Technical Report 1

Mechanical

ASHRAE Standard 62.1-2013 and Standard 90.1-2013 Evaluation

Author: Kale Mullikin

Advisor: Donghyun Rim

September 18, 2014

Contents

Project Summary

The Medical Office Building is located in North-East United States and is to house many medical offices as well as some examination rooms and a physical therapy area. The building is two stories with a total square footage of 72,706.

The main heating and cooling of the building will be supplied by two roof top units with a VAV system to regulate the air in the building. There are also five separate ductless split-system units that will serve areas that generate more heat than the rest of the building.

Executive Summary

This technical report was created to analyze the Medical Office Building and determine if it meets the requirements of ASHRAE 62.1-2013 and 90.1-2013.

ASHRAE 62.1 specifies minimum ventilation rates and other requirements to provide an air quality that is acceptable for human occupation. Since the Medical Office Building is a healthcare facility, it is very important that the building complies with this standard. This building does comply with 62.1. There was only one minor specification that was not met and that was bird screens on the intakes of the roof top units. This can be easily improved post construction if it proves to be a problem.

ASHRAE 90.1 is intended to set minimum requirements for energy efficiency of buildings. Due to the fact that the Medical Office Building was not intended to obtain a LEED rating, the building adhered to compliance but did not go above and beyond. The standard requires that there be energy saving controls on the lights and mechanical units as well as minimizing the amount of air to leak in or out of the building.

ASHRAE standard 62.1-2013

Section 5

5.1 Ventilation Air Distribution

Design for Air Balancing: System will be equipped with 100% modulating based economizer system. Fresh air will be measured and controlled with minimum and maximum fresh air set points that will be programmable at the human interface.

Plenum Systems: This building does not make use of plenum supply and return. Therefore this section does not apply.

Documentation: Minimum requirements for air balancing and testing shall be taken from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." Testing, adjusting, and balancing shall be done by a firm certified by NEBB.

5.2 Exhaust Duct Location: Exhaust fans will be located on the ceiling allowing for negative pressure of exhaust ducts. Exhaust fans will also comply with AMCA requirements.

5.3 Ventilation System Controls: System will be equipped with an automatic economizer cycle with maximum and minimum fresh air set points adjustable at a human interface to maintain required fresh air ventilation.

5.4 Airstream Surfaces

Resistance to Mold Growth: The duct materials in this building are composed of galvanized sheet steel complying with ASTM A 653/A 653M having a G90 coating, PVC-coated galvanized steel complying with ASTM A 653/A 653M having a G90 coating, carbon-steel sheets ASTM A 366/A366M, stainless steel ASTM A 480/A480M type 316, aluminum sheets ASTM B 209 alloy 3003 temper H14.

Resistance to Erosion: This building has sheet metal ducts which are excluded from this section. The duct liner present in some of the ducts will be coated to prevent the erosion of glass fibers.

5.5 Outdoor Air Intakes

Location: The closest exhaust fan is exhausting class 2 air and is further than 10 feet away from the inlet of the roof top units specified in drawings. Other fresh air inlets are located on the ground floor and there are no exhaust near outlets or loading areas near these inlets.

Rain Entrainment and Intrusion: Rain entrainment and intrusion is prevented by a downward facing hood on the intake of the roof top unit as well as linked damper blades and a damper filter.

Snow Entrainment: Roof access doors are provided as well as walking pads placed on the roof leading to the roof top units.

Bird Screens: Bird screens are called out on the roof top exhaust fans but are not called out on the intakes for the roof top units.

5.6 Local Capture of Contaminants: Separate exhaust fans have been provided for all the rooms that require direct venting to the outside.

5.7 Combustion Air: Fuel-burning appliances are located in the roof top units and therefore have plenty of air for combustion as well as venting.

5.8 Particulate Matter Removal: A pleated cartridge type pre-filter of minimum MERV 8 has been provided in accordance with ASHRAE standard 52.1.

5.9 Dehumidification Systems

Relative Humidity: The climate of the area already has a low humidity so humidifiers have been added to better control the humidity of the building. Humidity set points are adjustable at the operator's interface station was well as monitoring the relative humidity.

Exfiltration: Exfiltration is easily controlled by the presence of VAV boxes in different zones to control the amount of air entering the room which can easily be adjusted to keep the building pressurized.

5.10 Drain Pans

Drain Pan Slope: Drain pans are sloped to comply with ASHRAE 62.

Drain Outlet: Threaded nipples are mounted on both sides of the drain pan.

Drain Seal: No negative static pressure is present in the roof top unit at the drain pan therefore there is no need for a drain seal.

Pan Size: The drain pan will span the whole area under the roof top unit and be a minimum of two inches deep.

5.11 Finned-Tube Coils and Heat Exchangers

Drain Pans: A stainless steel formed drain pan has been provided in accordance with ASHRAE 62.1.

Finned-Tube Coil Selection for Cleaning: Easy access to upstream and downstream of the coil has been provided as well as detailed instructions on how to clean the coils.

5.12 Humidifiers and Water-Spray Systems

Water Quality: The humidifier being used is a self-contained humidifier that will use city water which meets potable water requirements.

Obstructions: The location of the humidifier with relation to manifolds in ducts, air handling units and occupied space has been coordinated to ensure proper humidifier operation.

5.13 Access for Inspection, Cleaning, and Maintenance

Equipment Clearance: The ventilation equipment is located on the roof with adequate space between the two units therefore providing enough room for inspection and maintenance.

Ventilation Equipment Access: Access doors have been provided for inspection and maintenance of the ventilation equipment.

Air Distribution System: Access doors have been provided in the ducts at major areas such as dampers and sensors.

5.14 Building Envelope and Interior Surfaces

Building Envelope: The building will be wrapped in a vapor air barrier and all seams and joints will have flashing and be caulked to keep moisture and air out.

Condensation on Interior Surfaces: Insulation will be provided for ducts and piping where condensation could possibly be present due to the cooler nature of the pipes and ducts.

5.15 Buildings with Attached Parking Garages: The Medical Office Building does not have an attached parking garage. Therefore this section is not applicable.

5.16 Air Classification and Recirculation

Classification: Most of the air in this building is classified as class 1. The restrooms are classified as class 2 and have exhaust fans that vent directly outside.

Redesignation: Air in this building will not be cleaned or mixed.

Recirculation Limitations: Class 2 air in this building will not be recirculated. Class 2 air will be vented directly outside.

Documentation: There is no change of classification from the ASHRAE standard.

5.17 Requirements for Buildings Containing ETS Areas and ETS-Free Areas: There are no ETS areas in this building.

Summary of ASHRAE 62.1

It can be said that the Medical Office Building is in compliance with ASHRAE 62.1. The only section found that the building was not in compliance with was section 5.5-Bird Screens. Although the building is not in compliance with this section, this can easily be fixed once the building is completed.

Ventilation Rate Procedure Analysis

Ventilation rate calculations are preformed to determine the amount of outdoor air needed in a building to provide a healthy environment for people to live and work in. In the Medical Office Building, there are two roof top units and they were both analyzed because the building is not very large and has many different rooms.

Supporting Equations

Breathing Zone Outdoor Airflow (V_{bz})

$$V_{bz} = R_p \times P_z + R_a \times A_z$$

A_z = *the net occupiable floor area of the ventilation zone* (ft^2)
P_z = *the number of people in the ventilation zone during typical usage*
R_p = *outdoor airflow rate required per person (table 6.2.2.1)*
R_a = *outdoor airflow rate required per unit area (table 6.2.2.1)*

Zone Outdoor Airflow (V_{oz})

$$V_{oz} = V_{bz}/E_z$$

V_{bz} = *breathing zone outdoor airflow*
E_z = *zone air distribution effectiveness is 1.0 due to ceiling supply of cool air*

Primary Outdoor Air Fraction (Z_{pz})

$$Z_{pz} = V_{oz}/V_{pz}$$

V_{oz} = *zone outdoor airflow*
V_{pz} = *zone primary airflow*

Uncorrected Outdoor Air Intake (V_{ou})

$V_{ou} = D\sum all\ zones\ (R_p \times P_z) + \sum all\ zones\ (R_a \times A_z)$

D = occupant diversity is taken to be 1

Outdoor Air Intake (V_{ot})

$V_{ot} = V_{ou}/E_v$

V_{ou} = uncorrected outdoor air intake
E_v = system ventilation efficiency (from table 6.2.5.2)

Summary of Ventilation Rate Procedure

The medical office building is in compliance with the ventilation rate procedure. Roof top unit one is compliant by about 1,000 cfm and roof top unit 2 is compliant by about 500 cfm. An opportunity for improvement could be to split the zones that roof top unit 2 has to handle in half and use two more roof top units so there would be slightly more outdoor air cfm to work with. For roof top unit 1, the nominal outside air ($\sum V_{oz}$) was the same as the required outside air (V_{ot}). For roof top unit 2, the nominal outside air ($\sum V_{oz}$) was less than the required outside air (V_{ot}).

RTU-1			
$\sum V_{oz}$ =	3267 cfm	V_{ot} =	3267 cfm
RTU-2			
$\sum V_{oz}$ =	4272 cfm	V_{ot} =	6213 cfm

Table 1: Comparison of RTU-1 and RTU-2 nominal and required outside air

ASHRAE standard 90.1-2013

Section 5: Building Envelope

5.1 Scope: The Medical Office Building is located in North-East United States. This location has very moist climate which requires that the air be conditioned before it enters the building to improve the comfort of the occupants.

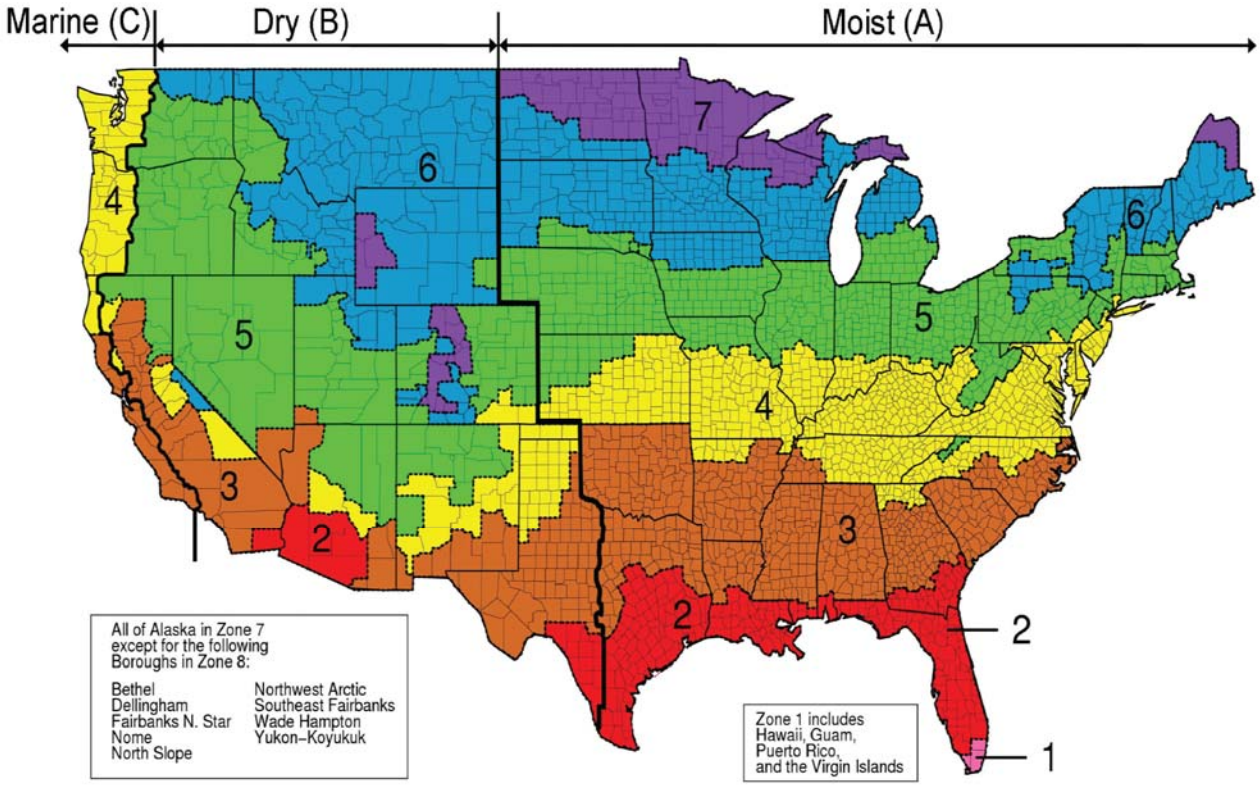

Figure 1: US Climate Zones

5.4 Mandatory Provisions: The building has design elements to reduce air leakage out of the building such as an air barrier, vestibules at the main entrances of the building, and sealants at all joints around windows and doors and any other areas that air my possibly leak in.

5.5 Prescriptive Building Envelope Option: The walls at the Medical Office Building are commonly built up in the following fashion:

- Brick veneer
- Air space
- 2" rigid insulation
- Air/vapor barrier
- 5/8" high density glass fiber reinforced sheathing
- 6" structural steel studs
- R-13 batt insulation
- 5/8" mold resistant gypsum wallboard

This wall makeup easily complies with the R-10 continuous insulation requirement and the R-13 filled cavity requirement from table 5.5-5 of ASHRAE 90.1. There is a 6" requirement for roof insulation which satisfies the R-30 continuous insulation required for the roof also from table 5.5-5 of ASHRAE 90.1.

According to section 5.5.4 of ASHRAE standard 90.1, vertical fenestration must not exceed 40% of the total vertical building surfaces and skylights may not exceed 3% of the fenestration of the roof.

Building Face	Total Wall Area (SF)	Fenestration (SF)
North	7423	2764
East	4705	710
South	7682	1971
West	5959	2346
Total	25769	7791
	% Fenestration	30.23

Table 2: Vertical Fenestration

Roof Area (SF)	Fenestration (SF)
40637	540
%Fenestration	1.33

Table 3: Roof Fenestration

Section 6: Heating, Ventilating, and Air Conditioning

6.4 Mandatory Provisions: The roof top units are equipped with an economizer cycle which will take into account when the building is occupied and when it is not to adjust the amount of conditioning needed to save energy. All the ductwork and piping will be insulated to conserve energy and reduce condensation.

6.5 Economizers: The economizers are expected to comply with all parts of section 6.5.1.1 which also have been called out in the specifications. The VAV system in this building will have static pressure sensors to monitor the air flow through the VAV box.

Section 7: Service Water Heating

The water heated in this building is not used for heating the building, it is for domestic use only. The heaters and storage tanks for domestic water heating do meet the requirements given in table 7.8 of ASHRAE.

Section 8: Power

Power to the Medical Office Building will be supplied by a 480/277 3 phase 4 wire source. There will be a 600KW emergency generator on site to provide emergency power since this is a medical building and emergency power is very important. The power in this building meets the requirements for voltage drop, energy monitoring, etc. given in the ASHRAE standard.

Section 9: Lighting

Table 9.5.1 was used to determine the lighting power density for the Medical Office Building. The building area type used was health-care clinic and the power density for this is 0.90 W/ft2. The total building area is 72,706 sf.

The building meets the ASHRAE requirements for lighting using different switches to control the lighting depending on occupancy.

Section 10: Other Equipment

All the electric motors in the building are compliant with the requirements of the Energy Independence and Security Act of 2007. The elevators also meet the requirements for lighting, ventilation and standby mode.

Summary of ASHRAE 90.1

The Medical Office Building is in compliance with ASHRAE 90.1. The building envelope meets building envelope requirements as well as requirements for heating, ventilation, and air conditioning, service water heating, power, lighting, and other equipment.

Appendix

Ventilation Rate Calculations:

- A value of 0.8 was used for E_z because there is a ceiling supply of warm air at 15˚F or more above space temperature and a ceiling return.
- Maximum Z_p value for each system is highlighted in green.

RTU-1

Space Use		Area	Occupancy	R_p	R_a	V_{bz} (cfm)	V_{oz}	V_{pz} (cfm)	Z_{pz}	E_v	$R_p * P_z$	$R_a * A_z$
Mall Corridor	Corridor	3348	0	0	0.06	200.88	251.1	1400	0.18	0.9	0	200.88
Storage	Storage	92	0	5	0.06	5.52	6.9	75	0.09	1	0	5.52
Bistro	Break Room	132	3	5	0.12	30.84	38.55	200	0.19	0.9	15	15.84
Radiology Waiting	Reception	1323	40	5	0.06	279.38	349.225	1600	0.22	0.9	200	79.38
Storage	Storage	82	0	5	0.06	4.92	6.15	75	0.08	1	0	4.92
Gift Shop	Sales	423	6	7.5	0.12	95.76	119.7	470	0.25	0.9	45	50.76
Gift Shop Corridor	Corridor	336	0	0	0.06	20.16	25.2	200	0.13	1	0	20.16
Reception/Greeter	Reception	173	5	5	0.06	35.38	44.225	200	0.22	0.9	25	10.38
Registration	Reception	828	25	5	0.06	174.68	218.35	915	0.24	0.9	125	49.68
Office	Office	132	2	5	0.06	17.92	22.4	150	0.15	1	10	7.92
Phelb Waiting	Reception	497	15	5	0.06	104.82	131.025	1000	0.13	1	75	29.82
Corridor	Corridor	182	0	0	0.06	10.92	13.65	200	0.07	1	0	10.92
Waiting Area	Reception	498	15	5	0.06	104.88	131.1	945	0.14	1	75	29.88
Corridor	Corridor	302	0	0	0.06	18.12	22.65	100	0.23	0.9	0	18.12
Reception	Reception	341	10	5	0.06	70.46	88.075	380	0.23	0.9	50	20.46
Waiting	Reception	498	15	5	0.06	104.88	131.1	1740	0.08	1	75	29.88
Corridor	Corridor	430	0	0	0.06	25.8	32.25	150	0.22	0.9	0	25.8
Office Manager	Office	135	2	5	0.06	18.1	22.625	150	0.15	1	10	8.1
Triage	Office	94	2	5	0.06	15.64	19.55	105	0.19	0.9	10	5.64
Physician	Office	141	2	5	0.06	18.46	23.075	160	0.14	1	10	8.46
Exam	Procedure Room	119	2	15	0.06	37.14	46.425	135	0.34	0.8	30	7.14
Corridor	Corridor	184	0	0	0.06	11.04	13.8	205	0.07	1	0	11.04
Exam	Office	119	2	5	0.06	17.14	21.425	135	0.16	0.9	10	7.14
Nurse Station	Reception	250	8	5	0.06	55	68.75	275	0.25	0.9	40	15
Business Office	Office	336	2	5	0.06	30.16	37.7	370	0.10	1	10	20.16
Procedure	Office	137	2	5	0.06	18.22	22.775	155	0.15	1	10	8.22

Reception	Reception	143	4	5	0.06	28.58	35.725	160	0.22	0.9	20	8.58
Physician	Office	139	2	5	0.06	18.34	22.925	155	0.15	1	10	8.34
Conference	Conference Room	202	10	5	0.06	62.12	77.65	225	0.35	0.8	50	12.12
Corridor	Corridor	263	0	0	0.06	15.78	19.725	290	0.07	1	0	15.78
Phleb Work Area	Office	276	10	5	0.06	66.56	83.2	330	0.25	0.9	50	16.56
Phleb Storage	Storage	170	0	5	0.06	10.2	12.75	100	0.13	1	0	10.2
Draw 1	Office	94	2	5	0.06	15.64	19.55	105	0.19	0.9	10	5.64
Draw 2	Office	93	2	5	0.06	15.58	19.475	105	0.19	0.9	10	5.58
Draw 3	Office	89	2	5	0.06	15.34	19.175	100	0.19	0.9	10	5.34
Draw 4	Office	126	2	5	0.06	17.56	21.95	140	0.16	0.9	10	7.56
Reception	Reception	273	3	5	0.06	31.38	39.225	310	0.13	1	15	16.38
Lead	Office	116	2	5	0.06	16.96	21.2	130	0.16	0.9	10	6.96
Private	Office	134	2	5	0.06	18.04	22.55	150	0.15	1	10	8.04
Private	Office	129	2	5	0.06	17.74	22.175	150	0.15	1	10	7.74
Workroom	Office	144	3	5	0.06	23.64	29.55	160	0.18	0.9	15	8.64
Office	Office	6283	31	5	0.06	531.98	664.975	12000	0.06	1	155	376.98
Corridor	Corridor	400	0	0	0.06	24	30	700	0.04	1	0	24
Drug Storage	Storage	57	0	5	0.06	3.42	4.275	100	0.04	1	0	3.42
Triage	Office	81	2	5	0.06	14.86	18.575	90	0.21	0.9	10	4.86
Exam	Office	115	2	5	0.06	16.9	21.125	130	0.16	0.9	10	6.9
Physician	Office	138	2	5	0.06	18.28	22.85	145	0.16	0.9	10	8.28
Exam	Office	92	2	5	0.06	15.52	19.4	105	0.18	0.9	10	5.52
Corridor	Corridor	138	0	0	0.06	8.28	10.35	155	0.07	1	0	8.28
Triage	Office	81	2	5	0.06	14.86	18.575	90	0.21	0.9	10	4.86
Exam	Office	92	2	5	0.06	15.52	19.4	105	0.18	0.9	10	5.52
Exam	Office	92	2	5	0.06	15.52	19.4	105	0.18	0.9	10	5.52
Corridor	Corridor	587	0	0	0.06	35.22	44.025	300	0.15	1	0	35.22
		SUM =	249			$\sum V_{oz}$ =	3267.55			SUM =	1280	1334.04
											V_{ou} =	2614.04
											V_{ot} =	3267.55

RTU-2

Space Use		Area	Occupancy	R_p	R_a	V_{bz} (cfm)	V_{oz}	V_{pz} (cfm)	Z_{pz}	E_v	$R_p * P_z$	$R_a * A_z$
Community Room	Conference Room	1504	75	5	0.06	465.24	581.55	3460	0.17	0.9	375	90.24
Storage	Storage	137	0	5	0.06	8.22	10.275	100	0.10	1	0	8.22
Staff Break	Break Room	508	13	5	0.12	125.96	157.45	1475	0.11	1	65	60.96
Staff Lockers	Locker Room	162	0	15	0.12	19.44	24.3	180	0.14	1	0	19.44
Corridor	Corridor	869	0	0	0.06	52.14	65.175	435	0.15	1	0	52.14
Exam	Office	106	2	5	0.06	16.36	20.45	290	0.07	1	10	6.36
Physician	Office	157	2	5	0.06	19.42	24.275	425	0.06	1	10	9.42
Triage	Office	77	2	5	0.06	14.62	18.275	85	0.22	0.9	10	4.62
Triage	Office	77	2	5	0.06	14.62	18.275	85	0.22	0.9	10	4.62
Exam	Office	99	2	5	0.06	15.94	19.925	270	0.07	1	10	5.94
Corridor	Corridor	283	0	0	0.06	16.98	21.225	315	0.07	1	0	16.98
Exam	Office	99	2	5	0.06	15.94	19.925	270	0.07	1	10	5.94
Physician	Office	161	2	5	0.06	19.66	24.575	435	0.06	1	10	9.66
Exam	Office	103	2	5	0.06	16.18	20.225	250	0.08	1	10	6.18
Triage	Office	94	2	5	0.06	15.64	19.55	230	0.09	1	10	5.64
Corridor	Corridor	353	0	0	0.06	21.18	26.475	150	0.18	0.9	0	21.18
Exam	Office	99	2	5	0.06	15.94	19.925	110	0.18	0.9	10	5.94
Exam	Office	96	2	5	0.06	15.76	19.7	110	0.18	0.9	10	5.76
Exam	Office	99	2	5	0.06	15.94	19.925	110	0.18	0.9	10	5.94
Storage	Storage	340	0	5	0.06	20.4	25.5	200	0.13	1	0	20.4
Physician	Office	154	2	5	0.06	19.24	24.05	170	0.14	1	10	9.24
Triage	Office	87	2	5	0.06	15.22	19.025	100	0.19	0.9	10	5.22
Exam	Office	119	2	5	0.06	17.14	21.425	135	0.16	0.9	10	7.14
Corridor	Corridor	238	0	0	0.06	14.28	17.85	120	0.15	1	0	14.28
Nurse Station	Reception	175	5	5	0.06	35.5	44.375	195	0.23	0.9	25	10.5
Exam	Office	114	2	5	0.06	16.84	21.05	130	0.16	0.9	10	6.84
Procedure	Procedure Room	117	2	15	0.06	37.02	46.275	130	0.36	0.7	30	7.02
Nurse Station	Reception	210	6	5	0.06	42.6	53.25	230	0.23	0.9	30	12.6

Film Files	Office	182	2	5	0.06	20.92	26.15	200	0.13	1	10	10.92
Consult	Office	122	2	5	0.06	17.32	21.65	135	0.16	0.9	10	7.32
Bone Density	Office	165	2	5	0.06	19.9	24.875	185	0.13	1	10	9.9
Gown Waiting	Reception	228	3	5	0.06	28.68	35.85	525	0.07	1	15	13.68
Mammo	Office	174	2	5	0.06	20.44	25.55	440	0.06	1	10	10.44
Nurse Navigator	Office	121	2	5	0.06	17.26	21.575	300	0.07	1	10	7.26
Future Mammo	Office	170	2	5	0.06	20.2	25.25	440	0.06	1	10	10.2
Reading 2	Office	137	2	5	0.06	18.22	22.775	155	0.15	1	10	8.22
Reading 1	Office	134	2	5	0.06	18.04	22.55	150	0.15	1	10	8.04
Supervisor Office	Office	120	2	5	0.06	17.2	21.5	135	0.16	0.9	10	7.2
Ultra Sound 1	Procedure Room	191	2	15	0.06	41.46	51.825	215	0.24	0.9	30	11.46
Ultra Sound 2	Procedure Room	191	2	15	0.06	41.46	51.825	215	0.24	0.9	30	11.46
Worktech	Office	230	2	5	0.06	23.8	29.75	255	0.12	1	10	13.8
Vestibule	Entry Lobby	81	1	5	0.06	9.86	12.325	90	0.14	1	5	4.86
Radiographic	Procedure Room	364	2	15	0.06	51.84	64.8	400	0.16	0.9	30	21.84
Gown Waiting	Corridor	55	0	0	0.06	3.3	4.125	65	0.06	1	0	3.3
Prep 1	Corridor	62	0	0	0.06	3.72	4.65	70	0.07	1	0	3.72
Nurse Station	Reception	117	3	5	0.06	22.02	27.525	200	0.14	1	15	7.02
CT Scanner	Procedure Room	512	2	15	0.06	60.72	75.9	350	0.22	0.9	30	30.72
CT Control	Office	206	4	5	0.06	32.36	40.45	250	0.16	0.9	20	12.36
MRI Control	Office	130	4	5	0.06	27.8	34.75	315	0.11	1	20	7.8
Screen Zone 2	Office	106	2	5	0.06	16.36	20.45	120	0.17	0.9	10	6.36
Zone 3	Entry Lobby	298	1	5	0.06	22.88	28.6	330	0.09	1	5	17.88
MRI Zone 4	Procedure Room	465	2	15	0.06	57.9	72.375	1100	0.07	1	30	27.9
Storage	Storage	108	0	5	0.06	6.48	8.1	100	0.08	1	0	6.48
Physical Therapy	Physical Therapy	1791	36	20	0.06	827.46	1034.325	200	5.17	0.55	720	107.46
PT Bay 2	Office	78	2	5	0.06	14.68	18.35	90	0.20	0.9	10	4.68
PT Bay 3	Office	82	2	5	0.06	14.92	18.65	95	0.20	0.9	10	4.92
PT Bay 4	Office	82	2	5	0.06	14.92	18.65	95	0.20	0.9	10	4.92
PT Bay 5	Office	82	2	5	0.06	14.92	18.65	95	0.20	0.9	10	4.92
Support Space	Office	68	0	5	0.06	4.08	5.1	75	0.07	1	0	4.08

Hand	Office	284	2	5	0.06	27.04	33.8	315	0.11	1	10	17.04
PT Bay 6	Office	99	2	5	0.06	15.94	19.925	110	0.18	0.9	10	5.94
PT Bay 7	Office	98	2	5	0.06	15.88	19.85	110	0.18	0.9	10	5.88
Clean	Storage	182	0	5	0.06	10.92	13.65	105	0.13	1	0	10.92
Office	Office	5195	26	5	0.06	441.7	552.125	9600	0.06	1	130	311.7
Corridor	Corridor	713	0	0	0.06	42.78	53.475	400	0.13	1	0	42.78
Exam	Office	99	2	5	0.06	15.94	19.925	110	0.18	0.9	10	5.94
Physician	Office	120	2	5	0.06	17.2	21.5	135	0.16	0.9	10	7.2
Corridor	Corridor	291	0	0	0.06	17.46	21.825	100	0.22	0.9	0	17.46
Corridor	Corridor	422	0	0	0.06	25.32	31.65	200	0.16	0.9	0	25.32
Clean Storage	Storage	81	0	5	0.06	4.86	6.075	90	0.07	1	0	4.86
Clean Storage	Storage	87	0	5	0.06	5.22	6.525	90	0.07	1	0	5.22
Corridor	Corridor	300	0	0	0.06	18	22.5	200	0.11	1	0	18
Clean Storage	Storage	59	0	5	0.06	3.54	4.425	50	0.09	1	0	3.54
Prep Area	Corridor	133	0	0	0.06	7.98	9.975	100	0.10	1	0	7.98
Prep 2	Corridor	61	0	0	0.06	3.66	4.575	70	0.07	1	0	3.66
Corridor	Corridor	583	0	0	0.06	34.98	43.725	200	0.22	0.9	0	34.98
Future Radiographic	Procedure Room	490	2	15	0.06	59.4	74.25	400	0.19	0.9	30	29.4
PT Bay 1	Office	82	2	5	0.06	14.92	18.65	95	0.20	0.9	10	4.92
		SUM =	265			$\sum V_{oz}$ =	4271.6			SUM =	2005	1412.28
											V_{ou} =	3417.28
											V_{ot} =	6213.236