in the building in cell B19. Then, input the total estimated # of taps opened by each occupant on a daily basis. Use 3 taps (or less, if <3 total taps) as a default if unknown.
Teachers	20	3	0.008		
Office/Admin	10	3	0.004		
0	0		0.000		
0	0		0.000		
0	0		0.000		
Kitchen Staff/Janitors	10	3	0.004		
Total	**240**		**0.10**	**effective hot water-tap openings/p.day for WP model**	Enter the calculated value to the left in WUFI Passive under: PH Case > Additional Data > ***Hot water tap-openings per person per day***

General | Additional data | Foundation interface | Manual J

Additional parameters

Required data	
Preferred minimum indoor temperature for night ventilation [°F]	68
Overheating temperature threshold [°F]	77
Fresh air per person [cfm]	18
Hot water tap-openings per person per day [-]	0.10
Hot water tap-opening utilization days per year [days/yr]	365
Air-tightness metric	Envelope airtightness at 50 Pa
Envelope airtightness at 50 Pa [cfm/ft²]	0.06
Non combustible materials	☐
Type of ventilation system	Balanced PH ventilation
Max. humidity ratio (if dehumidification) [lbw/lba]	0.012
Building wind exposure	Several sides exposed - moderate screening
Wind screening coefficient (e) [-]	0.07
Wind exposure factor (f) [-]	15
Wind shield factor [-]	0.05
Optional data (if not defined default value will be calculated)	
DHW consumption (140°F) per person per day [gal/Person/day]	2.2
Average cold water temperature of the supply [°F]	50
Mechanical room temperature [°F]	40

Non-Res Modeling: Internal Loads / Occupancy

2024 Guidebook Section 1.4.4.9

Non-Res Utilization Patterns

- Used for
  - Lighting energy calculation
  - Internal gains
- Columns highlighted in red (left) should be customized to align with the project-specific utilization schedule(s)
  - Provide a narrative supporting the modeled patterns for Certification

N-8 Non-Residential Utilization Patterns

Standard Default Patterns (per DIN V 18599-10:2007-02, Table 4) for Internal Loads and Occupancy Calculations for Non-Residential Buildings

Table N-8.0 Non-Residential Utilization Patterns

Building Type	Space Type	Notes	Start [time]	End [time]	Annual Utilization Days [d/a]	Maintained Illuminance [lux]	Height of the working plane [ft]	Relative Absence	Factor of lighting relative to building's operation time
Library	magazine and stores	-	8	20	300	100	2.6	0.9	1
	open stacks areas	-	8	20	300	200	2.6	0	1
	reading rooms	-	8	20	300	500	2.6	0	1
Office	1 - 6 workstations	-	7	18	250	500	2.6	0.3	0.7
	7+ workstations	-	7	18	250	500	2.6	0	1
	Meeting, conference, and seminar room	-	7	18	250	500	2.6	0.5	1
Restaurant	Dining Area	-	10	24	300	200	2.6	0	1
	Kitchen	-	10	23	300	500	2.6	0	1
	Kitchen	preparation room or storeroom	7	23	300	300	2.6	0.5	1
School	Cafeteria	Canteen	8	15	250	200	2.6	0	1
	Classroom	school and nursery school	8	15	200	300	2.6	0.25	0.9
	Lecture Room, Auditorium	-	8	18	150	500	2.6	0.25	0.7

Non-Res Utilization Patterns

- Columns highlighted in red (middle) influence lighting, but are overridden by modeling protocol in the 'Lighting' section.
  - Lux inputs can be used when installed lighting power is unknown, in the design or feasibility study stage of the project
  - Actual lighting power density should be modeled for certification

N-8 Non-Residential Utilization Patterns

Standard Default Patterns (per DIN V 18599-10:2007-02, Table 4) for Internal Loads and Occupancy Calculations for Non-Residential Buildings

Table N-8.0 Non-Residential Utilization Patterns

Building Type	Space Type	Notes	Start [time]	End [time]	Annual Utilization Days [d/a]	Maintained Illuminance [lux]	Height of the working plane [ft]	Relative Absence	Factor of lighting relative to building's operation time
Library	magazine and stores	-	8	20	300	100	2.6	0.9	1
	open stacks areas	-	8	20	300	200	2.6	0	1
	reading rooms	-	8	20	300	500	2.6	0	1
Office	1 - 6 workstations	-	7	18	250	500	2.6	0.3	0.7
	7+ workstations	-	7	18	250	500	2.6	0	1
	Meeting, conference, and seminar room	-	7	18	250	500	2.6	0.5	1
Restaurant	Dining Area	-	10	24	300	200	2.6	0	1
	Kitchen	-	10	23	300	500	2.6	0	1
	Kitchen	preparation room or storeroom	7	23	300	300	2.6	0.5	1
School	Cafeteria	Canteen	8	15	250	200	2.6	0	1
	Classroom	school and nursery school	8	15	200	300	2.6	0.25	0.9
	Lecture Room, Auditorium	-	8	18	150	500	2.6	0.25	0.7

Non-Res Utilization Patterns

- Default values in the columns highlighted in red (right) should be left as-is according to Guidebook (2024) Appendix N-8

N-8 Non-Residential Utilization Patterns

Standard Default Patterns (per DIN V 18599-10:2007-02, Table 4) for Internal Loads and Occupancy Calculations for Non-Residential Buildings

Table N-8.0 Non-Residential Utilization Patterns

Building Type	Space Type	Notes	Start [time]	End [time]	Annual Utilization Days [d/a]	Maintained Illuminance [lux]	Height of the working plane [ft]	Relative Absence	Factor of lighting relative to building's operation time
Library	magazine and stores	-	8	20	300	100	2.6	0.9	1
	open stacks areas	-	8	20	300	200	2.6	0	1
	reading rooms	-	8	20	300	500	2.6	0	1
Office	1 - 6 workstations	-	7	18	250	500	2.6	0.3	0.7
	7+ workstations	-	7	18	250	500	2.6	0	1
	Meeting, conference, and seminar room	-	7	18	250	500	2.6	0.5	1
Restaurant	Dining Area	-	10	24	300	200	2.6	0	1
	Kitchen	-	10	23	300	500	2.6	0	1
	Kitchen	preparation room or storeroom	7	23	300	300	2.6	0.5	1
School	Cafeteria	Canteen	8	15	250	200	2.6	0	1
	Classroom	school and nursery school	8	15	200	300	2.6	0.25	0.9
	Lecture Room, Auditorium	-	8	18	150	500	2.6	0.25	0.7

Non-Res Utilization Patterns & Occupancy

- Simplicity is key
  - Unique utilization patterns are only needed when major space types within the building are used differently by different groups of occupants
- Start with the Phius Non-res Occupancy calculator
  1. Define utilization patterns for major space types only (App. N-8)
  2. Define how occupants will typically use each space

Calculating Occupancy for Non-Residential Phius projects

Occupant Quantity	70	For input in WUFI the Occupancy > Occupant Quantity
Maximum Occupancy	237	For input in the Phius 2021 target setting calculator

1.

Utilization Patterns for WUFI & Occupancy Inputs					
Name	Begin Utilization	End Utilization	Annual Utilization Days	Relative Absence	Occupant Quantity for Pattern
Classroom (School)	7.0	16.0	240	0.25	215.0
Workgroup Office	7.0	17.0	240	0.30	10.0
Janitorial	5.0	22.0	300	0.90	2.0
Food Prep	7.0	16.0	240	0.25	10.0
	0.0	0.0		0.00	0.0
	0.0	0.0		0.00	0.0
	0.0	0.0		0.00	0.0
	0.0	0.0		0.00	0.0

2.

		Use 24 Hour Time (1:00 pm = 13)				Maximum Occupancy per day						
Spaces	Pattern	Start Hours	End Hours	Weeks/yr	Relative Absence	M	T	W	TH	F	Sa	Su
Students in Class	Classroom (School)	7	16	50	0.25	200	200	200	200	200	0	0
Teachers in Class	Classroom (School)	7	16	50	0.25	15	15	15	15	15	0	0
Office/Admin	Workgroup Office	7	17	50	0.3	10	10	10	10	10	0	0
Janitors	Janitorial	5	22	50	0.9	2	2	2	2	2	2	2
Kitchen Staff	Food Prep	7	16	50	0.25	10	10	10	10	10	0	0

Non-Res Utilization Patterns

Calculating Occupancy for Non-Residential Phius projects

Occupant Quantity	70	For input in WUFI the Occupancy > Occupant Quantity
Maximum Occupancy	237	For input in the Phius 2024 target setting calculator

Utilization Patterns for WUFI & Occupancy Inputs

Name	Begin Utilization	End Utilization	Annual Utilization Days	Relative Absence	Occupant Quantity for Pattern
Classroom (School)	7.0	16.0	240	0.25	215.0
Workgroup Office	7.0	17.0	240	0.30	10.0
Janitorial	5.0	22.0	300	0.90	2.0
Food Prep	7.0	16.0	240	0.25	10.0
	0.0	0.0		0.00	0.0
	0.0	0.0		0.00	0.0
	0.0	0.0		0.00	0.0
	0.0	0.0		0.00	0.0

		Use 24 Hour Time (1:00 pm = 13)				Maximum Occupancy per day						
Spaces	Pattern	Start Hours	End Hours	Weeks/yr	Relative Absence	M	T	W	TH	F	Sa	Su
Students in Class	Classroom (School)	7	16	50	0.25	200	200	200	200	200	0	0
Teachers in Class	Classroom (School)	7	16	50	0.25	15	15	15	15	15	0	0
Office/Admin	Workgroup Office	7	17	50	0.3	10	10	10	10	10	0	0
Janitors	Janitorial	5	22	50	0.9	2	2	2	2	2	2	2
Kitchen Staff	Food Prep	7	16	50	0.25	10	10	10	10	10	0	0

Non-Res Utilization Patterns

WUFI Navigation:
Internal Loads/Occupancy > Utilization Pattern

METr Navigation:
Shared Objects > Utilization patterns > Internal Loads

Utilization pattern | Occupancy | Office equipment | Kitchen equipment | Lighting | Process loads

Name	Begin utilization [hr]	End utilization [hr]	Annual utilization days [days/yr]	Illumination level [lux]	Height of utilization level	Relative absence [-]	Part use factor of operating period for lighting [-]
Classroom (School)	7	16	240	500	Level 2: 2.62 ft	0.25	1
Workgroup Office	7	17	240	500	Level 2: 2.62 ft	0.3	1
Janitorial	5	22	300	500	Level 1: 0 ft	0.9	1
Food Prep	7	16	240	500	Level 2: 2.62 ft	0.25	1

New | Delete | Copy | Insert | New/Insert: after

From calculator or N-8 **App N-8**

Building elements | Utilization patterns
Room ventilation | Internal loads

Utilization patterns - loads

Nr	Name	Begin utilization [hrs]	End utilization [hrs]	Annual utilization days [days/yr]	Illumination level [lux]	Height of utilization level	Relative absence [-]	Part use factor of oper. period for lighting [-]
1	Classroom (School)	7	16	240	500	Level 2: 0.8 m	0.25	1
2	Workgroup Office	7	17	240	500	Level 2: 0.8 m	0.3	1
3	Janitorial	5	22	300	500	Level 2: 0.8 m	0.9	1
4	Food Prep	7	16	240	500	Level 2: 0.8 m	0.25	1

Optional data: Work Space

Average occupancy [ft²/Person]	
Room setpoint temperature [°F]	
Heating reduction temperature [°F]	
Daily utilization hours [hrs/d]	
Annual utilization hours [hrs/yr]	
Annual utilization hours during daytime [hrs/yr]	
Annual utilization hours during nighttime [hrs/yr]	
Daily heating operation hours [hrs/d]	
Daily ventilation operation hours [hrs/d]	
Number of max water tap openings per day [-]	

ALWAYS Leave BLANK

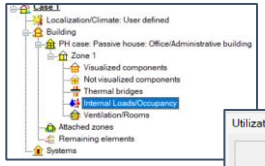
Optional data

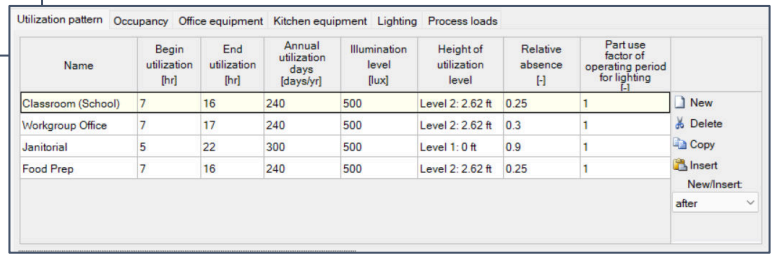
Average occupancy [m²/Person]	
Room setpoint temperature [°C]	
Heating reduction temperature [K]	
Daily utilization hours [hrs/d]	
Annual utilization hours [hrs/a]	
Annual utilization hours during daytime [hrs/a]	
Annual utilization hours during nighttime [hrs/a]	
Daily heating operation hours [hrs/d]	
Daily ventilation operation hours [hrs/d]	
Number of max water tabs per day [-]	

School Utilization Patterns

- Typical school with multiple occupancy groups & space types
  - Several patterns are appropriate
    - Janitorial staff may be in the building long after students leave.
    - Kitchen staff may not be there for the full day.
    - Are there any after school programs?
    - Etc…

WUFI





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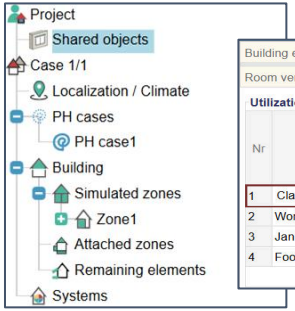
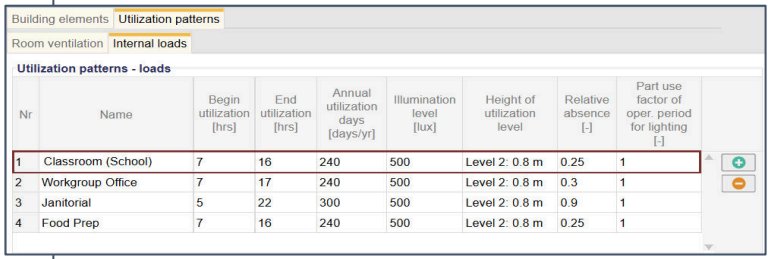
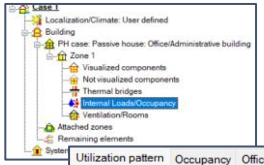


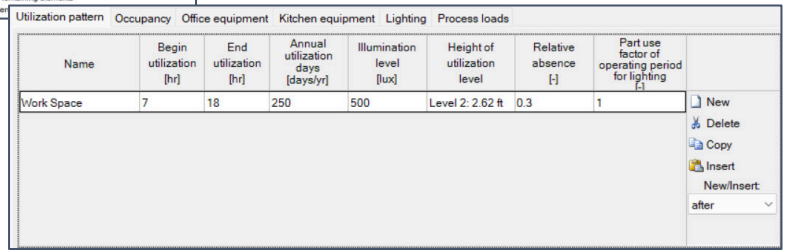


Office Utilization Patterns

- Typical office with single-shift operation
  - One pattern is enough to represent the entire building & all spaces within it
    - Office workstations
    - Kitchen
    - Bathrooms
    - Etc…

WUFI





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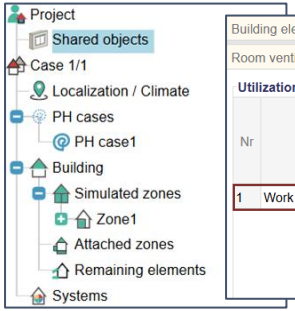
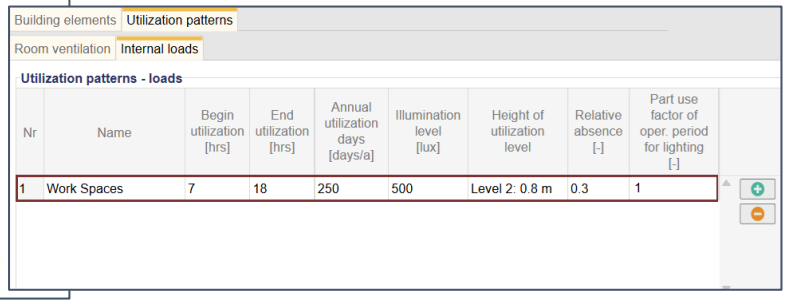
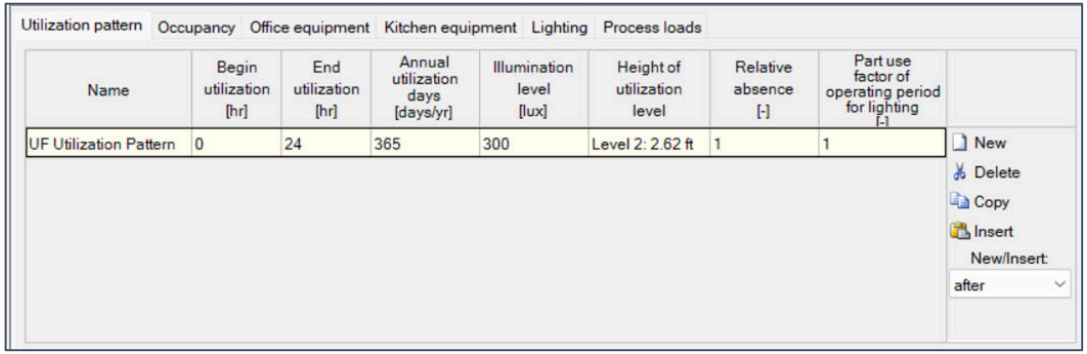
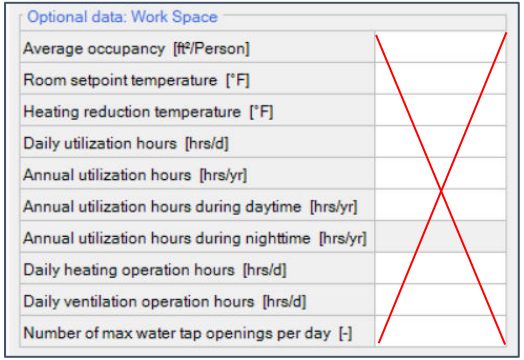




Unfinished (“UF”) Utilization Pattern

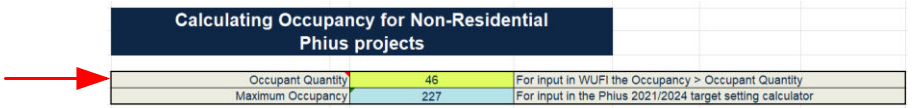
- Beginning utilization
  - Enter 0
- End utilization
  - Enter 24
- Annual utilization days
  - Enter 365
- Illumination level
  - Enter 300
- Height of utilization
  - Enter 2.62
- Relative absence
  - Enter 1
- Part use factor of building period for lighting
  - Enter 1
- Optional Data
  - Leave BLANK. No inputs needed





Non-Res Occupancy

- WUFI/METr Navigation:
  - Zone 1 > Internal Loads
- Occupant Quantity (whole-building average)
  - Average # of occupants in all spaces 24/7/365
  - Calculated in the 'Non-res occupancy calculator'
- Impacts DHW usage & supply air ventilation

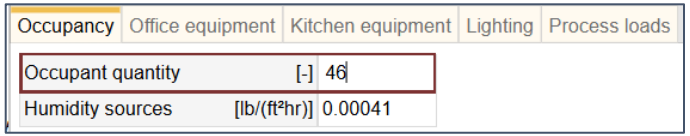


Calculating Occupancy for Non-Residential Phius projects		
Occupant Quantity	46	For input in WUFI the Occupancy > Occupant Quantity
Maximum Occupancy	227	For input in the Phius 2021/2024 target setting calculator

WUFI

Utilization pattern	Occupancy	Office equipment	Kitchen equipment	Lighting	Process loads
Occupant quantity [-]	46				
Humidity sources [lb/(ft²hr)]	0.00041				

METr



Occupancy	Office equipment	Kitchen equipment	Lighting	Process loads
Occupant quantity [-]	46			
Humidity sources [lb/(ft²hr)]	0.00041			

Non-Res Occupancy

- Occupancy Groups (design max. per space)
  - In general, there should be one occupancy group per unique utilization pattern
  - Calculated in the ‘Non-res occupancy calculator’
  - **Don’t** include:
    - Transient spaces such as stairwells/circulation
    - Restrooms
    - Auxiliary spaces serving the ‘main’ occupied areas (i.e. conference rooms serving a broader office environment)

		Use 24 Hour Time (1:00 pm = 13)				Maximum Occupancy per day						
Spaces	Pattern	Start Hours	End Hours	Weeks/yr	Relative Absence	M	T	W	TH	F	Sa	Su
Students in Class	Classroom (School)	7	16	50	0.25	200	200	200	200	200	0	0
Teachers in Class	Classroom (School)	7	16	50	0.25	15	15	15	15	15	0	0
Office/Admin	Workgroup Office	7	17	50	0.3	10	10	10	10	10	0	0
Janitors	Janitorial	5	22	50	0.9	2	2	2	2	2	2	2
Kitchen Staff	Food Prep	7	16	50	0.25	10	10	10	10	10	0	0

WUFI

Name	Utilization pattern	Activity of persons	Occupant quantity	Floor area of utilization zone [ft²]
Students in Class	Pattern 1: Classroom	Adult, standing or light work	200	
Teachers in Class	Pattern 1: Classroom	Kid, 0 - 10 years	15	
Office/Admin Staff	Pattern 2: Workgroup O	Adult, sitting	10	
Janitorial	Pattern 3: Janitorial	Adult, standing or light work	2	
Kitchen Staff	Pattern 4: Food Prep	Adult, standing or light work	10	

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METr

Nr	Name	Utilization pattern	Activity of persons	Occupant quantity	Floor area of utilization zone [ft²]
1	Students in Class	Pattern 1: Classroom	Kid, 0 - 10 years	200	
2	Teachers in Class	Pattern 1: Classroom	Adult, standing or light work	15	
3	Office/Admin Staff	Pattern 2: Workgroup Office	Adult, sitting	10	
4	Janitorial	Pattern 3: Janitorial	Adult, standing or light work	2	

Unfinished (“UF”) Occupancy

- Occupant quantity (whole-building average)
  - Assume 30% of the design (maximum) occupancy for the building
- Occupancy groups (design max. per space)
  - Add one line item
  - Complete inputs in WUFI to represent the maximum occupancy for the most realistic commercial tenant for the space according to IBC 2021 Table 1004.5 (or local code if more stringent)

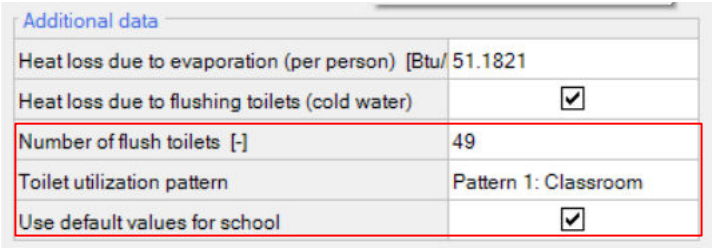
Example: A project under development has 3,000 ft^2 of additional commercial space available for lease. The owner hopes to lease it to a small local business for office space.

- Design (maximum)
  - IBC 2021: 150 GSF/person
  - 3,000 / 150 = 20 occupants
- Average occupancy (for target setting)
  - 20 * 0.3 = 6 occupants

Non-Res Occupancy - Additional Data

- Heat loss due to evaporation
  - Leave as-is, default 51.2 BTU/hr
- Heat loss due to flushing toilets
  - Leave as-is, box checked is default
- Number of flush toilets
  - Enter quantity of flush toilets planned in the project
- Toilet utilization pattern
  - Select utilization pattern with the most ‘Annual utilization days’
- Use default values for school?
  - Check this box only when modeling a school

WUFI



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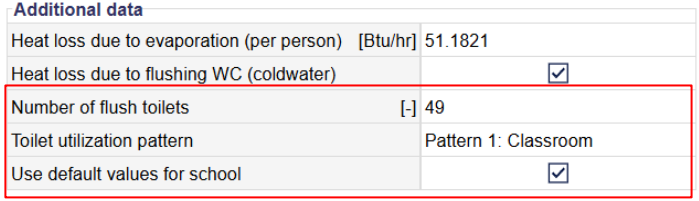


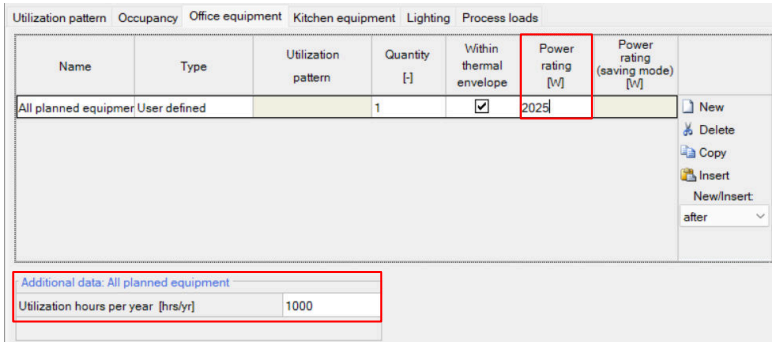
Utilization & Occupancy - Supporting Documentation

- Provide a narrative describing:
  - Operating periods of spaces within the model
    - Daily start/End time
    - Weekly utilization days (M-F, S/S)
    - Annual utilization weeks/yr
  - Occupancy groups using the space(s)
    - Full-time employees (FTE's)
    - Part-time employees
    - Age groups (schools, teachers vs students, etc)
    - Visitors / patients / customers
    - etc…
  - Quantity of people within each occupancy group

Non-Res Office Equipment

- Simple Method
  - Create one line-item in WUFI with type set to '**User defined**'
  - Calculate/estimate annual kWh/yr of <u>all</u> planned equipment (except kitchen equipment)
    - kWh/yr = EPD * iCFA * EFLH / 1000
    - EFLH = operating hours/day * operating days/yr
    - Enter this value as the **Power rating (W)** in WUFI
  - Enter 1000 hrs/yr under 'Additional data'
    - Multiplied by 'Power rating (W)' entry to get total kWh/yr
- Example: A 1,500 sf office space open 8a-5p M-F has an EPD of 0.6 W/sf
  - 0.6 * 1500 * (9*250) / 1000 = 2025 W

WUFI



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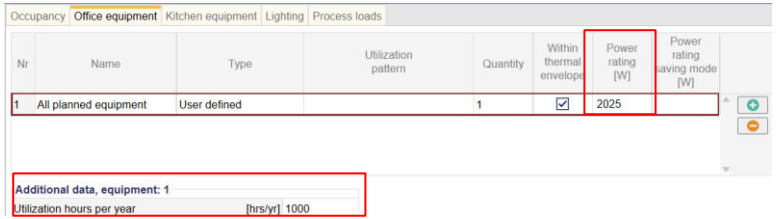
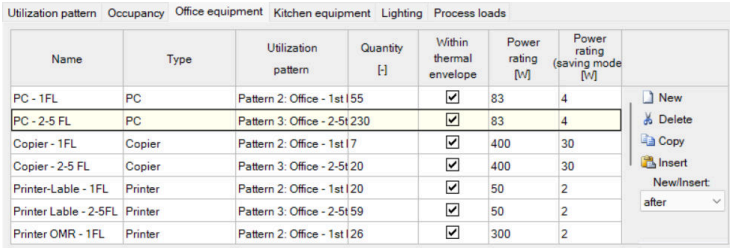


Non-Res Office Equipment

- Granular Method
  - Create a unique line item for each piece of electrical equipment in the building & set the appropriate device type: PC/Monitor, copier, printer, server, telephone system, or ‘user-defined’
    - Refer to Appendix I-3.11 (GB 2024) for typical non-residential equipment power consumption
    - Consolidate like-equipment as much as possible
    - Calculate inputs for user-defined equipment as described in the previous slide
  - Some predefined equipment types require an entry for the power rating in ‘sleep’ or ‘power saving’ mode
    - Time in power saving mode is automatically calculated. Don’t input anything when prompted

WUFI



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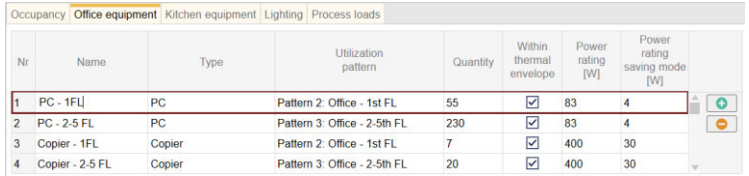


Non-Res Office Equipment

WUFI

Utilization pattern | Occupancy | Office equipment | Kitchen equipment | Lighting | Process loads

Name	Type	Utilization pattern	Quantity [-]	Within thermal envelope	Power rating [W]	Power rating (saving mode [W]
PC - 1FL	PC	Pattern 2: Office - 1st	55	☑	83	4
PC - 2-5 FL	PC	Pattern 3: Office - 2-5t	230	☑	83	4
Copier - 1FL	Copier	Pattern 2: Office - 1st	7	☑	400	30
Copier - 2-5 FL	Copier	Pattern 3: Office - 2-5t	20	☑	400	30
Printer-Lable - 1FL	Printer	Pattern 2: Office - 1st	20	☑	50	2
Printer Lable - 2-5FL	Printer	Pattern 3: Office - 2-5t	59	☑	50	2
Printer OMR - 1FL	Printer	Pattern 2: Office - 1st	26	☑	300	2

New | Delete | Copy | Insert | New/Insert: after

Additional data: Copier - 1FL

Duration of utilization time in energy saving mode

*-Optional data

METr

Occupancy | Office equipment | Kitchen equipment | Lighting | Process loads

Nr	Name	Type	Utilization pattern	Quantity	Within thermal envelope	Power rating [W]	Power rating saving mode [W]
1	PC - 1FL	PC	Pattern 2: Office - 1st FL	55	☑	83	4
2	PC - 2-5 FL	PC	Pattern 3: Office - 2-5th FL	230	☑	83	4
3	Copier - 1FL	Copier	Pattern 2: Office - 1st FL	7	☑	400	30
4	Copier - 2-5 FL	Copier	Pattern 3: Office - 2-5th FL	20	☑	400	30
5	Printer-Lable - 1FL	Printer	Pattern 2: Office - 1st FL	20	☑	50	2

Additional data, equipment: 3

*Duration of utilization in energy saving mode** *[hrs/yr]*

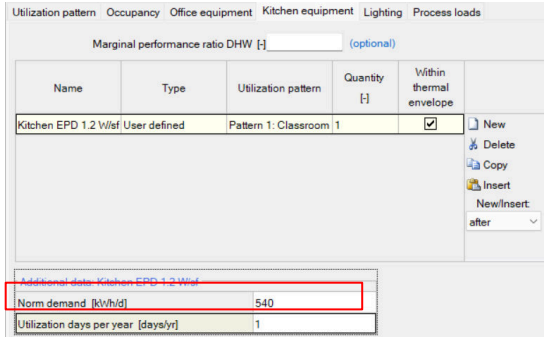
Leave blank for pre-defined devices. Only modify for user-defined

Non-Res Kitchen Equipment

- Simple Method
  - Create one line-item in WUFI with type set to ‘User defined’
  - Calculate/estimate annual kWh/yr of all planned kitchen equipment
    - kWh/yr = EPD * iCFA * EFLH / 1000
    - EFLH = operating hours/day * operating days/yr
  - Use this value as the kWh/d input in WUFI
  - Enter 1 utilization day/yr

- Example: A 200 sf kitchen has an EPD of 1.2 W/sf and operates within a generic office (M-F, 8a-5p)
  - 1.2 * 200 * (9*250) / 1000 = **540 kWh/yr**

WUFI



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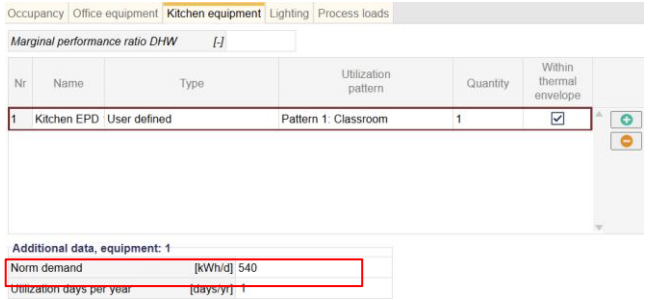
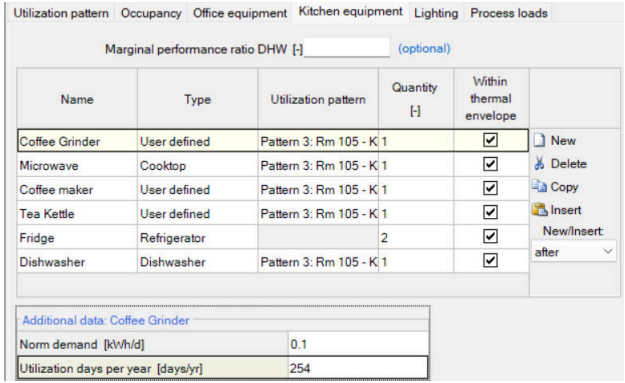


Non-Res Kitchen Equipment

- Granular Method
  - Create a unique line item for each piece of electrical kitchen equipment in the building (cooktop, dishwasher, refrigerator, or user-defined)
    - Consolidate equipment as much as possible
    - If multiple ‘cooking’ appliances (microwaves, range, etc) or dishwashers are present, only enter them ONE time with a quantity of ONE
      - Enter the number of meals per utilization day. Assume **one meal per occupant** as the conservative approach for most projects
  - Calculate inputs for user-defined equipment as described in the previous slide

WUFI



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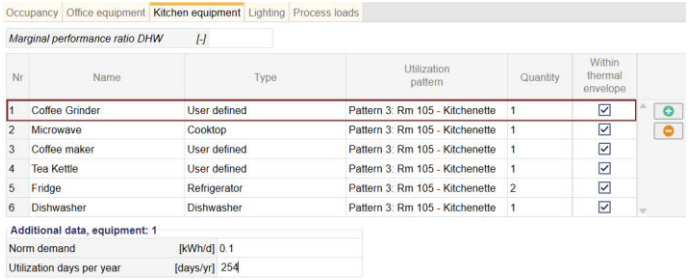
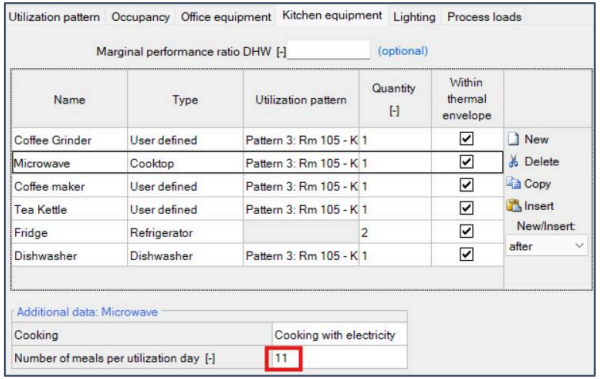
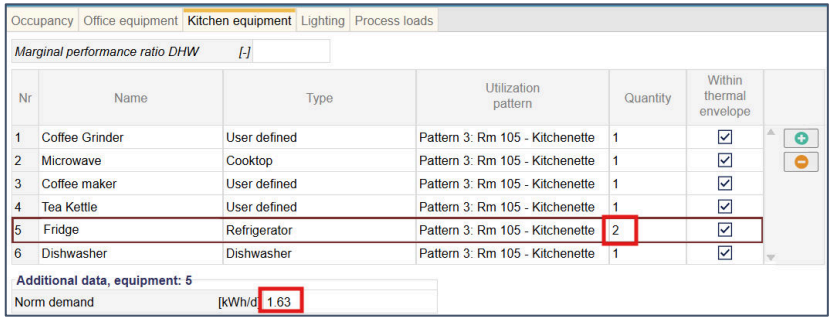


Non-Res Kitchen Equipment

- Occupancy-based equipment vs quantity-based equipment
  - Similar to residential projects, the use of appliances like cooktops, microwaves, coffee makers, dishwashers, and other devices that need to be manually turned on by an occupant to function is occupancy based.
    - Generally these should be input as if there is only ONE device
  - Appliances like refrigerators that are **constantly** running are not dependent on occupant use.
    - Therefore, the quantity of this kind of equipment should reflect the physical quantity of devices in the project





Office/Kitchen Equipment - Supporting Documentation

- Must be able to confirm **all** associated modeling inputs
  - Device power rating and/or calculations showing how device energy consumption was determined
    - Comprehensive list of equipment
    - Datasheets
  - Quantities of devices/equipment
    - Takeoffs
  - Calculations/documentation to justify estimated runtime for user-defined devices

Unfinished (“UF”) Equipment & Lighting

SKIP Office & Kitchen Equipment, Lighting & Process Loads. UF Projects should have **no** inputs in any of these sections.

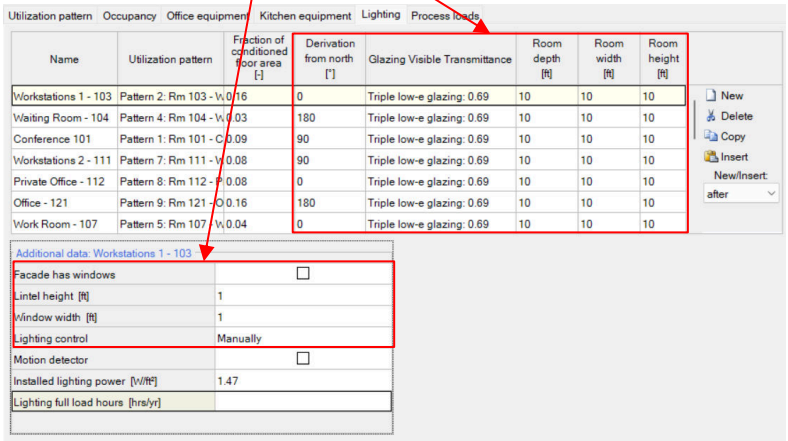
Move on to Rooms/Ventilation

Non-Res Lighting

WUFI & Daylighting

- The built-in daylighting function in WUFI should NOT be used
  - Up to a 10% reduction in lighting power density may be used in situations where rooms have windows, and a daylighting control system, whether continuous or stepped control is used.
  - Project teams may take a greater reduction of lighting power where a comparative daylighting simulation is provided showing the percentage reduction of lighting energy over a baseline with no controls.

These are for the daylighting calculation. They should be kept at default values shown on the next slide



Non-Res Lighting

- Inputs for <u>all</u> of the following should <u>not</u> be changed from the default values:
  - **Derivation from North:** 0
  - **Glazing visible transmittance:** Double **low-e glazing:** 0.78
  - **Room Depth/Width/Height:** 10 ft
  - **Facade has windows:** DO NOT check
  - **Lintel height/window width:** 1 ft
  - **Lighting control:** Manually

WUFI

Derivation from north [°]	Glazing Visible Transmittance	Room depth [ft]	Room width [ft]	Room height [ft]
0	Double low-e glazing: 0.78	10	10	10

Additional data: Library Open Stack

Facade has windows	☐
Lintel height [ft]	1
Window width [ft]	1
Lighting control	Manually
Motion detector	☐
Installed lighting power [W/ft²]	
Lighting full load hours [hrs/yr]	

METr

Derivation from north [°]	Glazing visible transmittance [-]	Room depth [ft]	Room width [ft]	Room height [ft]
0	Double low-e glazing: 0.78	10	10	10

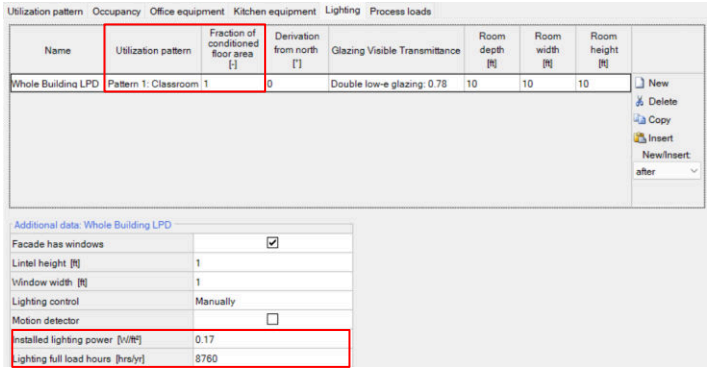
Additional data, lighting: 1

Facade has windows		☐
Lintel height	[ft]	1
Window width	[ft]	1
Lighting control		Manually
Motion detector		☐
*Installed lighting power**	*[W/ft²]*	
*Lighting full load hours**	*[hrs/yr]*	

Non-Res Lighting

- Simple Method
  - Create one line-item in WUFI to account for the lighting power for the full building/space being modeled.
  - Fraction of conditioned floor area
    - Input 1 to represent 100% of the floor area
  - Calculate/estimate whole-building LPD (W/sf) and input in WUFI
    - Apply 10% daylighting reduction by multiplying LPD * 0.9
  - Calculate full load hours for lighting
    - EFLH = operating hours/day * operating days/yr

WUFI



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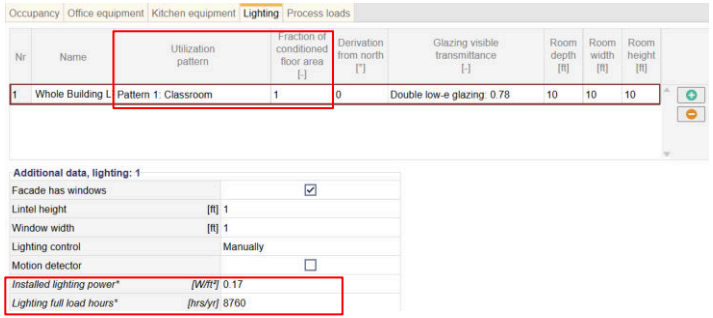
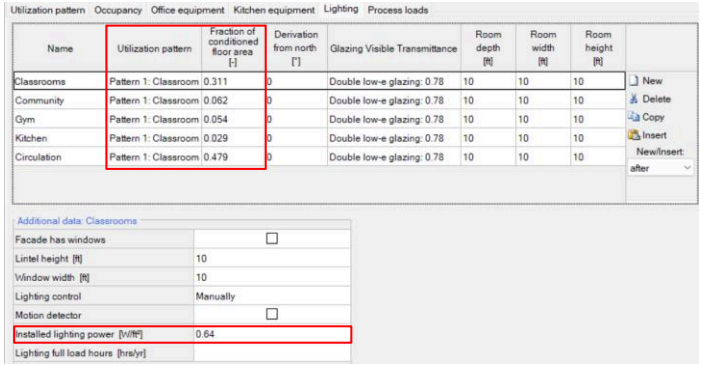


Non-Res Lighting

- Granular Method
  - Same as above, but one line-item for each unique space
  - Consolidate as much as possible
    - Appropriate to group rooms if they share a utilization pattern and have similar LPDs
  - Fraction of conditioned floor area
    - Input % of total iCFA made up by each space
  - Calculate/estimate LPD (W/sf) by space type and input in WUFI
    - Apply 10% daylighting reduction to applicable rooms only by multiplying LPD * 0.9
  - Do NOT input lighting full load hours

WUFI



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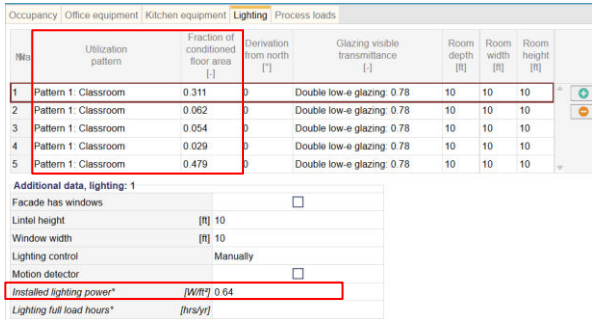


Lighting - Supporting Documentation

- Must be able to confirm **all** associated modeling inputs
  - Lighting plans & LPD Calculations
    - Fixture wattages
    - Fixture quantities
  - Fraction of conditioned floor area calculations
    - Granular modeling method for lighting only

Non-Res Process Loads

- What is a process load?
  - “Energy consumed in support of a manufacturing, industrial, or commercial process other than conditioning spaces and maintaining comfort & amenities for the occupants of a building”
- Allowances apply to source energy limit, **not** space conditioning targets
  - Custom space conditioning targets may be permitted on a case-by-case basis
  - Office & retail spaces do not qualify for this allowance

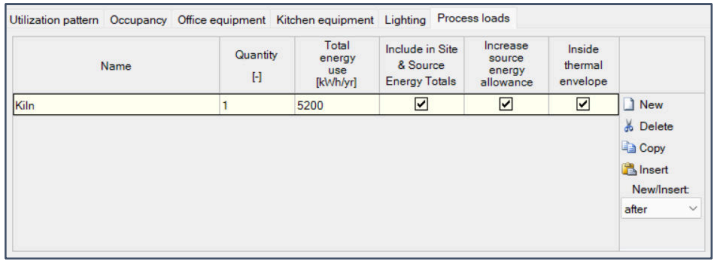
Non-Res Process Loads

- YES Process Loads
  - Grocery store refrigeration
  - Kiln in a pottery studio
  - Tank water pumps in an aquarium
  - Saws & dust collectors in a carpentry shop or makerspace
  - Incubators/lab equipment in a hospital
  - Fitness equipment in a gym
- NOT Process Loads
  - Computers/monitors
  - Staff lounge appliances
  - Televisions
  - Copiers/Printers (except in a building that is specifically a print-shop)
  - Miscellaneous “amenity” equipment

Non-Res Process Loads

- Simple Method
  - Create one line-item in WUFI to account for all process loads in the project
  - Calculate/estimate energy consumption (kWh/yr)
- Granular Method
  - Same as above, but one line-item for each unique space
    - Click into ‘Total energy use’ cell and use the [...] to input Power rating (W) & annual use hours
  - Consolidate similar equipment as much as possible
- Check the boxes for ‘Include in Site & Source Energy Totals’ and ‘Increase source energy allowance’ for all approved process-load devices

WUFI



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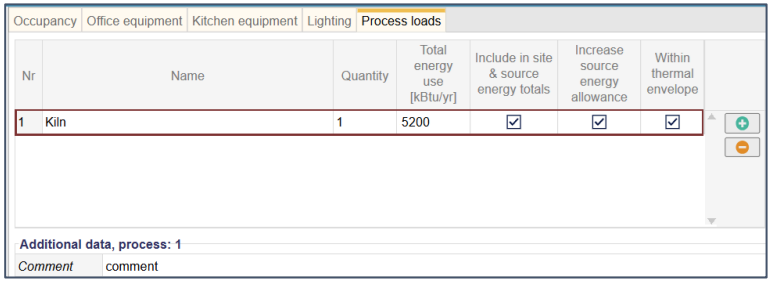


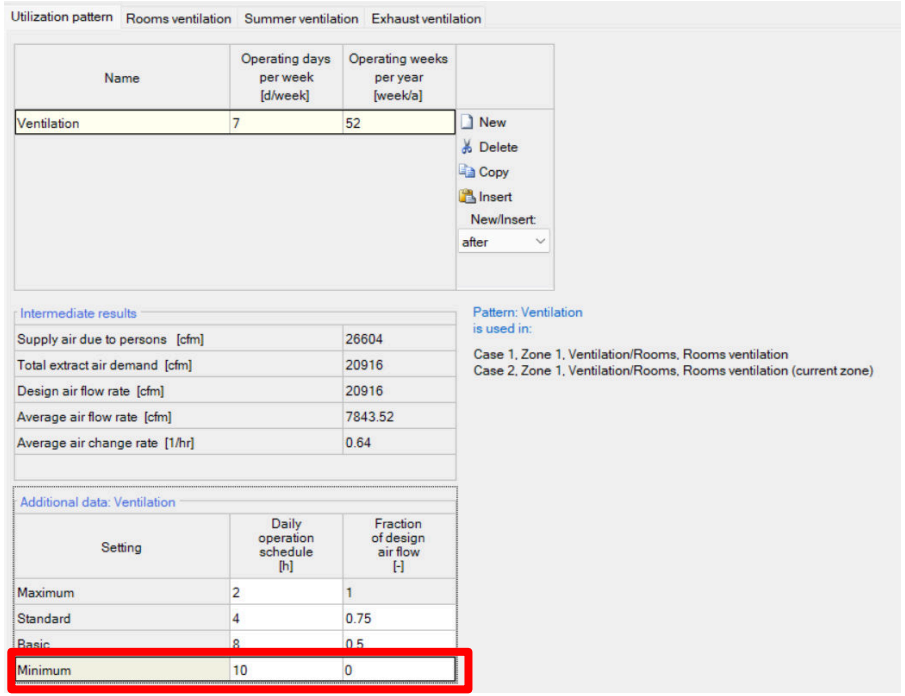
Non-Res Modeling: Mechanical Ventilation

2024 Guidebook Section 1.4.4.10

Ventilation

General Considerations

- Controls may be more complicated
- Ventilation when vacant
  - Less infiltration than code
  - Ramp up period before occupancy?
- IMC / ASHRAE 62.1 controls required rates
- Can have process ventilation



Ventilation

- Need to understand sequence of operations (SOO)
- Can be written in a few formats
- Should be converted to a few different flow conditions to be put into utilization patterns

AIR HANDLING UNITS

A DDC CONTROLLER USING ELECTRIC ACTUATION CONTROLS THE ROOFTOP AIR HANDLING UNIT OPERATION AS FOLLOWS:

RUN CONDITIONS - SCHEDULED:
THE RTU SHALL RUN BASED UPON AN OPERATOR-ADJUSTABLE SCHEDULE.

WARM-UP:
THE TERMINAL HEATING UNITS (RADIANT PANELS, WALL RADIATION UNITS, FINTUBE, ETC) VALVES SHALL MODULATE OPEN TO RAISE THE SPACES TO THE OCCUPIED SET POINT OF 70°F (ADJ.). ALONG WITH THE TERMINAL HEATING UNITS, THE RTU SHALL ALSO BE ACTIVATED. THE RTU OUTSIDE AND EXHAUST AIR DAMPERS SHALL BE CLOSED, THE RECIRCULATION DAMPER SHALL BE OPEN. THE TOTAL ENERGY RECOVERY WHEEL SHALL BE DE-ENERGIZED & ASSOCIATED ERW BYPASS DAMPERS SHALL CLOSE. THE SUPPLY FAN & RETURN FAN SHALL START AND RECIRCULATE BUILDING AIR. THE RTU HYDRONIC HEAT PUMP SHALL ENABLE IN HEATING MODE AND OPERATE TO MAINTAIN THE UNIT DISCHARGE AIR SETPOINT DURING WARM-UP OF 85°F (ADJ.). ONCE THE SPACE HAS REACHED SPACE SETPOINT, THE TERMINAL HEATING UNITS SHALL ENTER THE OCCUPIED MODE, ALLOWING THEIR HOT WATER VALVES TO MODULATE AS REQUIRED TO MAINTAIN THE SPACE SETPOINT. THE RTU SHALL ALSO ENTER OCCUPIED MODE. THE SYSTEM SHALL BE PREVENTED FROM ENTERING THE WARM-UP MODE MORE THAN ONCE PER DAY. THROUGH THE OPTIMIZED START PROGRAM LOGIC WITHIN THE DDC SYSTEM SOFTWARE, THE BMS SHALL MONITOR THE RATE OF TEMPERATURE RISE TO DETERMINE WHEN TO ACTIVATE THE WARM UP MODE TO ENSURE THAT THE BUILDING HAS REACHED ITS SETPOINT FOR OCCUPIED MODE.

COOL-DOWN:
THE RTU OUTSIDE AND EXHAUST AIR DAMPERS SHALL BE CLOSED, THE RECIRCULATION DAMPER SHALL BE OPEN. THE TOTAL ENERGY RECOVERY WHEEL SHALL BE DE-ENERGIZED & ASSOCIATED ERW BYPASS DAMPERS SHALL CLOSE. THE RETURN FAN & SUPPLY FAN SHALL START AND RECIRCULATE BUILDING AIR. THE HYDRONIC HEATPUMP SHALL ENABLE IN COOLING MODE AND OPERATE TO MAINTAIN THE UNIT DISCHARGE AIR SETPOINT DURING COOL-DOWN OF 55°F (ADJ.). ONCE THE SPACE HAS REACHED SPACE SETPOINT OF 75°F (ADJ.), THE RTU SHALL ENTER OCCUPIED MODE. THE SYSTEM SHALL BE PREVENTED FROM ENTERING THE COOL-DOWN MODE MORE THAN ONCE PER DAY. THROUGH THE OPTIMIZED START PROGRAM LOGIC WITHIN THE DDC SYSTEM SOFTWARE, THE BMS SHALL MONITOR THE RATE OF TEMPERATURE DECREASE TO DETERMINE WHEN TO ACTIVATE THE COOL DOWN MODE TO ENSURE THAT THE SPACE HAS REACHED ITS SETPOINT FOR OCCUPIED MODE. ECONOMIZER MODE OF OPERATION SHALL OVERRIDE NORMAL COOL-DOWN MODE OF OPERATION DURING UNOCCUPIED MODE.

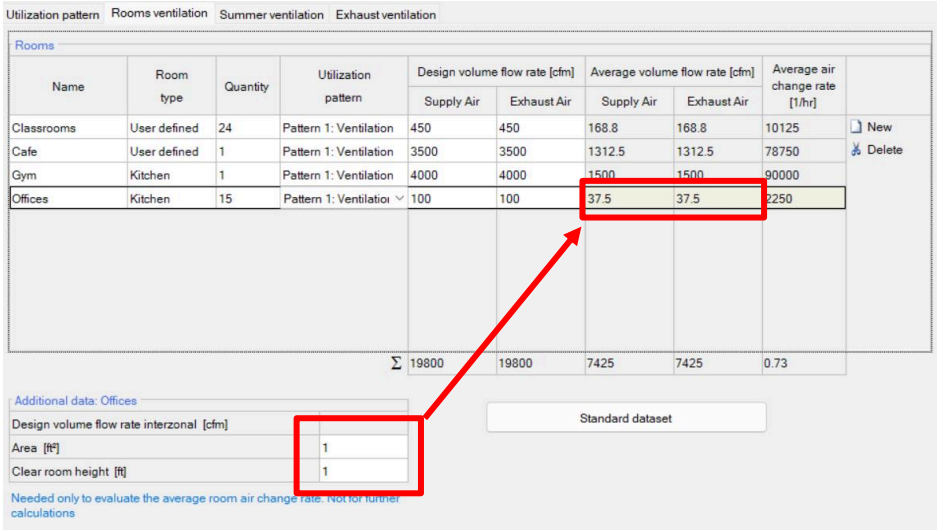
OCCUPIED MODE:

GENERAL:
THE FANS START OR CONTINUE TO RUN AND THE RTU IS CONTROLLED AS FOLLOWS:

THE EXHAUST AND OUTDOOR AIR DAMPERS SHALL OPEN TO MINIMUM POSITION AND THE RETURN AIR DAMPER SHALL OPEN TO MAXIMUM POSITION. THE ENERGY RECOVERY WHEEL SHALL BE ACTIVATED ERW BYPASS DAMPERS CLOSE AND OPERATE PER THE SEQUENCES BELOW. THE SUPPLY AND RETURN FANS SHALL BE ACTIVATED OR CONTINUE TO RUN AND THE SUPPLY FAN SHALL ADJUST ITS SPEED BASED ON THE SUPPLY DUCT MOUNTED STATIC PRESSURE SENSOR LOCATED 3/4 DOWN STREAM. THE SYSTEM'S ACTUAL STATIC PRESSURE SETPOINT WILL BE PROVIDED/OBTAINED THROUGH THE TESTING AND BALANCING CONTRACTOR DURING THE BALANCING PROCESS WITH THE HELP OF ATC CONTRACTOR. THE RETURN FAN SHALL TRACK THE SUPPLY FAN WITH A 5% (ADJ.) OFFSET TO MAINTAIN THE BUILDING AT A SLIGHTLY POSITIVE PRESSURE. THE ATC CONTRACTOR SHALL PROVIDE LOGIC TO CONSISTENTLY COLLECT THE TOTAL CFM FROM ALL VAV BOXES AND UTILIZE THAT VALUE IN CONJUNCTION WITH THE EXHAUST AIR FLOW SYSTEM CURVE PROFILE TO MODULATE THE RETURN FAN VFD.THE STATIC PRESSURE SET POINT SHALL BE RESET BASED ON PID (PROPORTIONAL-INTEGRAL- DERIVATIVE) LOGIC TO ALLOW THE VAV BOX ZONE REQUIRING THE MOST PRESSURE TO SATISFY ITS AIRFLOW REQUIREMENT AT ITS DESIGN FULL OPEN POSITION. THE STATIC PRESSURE SET POINT SHALL BE LOWERED TO THE POINT WHERE FAN SPEED REDUCTION CAN OCCUR, YET STILL ENSURE THAT THE VAV BOX ZONES REMAIN SATISFIED. THE SYSTEM SHALL USE INPUT SIGNALS FROM VAV BOX CONTROLLERS, THE MAIN DUCTWORK MOUNTED SYSTEM STATIC PRESSURE SENSOR AND THE CONTROLLER'S PROGRAM ALGORITHM TO ACHIEVE THIS CONTROL. IN ADDITION, PROVIDE DETECTION AND ALARM OF ANY VAV ZONE THAT EXCESSIVELY NEGATIVELY DRIVES THE RESET LOGIC. THE BMS SYSTEM SHALL BE CAPABLE OF ALLOWING OPERATOR TO READILY REMOVE OR ADD VAV BOX ZONES FROM THE RESET LOGIC ALGORITHM. THE PROJECT TAB/ATC CONTRACORS SHALL FIELD DETERMINE THE ADJUSTABLE SETPOINT RANGE FOR EACH RTU/AHU SYSTEM AND THE PRIMARY VAV BOX UTILIZED TO CONTROL THE STATIC PRESSURE RESET CONTROL STRATEGY.

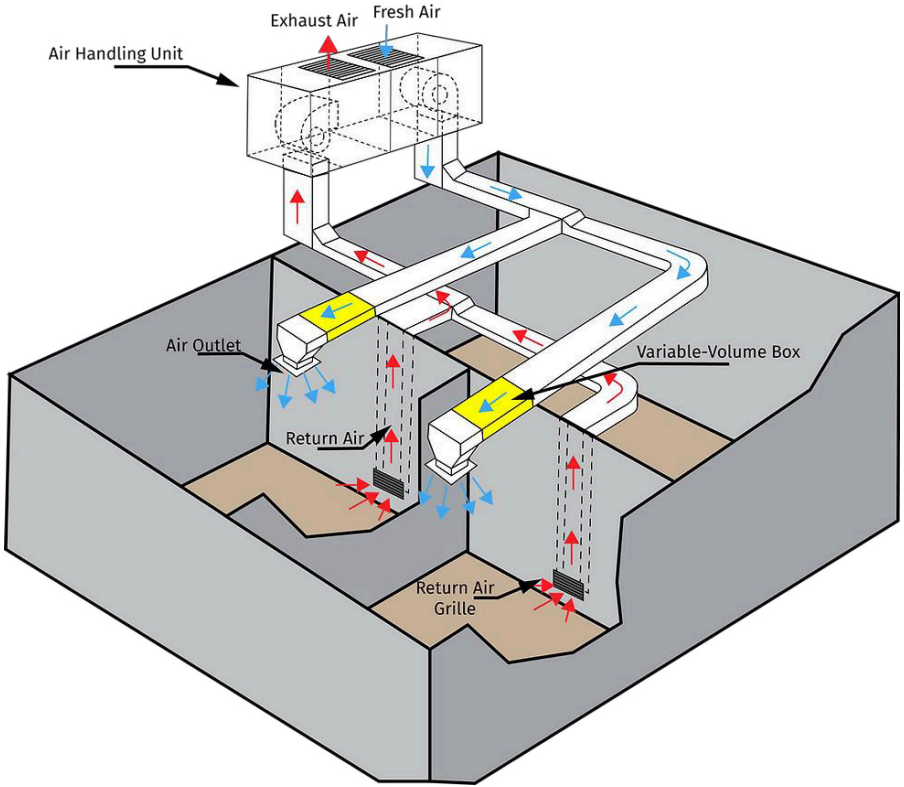
Ventilation

- Can model by unit or by space
- By space allows understanding average flow rates
- Multipliers are your friend



Ventilation

- Commonplace in mechanical practice for combined conditioning in ventilation
- Not precluded
- Challenges in testing
  - Need to verify OA flow rate
  - Assume mixed air
  - Can calculate OA flow to space as % of total flow
  - Or run in ventilation only mode

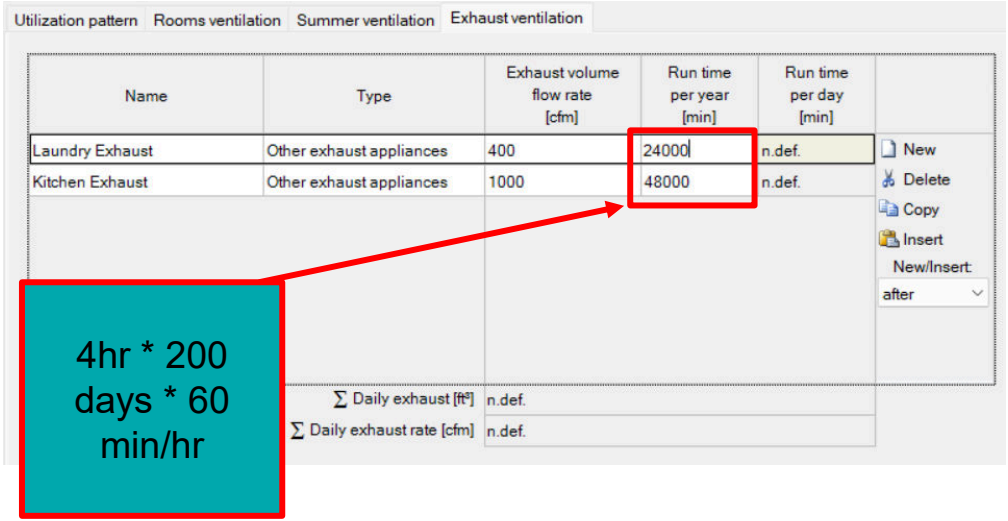


Direct Exhaust Ventilation

- No default exhaust run times
- Must estimate from hand calc

Process exhaust:

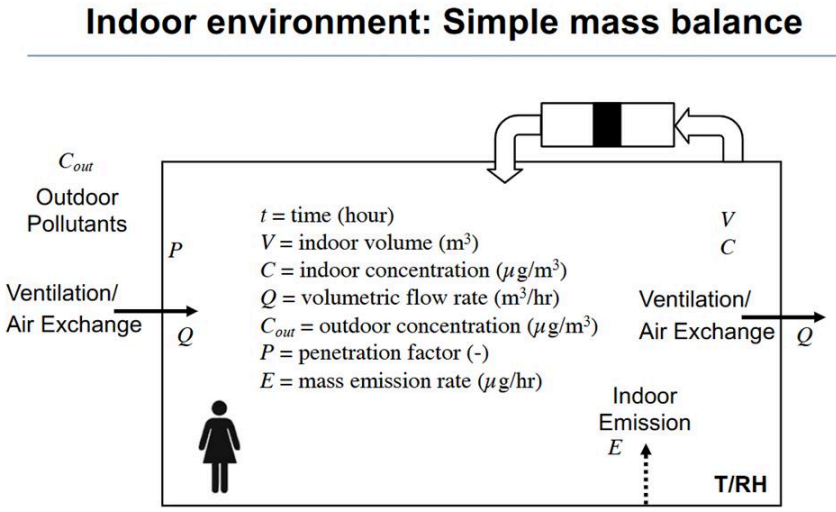
- There is precedent for taping kitchen exhaust for durability test
- High Exhaust (>1.0 ACH) might require custom targets



Demand Control Ventilation (DCV)

Many Non-residential buildings run a BAS

- Allows for detailed controls of mechanical systems
- DCV
  - Varies OA / EA rate base on pollutant concentration
  - CO2
  - VOC
  - CO



$$V\frac{dC}{dt} = PQC_{out} - QC + E$$

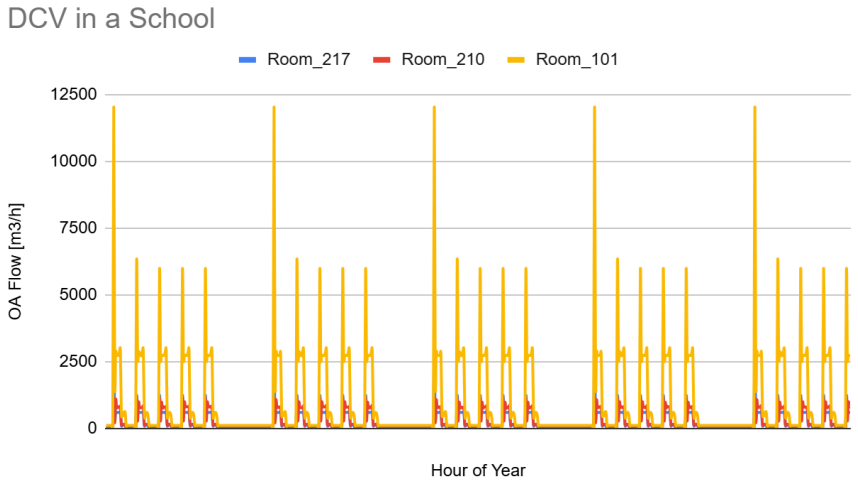
Demand Control Ventilation Paths

Path A: Engineers Model

- Utilize hourly flow rate from engineers model
- Bin flow rates for WUFI utilization pattern

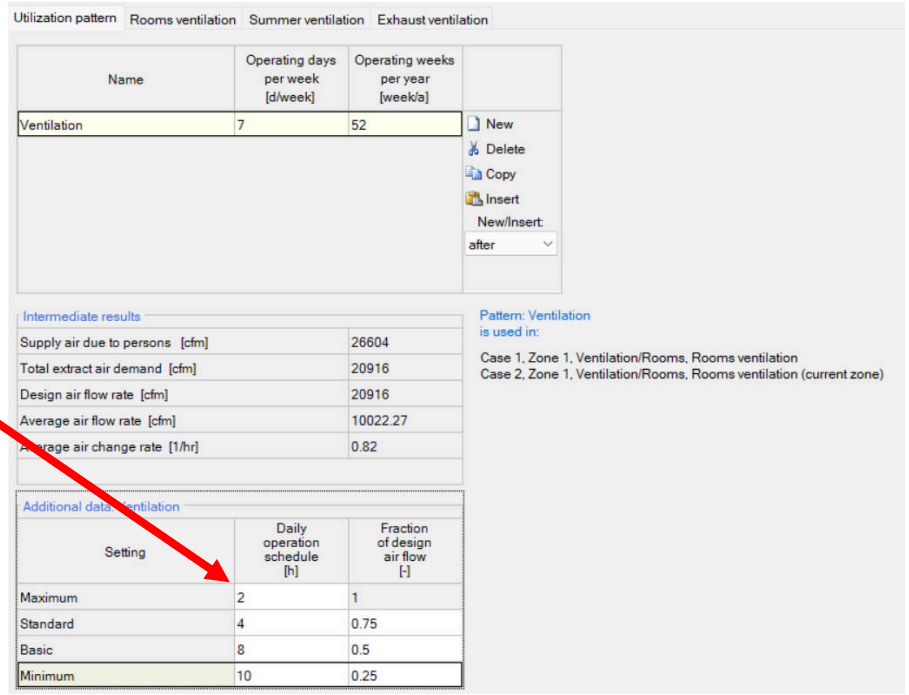
Path B: Iterative mass balance

- Utilize assumptions for exterior CO2 and occupant generation rates
- Python / Excel
- Bin flow rated for WUFI



Demand Control Ventilation for WUFI

Bin Limits [m3/h]	Room_217	Room_215	Room_213	Room_211	Room_209
100	5366	5366	5783	5366	5366
400	1305	1305	888	1305	1305
800	1827	1827	1827	1827	1827
1200	0	0	104	0	0
Overflow (Count towards max flow rate)	261	261	157	261	261



On-Site Review

2024 Guidebook Section 1.5

Non-Residential On-Site Review

The intent of on-site review work is to confirm what was built on-site to so the energy model can be updated to align. The general concept of Phius' on-site review requirements for non-residential projects follows the same logic as residential projects.

EPA Energy Star MFNC, IAP and DOE ZERH Checklists must be completed for all applicable items.

The checklists shall be applied to non-residential projects "as if" certification would be achieved, however, certification is not required.

Mixed-Use On-Site Review

Phius Quality Control Checklist & Quality Assurance Workbook is required for all projects.

Residential Portion

- Energy Star **Certification**
- Indoor AirPlus **Certification**
- Zero Energy Ready Home **Certification**
- Compartmentalization Testing
- Ventilation Testing & Balancing Report(s)
- Heating/Cooling Testing & Balancing Report(s)

Non-Residential Portion

- Co-Requisite Program **Checklists**
  - Applicable Items Only
  - May vary by non-residential project scope and program
- Ventilation Testing & Balancing Report(s)
- Heating/Cooling Testing & Balancing Report(s)

Future of Non-Residential Projects

2024 Guidebook Section 1.5

Coming at some point…

Short-Term

- Phius 2024 Non-Residential On-Site Quality Assurance Workbook
- More Supporting Calculators
  - Lighting
  - Mixed-Use Targets/Results
- METr Software Updates

Long-Term

- Phius 2027
  - 227P ASHRAE

Thank you!

Questions?