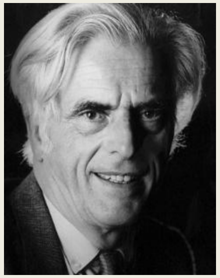
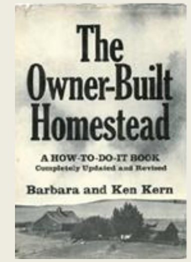
Commercial Passivhaus Design Principles

Presenter: **Adam J. Cohen**, RA, CPHC NA & EU, LEED AP

Adam who?

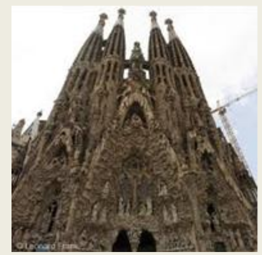




The Owner-Built Homestead
A HOW-TO-DO-IT BOOK
Barbara and Ken Kern

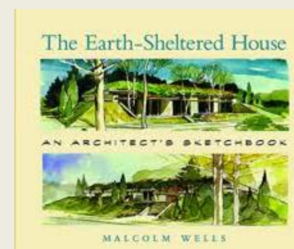
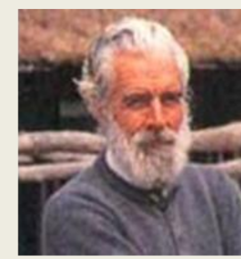
THE OWNER BUILT HOME
Ken Kern











The Earth-Sheltered House
AN ARCHITECT'S SKETCHBOOK
MALCOLM WELLS


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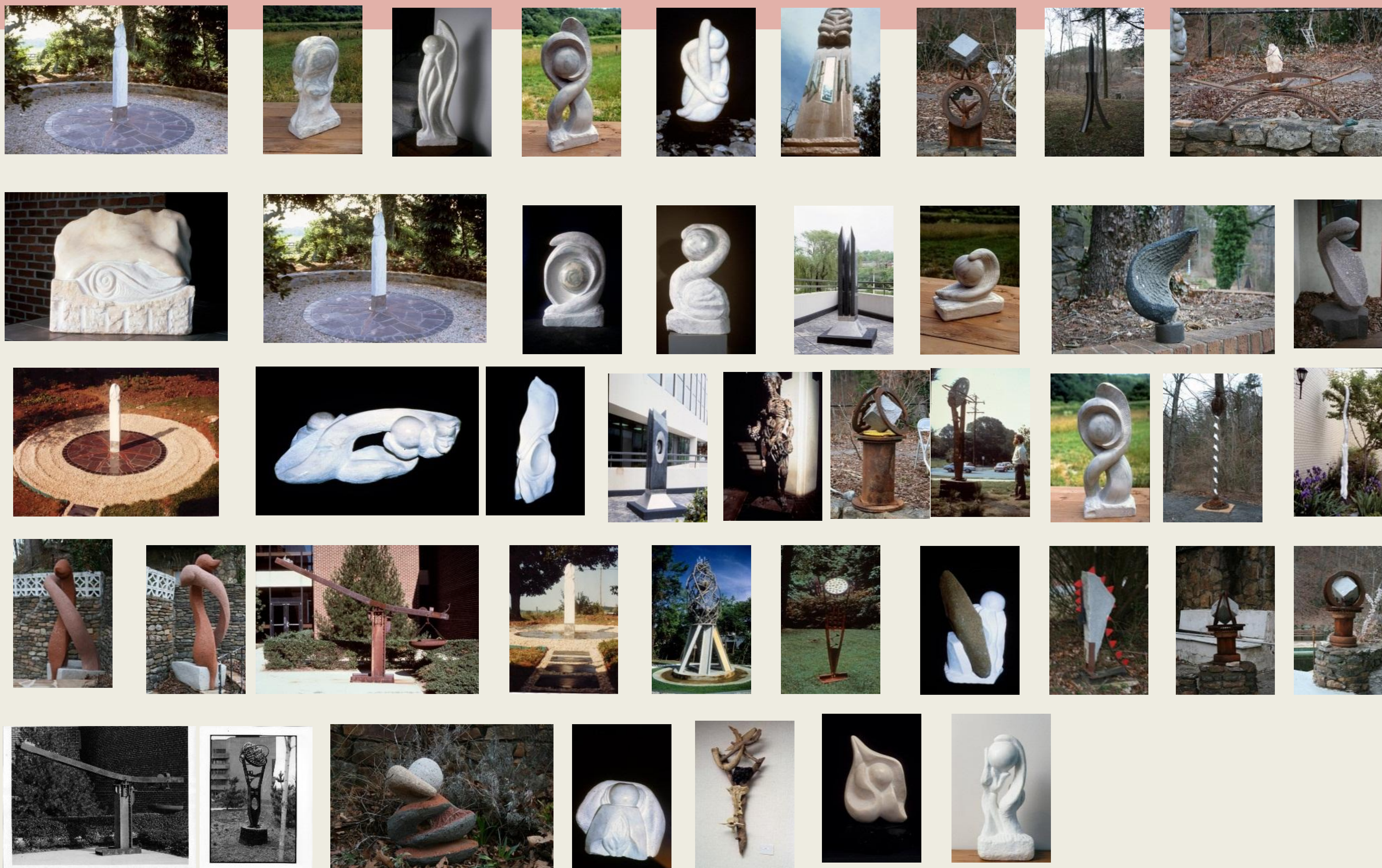


Adam who?


ARCHITECTURE PLANNING & PRESERVATION




STRUCTURES
Building with integrity















PHIUS
Passive House Institute US

DESIGNER
CERTIFIED PASSIVE HOUSE DESIGNER

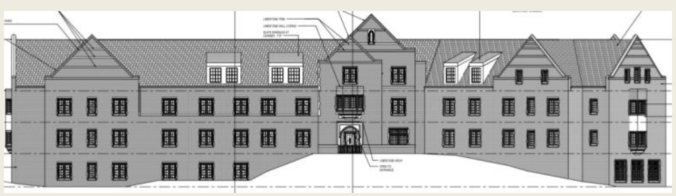
Adam who?

Near West Theater
- 20,000 sq ft
- Assembly
- New construction

The Distillery
- 50,000 sq ft
- Mixed Use
- New construction

Oracle Institute
- 8,000 sq ft
- Assembly
- New construction

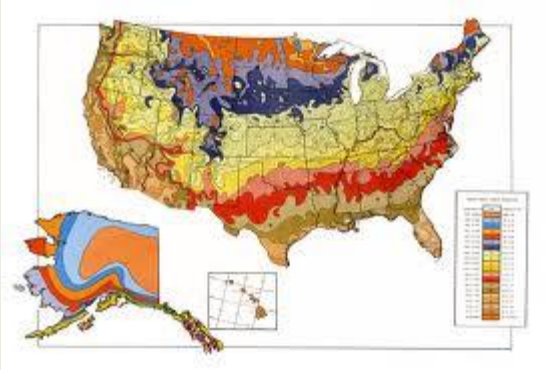
Competition BMW of Smithtown
- 20,000 sq ft
- Retail showroom
- Renovation and addition

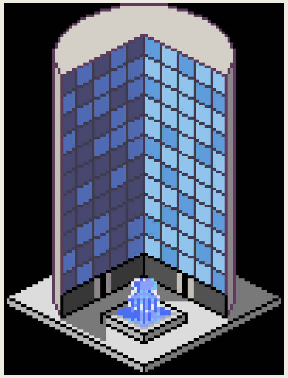


Westhampton Residence Hall
- 50,000 sq ft
- Dormitory
- New construction

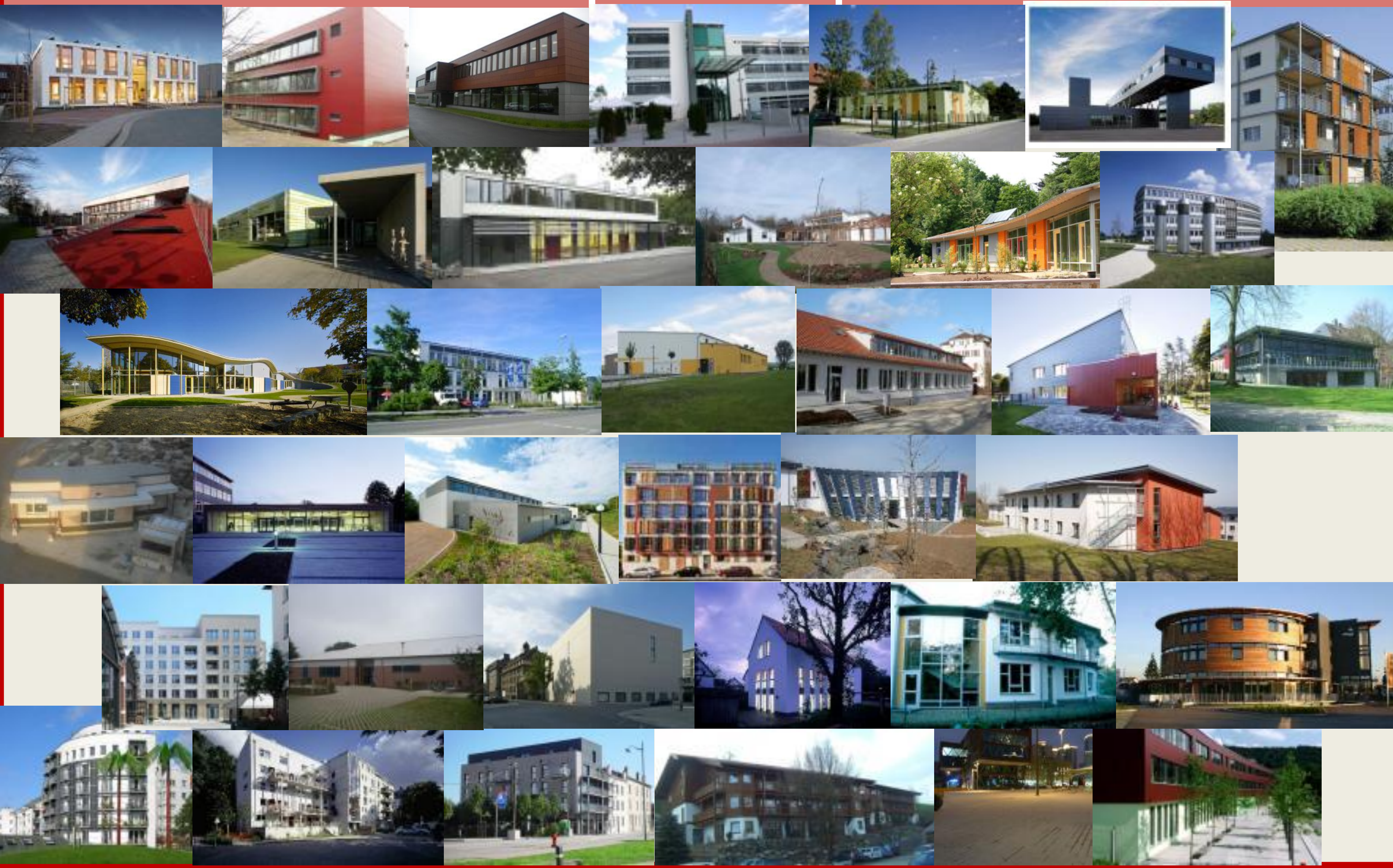
Commercial Passivhaus

What it feels like at first.





European Examples

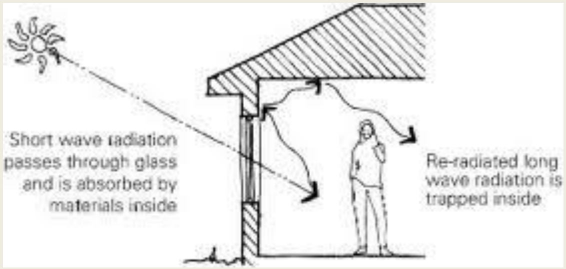


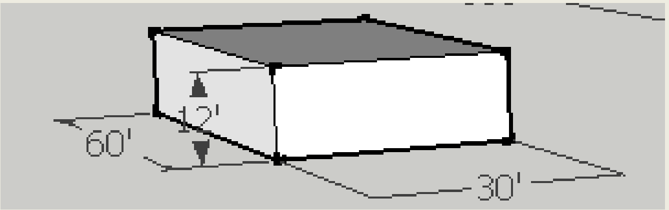
Our Responsibility as Pioneers

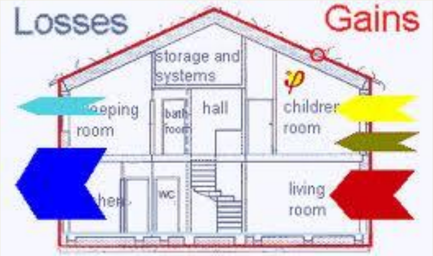
- We have the ability to move forward and change building in America
- We also have the ability to ruin the future of Passivhaus in America

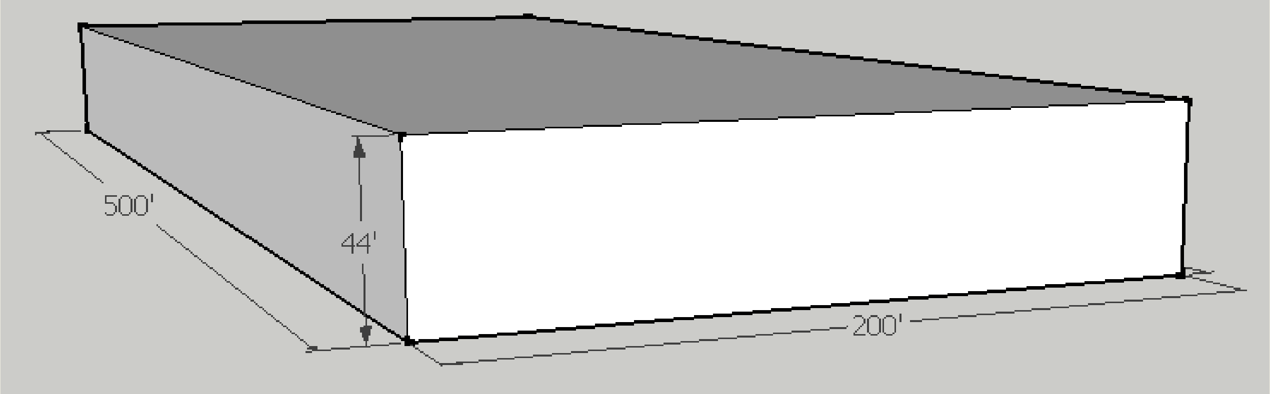
How does commercial PHPP differ from residential?

- Size
  - Smaller light commercial projects can be modeled in PHPP fairly easily (with some extra input and thought).
  - Larger projects can become quite a bit more complex to predict performance.









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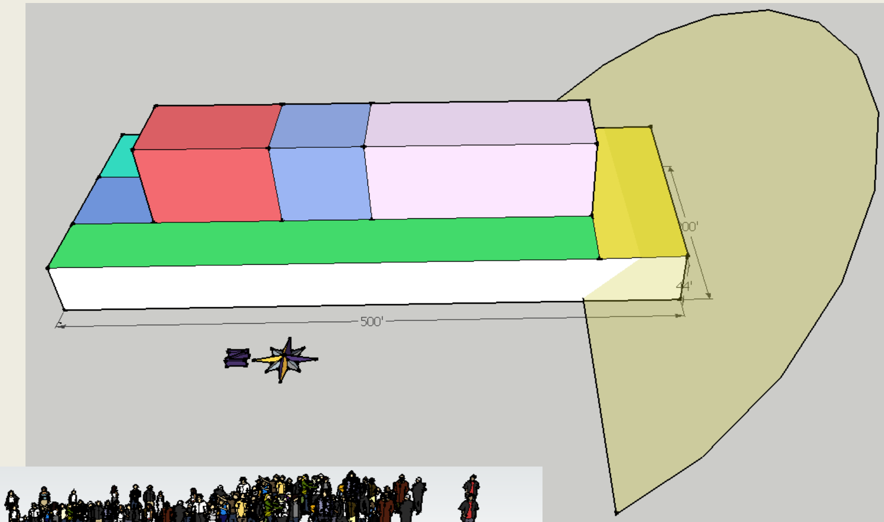
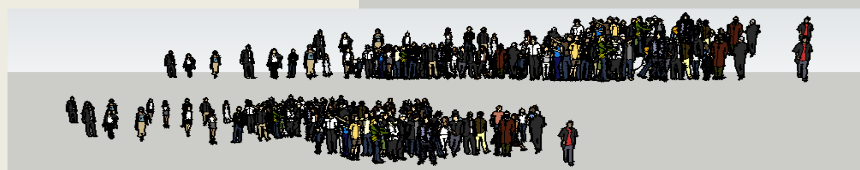
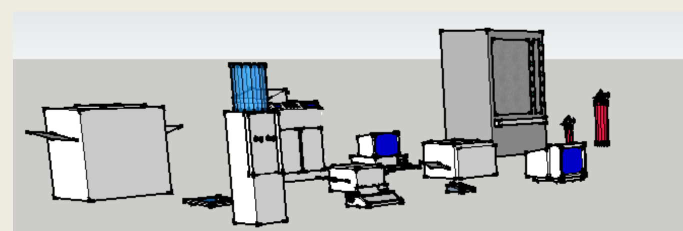
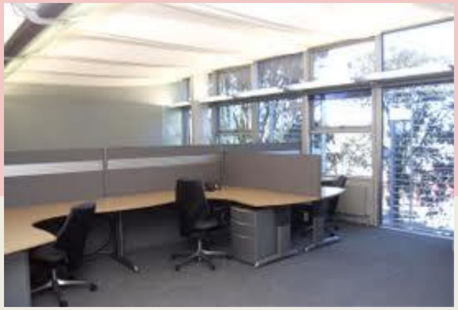






How does commercial PHPP differ from residential?

- Variables to consider in commercial PHPP
  - Use patterns
    - Interior gains & energy use
      - Humidity (bodies)
      - Equipment





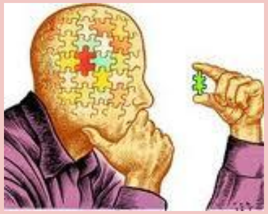


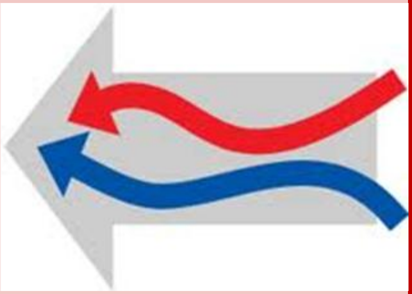



Occupancy design and use patterns

- SIMPLE OCCUPANCY

- Very important concept in PH commercial construction
  - In many buildings this becomes the driving comfort factor
- Three categories of occupancy
  - Simple occupancy
    - Easiest to model with PHPP
    - Can model larger projects in PHPP with confidence as long as you apply logic to static model heat balance of space.
    - Examples
      - Office
      - Multi-family
      - Dormitory
      - Classroom buildings
      - Retail





Occupancy design and use patterns

- COMPLEX OCCUPANCY
- Three categories of occupancy
  - Simple occupancy
  - Complex occupancy
    - Harder to model with PHPP
    - Heat gain (latent & sensible) drivers are highly varied
    - Design needs to look at low vs high occupant conditions
    - Comfort criteria need to be considered carefully
    - Examples
      - Assembly
      - Multi-purpose
      - Religious
      - Mixed use and occupancy (different zones with different conditions)
      - Sports halls
      - Gyms

Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria









Occupancy design and use patterns

❑ SPECIAL OCCUPANCY

- ❑ Three categories of occupancy
  - Simple occupancy
  - Complex occupancy
  - Special occupancy
    - May be fairly simple to model with PHPP depending on the conditions
    - Potential load drivers
      - ❖ Heat gain from people (latent & sensible)
      - ❖ Ventilation requirements
      - ❖ Equipment heat gain
    - Comfort criteria potentially less important then complex occupancy
    - Energy use may become critical factor
    - Examples
      - ❖ Kitchen
      - ❖ Laboratory
      - ❖ Operating rooms
      - ❖ Locker rooms
      - ❖ Swimming pools

How does commercial PHPP differ from residential?

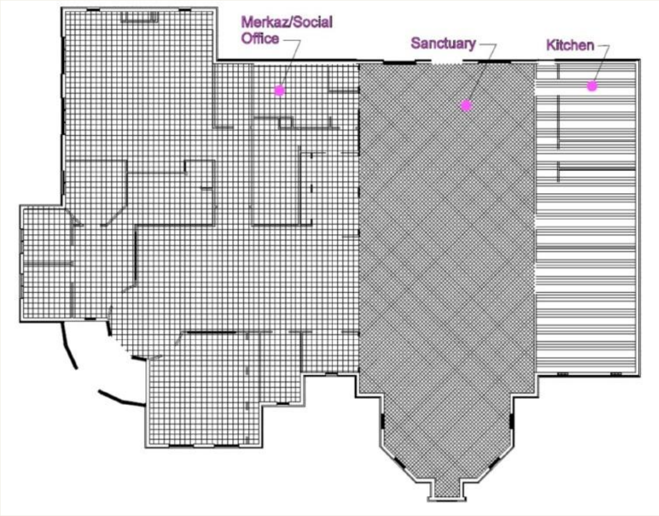
- Variables to consider in commercial PHPP
- Zoning
  - PHPP not really set up for zoning, but using it for simple zoning is possible
  - Fairly simple zoning which treats adjacent areas as either adiabatic or with reduce heat transfer is method for zoning calculations.
    - Run separate PHPP's and then combine outputs
  - Smaller buildings with complex usage patterns can also be difficult to model in PHPP, but can be done with additional inputs
    - Break the building into static zones and analyze the zones using PHPP, but this is time consuming and may be less accurate
  - Larger buildings with unbalanced gains and losses present particular problem for PHPP

Create a zone concept

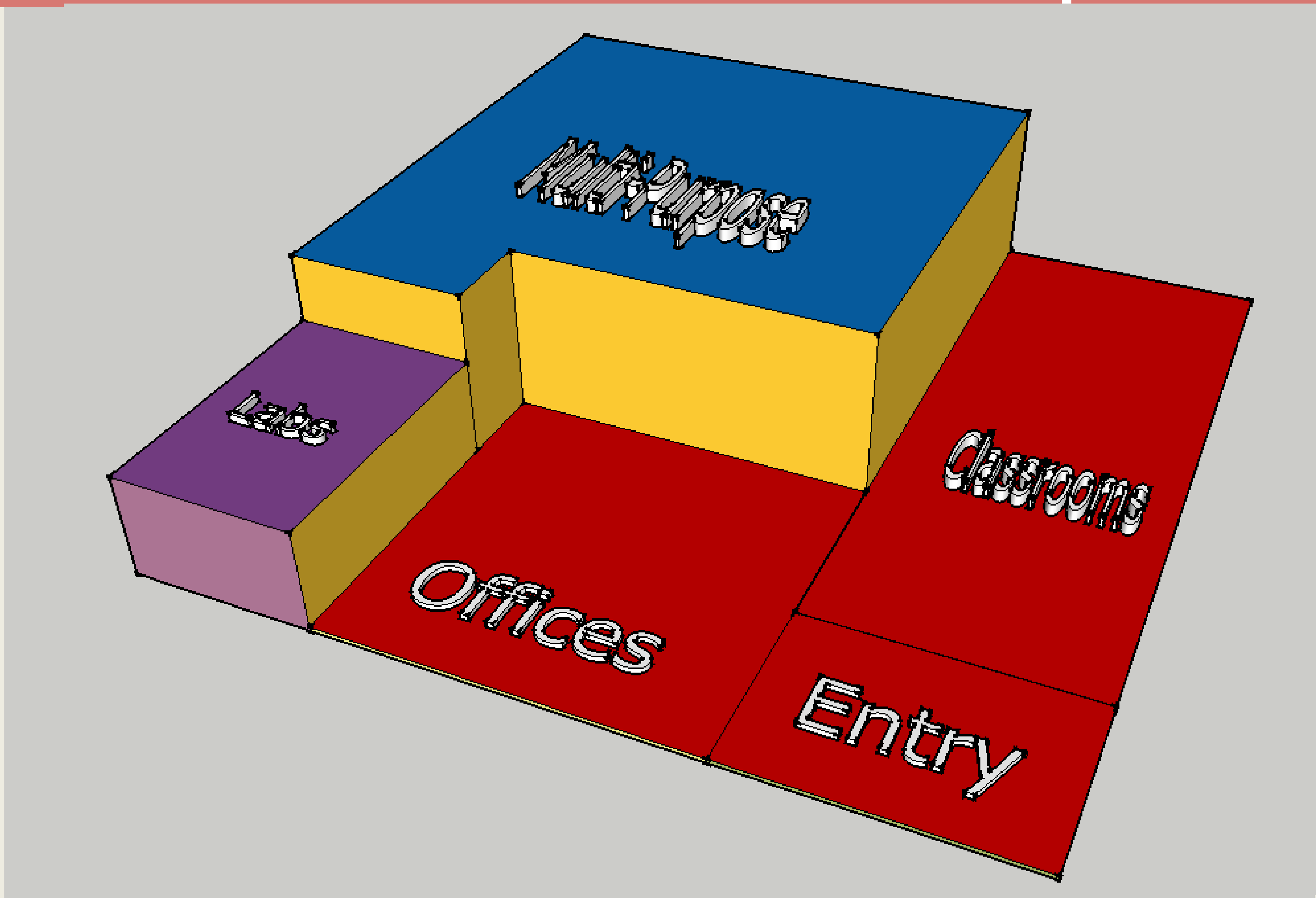
<u>SIMPLE OCCUPANCY</u>

<u>COMPLEX OCCUPANCY</u>

<u>SPECIAL OCCUPANCY</u>

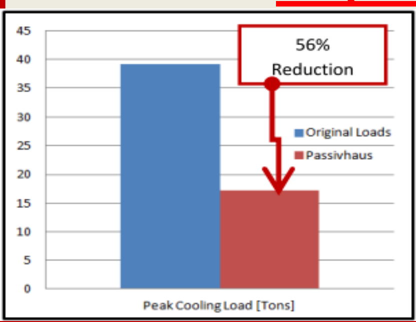


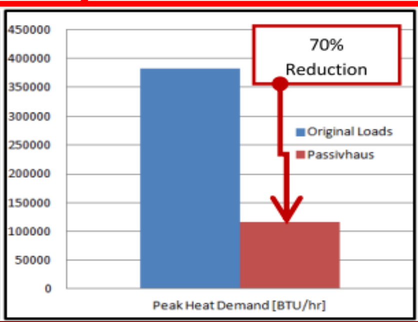
Create a static zone concept



How does commercial PHPP differ from residential?

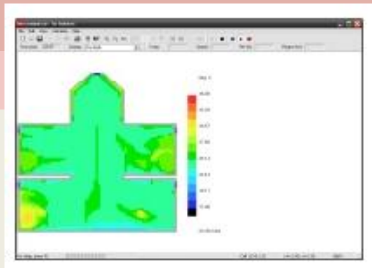
- ❑ Variables to consider in commercial PHPP
- ❑ Zoning
  - ▪ Dynamic simulation – When is it required?
    - Size of building becomes large
    - Example: Static model (PHPP) may show a heat balance but dynamic simulation of zones may show overheating
    - How variations in orientation affect thermal performance becomes critical issue to understand in order to effectively implement an optimized low energy design
      - ❖ Do not want to fall into the "larger more complex system trap" caused by large buildings when lower energy, simpler solutions may be as effective, but harder to model
      - ❖ Learning from Europe's experience is key here. Many earlier buildings had more complex control and larger sizes then later buildings.
    - **To prove your case to skeptical engineers**

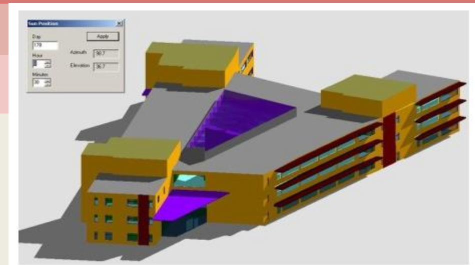


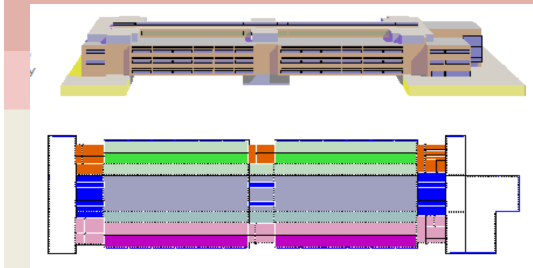


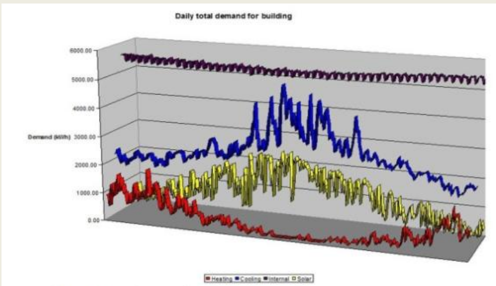
	Peak Cooling Load		Peak Heat Demand	
Original Loads	39.1	Tons	381400	BTU/hr
Passivhaus	17.2	Tons	115600	BTU/hr
% Reduction	56%		70%	

What Do I Want From a Dynamic Model?

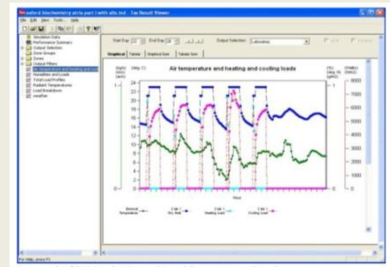



TAS 3d Building Model - with Shadow Casting

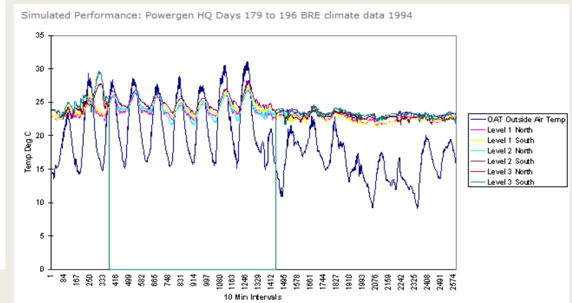


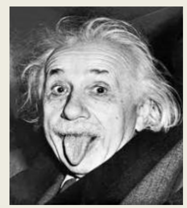


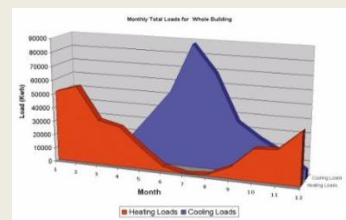
Annual Energy Demands Exported to Excel

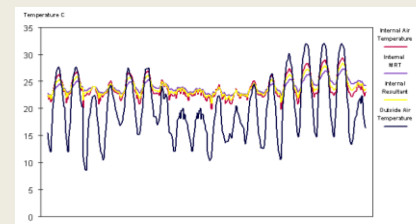


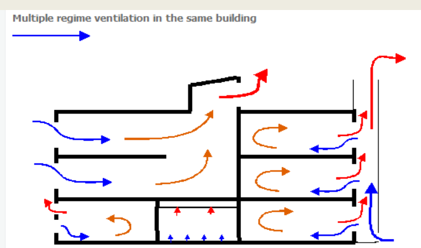
An example of TAS Results Viewer - Internal Temperature and Loads

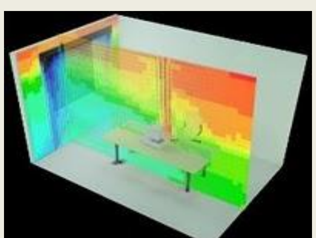


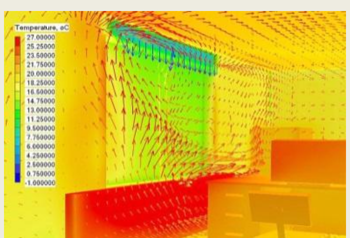


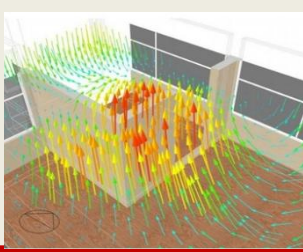












Efficiency Vermont
BBD
BETTER BUILDINGS BY DESIGN

Commercial Passivhaus Design Principles

Better Buildings by Design 2014 Burlington, VT

PASSIVSCIENCE
Knowledge saves power

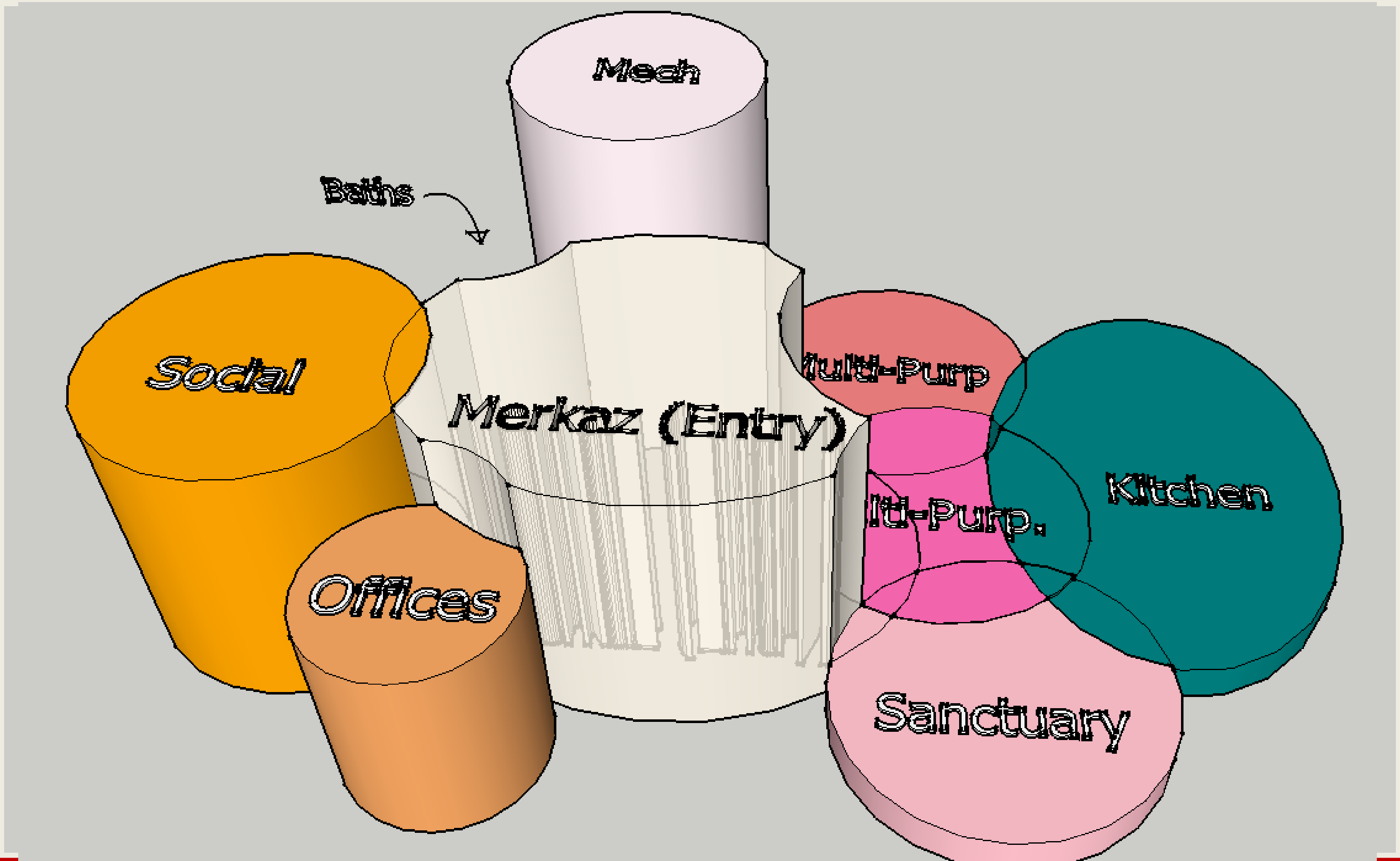
How does commercial PHPP differ from residential?

- Variables to consider in commercial PHPP

- Zoning
  - Dynamic simulation – When is it required?
    - Tools
      - Transys **http://sel.me.wisc.edu/trnsys/**
      - Wufi Plus **http://www.wufi.de/**
      - Tas **http://www.edsl.net/**
      - IES **http://www.iesve.com/**
      - Many others

How does commercial PHPP differ from residential?

- Understand the Program
  - Define the occupancy pattern



How does commercial PHPP differ from residential?

- Understand the Program
  - Define the occupancy pattern
  - Define the occupancy pattern for each zone
    - By day
    - By hour

Annual Schedule

Begin Date	End Date	Status
1-Jan	6-Jan	Unoccupied
7-Jan	22-Mar	Occupied
23-Mar	7-Apr	Unoccupied
8-Apr	14-Jun	Occupied
15-Jun	28-Jun	Unoccupied
29-Jun	25-Aug	Occupied
26-Aug	8-Sep	Unoccupied
9-Sep	13-Dec	Occupied
14-Dec	31-Dec	Unoccupied

Dorm Room Occupancy (across full building)

Time	Week Day % occupancy	Week End % occupancy
1:00	95%	95%
2:00	95%	95%
3:00	95%	95%
4:00	95%	95%
5:00	95%	95%
6:00	95%	95%
7:00	95%	95%
8:00	75%	75%
9:00	50%	75%
10:00	30%	60%
11:00	30%	60%
12:00	30%	60%
13:00	15%	40%
14:00	30%	60%
15:00	30%	60%
16:00	30%	50%
17:00	30%	50%
18:00	50%	50%
19:00	50%	50%
20:00	50%	50%
21:00	75%	50%
22:00	75%	75%
23:00	75%	75%
0:00	95%	95%

Lounge Occupancy (across full building)

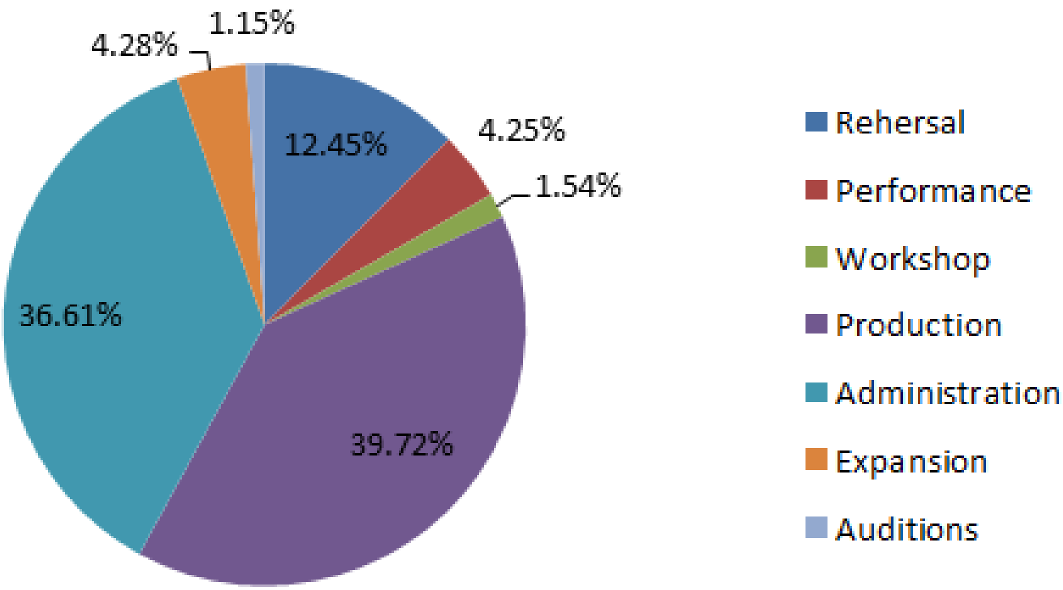
Time	Week Day % occupancy	Week End % occupancy
1:00	26%	26%
2:00	16%	16%
3:00	7%	7%
4:00	5%	5%
5:00	13%	13%
6:00	13%	13%
7:00	13%	13%
8:00	13%	13%
9:00	26%	26%
10:00	41%	41%
11:00	62%	62%
12:00	60%	60%
13:00	70%	70%
14:00	80%	80%
15:00	87%	87%
16:00	89%	89%
17:00	89%	89%
18:00	88%	88%
19:00	87%	87%
20:00	86%	86%
21:00	80%	80%
22:00	73%	73%
23:00	60%	60%
0:00	40%	40%

	Opening		Treatment		Lunch		Treatment		Closing			
	7:30am - 8am		8am - 1pm		1pm - 2 pm		2pm - 5 pm		5pm - 5:30pm			
Hours	0.5		5		1		3		0.5			
Monday											10	Occupied Hours
	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4		
	Doctors	3	Doctors	3	Doctors	3	Doctors	3	Doctors	3		
	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3		
	Hygienists	4	Hygienists	4	Hygienists	4	Hygienists	4	Hygienists	4		
	Patients (treatment)	0	Patients (treatment)	7	Patients (treatment)	0	Patients (treatment)	7	Patients (treatment)	0		
	Patients (waiting)	0	Patients (waiting)	7	Patients (waiting)	0	Patients (waiting)	7	Patients (waiting)	0		
		14		28		14		28		14		
Teusday											10	Occupied Hours
	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4		
	Doctors	3	Doctors	3	Doctors	3	Doctors	3	Doctors	3		
	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3		
	Hygienists	5	Hygienists	5	Hygienists	5	Hygienists	5	Hygienists	5		
	Patients (treatment)	0	Patients (treatment)	8	Patients (treatment)	0	Patients (treatment)	8	Patients (treatment)	0		
	Patients (waiting)	0	Patients (waiting)	8	Patients (waiting)	0	Patients (waiting)	8	Patients (waiting)	0		
		15		31		15		31		15		
Wednesday											10	Occupied Hours
	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4		
	Doctors	3	Doctors	3	Doctors	3	Doctors	3	Doctors	3		
	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3		
	Hygienists	5	Hygienists	5	Hygienists	5	Hygienists	5	Hygienists	5		
	Patients (treatment)	0	Patients (treatment)	8	Patients (treatment)	0	Patients (treatment)	8	Patients (treatment)	0		
	Patients (waiting)	0	Patients (waiting)	8	Patients (waiting)	0	Patients (waiting)	8	Patients (waiting)	0		
		15		31		15		31		15		
Thursday											10	Occupied Hours
	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4	Office Staff	4		
	Doctors	3	Doctors	3	Doctors	3	Doctors	3	Doctors	3		
	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3	Doctor's Assistant	3		
	Hygienists	5	Hygienists	5	Hygienists	5	Hygienists	5	Hygienists	5		
	Patients (treatment)	0	Patients (treatment)	8	Patients (treatment)	0	Patients (treatment)	8	Patients (treatment)	0		
	Patients (waiting)	0	Patients (waiting)	8	Patients (waiting)	0	Patients (waiting)	8	Patients (waiting)	0		
		15		31		15		31		15		
Friday											6	Occupied Hours
	Office Staff	4	Office Staff	4	Office Staff	0	Office Staff	0	Office Staff	4		
	Doctors	2	Doctors	2	Doctors	0	Doctors	0	Doctors	2		
	Doctor's Assistant	2	Doctor's Assistant	2	Doctor's Assistant	0	Doctor's Assistant	0	Doctor's Assistant	2		
	Hygienists	1	Hygienists	1	Hygienists	0	Hygienists	0	Hygienists	1		
		9		15		0		0		9		
											46	Occupied Hours

Event	Event Type	Notes	Days	Open	Close	Hours / Day	Days / Week	# WEEKS	Total # HOURS	Usage Months	Estimated # Occupants	Notes
SPRING SHOW											65	Includes Staff
SPRING SHOW											65	Includes Staff
SPRING SHOW											65	Includes Staff
SPRING SHOW											90	Includes Staff + crew+cast
SPRING SHOW											97	Includes Staff +crew+band+cast
SPRING SHOW											370	Audience, cast, Front of house, crew, band
SPRING SHOW											370	Audience, cast, Front of house, crew, band
SPRING SHOW											370	Audience, cast, Front of house, crew, band
SPRING SHOW											370	Audience, cast, Front of house, crew, band
AFTER SCHOOL YOUTH THEATRE MUSICAL/WINTER											55	Includes Staff
AFTER SCHOOL YOUTH THEATRE MUSICAL/WINTER											40	Includes Staff
AFTER SCHOOL YOUTH THEATRE MUSICAL/WINTER											65	Includes Staff+crew+cast
AFTER SCHOOL YOUTH THEATRE MUSICAL/WINTER											325	Audiences and all other
AFTER SCHOOL YOUTH THEATRE MUSICAL/WINTER											325	Audiences and all other
AFTER SCHOOL YOUTH THEATRE MUSICAL/WINTER											325	Audiences and all other
ANNUAL SUMMER YOUTH THEATRE	Auditions		x x x	6:00 PM	11:00 PM	5.00	3	1	15	x	65	Includes Staff
ANNUAL SUMMER YOUTH THEATRE											65	Includes Staff
ANNUAL SUMMER YOUTH THEATRE											65	Includes Staff
ANNUAL SUMMER YOUTH THEATRE											90	Includes Staff + crew+cast
ANNUAL SUMMER YOUTH THEATRE											97	Includes Staff +crew+band+cast
ANNUAL SUMMER YOUTH THEATRE											370	Audience, cast, Front of house, crew, band
ANNUAL SUMMER YOUTH THEATRE											370	Audience, cast, Front of house, crew, band
ANNUAL SUMMER YOUTH THEATRE											370	Audience, cast, Front of house, crew, band
ANNUAL SUMMER YOUTH THEATRE											370	Audience, cast, Front of house, crew, band
AFTER SCHOOL CHILDREN'S THEATRE MUSICAL/FALL											55	Includes Staff
AFTER SCHOOL CHILDREN'S THEATRE MUSICAL/FALL											40	Includes Staff
AFTER SCHOOL CHILDREN'S THEATRE MUSICAL/FALL											65	Includes Staff & Crew
AFTER SCHOOL CHILDREN'S THEATRE MUSICAL/FALL											325	Audiences and all other
AFTER SCHOOL CHILDREN'S THEATRE MUSICAL/FALL											325	Audiences and all other
AFTER SCHOOL CHILDREN'S THEATRE MUSICAL/FALL											325	Audiences and all other
FALL INTERGENERATIONAL MUSICAL											65	Includes Staff
FALL INTERGENERATIONAL MUSICAL											65	Includes Staff
FALL INTERGENERATIONAL MUSICAL											65	Includes Staff
FALL INTERGENERATIONAL MUSICAL											90	Includes Staff + crew+cast
FALL INTERGENERATIONAL MUSICAL											97	Includes Staff +crew+band+cast
FALL INTERGENERATIONAL MUSICAL											370	Audience, cast, Front of house, crew, band
FALL INTERGENERATIONAL MUSICAL											370	Audience, cast, Front of house, crew, band
FALL INTERGENERATIONAL MUSICAL											370	Audience, cast, Front of house, crew, band
FALL INTERGENERATIONAL MUSICAL											370	Audience, cast, Front of house, crew, band
ANNUAL BENEFIT EVENT											90	Includes Staff
ANNUAL BENEFIT EVENT											90	Includes Staff
ANNUAL BENEFIT EVENT											550	Not located @ this Venue
TECHNICAL THEATER WORKSHOP SESSIONS											15	Includes Staff
Production (Shop)											3	
Production Lighting (testing,hanging, dimmers, etc)											2	
Office											8	
Workshops, Night Kitchen, Coffeehouses	Expansion	Planned	x	6:00 PM	11:00 PM	5.00	1	26	130	x x x x x x x x x x x x	100	
Performances of Projected Program Expansion	Expansion	Planned	x	6:00 PM	10:00 PM	4.00	1	26	104	x x x x x x x x x x x x	125	

TOTALS	Hours	% of Total
Rehersal	680	12.45%
Performance	232	4.25%
Workshop	84	1.54%
Production	2170	39.72%
Administration	2000	36.61%
Expansion	234	4.28%
Auditions	63	1.15%

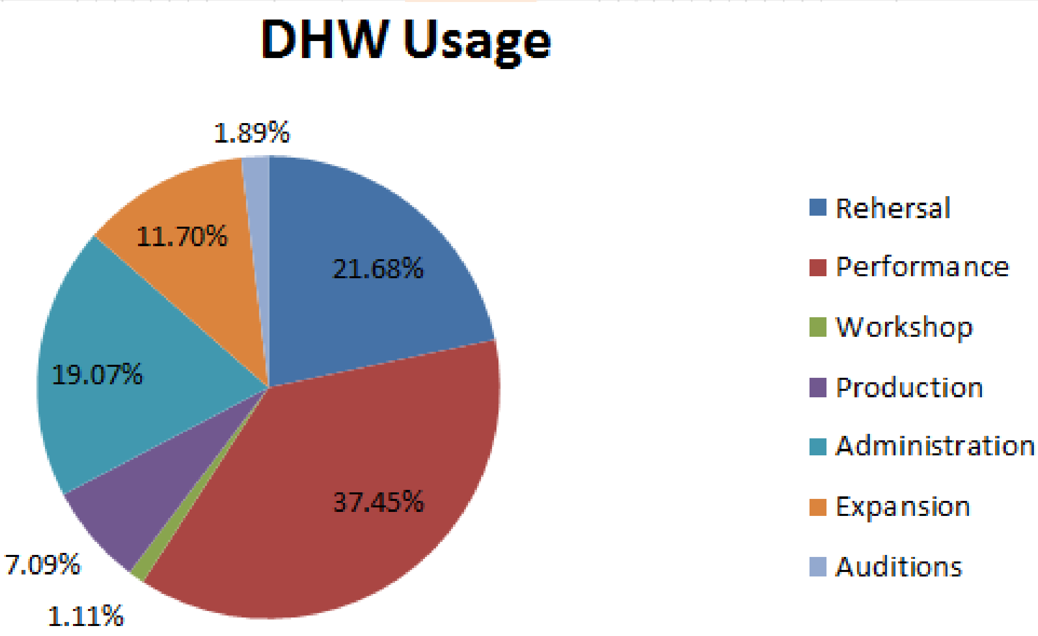
Usage Profile



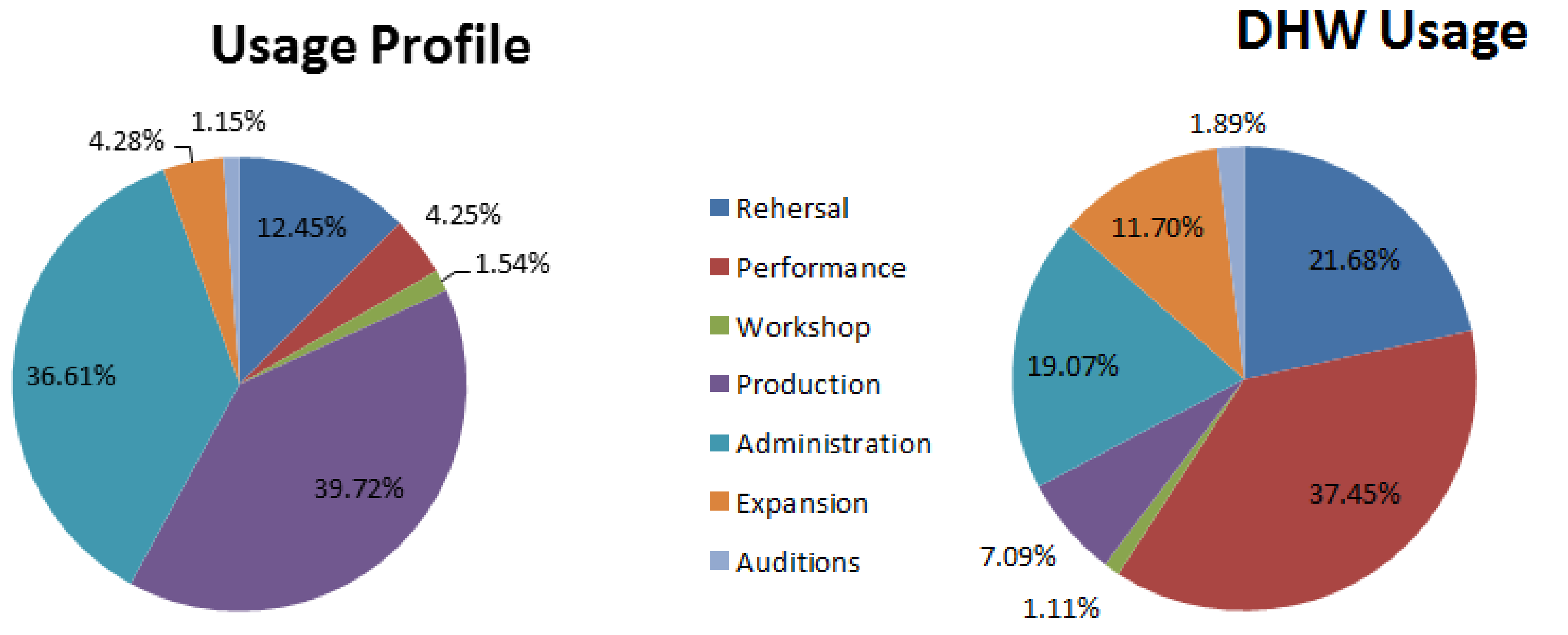
Applying occupancy to energy usage

- DHW

TOTALS	Total Gallons	% of Total
Rehersal	6141.55	21.68%
Performance	10608	37.45%
Workshop	315	1.11%
Production	2009	7.09%
Administration	5400	19.07%
Expansion	3315	11.70%
Auditions	535.5	1.89%



Comparisons are interesting



Ventilation Analysis

ASHRAE - Based on Actual Occupancy

Area	Use Type	Actual Max Occupancy	Base Rate CFM / Person	Person CFM based on Occupancy (CFM)	CFM Based on Area (CFM)	Total (CFM)
Basement	Lobby	287	5	1435	540.72	1975.72
First Floor & Mezz	Auditorium Seating Area	275	5	1375	607.86	2907.86
First Floor & Mezz	Stage	90	10	900		
First Floor & Mezz	Lobby	5	5	25		
Based on Non-Simaltaneous Usage max CFM						
Basement	Lobby	86	5	430	699.66	1129.66
First Floor & Mezz	Auditorium Seating Area	270	5	1350	108.36	1573.36
First Floor & Mezz	Stage	9	10	90		
First Floor & Mezz	Lobby	5	5	25		

PH Recommended

Max Occupancy (Persons)	CFM per person (Low) (CFM)	CFM per person (High) (CFM)	Total Range (CFM)	(CFM)	AVG
370	9	12	3330	4440	3885.0
287	9	12	2583	3444	3013.5
86	9	12	774	1032	903

Location	Use Type											Exhaust Rate CFM / Stall	CFM / SQFT	CFM
Basement	Multi-Use Assemb											0	0	0
Basement	Corridor											0	0	0
Basement	Baths - Low Use											50	0	50
Basement	Storage											0	0	0
Basement	Office Area											0	0	0
Basement	Corridor											0	0	0
Basement	Copy Area											0	0.5	20
Basement	Office Area											0	0	0
Basement	Office Area											0	0	0
Basement	Storage											0	0	0
Basement	Corridor											0	0	0
Basement	Storage											0	0	0
Basement	Storage											0	0	0
Basement	Kitchenette											0	0.3	87
Basement	Office Area											0	0	0
Basement	Storage											0	0	0
Basement	Corridor	Supply	298		0.06	17.88	0	0			17.88	0	0	0
Basement	Baths - High use	Exhaust	247	5	0	0	0	0			0	70	0	350
Basement	Baths - High use	Exhaust									0	70	0	350
Basement	Janitor	Exhaust									0	0	1	35
										CFM	1925.72		Total CFM	892
First Floor	Production	Exhaust									0	0	0.5	449
First Floor	Stage	Supply								300	325.32	0	0	0
First Floor	Stage	Supply								1280	1389.56	0	0	0
First Floor	Baths - Low Use	Exhaust									0	50	0	50
First Floor	Auditorium Seating Area	Supply								2930	3164.12	0	0	0
First Floor	Lobby	Supply								100	107.62	0	0	0
First Floor	Lobby	Supply								100	107.62	0	0	0
First Floor	Lobby	Supply								1445	1560.26	0	0	0
										Total CFM	6654.5		Total CFM	499
Mezzanine	Auditorium Seating Area	Supply	1591		0.06	95.46	5	6.6666667	239	1195	1290.46	0	0	0
Mezzanine	Office Area	Supply	215		0.06	12.9	5	200	2	10	22.9	0	0	0
Mezzanine	Baths - High use	Exhaust	61	1	0	0	0	0			0	70	0	70
										Total CFM	1313.36		Total CFM	70

Determine peak loads

Item	Unit	First & Mezz Max Occupancy - Performance	First & Mezz Min Occupancy	Basement Max Occupancy - Intermission	Basement Max During Performance	Basement Min Occupancy - Office
Specific Space Heat Demand:	kBTU/(ft²yr)	0	13.19	0	0	1.03
Pressurization Test Result:	ACH50	0.6	0.6	0.6	0.6	0.6
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	kBTU/(ft²yr)	82.3	27.1	91.9	69.6	22.7
Specific Useful Cooling Energy Demand:	kBTU/(ft²yr)	290.31	0.61	179.54	65.9	0.68
Peak Heat Load	BTU/HR	0	89302	0	0	16920
Peak Cooling Load	BTU/HR	480975	19574	183162	72643	4678
Peak Cooling Load	Ton	40.08	1.63	15.26	6.05	0.39

Plug loads

TOTAL Annual Kilowatt Hours Plug Loads	TFA	kWh/SF	Allowable kWh/sf 11.1/2.7
4396.986867	4640	0.94753	4.111111111

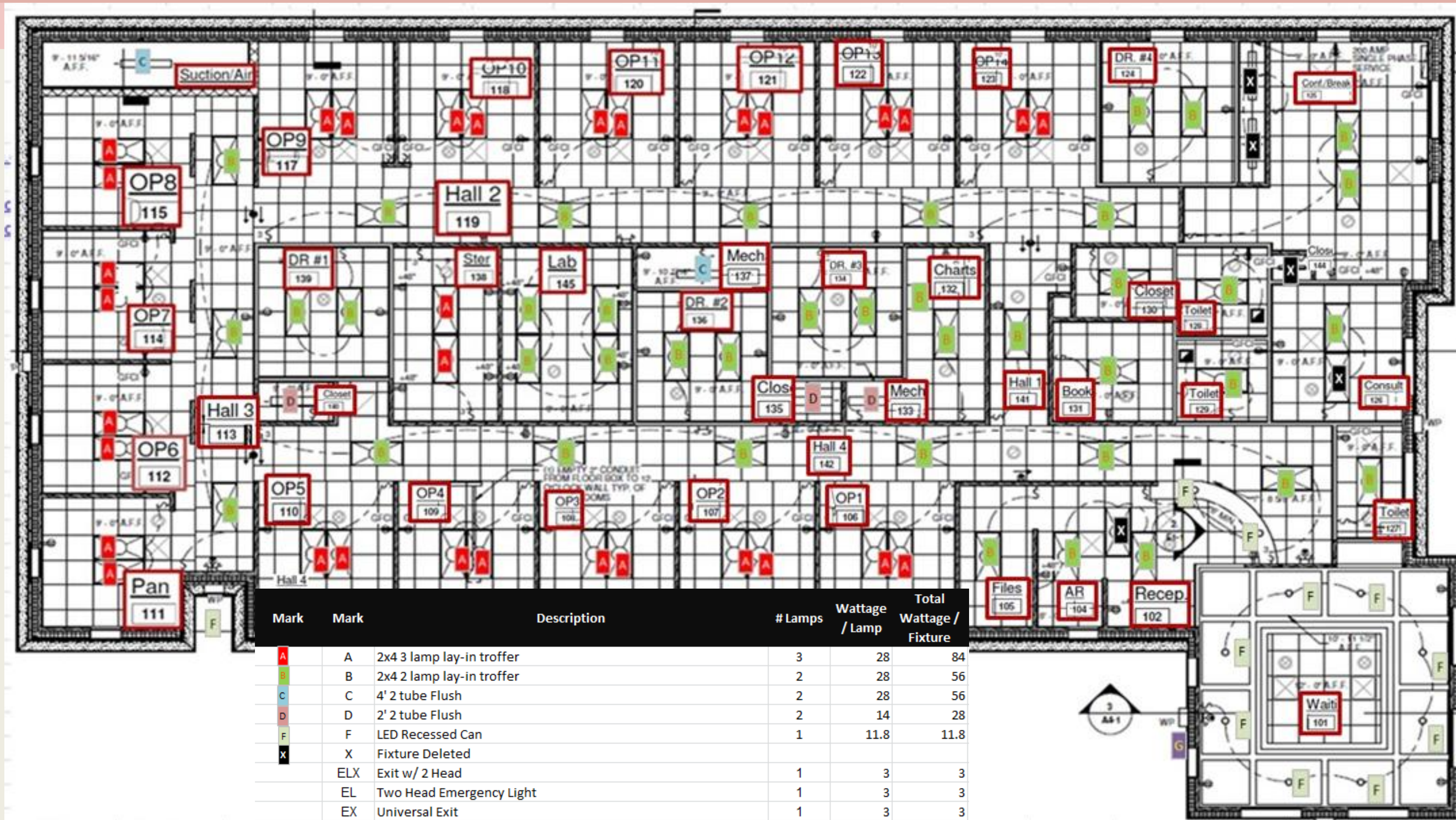
Description	Usage	QTY	Existing?	Elec Size	Hours of usage / week		Standby W/hr	% in Standby	Low Power W/hr	% in Low Power	Active W/hr	% Active	# Weeks	Annual Kilowatt Hours
OP #9 Hygienist														
Computer	24/7	1	Yes		168	OK	4.4	0.92	17.2	0.02	69.7	0.06	50	71.7604
LCD Monitor	24/7	1	Yes		168	OK	1	0.92	1.7	0.02	2.7	0.06	50	2.15176
OP #10 Hygienist														
Computer	24/7	1	Yes		168	OK	4.4	0.92	17.2	0.02	69.7	0.06	50	71.7604
Mini Refrigerator	24/7	1	Yes		168	OK	1	0.92	1.7	0.02	[illegible]	0.06	52	[illegible]
OP #11 Hygienist														
Computer	24/7	1	Yes		168	OK	4.4	0.92	17.2	0.02	69.7	0.06	50	71.7604
LCD Monitor	24/7	1	Yes		168	OK	1	0.92	1.7	0.02	2.7	0.06	50	2.15176
OP #12 Hygienist														
Computer	24/7	1	Yes		168	OK	4.4	0.92	17.2	0.02	69.7	0.06	50	71.7604
LCD Monitor	24/7	1	Yes		168	OK	1	0.92	1.7	0.02	2.7	0.06	50	2.15176
OP #13 Hygienist														
Computer	24/7	1	Yes		168	OK	4.4	0.92	17.2	0.02	69.7	0.06	50	71.7604
LCD Monitor	24/7	1	Yes		168	OK	1	0.92	1.7	0.02	2.7	0.06	50	2.15176
OP #14 Hygienist (FUTURE)														
Computer	24/7	1	Yes		168	OK	4.4	0.92	17.2	0.02	69.7	0.06	50	71.7604
LCD Monitor	24/7	1	Yes		168	OK	1	0.92	1.7	0.02	2.7	0.06	50	2.15176
Reception														
Computer	24/7	4	Yes		168	OK	4.4	0.78	17.2	0.02	69.7	0.22	50	[illegible]
LCD Monitor	24/7	4	Yes		168	OK	1	0.78	1.7	0.02	2.7	0.22	50	[illegible]
Laser Printers	10 hrs/day	1	Yes		46	OK	1.3	0.7	9.6	0.1	39	0.2	50	22.241
Copier/Fax	10 hrs/day	[illegible]	Yes		46	OK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	50	[illegible]
STOR #2		NONE												
Telephone System	24/7	1	Yes		168	OK					36	1	52	314.496
Waiting														
LCD Monitor	4 days/wk (10hr)/1 day/wk (6 hr)	1	Yes		46	OK	1.9	0.9	10	0.02	[illegible]	0.08	50	[illegible]
X-Ray														
Computer	24/7	1	Yes		168	OK	4.4	[illegible]	17.2	0.02	69.7	0.06	50	[illegible]
LCD Monitor	24/7	1	Yes		168	OK	1	[illegible]	1.7	0.02	2.7	0.06	50	[illegible]

Efficiency Vermont BBD BETTER BUILDINGS BY DESIGN

Commercial Passivhaus Design Principles

PASSIVSCIENCE Knowledge saves power

Lighting loads



Mark	Mark	Description	# Lamps	Wattage / Lamp	Total Wattage / Fixture
A	A	2x4 3 lamp lay-in troffer	3	28	84
B	B	2x4 2 lamp lay-in troffer	2	28	56
C	C	4' 2 tube Flush	2	28	56
D	D	2' 2 tube Flush	2	14	28
F	F	LED Recessed Can	1	11.8	11.8
X	X	Fixture Deleted			
	ELX	Exit w/ 2 Head	1	3	3
	EL	Two Head Emergency Light	1	3	3
	EX	Universal Exit	1	3	3
G	G	Exterior Wall Mount Flourescent	1	16	16
	H	38W LED Flood	1	39	39

Lighting loads

# Days	# Hours	Description
365	12	Exterior Lights on Timer
250	9.2	Regular Business Mon - Thurs
365	24	Emergency
24	0.5	Occasional Useage / Intermittent Days
250	1.5	Occasional Useage / Daily
65	1	Storage
30	2.5	Maintance
50	4	Once Per Week

Lighting loads

Room #	Room	Fixture Type	QTY	Wattage / fixture	Total Wattage	Days of Use	Daily Hours	OCC Sensor	kWh	TOTAL 9886.343
101 / 142	Waiting / Hall 4	G / EX	1 / 2	16 / 3	16 / 6	365	24	No	70.08 / 52.56	
101 / 142	Waiting / Hall 4	F / B	8 / 5	11.8 / 56	94.4 / 280	250	9.2	No	217.12 / 644	
101 / 139	Waiting / Dr. #1 Office	ELX / B	1 / 2	3 / 56	3 / 112	250	1.5	YES	26.28 / 42	
102/103 / 136	Reception / Dr. #2 Office	F / B	2	11.8 / 56	23.6 / 112	250	1.5	YES	54.28 / 42	
102/103 / 134	Reception / Dr. #3 Office	B	2	56	112	250	1.5	YES	257.6 / 42	
104 / 124	DR #4 Office (FUTURE)	B	1 / 2	56	56 / 112	250	1.5	YES	128.8 / 42	
105 / 133	Files / Sterilization	B / A	1 / 2	56 / 84	56 / 168	250	9.2	No	128.8 / 386.4	
106 / 145	OP #1 Hygienist / Lab	A / B	2 / 4	84 / 56	168 / 224	250	1.5	YES	386.4 / 84	
107 / 135	OP #2 Hygienist / Mechanical	A / D	2 / 1	84 / 28	168 / 28	30	2.5	No	386.4 / 2.1	
108 / 137	OP #3 Hygienist / Mechanical	A / C	2 / 1	84 / 56	168 / 56	30	2.5	No	386.4 / 4.2	
109 / 140	OP #4 Hygienist / Closet	A / D	2 / 1	84 / 28	168 / 28	65	9.2 / 1	No	386.4 / 1.82	
110 / 135	OP #5 Hygienist / Closet	A / D	2 / 1	84 / 28	168 / 28	65	9.2 / 1	No	386.4 / 1.82	
111 / 130	Pan / Closet	A / B	2 / 1	84 / 56	168 / 56	65	0.5 / 1	No	23.016 / 3.64	
112 / 127	OP #6 Doctor's (FUTURE) / Toilet	A / B	2 / 1	84 / 56	168 / 56	250	1.5	YES	386.4 / 21	
114 / 129	OP #7 Doctor's (FUTURE) / Toilet	A / B	2 / 1	84 / 56	168 / 56	250	1.5	YES	386.4 / 21	
115 / 128	OP #8 Hygienist(FUTURE) / Toilet	A / B	2 / 1	84 / 56	168 / 56	250	1.5	YES	386.4 / 21	
116 / 131	Suction/Air / Books	C / B	1	56	56	50	4	YES	11.2 / 4.2	
117 / 132	OP #9 Doctor's / Charts	A / B	2 / 1	84 / 56	168 / 56	250	1.5	YES	386.4 / 21	
118	OP #10 Doctor's / Exterior	A / H	2 / 3	84 / 65	168 / 195	365	12	No	386.4 / 854.1	
120	OP #11 Doctor's	A	2	84	168	250	9.2	No	386.4	
121	OP #12 Doctor's	A	2	84	168	250	9.2	No	386.4	
122	OP #13 Doctor's	A	2	84	168	250	9.2	No	386.4	
123	OP #14 Doctor's	A	2	84	168	250	9.2	No	386.4	
141	Hall 1	EX	1	3	3	365	24	No	26.28	
141	Hall 1	B	1	56	56	250	9.2	No	128.8	
119	Hall 2	EL	1	3	3	1	1	No	0.003	
119	Hall 2	EX	1	3	3	365	24	No	26.28	
119	Hall 2	B	5	56	280	250	9.2	No	644	
113	Hall 3	ELX	1	3	3	365	24	No	26.28	
113	Hall 3	B	3	56	168	250	9.2	No	386.4	
113	Hall 3	F	1	11.8	11.8	365	12	No	51.684	

Process loads

Description	Usage	QTY	Existing?	Elec Size	Hours of usage / week	Utility Factor	Volts	Amps	Watts	Kilowatt Hours/ week	# Weeks	Annual Kilowatt Hours
OP #11 Hygienist												
Curing Light	1 hr/day	1	Yes	9V, 1.2A, 11W	5		120	2.8	11	0.055	50	2.75
Operating Light	7 hr/day + 4 hr	1	Yes	120V, 2.8A, 95W halogen	32		120	2.8	95	3.04	50	152
Chair	20 min/day	1	Yes	120V, 10A	1.66667		120	10	1200	2	50	100
Operatory Unit	30 min/day	1	Yes	120V, 3.1A 2.8A 1.4A	2.5		120	3.1	372	0.93	50	46.5
OP #12 Hygienist												
X-Ray	30 sec/day	1	Yes	120V, 8A momentary	0.04167		120	8	960	0.04	50	2
OP #6 Doctor's												
Chair	20 min/day	1	Yes	120V, 10A	1.66667		120	10	1200	2	50	100
Ultrasonic Cleaner	30 min/day	1	Yes	120V, .5A	2.5		120	0.5	60	0.15	50	7.5
X-Ray	30 sec/day	1	Yes	120V, 8A momentary	0.04167		120	8	960	0.04	50	2
OP #13 Hygienist												
Operatory Unit	30 min/day	1	Yes	120V, 3.1A 2.8A 1.4A	2.5		120	3.1	372	0.93	50	46.5
Amalgamator	3 min/day	1	Yes	120V, 155W	0.25		120		155	0.03875	50	1.9375
X-Ray	30 sec/day	1	Yes	120V, 8A momentary	0.04167		120	8	960	0.04	50	2
OP #7 Doctor's (FUTURE)												
X-Ray	30 sec/day	1	Yes	120V, 8Amomentary	0.04167		120	8	960	0.04	50	2
OP #14 Hygienist (FUTURE)												
Operating Light	4 hr/day	1	No	120V, 2.8A, 95W halogen	32		120	2.8	95	3.04	50	152
Chair	20 min/day	1	No	120V, 10A	1.66667		120	10	1200	2	50	100
Operatory Unit	30 min/day	1	No	120V, 3.1A, 2.8A, 1.4A	2.5		120	3.1	372	0.93	50	46.5
Amalgamator	3 min/day	1	No	120V, 155W	0.25		120		155	0.03875	50	1.9375
Pan												
Gendex Model #46-154870G3	2 min/wk,	1	Yes	120V, 8.8A momentary, 1A cont.	0.03333		120	8.8	1056	0.0352	50	1.76
Sterilization												
Sterilizers	7 hours/day 4 days, 2 hours/day 1 day	2	Yes	120V, 12A	45	0.15	120	12	1440	6.48	50	324
Ultrasonic Cleaner Sterilization	4 hr /day 4 days, 1 hr/ 1 day	2	Yes	120V, 1.75, 400W	17		120		400	6.8	50	340
Water Distiller	22 hr/day	1	Yes	120V, 750W	10		120		750	7.5	50	375
Suction/Air												
Compressor MDS Matrix OL1003	2 days / wk (10hr) (10% usage)	1	Yes	208-231V / 33A	1.6	0.1	231	33	7623	12.1968	50	609.84
Compressor Air Techniques AS70	2 days / wk (10hr), 1 day/wk (6 hr) (10% usage)	1	Yes	208-230V, 24A, 1 1/2hp	2.1	0.1	230	24	5520	11.592	50	579.6
Suction Airtechniques 54110	4 days/wk (10hr), 1 day/wk (6 hr) (60% usage)	1	Yes	200-240V, 15A, 3ph	2.52	0.12	240	15	3600	9.072	50	453.6
X-Ray												
Image Developer	20min/day	1	Yes	110V, 1A	1.66667		110	1	110	0.183333333	50	9.166667
Image Deleter	20min/day	1	Yes	108V, .75A	1.66667		108	0.75	81	0.135	50	6.75
OP #10 Hygienist												
Operating Light	4 hr/day	1	Yes	120V, 2.8A, 95W halogen	32		120	2.8	95	3.04	50	152
Chair	20 min/day	1	Yes	120V, 10A	1.66667		120	10	1200	2	50	100

Total (plug + lighting + process) loads

TOTAL Annual Kilowatt Hours Process Energy	TFA	kWh/SF	Allowable kWh/sf 11.1/2.7	Total Annual Lighting Load	kWh/SF	TOTAL Annual Kilowatt Hours Plug Loads	kWh/SF	TOTAL kWh	TOTAL kWh/sf	% Over	TOTAL kWh Allowable	TOTAL kWh Cut Needed
6742.248667	4640	1.45293	4.111111111	9886.343	2.13047	4396.9869	0.947533	21025.579	2.4004593	9.3%	19077.44667	1948.132

INTERNAL HEAT GAINS Non-domestic Use

Building: Dental Office for Drs. Lynch, Singleton & Dickey

Calculation Result from this Worksheet

Utilization Pattern: Office — 2.429 BTU/hr.ft² — 2.46 BTU/hr.ft² — Carefully complete the Electricity Non-Dom worksheet!

Type of Values Used: PHPP Calculation Non-Residential — Enter result from row above: 2.92 BTU/hr.ft² — False input

Calculation Internal Heat	Persons: 12.31752166 P		Room Temperature: 68 °F
	TF Area: 4640.46 ft²	Heating Period: 204.517 day/yr	Internal Heat Gains Aux. Electricity: 6458.83 BTU/hr

Column Nr.

Persons	Select	Utilization Pattern	Select	Activity of Persons	Planning with the number of persons or via floor area of utilization zone (planning via area only if the occupancy is available for this utilization pattern). Pers./Area (1 / 0)		Number of Occupants	Number of persons greater than planning in Verification worksheet	Floor Area of Utilization Zone (ft²)	Average Occupancy (Persons / ft²)	Heat Emitted per Person (BTU/hr)	Utilization Hours per Year [hr/yr]	Relative Presence	Used in Time Span (hr/yr)	Average Heat Emitted by Persons (BTU/hr)
										27		9	18		
Persons A - Monday Treatment	2	…nday AM Treatment	3	>10 yr., standing or light work	1	planning with # of persons	28	or		0.006809339	341.21	250	0.9	8760	245.3936301
Persons B - Monday Lunch	3	Monday Lunch	3	>10 yr., standing or light work	1	planning with # of persons	14	or		0.003404669	341.21	50	0.9	8760	24.53936301
Persons C - Tu-ThTreatment	7	- Thurs AM Trtmnt	3	>10 yr., standing or light work	1	planning with # of persons	31	or		0.007538911	341.21	750	0.9	8760	815.0574144
Persons D - Tu-Th Lunch	8	…ue - Thurs Lunch	3	>10 yr., standing or light work	1	planning with # of persons	15	or		0.00364786	341.21	150	0.9	8760	78.87652397
Persons E - Friday Treatment	12	…iday AM Treatment	3	>10 yr., standing or light work	1	planning with # of persons	15	or		0.00364786	341.21	250	0.9	8760	131.4608733
Persons F - Friday Close	13	Friday Close	3	>10 yr., standing or light work	1	planning with # of persons	9	or		0.002188716	341.21	25	0.9	8760	7.887652397
Persons G				no valid input		Enter # of persons or floor area		or		no standard value	0	0	1	8760	0
Evaporation (person specific)							50				-51.18	750	0.9	8760	-197.1913099

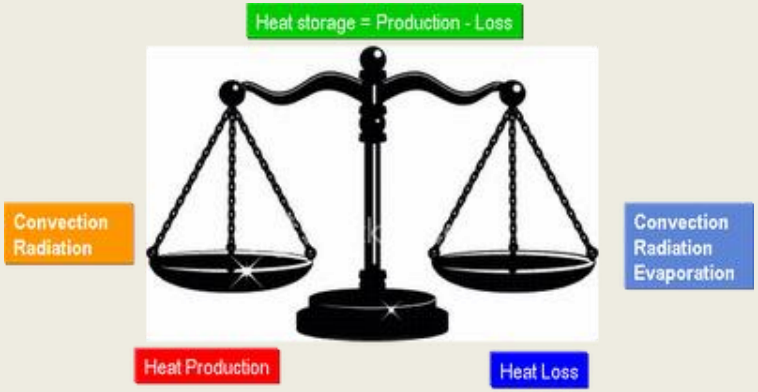
Lighting / Equipment / Aux. Electricity	Useful Energy [kBTU/yr]	Availability	Used in Time Period (khr/yr)	Average Heat Release (BTU/hr)
Lighting	33733.5864	1	8.76	3850.866028
Office Applications (Within Therm. Envelope)	0	1	8.76	0
Cooking (Within Therm. Envelope)	0	0.5	8.76	0
Dishwashing (Within Therm. Envelope)	0	0.3	8.76	0
Cooling (Within Therm. Envelope)	0	1	8.76	0
Other (Within Therm. Envelope)	0	1	8.76	0
Auxiliary Appliances (See Aux Electricity Worksheet)				6458.832815

Heat Loss Due to Cold Water (calculation from column AJ)	on/off (1 / 0)	Predominant Utilization Pattern of Building (Data transfered from Electricity Non-Dom worksheet; input kitchen)	Number of Toilets (user data)	Number of Toilets: Use standard value for schools (X)	Number of Toilets (calculation value)	ΔT: Cold Water Temp. - Room Temp. [F]	Occupied Days per Year [day/yr]	Loss Daytime [BTU/hr]	Loss Nighttime [BTU/hr]	Availability	Used in Period (day/yr)	Average Power Cold Water (BTU/hr)
		2					8					
Cold Water Due to Flushing WC	1		3		3	-14.4	0	0	-41.5	1	365	0

Total		BTU/hr	11415.723
Specific Demand		BTU/hr.ft²	2.46004124
Heat Available From Internal Sources	204.5165 day/yr	kBTU/(hr.ft²yr)	12.0748566

How does commercial PHPP differ from residential?

- Getting the heat balance right

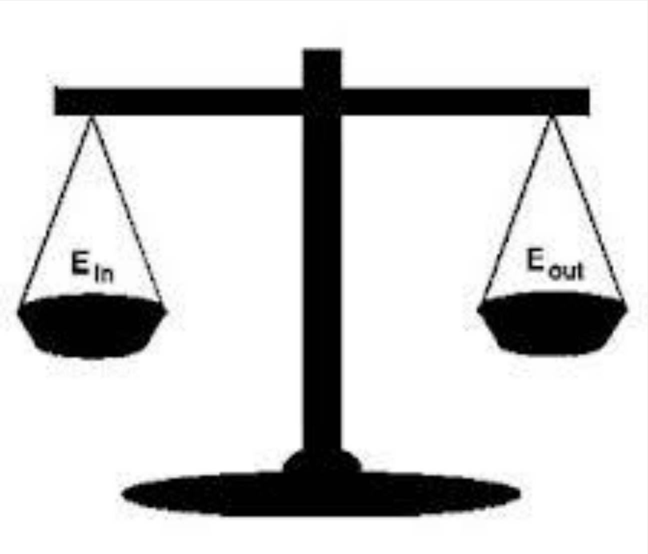


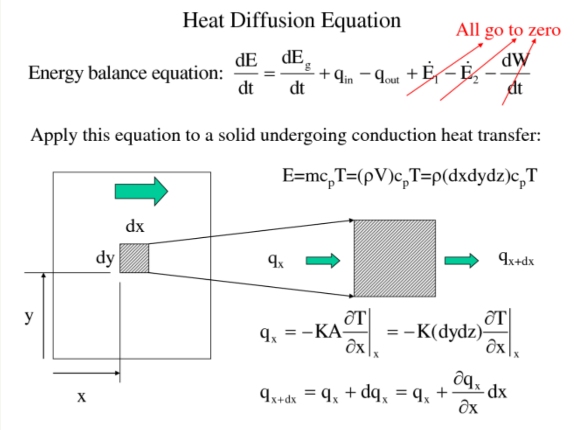
Proportional to:
- Speed (intensity)
- Body mass

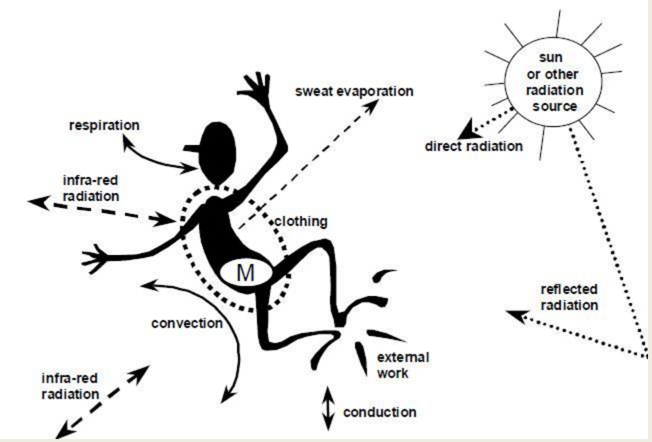
Affected by:
- Mech. Efficiency

Influenced by:
- Environmental conditions
  - Temperature
  - Humidity
  - Wind-speed
- Body size (surface area)

$$\varepsilon = \frac{(m\,C_p)_{hot}(T_{in} - T_{out})_{Hot}}{(m\,C_p)_{min}(T_{in\,hot} - T_{in\,cold})} = \frac{(m\,Cp)_{cold}(T_{out} - T_{in})_{Cold}}{(m\,C_p)_{min}(T_{in\,hot} - T_{in\,cold})}$$







How does commercial PHPP differ from residential?

- Getting the heat balance right
  - Example: Dorm Room
    - Refrigerator - Y / N, #, type
    - Microwave - Y / N, #, type, usage
    - Tea Kettle - Y / N, #, type, usage
    - Hair Dryer - Y / N, #, type, usage
    - TV – Y/N, #, usage
    - Gaming systems – Y/N, #, usage
    - Peripherals - Y/N, #, type, usage
    - Task lighting – Y/N, #, type, usage
    - Bodies??





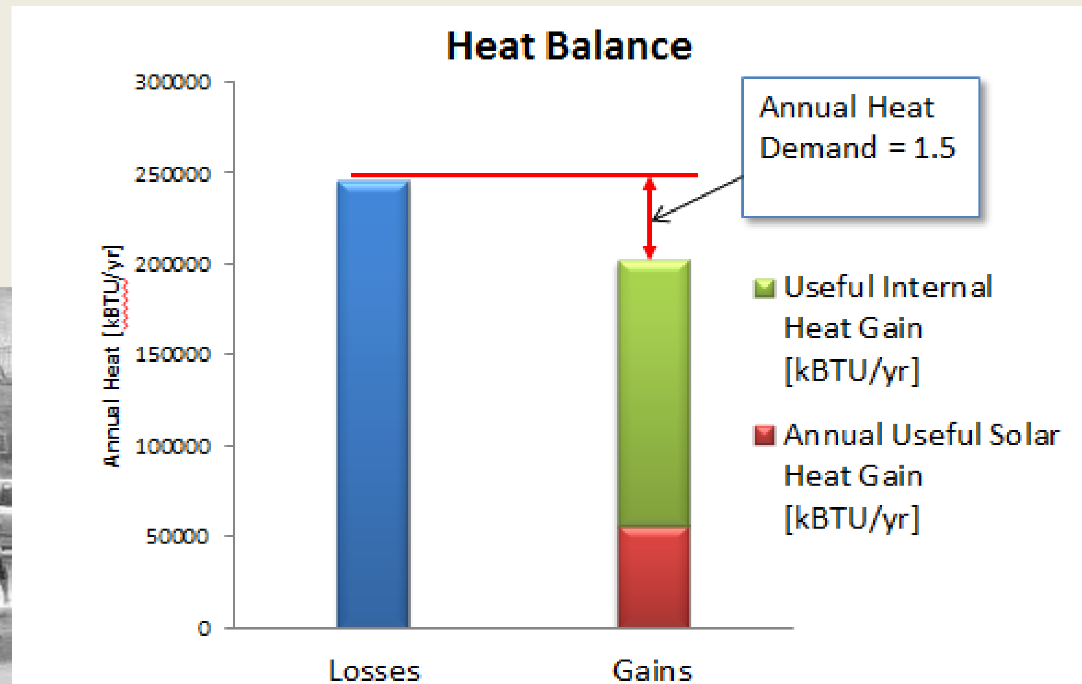






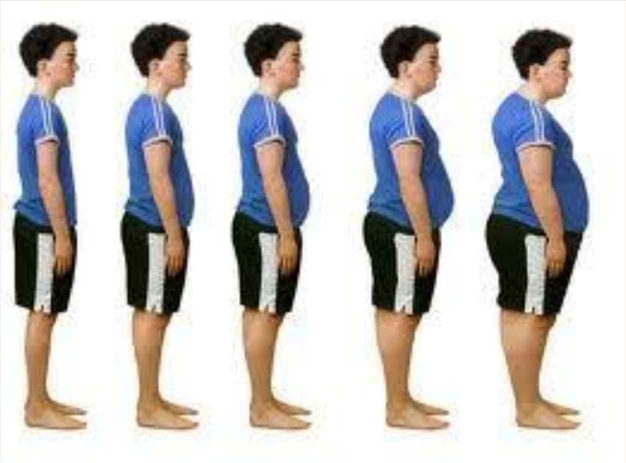
How does commercial PHPP differ from residential?

- Getting the heat balance right
  - Example: Multi Story dorm - determine room peak loads
    - Heating
      - Upper northwest corner (3 sides exposed, twin window)
      - Minimalist occupants
    - Cooling
      - Center south (1 side exposed, twin window)
      - Maximalist occupants



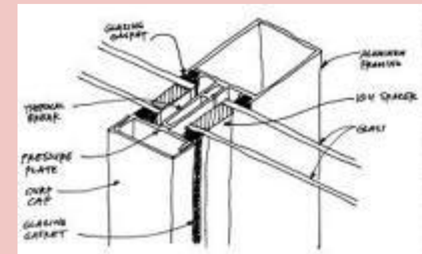
Why does commercial construction make sense?

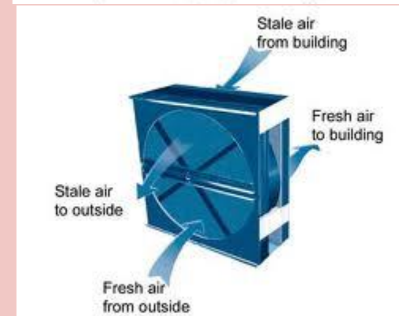
- ❑ It makes dollars and sense!
- ❑ Cost
  - ▪ Larger projects marginal cost for achieving Passivhaus is less than residential .
- ❑ Owner understanding
  - For owner occupants the idea of ROI makes sense
  - Less concerned with the “pay back question”
- ❑ Geometry
  - Potential to be simpler
  - Skin to volume efficiency increase



Challenging aspects of commercial construction today?

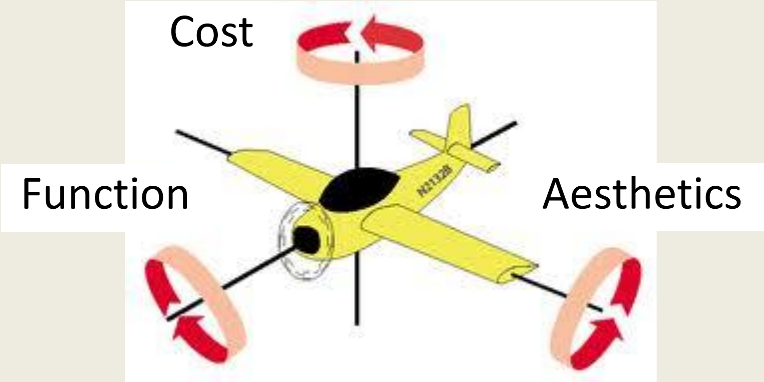
- Technological challenges
- Available technology
  - Window challenges (we all know about these, it is worse in commercial)
  - Doors
    - Handicapped code related issues
      - Closure rules
      - Low thresholds
      - Panic devices
      - Push/pull force
      - Market opportunity!!
  - ERV/HRV sizes and availability
- Accurate heat gain/loss simulations
- Accurate energy usage projections
- Common construction materials
  - Steel is not easy to model in PHPP
  - Thermal bridging can be very significant
  - Obtaining accurate data on US materials and techniques





Biggest Challenge of commercial construction today?

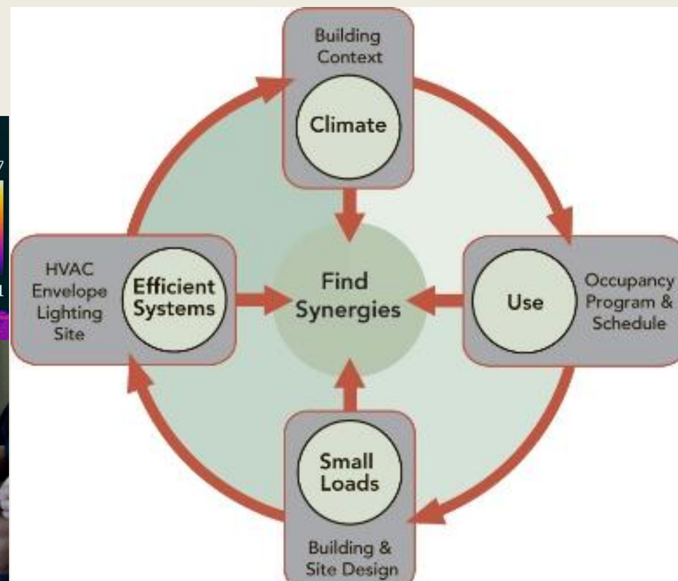
- Project delivery
  - Control

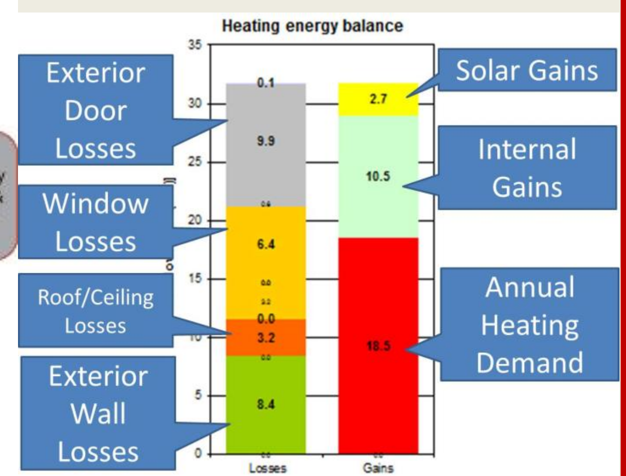


Why is Passive Building Different?

It really is not, but it is.

- The difference in the **process** changes the **product**
  - Design - The building is designed to work as a holistic system, working symbiotically with the occupants use pattern. The fresh air, cooling, dehumidification, heating, hot water system and usage are all considered in the design of the systems.
  - Construction – Passive Building goes beyond the typical commissioning of the mechanical systems, the building envelope is extensively commissioned with air tightness and thermal image testing to quality assure the built project.



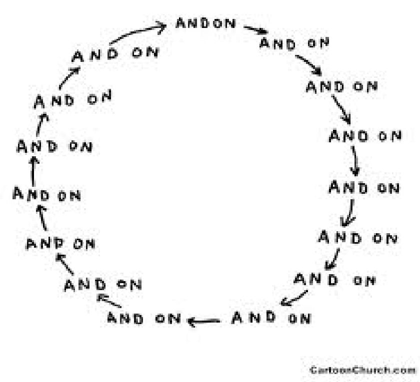


History

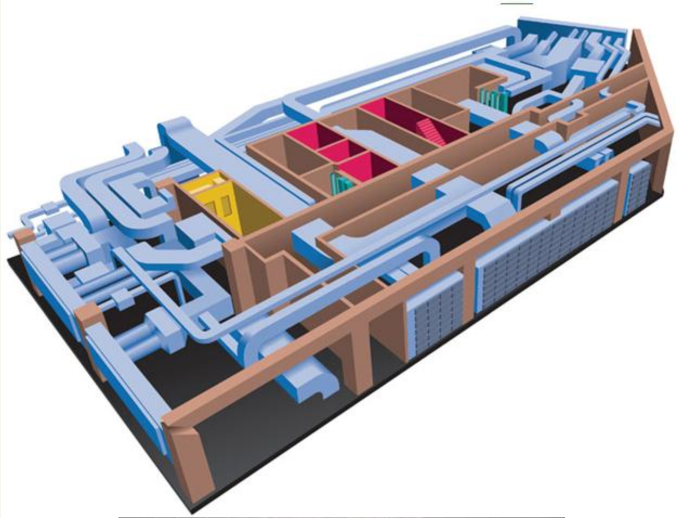
How did we get here?

Late 19th and 20th Century buildings -

- Industrialization, globalization and innovation frees designers from climatic constraints.
- In wealthy nations, form and function no longer require climatic responses
- Many designs depend on energy input and thus fossil fuel to function long term



Seagram Building, New York City (1954-58),
Mies van der Rohe & Philip Johnson

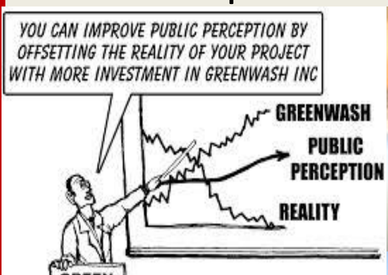


History

How did we get here?

Architects no longer have to have an intimate knowledge of climate responsive design as engineering becomes the architect's crutch.

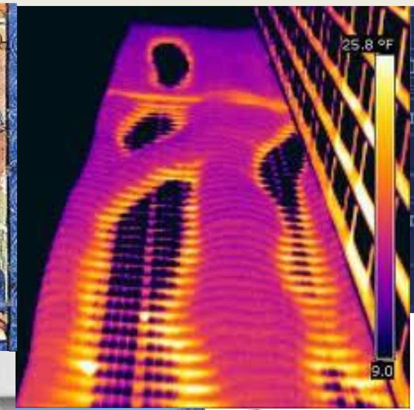
- Design takes precedence over sustainability and adaptability
- Architects become less master builder and more artist
- Reflected in the North American architectural education system until recently
- Even now sustainability is discussed without truly being understood and thus implemented in both education and the field.



HAHAHA!
Wait, i don't
get it.





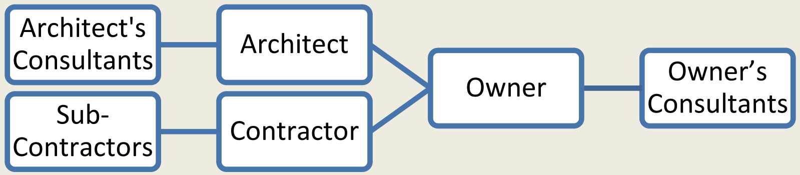





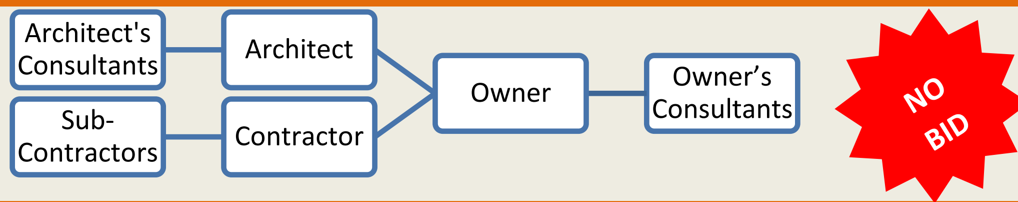


Project Delivery

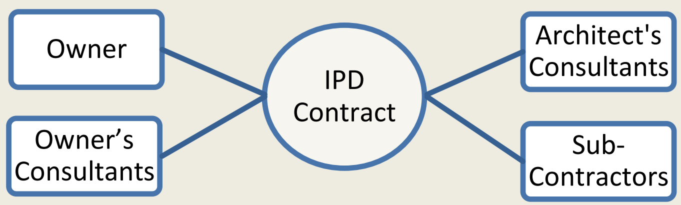
Definition of Terms



Design / Bid / Build



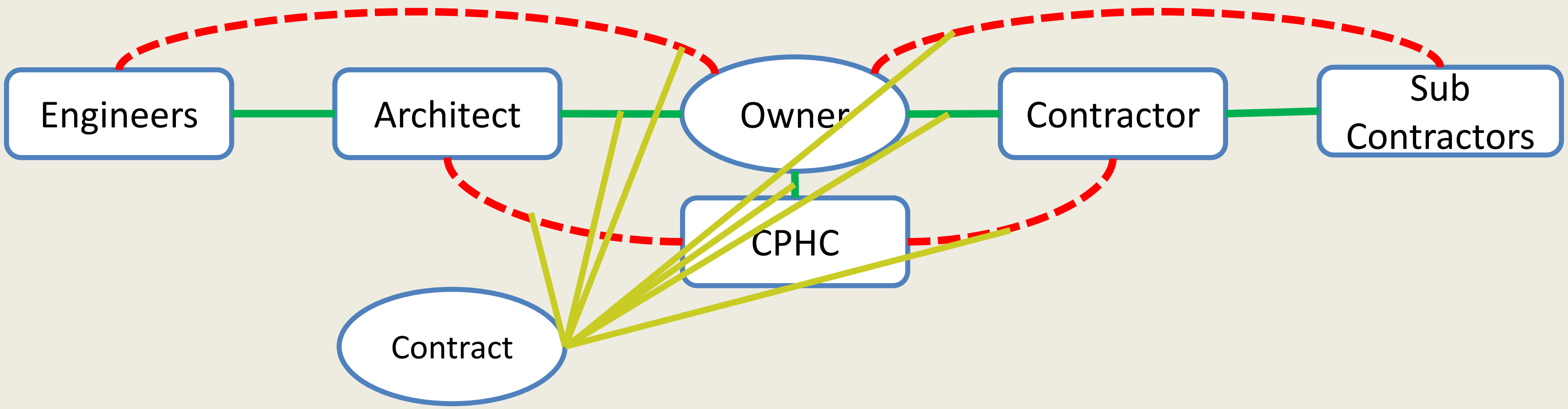
Team Build



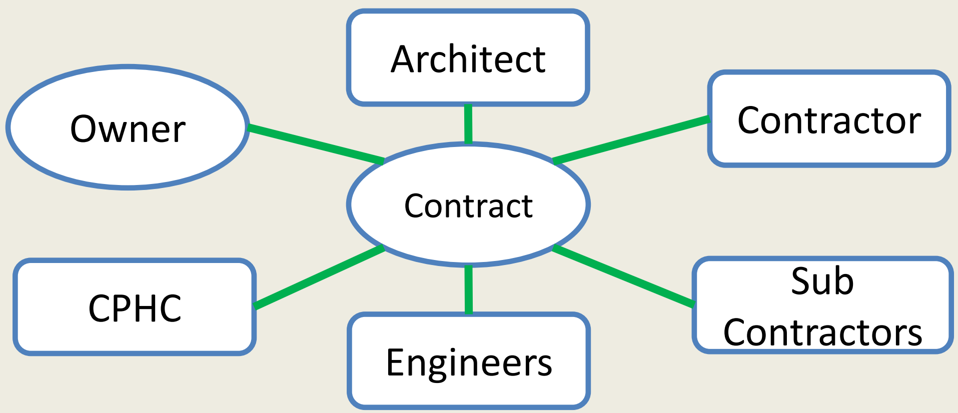
Integrated Delivery

Why is Integrated Project Delivery Different?

It is partly about responsibilities



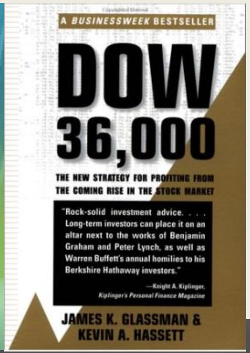
Design / Bid / Build | **Traditional Delivery** | **Team Build**

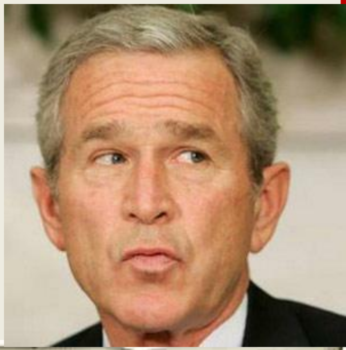


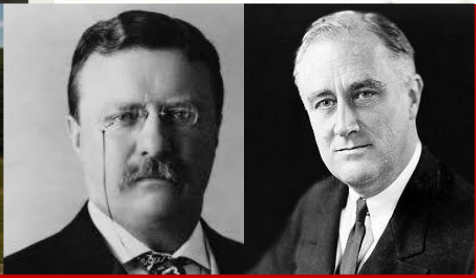
Integrated Delivery

Why is Integrated Project Delivery Different?

It is partly about responsibilities







Why is Integrated Project Delivery Different?

It is partly about responsibilities

<u>From AIA B101 Owner – Architect Agreement</u>

The Architect shall not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the WORK, nor shall the Architect be responsible for the Contractor’s failure to perform the Work in accordance with the requirements of the Contract Documents.

<u>From AIA 201 Owner – Contractor Agreement</u>

The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibilities of the Contractor as required by the Contract Documents. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

Why is Integrated Delivery different?

It is mostly about information flow

- Traditional Project Delivery
  - Information and design is siloed
    - Integration of information is based on assumptions
      - This can work for traditional buildings, but it will lead to waste
        - This waste is assumed and built into the project costs
          - Standard way of doing business

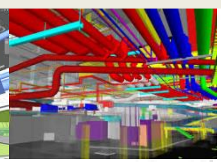
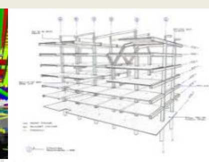
Division		Div. Cost
DIVISION 01 00 00 - GENERAL REQUIREMENTS	$	58,050.31
DIVISION 02 00 00 - EXISTING CONDITIONS	$	13,278.00
DIVISION 03 00 00 - CONCRETE	$	3,200.00
DIVISION 04 00 00 - MASONRY	$	8,400.00
DIVISION 05 00 00 - METALS	$	31,150.00
DIVISION 06 00 00 - WOOD, PLASTICS AND COMPOSITES	$	28,652.00
DIVISION 07 00 00 - THERMAL AND MOISTURE PROTECTION	$	51,654.00
DIVISION 08 00 00 - OPENINGS	$	7,230.00
DIVISION 09 00 00 - FINISHES	$	14,194.00
DIVISION 10 00 00 - SPECIALTIES	$	490.00
DIVISION 11 00 00 - EQUIPMENT	$	-
DIVISION 12 00 00 - FURNISHINGS	$	6,850.00
DIVISION 13 00 00 - SPECIAL CONSTRUCTION	$	-
DIVISION 14 00 00 - CONVEYING EQUIPMENT	$	-
DIVISION 21 00 00 - FIRE SUPRESSION	$	-
DIVISION 22 00 00 - PLUMBING	$	11,933.00
DIVISION 23 00 00 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)	$	-
DIVISION 25 00 00 - INTEGRATED AUTOMATION	$	-
DIVISION 26 00 00 - ELECTRICAL	$	14,308.00
DIVISION 31 00 00 - EARTHWORK	$	-
DIVISION 32 00 00 - EXTERIOR IMPROVEMENTS	$	-
DIVISION 33 00 00 - UTILITES	$	-
DIVISION 33 00 00 - TRANSPORTATION	$	-
DIVISION 35 00 00 - Waterway and Marine Construction	$	-
DIVISION 40 00 00 - Process Integration	$	-
DIVISION 41 00 00 - Material Processing and Handling Equipment	$	-
DIVISION 42 00 00 - Process Heating, Cooling, and Drying Equipment	$	-
DIVISION 43 00 00 - Process Gas and Liquid Handling, Purification, and Storage Equipment	$	-
DIVISION 44 00 00 - Pollution and Waste Control Equipment	$	-
DIVISION 45 00 00 - Industry-Specific Manufacturing Equipment	$	-
DIVISION 46 00 00 - Water and Wastewater Equipment	$	-
DIVISION 48 00 00 - Electrical Power Generation	$	-
SUB TOTAL	**$**	**249,389.31**
Design Contingency	$	5,089.58
Construction Contingency	$	13,125.75
Overhead	$	21,686.03
Fee	$	13,125.75
TOTALS	**$**	**302,416.42**

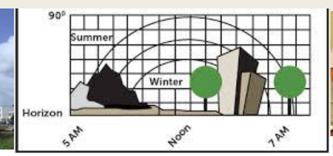
SYNERGY

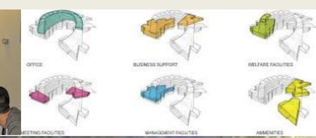
Buildings need to be viewed as functional wholes, with synergies inherent in the function and form

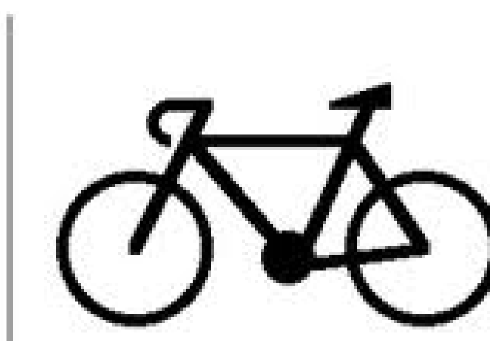
- Synergy is the interaction of multiple elements in a system to produce an effect different from or greater than the sum of their individual effects.
  - The term synergy comes from the Greek word synergia, συνέργια from synergos, συνεργός, meaning "working together".
- As an industry, we pay lip service to the concept, but to ***cost effectively*** meet the climate change imperative, we must understand this at a visceral level
- We can do this today if we understand:
  - Program, use, occupancy, site, form, structure, MEP systems, process energy, cost
- **AND**
  - All are analyzed and all considered in the design process from day 1.





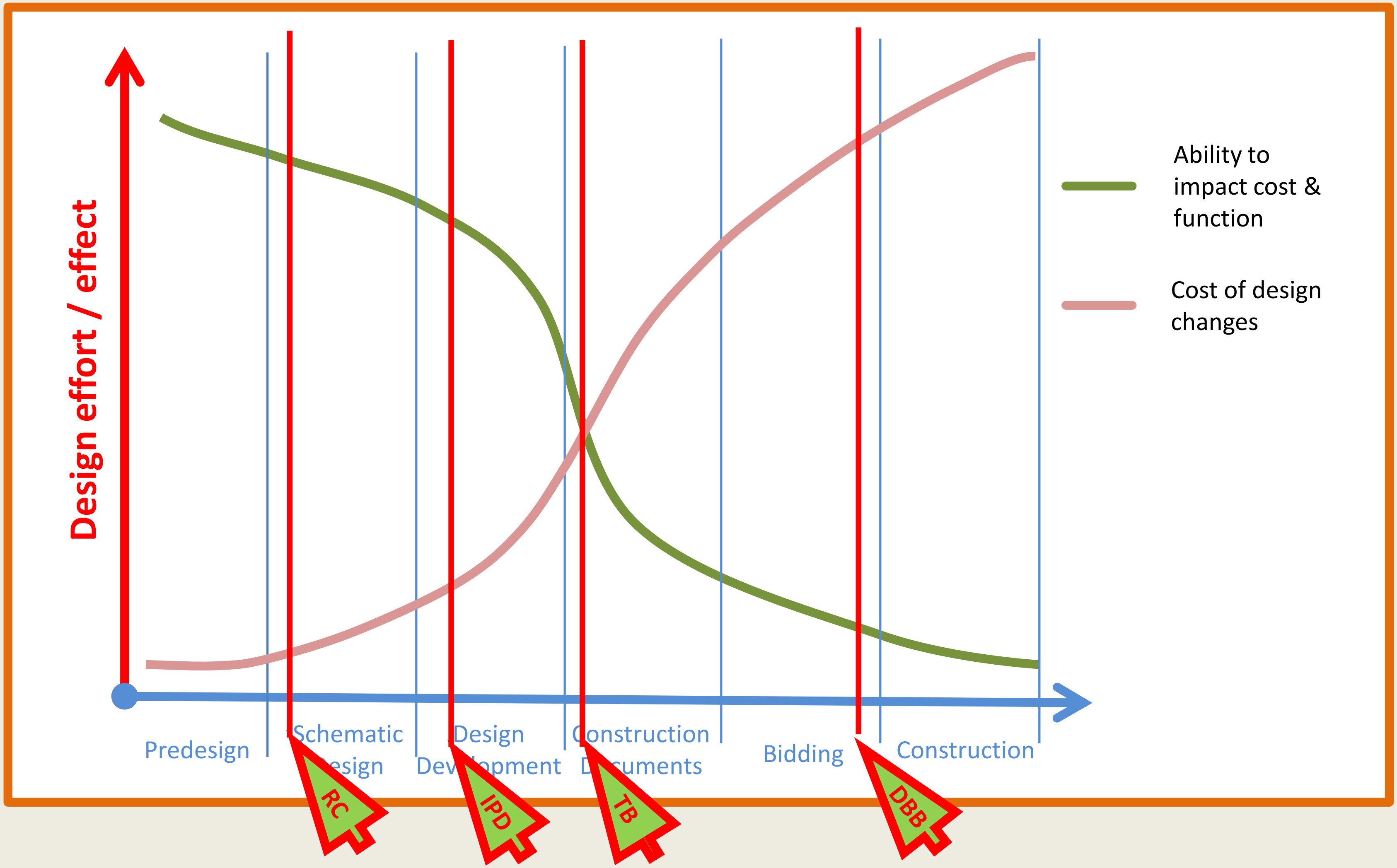

Why is Integrated Delivery different?

It is mostly about information flow

THE BIG PICTURE

Why is Integrated Project Delivery Different?

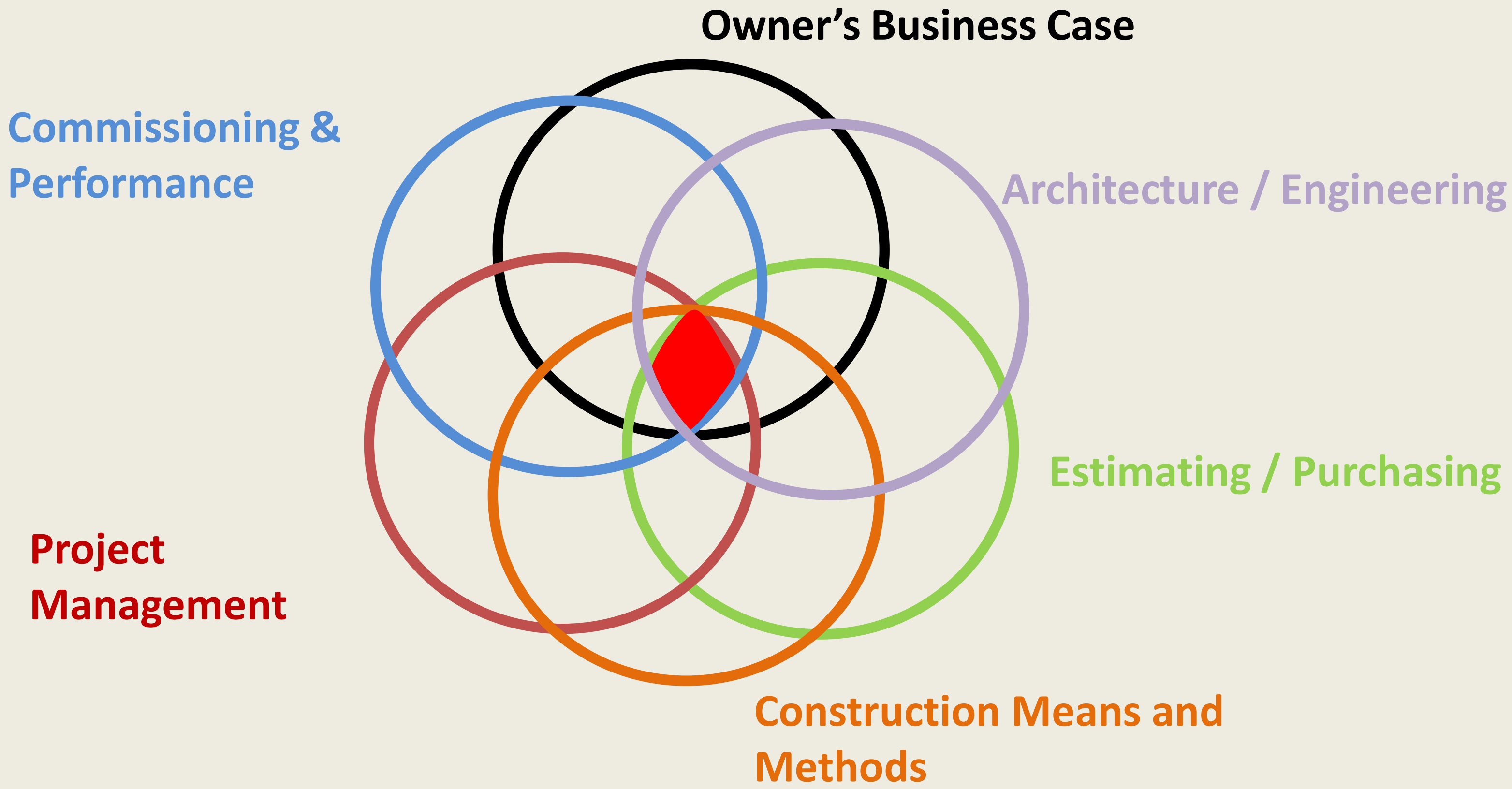
Integrated information flow leads to Fiscal Control



Delivery of MARKET RATE high performance

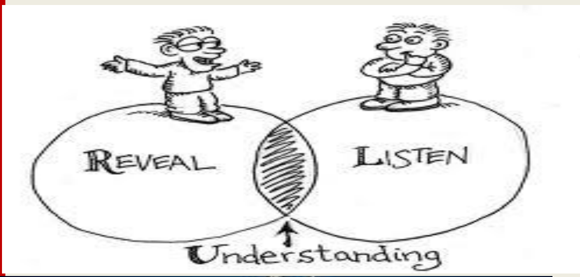
It is mostly about information flow and breaking barriers

Integrated Project Delivery



Project development starts with Understanding

- ❑ "I got it all together now with my very own disco clothes" Frank Zappa
- ❑ Project Roles – Motivations differ
  - Owner / Client
  - Architect
  - CPHC
  - Builder
  - Engineers
  - Building Officials
  - Bank



Design & Construction

Understand the Process and Integrate

- Program, Use & occupancy
- Site
- Form
- Structure
- MEP systems
- Process energy
- Cost

Client

Architect

General Contractor

Operations & Maintenance Personnel

Financier

MEP Engineers

Sub-Contractors

Users

Energy Modeler

Civil Engineer

Landscape Architect

Structural Engineer

Roadmap to a sustainable future

We WILL Change – Our Choice to be **PROACTIV**E or **REACTIVE**

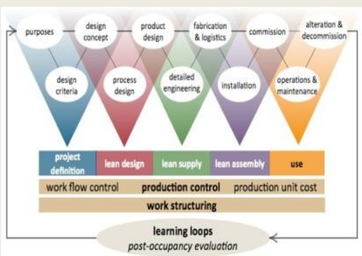
- As a profession, we need to make a hard turn towards a sustainable future this means thinking beyond the checklist approach to sustainability and returning to a master builder model of thinking
- As designers we must focus on mastering an understanding the synergies inherent a building and levering those synergies to create high performance buildings.
- We can do that now at market rate, we just have to want to

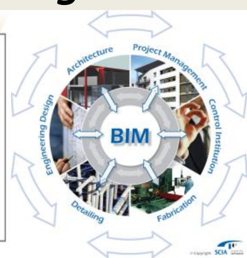
Roadmap to a sustainable future

An Often Overlooked Opportunity

Delivery Method

- A no cost strategy for truly sustainable design and construction
- Integrated Project Delivery
    - Integrated team based on trust and mutually beneficial relational contracts
        - Process is not ***bid based*** but ***objective driven***
    - Fully and truly functional BIM
        - Model functions through design, construction & operations
    - Lean construction principles
        - Just in time delivery of information and materials
    - ***New Paradigm*** is really and olde way of doing what we do





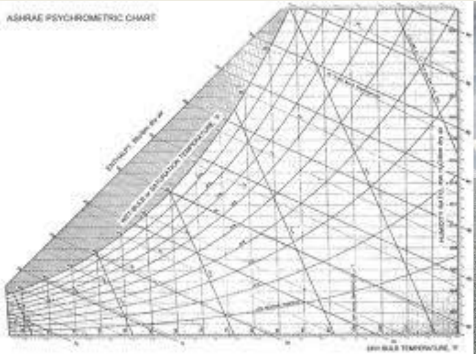
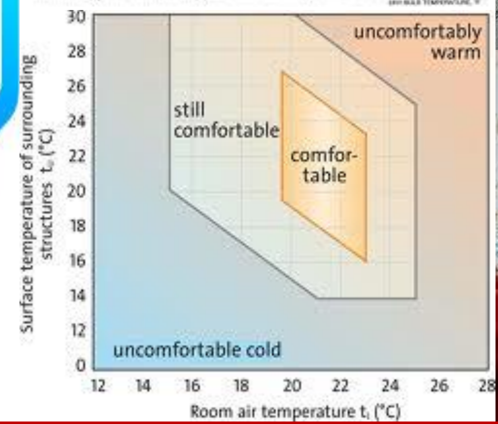
Roadmap to a sustainable future

One Last Opportunity

Thermal Comfort

- ANSI/ASHRAE Standard 55
  - ***Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation*.**
- Cultural expectation of comfort






Examples

Structures Design/Build, LLC has consistently demonstrated market rate solutions

Simple choice - Pay for electrons or equity

Examples

Center for Energy Efficient Design

Location: Rocky Mount, Virginia

ent: Franklin County School Board

The First US public school
uilding built to Passivhaus Standards

Size: 3,600 GSF
Construction: 5B, non-sprinkled

Delivered for $26,000 less than earth sheltered building with 25% higher energy savings!

Examples

The Malcolm Rosenberg Center for Jewish Life

Delivered for $135 per sq ft

79% Energy Savings @ Market Rate!

Location: Blacksburg, Virginia
Client: Hillel @ Virginia Tech
First US assembly building built to Passivhaus Standards

Size: 8,000 GSF
Construction: 5B, non-sprinkled

Examples

Hickory Hall

Location: Emory, Virginia

Client: Trustees of Emory & Henry College

The largest US building built to Passivhaus Standards

Size: 40,000 GSF

Construction: 5B, sprinkled

Delivered for $5.75 per sq ft LESS than twin!!

60% Energy Savings!!

Examples

New Office for Dr.s Lynch, Dickey & Singleton

Location: Roanoke, Virginia

Client: Dr.s Lynch, Dickey & Singleton

The first dental clinic built to Passivhaus Standards

Delivered for $155 per sq ft
Low Market Rate!

Size: 5,000 GSF

Construction: 5B, non-sprinkled

Summary

And now a message from Dr. Feist

"Investing in value instead of energy consumption requires little financial efforts but rather creativity and intelligent solutions"

~ Wolfgang Feist

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