

Technical Assignment 1

ASHRAE 62.1 & 90.1-2007 Analysis



City of Hope: Amini Medical Center
Duarte, CA

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Executive Summary

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) publish standards which serve as a basis of acceptable design for the building construction & design industry. Two standards in particular, ASHRAE 62.1-2007 and ASHRAE 90.1-2007, were used in this report to provide a basis of compliance for the City of Hope: Amini Medical Center.

The Amini Medical Center is a new building located in the county of L.A., California. This three story, 59,800 square foot, building is the newest addition to the City of Hope campus community. The Amini Center is designated as a clinical building comprised of labs, patient areas, offices, and storage areas.

For the compliance evaluation against ASHRAE 62.1-2007, Section 5: "Systems and Equipment" and Section 6: "Procedures" of the standard were assessed.

Compliance with section 5 required a systems and equipment review which identified construction measures, equipment fabrication, and materials to help prevent contaminants from entering and growing in a building. When evaluating the Amini Center for each compliance, I discovered that almost all the criteria had been met. Please see Appendix A for the breakdown this evaluation.

Compliance with section 6 dealt with performing the Ventilation Rate Procedure. As a result of this procedure, it was evident that the building air handling units (AHUs) surpassed the minimum ventilation required by Standard 62.1. The buildings fan coil units, however, were not provided with outside air, causing a compliance failure for 8 small units/rooms. Exhaust rates were also checked for compliance in rooms that that are known to produce contaminants or fumes and it was found that all applicable room were compliant with the exception of two "Break/Locker" rooms.

For the compliance evaluation against ASHRAE 90.1-2007, Sections 5 thru 9; Building Envelope, Heating, Ventilation and Air-Conditioning (HVAC), Service Heating Water, Power, and Lighting, were assessed.

The designed building envelope analysis revealed that the Amini Center fails the compliance of certain categories. These failures include lack of necessary building vestibule (or revolving doors) at the building main entrance, floor construction, and the glazing type selected. Beside these failures, all other requirements were met or were assumed to be compliant.

All mandatory provisions of the HVAC evaluation complied with standard 90.1. Due to a lack of the campus central cooling and heating plant information, minimum efficiency comparisons could not be performed.

Service water heating for the Medical Center is provided by a steam water heater. This type of equipment does not appear in the evaluation Table in section 7 and therefore does not have a minimum efficiency requirement. All other provision of the section were met which shows entire compliance for this section.

Section 8: "Power" requires wire sized at a maximum of 2% and 3% voltage drop for feeders and branch circuits respectively. It shall be assumed for this report that the design engineer took this into account when designing the system.

Lighting compliance was evaluated using the Building Area Method. This method provides a maximum lighting power density (LPD) in Watts/ft² that the designed lighting must not exceed. For the design of the Amini Center, the LPD was calculated at 0.85 W/ft²; which was less then the ASHRAE requirement of 1.0 W/ft² for a Health-care clinic.

Overall, the Amini Medical Center meets the majority of requirements set for by ASHRAE 62.1 & 90.1-2007. For the requirements that were not met, simple modifications could have been implemented at the design stage to meet ASHRAE, but, since ASHRAE was not the governing body for compliance when this building was designed, these issues did not come to fruition.

System Description

Custom Central Air-Handlers

Five(5) Custom air handlers located on the roof serve the entire building. Air handlers consist of a supply fan, chilled water coil, pre-heat coil (AHU-2 only), pre-filter, final filter, and return fans.

AHU-1: Constant volume unit serving the first floor Stem Cell Lab. Air is supplied to the space through ceiling mounted HEPA filters.

AHU-2: Primarily a constant volume system serving blood processing lab and Cryo Freezer on first floor.

AHU-3: VAV system serving administrative offices and support spaces on the first and second floor.

AHU-4&5: Future AHUs serving separate wings of the 3rd floor.

Exhaust Systems

All exhaust fans are located on the roof of the clinic.

EF-1: General toilet and building exhaust.

EF-2A & 2B: Lab exhaust fans for the Cryo Freezer

EF-3: Exhaust for bio-safety cabinets

Chilled water system

Central plant chilled water distribution enters the building in the mechanical equipment room on the 1st floor. Two chilled water pumps distribute the water to the building AHUs and scattered FCUs serving equipment rooms.

Steam and Steam Condensate Return System

Central plant steam and condensate return piping enters the building in the first floor mechanical room. Pressure reducing station located in Mech. Room reduces the steam from high to low pressure which is distributed through the building. Low pressure steam is then distributed to a heat transfer package on the roof.

Hot Water System

Hot water is generated by a heat transfer package located on the roof. Hot water is then distributed through out the building to reheat coils and terminals in the air distribution system. Domestic hot water is supplied by incoming steam converted to 140 degree hot water in the main mechanical room and pumped through out the building.

ASHRAE 62.1-2007 Compliance

ASHRAE Standard 62.1-2007 is the latest volume which provides guidelines for ventilation system design. The standard sets forth minimum requirements to provide acceptable indoor air quality for building occupants. The purpose of this section is to discuss the Amini Medical Center design and determine if the current systems meet the 62.1-2007 requirements. This report will focus specifically on Section 5, "Systems and Equipment" along with the ventilation rate procedure described in Section 6 of the standard.

Section 5 - Systems and Equipment:

See Appendix A for breakdown of section compliance.

Section 6 – Procedures:

The Ventilation Rate Procedure was used to check the Amini Medical Center's compliance with this section of the standard. AHUs 1 thru 3 were analyzed, along with the only fan coil unit (FCU-1-5) to receive outside air.

Assumptions Made:

- Occupancy for each room was dictated by the default occupancy provided in Table 6-1, not by the architect's furniture layout.
- No occupant diversity was taken into account.
- Science Labs from Table 6-1 was used to generate ventilation rates for lab spaces.
- Choosing a select number of rooms served by AHU-3 instead of analyzing every zone will produce adequate information on whether the system is compliant.

Procedure:

Breathing Zone Outdoor Airflow (V_{bz}):

$$V_{bz} = (R_p * P_z) + (R_a * A_z) \text{ (Eq. 6-1)}$$

where

A_z = zone floor area (ft²)

P_z = zone population (Table 6-1)

R_p = outdoor airflow rate per person (cfm/person) (Table 6-1)

R_a = outdoor airflow rate per unit area (cfm/ft²) (Table 6-1)

Zone Air Distribution Effectiveness (E_z):

$$E_z = 1.0 \text{ (Table 6-2; Ceiling Supply of cool air)}$$

Zone Outdoor Airflow (V_{oz}):

$$V_{oz} = V_{bz} / E_z \text{ (Eq. 6-2)}$$

Zone Primary Outdoor Air Fraction (Z_p):

$$Z_p = V_{oz} / V_{pz} \text{ (Eq. 6-5)}$$

System Ventilation Efficiency (E_v):

$$E_v \text{ (Table 6-3; Using Max } Z_p)$$

Uncorrected Outdoor Air Intake (V_{ou})

$$V_{ou} = \sum_{\text{all zones}} (R_p * P_z) + \sum_{\text{all zones}} (R_a * A_z) \text{ (Eq. 6-6)}$$

Outdoor Air Intake

$$V_{ot} = V_{ou} / E_v \text{ (Eq. 6-8)}$$

Results:

The calculations for the above procedure can be found in Appendix B.

Discussion:

AHU-1 & AHU-2:

AHU-1&2 surpass the minimum outdoor air requirements by 375% and 205% respectively. This increased ventilation quantity is most likely due to special requirements needing to be maintained in the lab spaces these units serve. The Cryo Freezer, in this case, is supplied air through ceiling diffusers with HEPA filters. This design aspect, along with the increased ventilation, shows that the Cryo lab has certain clean air requirements. As long as the outside air is clean, increasing the ventilation will help to dilute airflow contaminants and meet the required design concentration levels.

AHU-3:

The system as a whole appears to have enough outside air based on the selected control group. This air handler, however, has a few zones that lack the required ventilation rate. Considering the deficiency is maxed at 25 cfm OA, I don't view this as a compliance issue. One reason for this shortage could be the occupant discrepancy from the default value in Table 6-1 and the actual number of occupants. Other reasons could be accounting for transfer air, dividing open areas differently (sq. ft. or occupancy type), etc. No matter the reason, this problem could be fixed by rebalancing the VAV system slightly.

One issue that does pose a problem for this unit is the design documents showing the VAV boxes set for 30% minimum flow. If the VAV terminals back down to their minimum settings, many zones will be lacking the required ventilation. Unless the outside air is increased, or the minimum settings raised, the compliance at part load conditions will be an issue.

FCUs:

FCU-1-5, as indicated in the calculations, exceeds the ventilation requirements. As to why the quantity of OA is 8500% the minimum required, I do not know. Serving mechanical, electrical, and a UPS room, the quantity of OA seems excessive. Reducing the quantity of OA for this unit would help reduce the load on the FCU, reduce energy costs, and still meet Standard 62.1-2007.

The Amini Medical Center is designed with eight other FCUs serving mechanical rooms, elevator machine rooms, storage rooms, etc. in which no OA is being provided. These rooms do not meet the 62.1-2007 ventilation code. Bearing in mind that these rooms do not contain occupants, and the OA required is a small quantity, I do not think this is a major issue.

Exhaust:

Exhaust rates for the Amini clinic can be viewed in Appendix A. The compliance is seen in all zones with the exception of Break/Locker rooms. The design at the medical center has the locker/break rooms in positive pressure, instead of having them exhausted. I do think this could be a potential problem for the transfer of odors. These rooms do not comply with the 62.1 standard. This design difference is most likely due to the code used in design or might be a requirement of the clinic.

ASHRAE 90.1-2007 Compliance

ASHRAE Standard 90.1-2007 is the latest volume which provides guidelines for energy efficient design of buildings. The standard sets forth minimum energy efficient requirements for building and system requirements. The purpose of this section is to discuss the Amini Medical Center design and determine if the designed building and systems meet the 90.1-2007 requirements. This report will focus on sections 5 thru 10; sections dealing with compliance for building envelope, HVAC, service water heating, power, and lighting.

Section 5 – Building Envelope:

5.1 General:

Durante, California is considered to be in ASHRAE Climate Zone 3B.

5.2 Compliance Paths:

For this report, the Amini Medical Center shall be compared using the Prescriptive Building Envelope Option of section 5.5. Later reports might use the Energy Cost Budget Method of Section 11.

5.4 Mandatory Provisions:

5.4.3 Amini clinic provides necessary seals, barriers, caulking, etc. to minimize air leakage

5.4.3.4 The main entrance does not contain a vestibule separating the conditioned space from the exterior. This building does not comply with this section.

5.5 Prescriptive Building Envelope Option

5.5.3 Opaque Areas

Opaque Area	Type	ASHRAE Assembly Max	ASHRAE Min. R-value	ASHRAE SHGC	Designed U or F Values	Designed R-value	Design SHGC	Compliance
Roof	Insulation entirely above deck	U-0.048	R-20.0c.i.	-	-	27	-	Y
Walls, AG	Metal building	U-0.113	R-13.0+R3.8c.i.	-	-	17	-	Y
Floors	Mass	U-0.107	R-6.3c.i.	-	U-0.153	-	-	N
Slab on Grade	Unheated	F-0.730	NR	-	F-0.213	-	-	Y
Glazing	Metal Framing	U-0.60	-	0.25	U-0.28	-	0.37	N

5.6 Building Envelope Trade-Off Option

Option for compliance that requires a baseline model comparison. Not used for this report, but would be a viable method that could result in envelope compliance.

5.7 & 5.8 Submittals & Product Information and Installation Requirements

Two sections that require documentation and installation requirements. I assumed that all these requirements were met for this building.

Section 6 – Heating, Ventilation, and Air-Conditioning:

6.1 General:

The Amini clinic is considered new construction.

6.2 Compliance Paths:

For this section of the report, the Amini clinic was evaluated for compliance using the Prescriptive Path of section 6.5.

6.4 Mandatory Provisions:

6.4.1 Minimum efficiencies could not be compared to the min. levels of this standard because all the units are served by chilled water from a central chiller plant. I do not have the central chiller plant information and therefore could not check compliance against this section.

6.4.4 Insulation is provided for all ductwork as specified in the Spec Section 230700 for the Medical center. I do not have the actual insulation submittals and cannot confirm if the insulation meets the required R-values of Tables 6.8.2A & 6.8.2B.

6.4.4.2.1 According to the Amini Medical center specs, all ductwork is to be sealed to achieve a seal class A, the best seal rating according to Table 6.4.4.2B. The building complies with this section of code.

6.5 Prescriptive Path

6.5.1 AHU-2 & 3 of the medical center are provided with economizers in accordance to section 6.5.1. AHU-1 does not have a economizer, however, it is exempt from this compliance due to exemption for nonparticulate air treatment. I am assuming for this report that all Amini clinic system economizer control, access, and installation meet the standard requirements.

6.5.3.1 Fan system Power limitation (Option 1) and 6.5.3.1.2 Nameplate HP

Unit	Supply Fan BHP @ design	Supply Fan MHP	Return Fan BHP @ design	Return Fan MHP	Compliance
AHU-1	12.37	15	-	-	Y
AHU-2	8.9	15	2.1	3	Y
AHU-3	31.9	40	10.9	15	Y

All of the fans comply with this section because the bhp at design does not exceed the nameplate hp. It also complies with the Nameplate hp section because each fan is within the 30% exception if the MHP was not the next motor size up from the bhp.

6.8 Minimum Equipment Efficiency Tables

Please refer to response for 6.4.1 above.

Section 7 – Service Water Heating

The Amini Medical center complies with all insulation, controls, and installation requirements of this section. The Domestic Water Heater for this project (DWH-1) is a Steam semi-instantaneous water heater. The steam service is supplied from a central plant which I do not have the information for. This type of domestic water heater is not on the listed in Table 7.8 and according to section 7.4.2, "Equipment not listed in Table 7.8 has no minimum performance requirements." Therefore, the Amini Medical Center complies with section 7 of ASHRAE 90.1-2007.

Section 8 – Power:

This section requires Feeders to be sized for a maximum voltage drop of 2% at design conditions, and branch circuits sized for a maximum voltage drop of 3% at design conditions. It will be assumed that the design engineer met these requirements when the building was designed.

Section 9 – Lighting:**9.2 Compliance Paths**

The lighting compliance evaluation for the Amini Medical center was compared using the Building area method of section 9.5.

9.4 Mandatory Provisions

Automatic lighting shut-off controls were designed for spaces of the clinic that did not involve 24/7 operation or patient care.

9.5 Building Area Method Compliance Path

For this compliance method, a lighting power density (LPD; watts per unit area) is given in Table 9.5.1 for the occupancy type. In this case, the Amini Medical Center needs to meet a LPD of 1.0 W/ft²; which is the LPD for a “Health-care clinic” from Table 9.5.1. Please refer to the chart below for the compliance results.

ASHRAE 90.1-07 Section 9.5 - Building Area Method Compliance				
Building lighted floor area (ft ²)*	Designed lighting power* (Watts)	AMC LPD (W/ft ²)	Max. LPD (1.0 W/ft ²)	Compliance
56,364	47,909	0.85	1.0	Y

*Area and lighting power density taken from Title 24 Report

Results:

Using the prescriptive methods of sections 5 thru 9 led to compliance in many areas for the Amini Medical Center. These methods also revealed some issues of non-compliance with regards to ASHRAE 90.1-2007. The areas of non-compliance are summarized below:

- Vestibule requirement on main entries
- Floor construction type
- Glazing selected

Discussion:

Section 5 – Building Envelope:

The building envelope for this climate zone is deficient compared to standard 90.1-2007 in two areas, the floor construction and the glazing. If the building trade-off option were pursued, it is possible that the entire envelope would pass compliance. The floors wouldn't make much of a difference to the loads and energy because the level above or below is kept at the same, or nearly the same, temperature. The glazing difference, however, can have a significant impact on the building energy. Reducing the SHGC would decrease the solar impact on the space, thus decreasing the amount of energy needed to cool the space. Considering this building is part of a campus community, it is probably reasonable to assume that the characteristics, specifically the glass and building colors, would be relatively similar for all surrounding buildings. This might have been the reason for the selection of glass that doesn't fall under the maximum SHGC value.

Section 6 – Heating, Ventilation, and Air-Conditioning:

Due to a lack of information in regards to the campus' central heating and cooling plants, the efficiencies could not be evaluated for compliance. Considering it is central plant systems for a group of buildings, I would assume the efficiencies would be pretty high due to the equipment running at part load or some equipment not running at all. All other aspects of this section meet compliance, and I feel that the central plants follow suit.

Section 9 – Lighting:

The Amini Medical Center lighting power complies with ASHRAE 90.1-2007 using the Building Area Method. I believe the California code is a bit stricter in lighting power allowance than

ASHRAE 90.1. The lighting power density designed is 0.85 W/ft², which is 15% below 90.1-2007. If the space-by-space method were used, this difference could be much greater, however, the designed power density, includes the 3rd floor shell space. When the floor is actually fit out, the power density has the possibility of exceeding the ASHRAE LPD, unless the building is regulated by the 0.85 W/ft².

References

ASHRAE. 2007, ANSI/ASHRAE, Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., Atlanta, GA.

ASHRAE. 2007, ANSI/ASHRAE, Standard 90.1-2007, Energy Standard for Building Except Low-Rise Residential Buildings. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., Atlanta, GA.

EwingCole. 2007. City of Hope: Amini Medical Center Construction Documents and Specifications. EwingCole, Irvine, CA

City of Hope: Amini Medical Center			ASHRAE 62.1-2007 Section 5 - Compliance	
Subsection	Subsection	Issue	City of Hope Compliance	Explanation
5.1	5.1.1 & 5.1.2	Natural Ventilation	Y	The only natural ventilation to account for on this project are doors to the outside. Access and location of the doors are acceptable for the areas they serve.
5.2		Ventilation Air Distribution		
	5.2.1	Designing for Air Balancing	Y	Volume Dampers, VAV boxes, VFDs, etc. provided in the design.
	5.2.2	Plenum Systems	Y	Direct connection of ventilation air ducts to ventilation units.
	5.2.3	Documentation	Y	Documentation provided in specs and construction documents.
5.3		Exhaust Duct Location	Y	All exhaust ducts are negatively pressured or sealed according to applicable codes.
5.4		Ventilation System Controls	N	Controls provided in the design. Spec Section 250900. The system, however, should be rebalanced in order to comply with the requirements of section 6.
5.5		Airstream Surfaces		
	5.5.1 & 5.5.2	Resistance to Mold growth	NA	Sheet metal surfaces are exempt from these sections
5.6		Outdoor Air Intakes		
	5.6.1	Location	Y	Minimum Distances are met according to Table 5-1
	5.6.2	Rain Entrainment	Y	Covered in Spec Section 089000 "Louvers and Vents"
	5.6.3	Rain Intrusion	Y	Covered in Spec Section 089000 "Louvers and Vents"
	5.6.4	Snow Entrainment	NA	Climate Conditions don't allow much snow, if any.
	5.6.5	Bird Screens	Y	Covered in Spec Section 089000 "Louvers and Vents"
5.7		Local Capture of Contaminants	?	Don't fully understand this section
5.8		Combustion Air	NA	No Combustion Appliances are part of this project.
5.9		Particulate Matter Removal	Y	Filters provided were needed. Spec Section Z34100 "Air Filtration".
5.10		Dehumidification Systems		
	5.10.1	Relative Humidity	Y	I assume the design engineer took this into account.
	5.10.0	Exfiltration	Y	I assume this is in the control scheme.
5.11		Drain Pans		
	5.11.1	Drain Pan Slope	Y	Equipment manufacturer compliance
	5.11.2	Drain Outlet	Y	Equipment manufacturer compliance
	5.11.3	Drain Seal	Y	Equipment manufacturer compliance
	5.11.4	Pan Size	Y	Equipment manufacturer compliance
5.12		Finned-Tube Coils and Heat		
	5.12.1	Drain Pans	Y	Equipment manufacturer compliance
	5.12.2	Finned-Tube Coil selection for	Y	Equipment manufacturer compliance
5.13		Humidifiers and Water Spray Systems	NA	Not used on this project.
5.14		Access for Inspection, Cleaning and Maintenance		
	5.14.1	Equipment Access	Y	Manufacturer recommended access indicated on the drawings, sufficient clearance provided.
	5.14.2	Ventilation Equipment Access	Y	Manufacturer recommended access indicated on the drawings, sufficient clearance provided. Drawing notes and specs also mention providing clearance.
	5.14.3	Air Distribution System	Y	Access doors indicated on drawings. Drawing and spec notes also mention necessary access points.
5.15		Building Envelope and Interior		
	5.15.1	Building Envelope	Y	Appropriate barriers indicated on Architectural wall sections.
	5.15.2	Condensation on Interior Surfaces	Y	Insulation on appropriate surfaces is specified.
5.16		Building with Attached Parking	NA	No attached Parking Garage
5.17		Air Classification and Recirculation		
	5.17.1	Classification	Y	
	5.17.2	Re-designation	Y	
	5.17.3	Recirculation Limitations	Y	This project abides to the recirculation of air according to the the air classification mentioned in 5.17.1 and 5.17.2
	5.17.4	Documentation	Y	Documentation provided in specs and construction documents.
5.18		Requirements for ETS & ETS-free Areas	NA	This building contains no ETS Areas.

City of Hope: Amini Medical Center														ASHRAE 62.1-2007 Ventilation Compliance			
	Room Number	Room Name	ASHRAE Room Type	Area (sf) [Az]	Occupant Density (#/1000sf)	Occupancy [Pz]	(cfm/person) [Rp]	(cfm/sf) [Ra]	Req. OA (cfm) (Pz*Rp)+(Az*Ra)= [Vbz]	Table 6-2 [Ez]	Vbz / Ez [Voz]	SA for room [Vpz]	Zp for Tbl. 6-3 Voz/Vpz [Zp]	Table 6-3 or Appendix A [Ev]	Required Room OA (Voz/Ev)	Designed Room OA	Compliance
AHU-1 (54.4% OA)	151	Stem Cell Processing Lab	Science Lab	2148	25	54	10	0.18	924	1.0	924	5320	0.17	0.9	1026	2894	Y
	154	Gown In	Corridor	148	0	0	0	0.06	9	1.0	9	440	0.02		10	239	Y
	155	Vestibule	Corridor	44	0	0	0	0.06	3	1.0	3	160	0.02		3	87	Y
	158	Vestibule	Corridor	40	0	0	0	0.06	2	1.0	2	120	0.02		3	65	Y
	161	Gown Out	Corridor	102	0	0	0	0.06	6	1.0	6	310	0.02		7	169	Y
	162	Packing Room	Storage Room	140	0	0	0	0.12	17	1.0	17	420	0.04		19	228	Y
	164	Storage	Storage Room	125	0	0	0	0.12	15	1.0	15	380	0.04		17	207	Y
	165	Clean Storage	Storage Room	125	0	0	0	0.12	15	1.0	15	380	0.04		17	207	Y
Totals:															1101	4096	Y
AHU-2 (42.1% OA)	160	Cyro Freezer	Science Lab	1679	25	42	10	0.18	722	1.0	722	5580	0.13	0.8	902	2349	Y
	120, 121, 123, 124, 125, 127, 128, 140, 141, 142, 145, 146	Open Area Lab	Science Lab	3789	25	95	10	0.18	1629	1.0	1629	8460	0.19		2037	3562	Y
	122	Control Room	Corridor	59	0	0	0	0.06	4	1.0	4	60	0.06		4	25	Y
	126	Irradiator Room	Office	108	5	1	5	0.06	9	1.0	9	110	0.08		11	46	Y
	134	Labeling	Office	255	5	1	5	0.06	22	1.0	22	260	0.08		27	109	Y
	137	Biowaste Holding	Storage	86	0	0	0	0.12	10	1.0	10	120	0.09		13	51	Y
	143	CPMG Storage	Storage	137	0	0	0	0.12	16	1.0	16	60	0.27		21	25	Y
	144	Control Room	Corridor	127	0	0	0	0.06	8	1.0	8	60	0.13		10	25	Y
Totals:															3025	6193	Y

City of Hope: Amini Medical Center														ASHRAE 62.1-2007 Ventilation Compliance			
	Room Number	Room Name	ASHRAE 62.1-07 Room Type	Area (sf) [Az]	Default Occupant Density (#/1000sf)	Occupancy [Pz]	(cfm/person) [Rp]	(cfm/sf) [Ra]	Req. OA (cfm) (Pz*Rp)+(Az*Ra)= [Vbz]	Table 6-2 [Ez]	Vbz / Ez [Voz]	Max. SA for room [Vpz]	Zp for Tbl. 6-3 Voz/Vpz [Zp]	Table 6-3 [Ev]	Total Room OA Required (Voz/Ev)	Designed Room OA [Max Flow]	Compliance
AHU-3	100	Lobby	Main Entry Lobby	971	10	10	5	0.06	107	1.0	107	840	0.13	0.8	134	213	Y
	101	Hallway	Corridor	1322	0	0	0	0.06	79	1.0	79	300	0.26		99	76	N
	116	Office	Office	139	5	1	5	0.06	12	1.0	12	130	0.09		15	33	Y
	117	Office	Office	147	5	1	5	0.06	12	1.0	12	210	0.06		16	53	Y
	170	Break Rm/Lockers	Break Room	314	25	8	5	0.06	58	1.0	58	720	0.08		73	182	Y
	171	Record Storage	Storage	212	0	0	0	0.12	25	1.0	25	240	0.11		32	61	Y
	173	Office	Office	116	5	1	5	0.06	10	1.0	10	180	0.05		12	46	Y
	178	Hallway	Corridor	228	0	0	0	0.06	14	1.0	14	70	0.20		17	18	Y
	001-015	Bed	Medical Procedure	2275	20	46	15	0	683	1.0	683	3285	0.21		853	831	N
	221-222	Nurse Station	Office	935	5	5	5	0.06	79	1.0	79	990	0.08		99	250	Y
	235	MD1	Office	136	5	1	5	0.06	12	1.0	12	280	0.04		14	71	Y
	256	Recovery	Recovery & ICU	76	20	2	15	0	23	1.0	23	330	0.07		29	83	Y
	260	Work Area	Office	1026	5	5	5	0.06	87	1.0	87	1300	0.07		109	329	Y
	282	Training Room	Conf./Meeting	326	50	16	5	0.06	101	1.0	101	440	0.23		126	111	N
	283	Conference Room	Conf./Meeting	288	50	14	5	0.06	89	1.0	89	460	0.19		112	116	Y
	290	Telerecruiter Room	Telephone/data Entry	372	60	22	5	0.06	134	1.0	134	840	0.16		167	213	Y
	Totals:															1907	2686
FCU-1-E	177	Elec Rm	Electrical Equip. Rm	146	0	0	0	0.06	9	1.0	9	925	0.01	1.0	9	465	Y
	188	Mech Pump	-	392	0	0	0	0	0	1.0	0	1200	0.00		0	604	Y
	190	UPS Room	Electrical Equip. Rm	88	0	0	0	0.06	5	1.0	5	260	0.02		5	131	Y
Totals:															14	1200	Y

* All other FCUs are not provided with OA. These FCUs serve storage rooms, elec. rooms, elev. machine room, etc.

City of Hope: Amini Medical Center			ASHRAE 62.1-2007 Exhaust Compliance					
Room Number	Room Name	ASHRAE 62.1-07 Room Type	Area (sf)	Required Exhaust Rate (cfm/sf)	Required Exhaust Rate (cfm/unit)	Exhaust Required (cfm)	Designed Exhaust Rate (cfm)	Compliance
137	Biowaste Holding	Soiled Laundry Storage Rooms	86	1.00	-	86	160	Y
148, 268	Toilet	Toilet-Public (Cont.)	204	-	50	200	380	Y
149, 269	Toilet	Toilet-Public (Cont.)	206	-	50	200	380	Y
151	Stem Cell Lab	Science Lab	1943	1.00	-	1943	2200	Y
157	Tit	Toilet-Private (Cont.)	65	-	25	25	100	Y
170	Break Rm/Lockers	Kitchenette	314	0.30	-	94	0	N
184	Biowaste	Soiled Laundry Storage Rooms	53	1.00	-	53	220	Y
189, 274	Jan	Janitor Closet	37	1.00	-	37	60	Y
214B	Copy	Copy/Printing Rooms	43	0.50	-	22	80	Y
211	Tit	Toilet-Private (Cont.)	67	-	25	25	140	Y
212	Tit	Toilet-Private (Cont.)	67	-	25	25	140	Y
230	Tit	Toilet-Private (Cont.)	57	-	25	25	120	Y
231	Soiled Utility	Soiled Laundry Storage Rooms	53	1.00	-	53	130	Y
280	Break Rm/Lockers	Kitchenette	518	0.30	-	155	0	N