Technical Report 1

ASHRAE Standard 62.1 & Standard 90.1 Evaluation



The Salvation Army Ray & Joan Kroc Corps Community Center of Salem Oregon

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Executive Summary

In the following report, a detailed analysis will be performed on the Ray & Joan Kroc Corps Community Center of Salem Oregon to determine whether or not the building complies with ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) Standard 62.1 and Standard 90.1. Standard 62.1 analyzes the ventilation equipment and addresses ventilation requirements for each room based on occupancy and square footage. Standard 90.1 evaluates the energy usage of buildings. This standard addresses the tightness of the building envelope, the intelligence of the HVAC control system, the efficiency of the water heaters, the distribution of power, and the density of lighting. This report will break down each part of these standards to reveal how closely the Kroc Center adheres to ASHRAE's standards.

The Kroc Center followed ASHRAE's requirements remarkably well in section five of Standard 62.1. The building met or exceeded the requirements in all but one category. The area where the building failed to comply dealt with air filters in the air handling units; about half of the air handlers did not specify filters with high enough quality. The design team probably consulted ASHRAE Standard 62.1 when designing the building for it to perform this well.

The building met minimum design standards addressed in section six of Standard 62.1 for all but one of the air handlers. As addressed later in the report, the compliance failure was most likely a result of different assumptions which caused a few of the spaces to be grossly over ventilated. The two pools had very high ventilation rates, but that may have been an air quality issue that caused such high rates. The design team must have been much more conservative when laying out the ventilation system which would explain the high outdoor air rates. Whether the high ventilation rates are justifiable or not, they do present an area of potential energy savings.

The Kroc Center performed well in Standard 90.1, and it should have since the building was designed to achieve LEED Gold. The building envelope failed to meet the requirements for floor, roof, and window insulation values. These systems were close to passing but came up a little short. The building has a very advanced control system which allowed it meet the requirements for HVAC control and water heating. Also, a well thought out lighting and electrical scheme helped earn more energy savings. The Kroc Center performed very well with Standard 90.1, complying in nearly every section.

Building Summary

The Salvation Army Ray & Joan Kroc Corps Community Center of Salem Oregon was a new construction project located in Salem, Oregon. The Kroc Center is a one story, ninety-two thousand square foot facility located on a ten and a half acre campus. The building has a number of large, energy-intensive spaces including a full-size gymnasium, a competition pool, a leisure pool, a large chapel, a commercial size kitchen, and rooms to host community events. The Kroc Center also contains several offices, classrooms, small recreation rooms, and support spaces for the larger areas. The Kroc Center is surrounded by large athletic fields which are owned by the Salvation Army. The different building features enable the Kroc Center to be used by children, teens, families and adults from the community.

The Kroc Center was funded entirely by the Salvation Army. The Salvation Army allotted \$35.5 million to build the Kroc Center, but the total cost of construction was slightly less then that at approximately \$33.3 million. The Salvation Army also donated a matching \$35.5 million endowment to operate the building.

Mechanical System Summary

The Kroc Center uses a variety of mechanical equipment to condition its many different spaces. All of the heating, cooling and ventilation loads are supplied by air handlers scattered across the roof of the building. The two pools are conditioned by very large, individual air handling units. The kitchen, community spaces, and most of the classrooms are conditioned by an individual packaged rooftop unit. Two rooftop units are used to condition the gymnasium space. Other packaged rooftop units are spread out across the roof and service smaller spaces around community center. Two fan coil units are used to condition the platform of the chapel and the backstage spaces. Also the Kroc Center has two make-up air units; one above the kitchen, and one above the restrooms and storage areas on the south side of the competition pool. All of the ventilation for the entire building is supplied through the above equipment. Also, there is a mechanical room by the leisure pool that supplies domestic hot water for the entire building and hot water for the two pools.

ASHRAE 62.1 Analysis

Section 5 - Systems and Equipment

Section 5.1 - Natural Ventilation

Natural Ventilation is not a viable option given the colder, northern climate of Oregon. As a result, the windows in the Kroc Center are not operable.

Section 5.2 – Ventilation Air Distribution

The individual air handlers were able to meet the ventilation requirements stated in section 6 of ASHRAE Standard 62.1 except one. Rooftop Unit 7 is about 200 CFM below the required level. The results will be discussed in more detail later in the report.

Section 5.3 – Exhaust Duct Location

The Kroc Center is a one-story building. All of the exhaust ductwork is exhausted directly through the roof or exterior walls; there is no potential for leakage between spaces. Also, the exhaust fans are located away from outdoor air inlets on the rooftop mechanical equipment, so there is no possibility of cross contamination there. The areas of most concern are the pool areas, but the air is returned to the air handling unit and exhausted away from the outdoor air inlet.

Section 5.4 – Ventilation System Controls

The Kroc Center uses a VAV system to distribute the conditioned air. Each VAV box has a minimum setting that meets the minimum outdoor airflow requirements as require by section 6 of ASHRAE Standard 62.1. Actuators are located on dampers upstream of the diffuser. The actuators are thermostatically reset to maintain airflows within ten percent of required load even at part load.

Section 5.5 – Airstream Surfaces

The Kroc Center uses both sheet metal and fabric ducts. Section 15880 of the project specifications states that all ductwork must conform to the requirements of UL181. The Kroc Center complies with ASHRAE's standards on this subject.

Section 5.6 – Outdoor Air Intakes

The outdoor air intakes on the rooftop units and air handling units exceed the minimum distance from exhaust vents as described in table 5-1 of Standard 62.1. Also, all exterior ductwork is designed to prevent the intrusion of moisture into the airflow, see Note 8/M702.

Section 5.7 – Local Capture of Contaminants

The major area for contamination is the two pool areas. A quick check with a ductulator reveals that the exhaust ductwork is large enough to handle airflows much higher than the supply air. By exhausting more air than is being supplied, the pools are negatively pressurized which will keep the chlorine and other chemicals from spreading into the building. The building complies with this section.

Section 5.8 – Combustion Air

There are five natural gas boilers housed in the mechanical room on the south side of the leisure pool. A large relief vent is located above the mechanical room to provide an adequate amount of combustion air to the space.

Section 5.9 – Particulate Matter Removal

Filters are specified to have a rating of MERV 6 for rooftop units from 20 to 75 tons. For the smaller units, filters are called for but are not specified strictly enough to meet the requirements of the ASHRAE standard. These filters are inadequate to fulfill the requirements, so the Kroc Center does not comply with this section.

Section 5.10 – Dehumidification Systems

The maximum humidity specified for the Kroc Center is 60% and occurs in summer mode; this is less than the 65% required by ASHRAE. The entire building has a net positive pressure which will help limit infiltration. The building complies with this section.

Section 5.11 – Drain Pans

Air Handling Units are to have stainless steel, insulated drain pans with two connections, one to each side of the unit. The packaged rooftop units are also specified to have drain pans under the entire unit. The Kroc Center complies with this section.

Section 5.12 – Finned-Tube Coils and Heat Exchangers

The air handling units are specified to have drain pans under the heat exchangers in the unit. The drain pans meet the requirements of Section 5.11, and comply with this section.

Section 5.13 – Humidifiers and Water-Spray Systems

The Kroc Center does not employ humidifiers or water-spray systems.

Section 5.14 – Access for Inspection, Cleaning, and Maintenance

An access panels to above the ceiling is provided for the series fan powered boxes inside the building. The remainder of the air handling equipment is located on the roof, so the maintenance staff has easy access to them.

Section 5.15 – Building Envelope and Interior Surfaces

Vapor barriers are provided throughout the entire building envelope to prevent liquid penetration through the walls and roof. All HVAC ductwork, condensate piping, cold water piping, and refrigerant piping is specified to have insulation to prevent condensation. The Kroc Center complies with this section.

Section 5.16 – Buildings with Attached Parking Garages

The Kroc Center does not have an attached parking garage.

Section 5.17 – Air Classification and Recirculation

Most of the building contains Class 1 air that can be recirculated throughout the building. The restrooms and locker rooms are considered Class 2 air and are exhausted through the roof. The gymnasium is also Class 2 air but some of the air is recirculated back into the gym only. The two pools have Class 3 air and recirculate a portion of the air but only in their respective spaces. The kitchen has Class 4 air, but that air is exhausted outdoors and not recirculated to other parts of the building.

Section 5.18 – Requirements for Buildings Containing ETS Areas and ETS-Free Areas The Kroc Center is a community center trying to reach LEED status, so the entire building is ETS-free. This section does not apply to this building.

Section 6 – Procedures

The Kroc Center was tested against ASHAE Standard 62.1-2007 to discover whether or not it complies with ASHRAE's minimum ventilation design requirements. With such a large variation of spaces within the Kroc Center, it was determined that all of the mechanical units that supply outside air should be checked for compliance. A spreadsheet was provided to run the tests, and the spreadsheet results for each of the units are listed in Appendix A. The following equations were used to determine compliance.

Breathing Zone Outdoor Airflow

$$V_{bz} = (R_{p} * P_{z}) + (R_{a} * A_{z})$$

Where:
$$V_{bz}$$
 = breathing zone outdoor airflow (cfm)
 R_p = required airflow rate per person (cfm/person)
 P_z = zone population (people)
 R_a = require airflow rate per unit area (cfm/sq.ft.)
 A_z = zone floor area (sq. ft.)

Zone Outdoor Airflow

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

Where: V_{oz} = Zone Outdoor Flow E_z = Zone Air Distribution Effectiveness = 1.0

Outdoor Air Intake Flow

$$V_{ot} = V_{oz}$$

Primary Outdoor Air Fraction

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

Where: V_{pz} = Zone Primary Airflow

For VAV systems V_{pz} is the minimum expected airflow

After analyzing the entire ventilation system for the Kroc Center, it was determined that the current ventilation system meets or exceeds minimum design requirements established by ASHRAE Standard 62.1 for all units except one. Rooftop unit 7 is a little below the required level. The main space that RTU 7 services is an aerobics exercise room. ASHRAE's suggested population density and required airflow per person seemed high, 40 (people / 1000 sq ft) and 20 (cfm / person) respectively. The design team most likely used less conservative assumptions for that space which could explain the small outdoor air deficit. Table 1 shows how the current system compares to ASHRAE's minimum standards.

Unit	Description	Scheduled OA	ASHRAE Required OA	Compliance	% Difference
AHU 1	Competition Pool	10488	5818	Y	80%
AHU 2	Leisure Pool	8988	4735	Y	90%
FCU 1	Stage - North	880	648	Y	36%
FCU 2	Stage - South	880	647	Y	36%
RTU 1	North Office Wing	9610	8188	Y	17%
RTU 2	Office Wing	1640	1094	Y	50%
RTU 3	Chapel	4800	1795	Y	167%
RTU 4	Climbing Wall	2300	342	Y	573%
RTU 5	Gym - North	2800	2203	Y	27%
RTU 6	Gym - South	2800	2203	Y	27%
RTU 7	Aerobics	1230	1430	Ν	-14%
RTU 8	Fitness	1200	1005	Y	19%
RTU 9	Wet Multi-Purpose	1360	370	Y	268%
RTU 10	Locker Rooms	2750	1142	Y	141%

Table 1 – Ventilation Compliance

A number of units have outside air measurements much higher than the required amount. The pool areas probably have much higher amounts to maintain a healthier indoor air quality level by flushing out the chlorine and other chemicals. The other areas that are significantly over the required values are the chapel, climbing wall, and the locker rooms. The locker rooms are probably high to maintain a better indoor environment, much like the pools. The chapel probably accounted for a higher density of people or a higher activity level for the people in the chapel. The climbing wall is a very unique space and doesn't fit well into any of ASHRAE's predetermined spaces. The closest option was selected, but the designers probably took a more conservative approach. Overall, the ventilation rates are a little larger than the minimum required amount to ensure that the ventilation requirements will be met, even when the VAV boxes are at partial load.

Standard 62.1 Summary

The Kroc Center complied very closely to ASHRAE Standard 62.1. A few small issues arose, but they do not pose serious problems. The failure of the filters to meet ASHRAE's requirements could be easily remedied, and the one ventilation deficit could be fixed by dispersing the air slightly differently. Overall, it was impressive how well the Kroc Center performed.

ASHRAE Standard 90.1 Analysis

Section 5 – Building Envelope

5.1.4 Climate

The Kroc Center was built in Salem, Oregon which is located in climate zone 4.



Figure 1 - United States Climate Map

5.4 Mandatory Provisions

All fenestrations and doors are to be sealed as mentioned in the drawings and the specifications. Additionally all fenestrations and doors in the pool areas are to use bituminous dampproofing to prevent moisture penetration in areas subject to high humidity, dampness, and direct water content.

The Kroc Center has two primary entrances. Both have sets of double doors more than seven feet apart when closed. Another back entrance has a set of double with close to seven feet in between the doors, which is acceptable because those doors are not used as a primary entrance.

5.5 Prescriptive Building Envelope Option

Verify that the building elements meet minimum Building Envelope Requirements for Climate Zone 4. The walls, roof, floor, and glazing were all evaluated. The results are listed below in Table 2 and Table 3.

		Prescrib	ed by 90.1	As D	esigned	
Element	Description	Assembly U Max	Insulation Min R-Value	Assembly U Max	Insulation Min R-Value	Std. 90.1 Compliance
Roof	Insulation Entirely Above Deck	0.048	20	0.053	19	No
Walls Above Grade	Mass	0.104	9.5	0.077	13	Yes
Walls Below Grade	Below-Grade Walls	1.140	NR	NA	NA	Yes
SOG Floors	Unheated	0.073	NR	0.100	NA	No

After a quick glance at the building elevations, one can see that the glazing is well under forty percent of the total surface area of the exterior of the building, which is a requirement for the building to comply with the ASHRAE standard.

		Prescrib	ed by 90.1	As D	esigned	
Element	Description	Assembly U Max	Max SHGC	Assembly U Max	Max SHGC	Std. 90.1 Compliance
Glazing (Base)	Metal Framing (Curtain Wall)	0.50	0.40	0.35	0.50	No
Glazing (Alternate)	Metal Framing (Curtain Wall)	0.50	0.40	0.28	0.31	Yes

Table 3 – Building Glazing Compliance

There are several areas where the building envelope fails to comply with ASHRAE Standard 90.1. The roof u-value is just slightly under the ASHRAE standard, so it does not represent a major concern. The floors also failed to comply with ASHRAE Standard 90.1, but the U-value is still very low so the floors will not pose a problem either. Lastly the glazing. It could not be determined which glazing the contractor selected. If the contractor chose the base product it would fail to comply because the shading coefficient was too high. But if the contractor selected the alternate glazing, then it would comply with the standard. There were a lot of little areas where the building failed to comply, but none will present major problems moving forward.

Section 6 – Heating, Ventilating, and Air Conditioning

6.2 Compliance Paths

There are two methods for determining compliance with this standard: the simplified approach or the mandatory provisions. The simplified approach can only be used for buildings with less than 25,000 square feet, so this report used the mandatory provisions method.

6.4 Mandatory Provisions

The Building Control System is a Direct Digital Control (DDC) system which can perform all of the automatic temperature control and energy management functions as required in the plans and specifications. The system will independently control the building's HVAC equipment to maintain a controlled environment in an energy efficient manner. The building operator can communicate with the system and control the sequence of operation to maintain the desired temperature.

The control system allows for all of the mechanical equipment to be turned down or off according the owner's desire to allow for energy savings. The owner is given a lot of control over the system and the owner can determine the operating times for all of the equipment. Some of the mechanical equipment will shut off until the building drops below 60F. When the temperature of the building drops that low the equipment will turn back on to prevent the building from cooling too much and causing possible freezing damage. This allows the building to save the most energy without worrying about damaging the building. The Kroc Center meets all the control requirements and complies with this section.

All of the HVAC piping and ductwork is to be insulated. All exterior ductwork will have rigid insulation, and all interior ductwork will be covered in fiberglass insulation. Also, all hot and cold water piping will be wrapped in fiberglass insulation, elastometric foam, or cellular glass.

6.5 Prescriptive Path

All of the rooftop units are equipped with economizers that are capable of producing up to one hundred percent outdoor air to allow for free cooling. The DDC control system controls the adjusting of the dampers on the unit, but the owner can adjust the ventilation rates. The two large air handling units do not employ economizers because they are over 65,000 Btu/h and do not need economizers as required in Table 6.5.1 in ASHRAE Standard 90.1

All fan motors that are over 1 hp must meet the restrictions listed in Table 6.5.3.1.1A of ASHRAE Standard 90.1. Table 4 shows the compliance of all fans that exceed 1 hp; the smaller fans were left off to conserve space. The two large air handlers have VFD controls instead of VAV boxes, so they were still treated the same as the other variable systems.

Unit	HP	CFM	CFM x 0.0015	Compliance
AHU 1 Supply	25 (2)	41960	31.5 (2)	Y
AHU 1 Return	15 (2)	26170	20 (2)	Y
AHU 2 Supply	20 (2)	35950	27 (2)	Y
AHU 2 Return	10 (2)	21570	16 (2)	Y
REF R2	5	5400	8.1	Y
REF R5	5	7000	10.5	Y
REF R6	5	7000	10.5	Y
REF R8	5	8300	12.45	Y
MAU R2	5	5200	7.8	Y

Table 4 – Fan HP Compliance

There is a fume hood in the kitchen. However, the total cfm is under 5000, so no makeup air is necessary, although some is provided. The Kroc Center complies with this section.

6.7 Submittals

The specifications call for copies of all drawings and operating and maintenance manuals to be handed over to the owner upon completion of the building. Also, a testing and balancing report is to be performed after the entire system is installed. The Kroc Center is still going through the LEED certification process at this time, so the final commissioning report is not available.

Section 7 – Service Water Heating

There are four water heaters that supply the domestic hot water to the building. Two gas boilers are located in the mechanical room. Another gas boiler is located in the janitor closet near the kitchen, and an electric hot water heater is located in the janitor closet by the competition pool. The two satellite water heaters are primarily used to provide a quick source of hot water to areas of the building far from the mechanical room. All of the hot water heaters in the Kroc Center besides the two satellite heaters are tankless. Three additional gas boilers are located in the mechanical room and supply hot water to the two pools and two air handling units. These boilers are connected and work together to meet the hot water demands; so when the pools are at partial load one or two of the boilers can shut off. The three pool boilers can also be manually shut off as is required in ASHRAE Standard 90.1. Overall the water heating service complies with ASHRAE Standard 90.1

Section 8 – Power

The specifications state that the maximum allowable voltage drop for feeders is two percent, and the maximum voltage drop for branch circuits is three percent. It is the responsibility of the contractor to increase cable sizes to ensure that proper voltage drop levels are achieved. This is exactly what is called for in section 8 of ASHRAE Standard 90.1, so the Kroc Center complies with this section.

Section 9 – Lighting

9.2 Compliance Path

There are two methods for determining the compliance of the Kroc Center: the Building Area Method and the Space-by-Space Method. This report will use the Building Area Method to check for compliance.

9.4 Mandatory Provisions

Photoelectric switches are to be used on exterior and interior lighting. The exterior switches will turn off the exterior lighting during the day. The interior switches will adjust interior lighting levels based on daylight levels within the building. Occupancy sensors are also to be installed in the rooms to prevent wasted electricity.

9.5 Building Area Method Compliance Path

The first step is to determine the building type which will give you a specific maximum lighting density. The Kroc Center is composed of a lot of different types of spaces, so I chose the Convention Center. It is an accurate depiction because it is a little higher than the gymnasiums to show the increased lighting density in the smaller areas. The results are summarized in Table 5, but the full worksheet can be seen in Appendix B.

Total Watts	Total SF	Design W/SF	Required W/SF	Compliance
104998	92000	1.14	1.20	Yes

Table 5 – Lighting Compliance

Standard 90.1 Summary

Overall the Kroc Center complied very well with the requirements established in ASHARE Standard 90.1. There were a few small issues with the building envelope, but these issues are minor and not cost-effective to change. Even as they stand, the envelope systems that fail to comply are very close to the ASHRAE requirements. The section on HVAC complied nearly perfectly with the standard 90.1. The Kroc Center has a very sophisticated control sequence enabling it to meet the requirements for optimal energy savings. Also, the fan power selections in the air handlers were well done; the design team kept them well below ASHRAE standards. The water heaters also benefited from the advanced control system, and fit within the standard 90.1 guidelines. The electrical power system also fulfills ASHRAE's requirements by maintaining low voltage drops throughout the whole system. Lastly, the lighting system came in just under the requirements, which was surprising considering the accent lighting and high-bay lighting throughout the building. Overall the Kroc Center fulfills the requirements of ASHRAE Standard 90.1 with only a few minor faults.

References

ASHRAE. 2007, ANSI/ASHRAE, <u>Standard 62.1-2007</u>, <u>Ventilation for Acceptable Indoor</u> <u>Air Quality</u>. 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.

Construction Documents and Project Specifications for The Salvation Army Ray & Joan Kroc Corps Community Center of Salem Oregon. Courtesy of BRS Architecture.

Mathias Kehoe Mechanical Option

Appendix A

OA temp at which mint OA provides all cooling. OAT below which OA Intake flow is @ minimum	Outdoor Air Intake Flow required to System OA Intake req'd as a fraction of primary SA Outdoor Air Intake Flow required to System (Table 6.3 Method) Vot OA Intake req'd as a fraction of primary SA (Table 6.3 Method) Y	Zone Ventuation Emclency (App A Method) Zone Ventuation Emclency (App A Method) System Ventuation Emclency (App A Method) Ventuation System Emclency (Table 6.3 Method) Ev	Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed Uncorrected OA requirement for system Uncorrected OA requirement for system Uncorrected OA requirement for zone OA rate per unit area for zone OA rate per unit area for zone OA rate per unit area for zone Total supply air to zone (at condition being analyzed) Unused OA requirement for zone Fraction of zone supply not directly recito. from zone Fraction of zone supply from fully mixed primary air Fraction of zone of an ot directly recito. from zone Fraction of zone of an equired in supply air to zone Unused OA fraction required in primary air to zone Calculation of zone Zone (at condition to zone) Unused OA fraction required in primary air to zone Calculation periodeners	Results Ventilation System Efficiency Outdoor air intake required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) VotPs Outdoor air as a % of design primary supply air Ypd	Inputs for Operating Condition Analyzed Ds Percent of total design alfrow rate at conditioned analyzed Ds Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed Ez Primary air fraction of supply air at conditioned analyzed Ep	hary plus local recirculated) n Dual Duct or Transfer Fan? 2 of ave system return air	Inputs for System Floor area served by system Population of area served by system (including diversity) Ps Design primary supply fan aliflow rate OA req'd per unit area for system (Weighted average) CA req'd per person for system area (Weighted average) Ras Inputs for Potentially Critical zonee	Building: Kroc Center System TagNama: AHU 1 Operating Condition Description: Ventilation Units (select from pull-down list) IP
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Fraction of zone OA not directly rediro, from zone Unused OA fraction required in supply air to zone	2 7		 I-(I-EZ)(I-Ep)(I-Er) Voz / Vdz 	• •		0.13	0.00
Unused OA fraction required in primary air to zone	4		 Voz / Vpz 	•		0.13	0.00
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System Ventilation Efficiency (App A Method)	Ð		- min (Evz)	•	1.00		
Ventilation System Emclency (Table 5.3 Method) Minimum outdoor air Intake airtiow	ų		 Value from Table 6.3 		1.02		
Outdoor Air Intake Flow required to System	< of	dim	- Vou / Ev	•	4735		
Outdoor Air Intake Flow required to System (Table 6.3 Method)	ğ.	and a second sec	 Vou / Ev 	•	4649	85.86	
OA Temp at which Min OA provides all cooling	-		- vutrivpe		5	0.02	
OAT below which OA Intake flow is @ minimum		Deg F	 - {(Tp-dTsf)-(1-Y)"(Tr+dTrf 	•	-57		

Minimum outdoor all intake airflow Outdoor All intake Flow required to System OA intake reqd as a fraction of primary SA OUtdoor All intake Flow required to System (Table 6.3 Method) OA Intake reqd as a fraction of primary SA (Table 6.3 Method) OA Temp at which Min OA provides all cooling OAT below which OA Intake flow is @ minimum	Initial Calculations for Individual zones OA rate per unit area for zone OA rate per person Total supply air to zone (at condition being analyzed) Unused OA regultement for zone Fraction of zone supply not directly resins, from zone Fraction of zone supply from fully mixed primary air Fraction of zone of une supply from fully mixed primary air Fraction of zone of une supply from fully mixed primary air Fraction of zone of une supply from fully mixed primary air Fraction of zone of une of the supply resins, from zone Unused OA fraction required in primary air to zone Unused OA fraction required in primary air to zone Unused OA fraction required in primary air to zone System Ventilation Efficiency (App A Method) System Ventilation Efficiency (Fabe 6 3) Method) Ventiation Settien Efficiency (Fabe 6 3) Method)	0.02	Results Ventilation System Efficiency Outdoor all intake required for system Outdoor all intake required for system Outdoor all per unit floor area Outdoor all per unit floor area	Inputs for Operating Condition Analyzed Percent of total design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed Primary air fraction of supply air at conditioned analyzed	Zone Tag Space type Floor Area of zone Design population of zone Design total supply to zone (primary plus local recirculated) Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan? Local recirc. air % representative of are system return air	Inputs for System Floor area served by system Population of area served by system (including diversity) Design primary supply fan aliftow rate OA req't per unit area for system (Weighted average) OA req't per person for system area (Weighted average) OA req't per person for system area (Weighted average) Zone Name	Building: System Tag/Name: Operating Condition Description: Units (select from pull-down list)
<mark>≺ g</mark> ≺ g		XS 2 Sps	VotiAs	80 8	타 성경	Name As Ps Vpsd Ras Rps	Kroc Center FCU 1 Ventilation
cim Deg F	chmist chm chm		cimis cimis	% Selectr	Selecti Selecti Selecti	Units sf p p dm dm f dm f dm f	anter
 Vou / Ev Vot / Vps Vot / Vps Vot / Vps Vot / Vps ((Tp-dTsf)-(1-Y))(Tr+dTrf 	Fpz Pz + Raz Az Vbz/Ez Ep + (1-Ep)Er Ep + (1-Ez)(1-Ep)(1-Er) Vdz / Vdz Vdz / Vdz Vdz / Vdz (Fa + FbXs - Fc2) / Fa min (Evz) Value from Table 6.3	 VpdDs Fps Ps + Ras As Vou / Vps 		% Select from pull-down list	Select from pull-down list sf P (default value listed; may be overridden) dm Select from pull-down list or leave blank if N/A	Name Units As sf Ps p Npsd dmm Ras dmist Rps dmip Zone the turns purple italic for critical zone(3)	
· · · · · ·	· · · · · · · · · · · ·	····	11 2 9 2	100%	rridden) If N/A	System 1190 1,600 0,00 9,0	
648 0.41 865 30	0.12 0.00 150 1.00 1.00 1.00 0.25 1.13	41% 615 0.38	0.95 648 0.54	2001 2011 2005	B118, 122, 123 storage rooms 315 0 170 75%	chap	
	5006 1100 1100 1100 1100			100%	B117 Office space 0 0.65 0 150 150 150 75%	Potentially Critical Zones el Office Sta	
	0.06 1300 566.2 1.00 1.00 1.00 0.44 0.44			100%	B119 Stages, studios 52.15 52.15 1300 ITU 75%	ones Scage (Hail)	

Building: System Tag/Name: Operating Condition Description: Units (select from pull-down list) Inputs for System	Kroc Center FCU 2 Ventilation				Syst			
Inputs for System Floor area served by system Population of area served by system (including diversity) Design primary supply fan aliflow rate OA req'd per unit area for system (Weighted average) OA req'd per person for system area (Weighted average) Inputs for Potentially Critical zones	Name As Ps Vpsd Ras Rps	units P cim cimisi		100% diversity	System 1138 1,600 10.00 10.00		Potentially Critical Zonee	0008
Zone Name Zone Tag	Zone ti	tie turns p	urple fa	Zone the turns purple halts for critical zone(s)				ge (Half) B119 Stades.
Space type		Select f	rom puli-	Select from puli-down list			nooms studios	lioa Jea
Floor Area of zone	38	० व	inter the second se	tradical listent: second his out	(and distant)	Π	8	3 145
Design bolansion of zone Design training supply to zone (primary plus local redirculated) Industry Transfer Link Find End End Find Totat or Totated State	Vdzd	om official	(ueidu	(detadit valde listed; filay be overfidden)	ennoenj		300	1300
	Ψ	Octoor II	- International	octor non brinning of case name in so	1100		75%	75%
Inputs for Operating Condition Analyzed Percent of total design airflow rate at conditioned analyzed	ß	*			_	10% %	100%	100%
Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed	7 17	Select f	rom pul-	Select from pull-down list			100	ទីន
Results	? {					Ŕ	100.00	100.00
Outdoor air Intake required for system	ŝ	Сm				5		
Outdoor all per unit floor area Outdoor all per parcels could be exchanging the liver by	VotiAs					12.0		
Outdoor air as a % of design primary supply air	Ypd B	dim b				40%		
Detailed Calculations Initial Calculations for the System as a whole Primary supply air flow to system at conditioned analyzed	Vps	đm	• \$	VpdDs	•	1600		
Uncorrected UA regid as a fraction of primary SA	Xs Vol	am	• • ≲ Z	rtps PS + Ras As Vou / Vps	•••	613 0.38		
OA rate per unit area for zone	Raz	climist					0.12	0.06
OA rate per person	Rpz	olmip					0.00	10.00
Unused OA req'd to breathing zone	SDZ 1	om i	-	Rpz Pz + Raz Az	•		45.8	566.2
Unused OA requirement for zone Fraction of zone supply not directly regire, from zone	50 ⁶	am	 D ≤	Voziez Eo + (1-EoVEr	• •		100	- 1 8 8
Fraction of zone supply from fully mixed primary all	777		• 		•			
Fraction of zone CA not orrectly redire. from zone Unused CA fraction required in supply air to zone	22		•• ≲⊤	1-(1-EZ)(1-EP)(1-Er) Voz / Vdz	• •		0.16	0,44
S .	4		- ≲	Voz / Vpz	'		0.16	0.44
Zone Ventilation Efficiency (App A Method)	Evz		•	(Fa + FbXs - FcZ) / Fa	'	2	1.23	0.95
System Ventulation Enrolency (App A Method) Ventilation System Efficiency (Table 6.3 Method)	0 0		••• < 3	min (Evz) Value from Table 6.3	••	0.35		
Minimum outdoor air Intake airflow	1							
Outdoor Air Intake Flow required to System	< Sof	đľm	 ≲≲	Vou / Ev	•••	647		
Outdoor Air Intake Flow required to System (Table 6.3 Method)	(<u>6</u>	đ	• •	Vou / Ev	•	8		
OA Temp at which Min OA provides all cooling	1	1						
OVER DELAW WITH OVER THERE THE IN THE DELAMINE	I	- Kno		The second s		\$		

Building: Suctor TaoName:	Kroc Center	anter				
Operating Condition Description: Units (select from pull-down list)	Ventilation IP	lion				
Imputs for System Floor and served by system	Name	d, Units		System		
Population of area served by system (including diversity) Design primary supply fan airflow rate OA redd per unit area for sessem (Weighted average)		dm eff	100% diversity	23,0 0.		
OA redd per person for system area. (Weighted average) Inputs for Potentially Critical zones.		ofmlp				Potentially Critical Z
Zone Name Zone Tao	Zone M	the factory particular	Zone title turns purple italic for critical zone(s)		VAV M1.1 VAV M1.2 VAV M1.3 VAV M1.4 VAV M1.5 VAV M1.7 VAV M1.7 VAV M1.8 VAV M1.7 VAV M1.7	126 VAV N1.10 A103
Scece troe					Multi-use Multi-use Cafeteria/tast- Classrooms Multi-use Classrooms Art classroom Multi-use Computer lab	ter lab Multi-use
Floor Area of zone	Az	Selection	Select from pull-down list		(age 9 plus)	assembly 555
Design population of zone Design total supply to zone formany plus local moleculation	5 P2	1	(default value listed; may be ovenidden)	enidden)	40 40 20 33.5 60 23.1 15.6 60	4050 40
Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	ņ	Select fro	Select from pull-down list or leave blank if N/A	INVA		
Inputs for Operating Condition Analyzed	?	ę			40000	
Air disinisation type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed	Ø	Select fro	Select from pull-down list		1.00 1.00 1.00 1.00 1.00 1.00	1.00 1.00
Results Ventilation Overlage BReisens	2				Large Large Large Large Large Large Large Large	
Outdoor air intake required for system		đm		22		
Outdoor air per untition area Outdoor air per person served by system (including diversity)	ň 6	ofm/st		14.1		
Outdoor air as a % of design primary supply air	Ypd	đ,		36		
Detailed Calculations for the System as a whole			5			
Primary suppy air flow to system at conditioned analyzed UnconsciedCA requirement for system	X on the second se	dm	 VpcLs Rps Ps + Ras As Vou / Vre 	23800		
Initial Calculations for individual zones		-				
OA rate per unit area nor zone OA rate per person		dun/p			7.50 7.50 10.00 7.50 10.00 10.00 7.50	
Total supply air to zone (at condition being analyzed) Unused OA regid to breathing zone		9 9 9	 Rpz Pz + Ruz Az 		850 3010 1800 1050 1050 1100 1050 333.0 618.0 465.8 482.0 310.2 296.4 482.0	
Unused CA requirement for zone		ofm	VhatEz		333 618 496 492 310 296 492	
Fraction of zone supply from fully mixed primary air	73		- Ep (1-ch)e		1.00 1.00 1.00 1.00 1.00 1.00 1.00	
Fraction of zone OA not directly recirc. from zone Instant OA fraction monitorial is experted at to zone	27		1-(1-Ez)(1-Ep)(1-Er)		1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	
Unused OA fraction required in primary air to zone	Ę			'	0.39 0.21 0.28 0.47 0.30 0.27 0.47	
Zone Ventilation Efficiency (App A Method)	Evz		 (Fa + FbXs - FcZ) / Fa 		1.01 0.81	1.04 0.89
System Ventilation Efficiency (App A Method)	2			- 0.81		
ventietion system Enterney (Labe 5.3 Method) Minimum outdoor air intake airflow	ą		 Value from Lade 6.5 			
Outdoor Air Intake Flow required to System	Vot	ofm				
Ovinteen Ar Intelle Flow required to System (Table 6.3 Method)	Vot	ŝ	 Vou / Ev 	- 9778		
OA make requise a fraction of primary SA (Table 5.3 Method OA Temp at which Min OA provides all cooling	3		= votras			
OAT below which OA intake flow is @ minimum		Deg F	 {Tp-dTsf}-(1-Y)/(Tr+dTr) 	- 23		

a 6.3 Method) a 6.3 Method)	* * * * * *	Verifiation System Efficiency Outdoor air insise required for system Outdoor air par unit floor area Outdoor air as a % of disrign primary supply air Outdoor air as a % of disrign primary supply air Detailed Calculations Primary supply air flow to system at conditioned analyzed Unconnected CA requirement for system Unconnected CA requirement for system	Space type Floor Area of zone Disign population of zone Disign population of zone Disign population of zone (of many plus local rectruitated) Induction Terminal Unit, Diai Fan Duai Duct or Transfer Fan? Local rectr. air X representative of area system return air leguts for Openating Condition Analyzed Arr distribution type at conditioned analyzed Arr distribution whetherwas at conditioned analyzed Primary air flued on of supply air at conditioned analyzed Primary air fluedon of supply air at conditioned analyzed	tem n alfSystem (including diversity) n alfOwrate r system (Weighted average) system area (Weighted average) as	Building: System TagName: Operating Condition Description: Units (select from pull-down list)
	NNNNN	Ev Vot VotPs VotPs Vps Vps Vps		Name As Ps Ras Ros	Kroc Center RTU 1 Ventilation
ofm Deg F	chuy chuy chu	an shirt	Selection Selection	ofm b	on
		= VpdDs = Pps Ps	Sainet from pull-down list P Sainet from pull-down list Sainet from pull-down list Sainet from pull-down list		
Vou / Ev Vot / Vps Vou / Ev Vou / Ps Vou / Vps	Hour Pa + Rua Az Vita/Ez + Rua Az Ep + (1-Ep)Er Ep + (1-Ep)(1-Er) Vita / Vita Vita / Vita Vita / Vita (Fa + F105a - Fo2) / 1 Hour Toole 1	VpcDs Rps Ps + Ras As Vou / Vts	Sown list Sown list Iown list	100% diversity	
Vou / Ev Vot / Vps Vou / Vps Vou / Vps Vot / Vps	Figur Fiz + Riaz Az Figur Fiz + Riaz Az Ep + (1-Ep)(Fiz Ep + (1-Ep)(1-Er) Viaz / Viaz Viaz / Viaz (Fiz + Fiz)(2 - Fiz2) / Fiz with (Fiz2) Viaz / Viaz	s As	select from pull-down list P Select from pull-down list or leave blank if NA Select from pull-down list	Name Luiks As of P Ps P Ps d fm Rus cfmbf Rus cfmbf Rus cfmb Rus cfmb	
3			Sank I N		
23	0.81	0.21 0.45 0.45 0.23 0.23	(A 100%)	System 18090 23.600 0.10 8.3	
	0.06 7.50 850 333.3 1.00 1.00 1.00 0.39		Matti-use assembly 10 100%	VAV N1.11 A103	
	0.12 10.00 900 319.6 1.00 1.00 1.00 0.35 0.93		Classrooms C (age 9 piles) (a 100% 1100% 100% 100%	VAV N1.12 V A105, 107 A	
	0.12 10.00 950 312.6 315 1.00 1.00 0.33 0.33		Classrooms ((age 9 plus) 23.275 100% 100% 100%	VAV N1.13 V A194, A195 J	
	0.12 5.00 146.5 1.00 1.00 0.12 0.12		Librarites C 6.82 170 75% 100% 100%	VAV N1.54 V A121, 122 A	
	0.12 10.00 9.20 3.34,3 3.34,3 3.34,3 3.34,3 3.34,3 1.00 1.00 1.00 1.00 0.35 0.35		Classrooms (age 9 pilus) 24.110 170 100% 1.00%	VAV N1.15 V A119, A120 J	
	0.005 1580.0 1580.0 1.000 1.000 1.000 0.005 1.200		Corridors 0 2200 (170 1800 175% 100% 100%	VAV N1.16 1 A105, 128 1	
	0.12 10.000 371.3 371.3 1.00 1.00 0.35 0.35		Classrooms Lo (age 9 plus) 27.65 100 100% 100%	11.	
	1740 4275 4275 1000 1000 1000 1000		Lobbiesiprefu nction 150 170 170 100% 100%	VAV N1.18 1	
	0.06 7.50 349.8 4.00 1.00 1.00 0.20 0.20 1.08		Mutti-use assembly 170 1705 100% 100%	VAV N1.15 100.	

OAT below which our OA Intake flow is @ minimum	communication of the second to record a product when even were	C ANT THREE TRANSPORTS	CA make regulas a naction of primary CA	Cutabor Air Intake Hide required to system	Minimum outdoor air intake airflow	Ventilation System Efficiency (Table 6.3 Method)	System Ventilation Efficiency (App A Method)	Zone Ventilation Efficiency (App A Method)	System Ventilation Efficiency	Unused OA fraction required in primary air to zone	Unused OA fraction required in supply air to zone	Fraction of zone OA not directly recirc. from zone	Fraction of zone supply from fully mixed primary air	Fraction of zone supply not directly recirc. from zone	Unused C/A requirement for zone	Unused CA regal to breathing zone	(pervinue fixing uccentrico te) anor or un Addre recor-	Constant international and anter and	Constant per units and and access	CA asta non-mit assa for sona	halfial Calculations for induktion a second or particulation	Unconnected OA racid as a fraction of primary SA	I many analysis and the second for each on	Primary supply air flow to system at conditioned analyzed	Detailed Calculations Initial Calculations for the System as a whole	Outdoor air as a % of design primary supply air	Outdoor air per person served by system (including diversity)	Outdoor air per unit floor area	Outdoor air intake required for system	Ventilation System Efficiency	Results	Primary air fraction of supply air at conditioned analyzed	Zone air distribution effectiveness at conditioned analyzed	Air distribution type at conditioned analyzed	Percent of total design ainflow rate at conditioned analyzed	Inputs for Operating Condition Analyzed	Local regire, air % representative of ave system return air	Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Design total supply to zone (primary plus local recirculated)	Design population of zone	Floor Area of zone		Space type		Zone Teg	PLUEN IN THE PLUE INTERPLECIES	The second	(afterave neutlinex) were unreale on unread and phar wo	(after the result of the second	Design primary suppy fan armow rate	(Areaken Burnnau) mareke ka pakare mur jo jonando.	Floor area served by system	Imputs for System	Units (select from pull-down list)	Operating Condition Description:	System Tao/Name:	R 1d/may	
	1	to A day	-	VOT		ę	2	Evz		þ	2d	7	Ð	72	YOZ	VDZ	VUZ	arity.		Dav	-	X	Non 1	Vps		Ypd	VotiPs	VotVAs	Vot	ĥ		8	Ņ		8		φ		Vdzd	N	ž					1.0107	l	NC PR	TO BO	Vpsd	3	8	Name	9	Ventilation	RTU 2	Kroc	
Deg F		-	}	dm	•										dm	om	am	damp	- Annie	afinital		-	Ì	đ		ofm		s ofm/st	đ					Select	ş			Select	đ	σ	10,	Select				Date and		dumb	dunk	Î		9 10,			ation		ne Center	
						-				- <		-	n pe	-									н Ю -	"										from put				from put		(defau		from put				to active 1	ļ				г	1						
RTp-dTsD-(1-Y)Y(Tr+dTr	sda 130	AD LOO	sch / 20A	VOU / EV		Value from	THE DEAL	(Fa + FbXs - FoZ) / Fa		Voz / Vpz	Voz / Vdz	1-(1-Ez)(1-Ep)(1-Er)	ų	Ep + (1-Ep)Er	VIDDEZ	HTZ PZ + RAZ AZ					and a new	Viou / Vins	Ros Ps + Ras As	VpdDs										Select from pull-down list				I-down lis		t value lit		Select from pull-down list				(clearer source or cress and not ource and all					1007							
(I-Y)/(Tr						Table 6.3		- Fe2)/				00)(1-0)		Ξų.		CRZ AZ							as As											74				t or leave		sted; may		74				ALC: NO					Ansamp Group							
Ma∏n =																																		_				Select from pull-down list or leave blank if NIA		(default value listed; may be overridden)						2	1	_					_					
\$	910	in the second		Picore a		0.80	0.88															014		6750		16%	13.1	0.20	1094	88.0					N001			MA.		(dolern)								2		6,756	9	5500	System					
		0.10						0.96		0.18	0.18	1.00	1.00	1.00	147	147.1	00	out o	112	043												100%	1.00	8	100%		10%	3	800	865	288	central		-	411, 112, 114,	C409 440	10000 64 4	-			+-		H	+	•	+		
								1.04		0.10	0.10	1.00	1.00	1.00	90	50	80	000	0.00	0.00												100%	1.00	8	100%		75%	3	860	5.3	1080			ace	421	+	VIANFOLD											
								0.88		0.26	0.26	1.00	1.00	1.00	242	242.4	0.00	10.00	10.00	0 13												100%	1.00	S	100%		75%	5	920	16.375	559			Ĭ	148	C112 112	1411 04 0											
								1.01		0.14	0.14	1.8	18	1.8	8	79.6	000	0.00	10.16	043												100%	1.00	8	100%		75%	3	580	5.375	215			Computer lab C	0.110	VAV STA	-1											
								0.96		0.18	0.18	1.00	1.0	1.00	124	124.0	000	000	-	20.00												100%	1.8	8	100%		70%	10	650	28	400	,		Conferenceim		C435 633	MANGER 20											
								1.04		0.11	0.11	1.00	1.00	1.00	69	8.0	90	000	0.00	0.00												100%	1.00	ន	100%		75%	3	640	0	725		_	-	427, 428, 434	C405 430	20002											
								1.08		0.06	0.06	1.00	1.00	1.00	5	6.02	100	000		0.00												100%	1.00	80	100%		75%	3	420	1.525	305			Office space	0100	VAV 51-1	LIAU 64 7											
								1.08		0.05	0.05	1.00	1.8	1.8	1	44.2	040			200												100%	1.00	8	100%		10%	10	840	2.6	620		_	éče	438	C410 407	11411 64 6											
								1.00		0.14	0.14	1.00	1.00	1.00	140	139.7	TOUR D	0.00	0.00	0.00												100%	1.00	8	100%		75%	8	1000	18.875	755			Break rooms	0110100	C140 444	VIAN CA S											

OAT below which OA intake flow is @ minimum	OA Temp at which Min OA provides all cooling	(Table 6.3 Method)		Outdoor Air Intake Flow required to System	Ventueum outdoor ale indexe alefiow	system ventulation Entorency (App A Method)		System Ventilation Efficiency	Unused OA fraction required in primary air to zone	Unused OA fraction required in supply air to zone	Fraction of zone OA not directly redirc: from zone	Fraction of zone supply from fully mixed primary air	Fraction of zone supply not directly redro. from zone	Unused OA requirement for zone	Unused OA req'd to breathing zone	Total supply air to zone (at condition being analyzed)	OA rate per person	OA rate per unit area for zone	Initial Calculations for Individual 20000 of printing SA	unconected UA requirement for system	Calc	Detailed Coloniations	Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air		system	Ventilation System Efficiency		Zone all disultation of supply all af conditioned analyzed Primary all fraction of supply all af conditioned analyzed	An also de determine advantación el apartica de actividad	Percent of total design airflow rate at conditioned analyzed	Inputs for Operating Condition Analyzed	Local rectro, air % representative of ave system return air	Induction Terminal Unit. Dual Fan Dual Duct or Transfer Fan?					Zone Tag	Zone Name	Inputs for Potentially Critical zones			Floor area served by system Population of area served by system (including diversity)	Inputs for System	And the second	Operating Condition Description:		Building:
	1	ğ	×	≶ot	9	2	Evz	-	61	Zd	Fc	5	Fa	Yoz	Vloz		Rpz	Raz	XS	NO1	NDS	1		VOUAS	Vor	Ð	£	97	7	05		Φ	İ	∑dzd	12				Zone ti	advi	Ras	Vpsd	₿ 8	Name	1	Ventilation	RTU 3	Kroc Center
Deg F		and and a		đ										đm	đm	đ	ofinip	climist		qm	dim		dunio	crimvsr	âm				Contract	%			Select	ŝτ) द	Select			ie turns	duinh	climis	đm	פס	Units		tion		enter
•				•			•		•	•	•	•	•		•						•	L							ind in but				na woi	(delat		nd wou			purple t			T	_		I			
(Tp-dTsf)-(1-Y)'(Tr+dTrf	vot / vps	Vou / Ev	Vat / Vps	Vou / Ev	Value Irom Lable 6.5	min (EVZ)	(Fa + FbXs - FcZ) / Fa		Voz / Voz	Voz / Vdz	1-(1-Ez)(1-Ep)(1-Er)	8	Ep + (1-Ep)Er	VoziEz	Rpz Pz + Raz Az				Non / Nbe	NDS PS + NdS AS	VpdDs								Select II offi pull-down list				Select from pull-down list or leave blank if N/A	(derault value listed; may be overnoden)		Select from pull-down list			Zone the turns purple talls for critical zone(s)				100% diversity					
•	ľ	ł	•	•	ľ	'	•		•	•	•	•	•	'	'				1	1	•	L									r		INA	emoder						Γ			Τ	Sy				
÷-	0.25	1958	0.23	1795	16.0	1.00	2												0.20	08/1	7680		290	0.60	1735	1.00		_	_	100%			_	3	,	_	_			0.0	0.07	7,680	318	System				
							1.00 1.08		0.24 0.15								5.00 0.00										8,001	100% 100%		100% 100%		75%		310 U 7 410 270	2,650 340		Multipurpose Storage	B101 B102, 103,	Chapel Support	Potentially Critical Zones								

Mathias Kehoe Mechanical Option

Technical Assignment 1 09/23/11

Building: System TagiName: Operating Condition Description: Units (select from pull-down list)	Kroc Center RTU 4 Ventilation	anter					
Inputs for System Floor area served by system (including diversity) Population of area served by system (including diversity) Design primary supply fan almow rate OA req'd per unit area for system (Weighted average) OA req'd per person for system area (Weighted average) Inputs for Potentially Critical zones	As Ps Ras Rps	untta P dm dm/sf	100% diversity	System 2700 6,000 0.06 5,0	Potenti	Cone	
Zone Name Zone Tan	Zone ti	tie turns pu	Zone the turns purple italic for critical zone(s)		Lobby C	Cilmbing Wall S	Storage
Zone Tag Space type		Select fin	m null-from list		Y	æ	D102 Storage
Floor Area of zone	R	Selectific	select from pull-down list		1000les 2,160	assembly 405	135
Design population of zone	망망	ар;	(default value listed; may be overridden)	ridden)	21.6 2 Snn		300
Design total supply to zone (primary plus local reoroutated) Induction Terminal Unit, Dual Fan Dual Duot or Transfer Fan?	VUZU	select fro	orn Select from pull-down list or leave blank if N/A	NA	ULI ULI	TT SOU	12 200
	φ				75%	75%	75%
Inputs for Operating Condition Analyzed Percent of local design airflow rate at conditioned analyzed	ß	*		100%	100%	100%	100%
Air discription type at continuoted analyzed Zone air distribution effectiveness at conditioned analyzed	2	Collect IIO	Select from pull-down list		100	19 8	រីន
Primary air riacuon of supply all at conditioned analyzed Results	8				-UUT	SCD0	100%
Ventilation System Efficiency	₹₽	dim		36.0			
Outdoor air per unit floor area	VotiAs			0.13			
Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Ypd Ypd	ơm) đim		10.8 6%			
Detailed Calculations Initial Calculations for the System as a whole							
Primary supply air flow to system at conditioned analyzed	Vps	am		- 6000			
Uncorrected OA regularement for system Uncorrected OA regid as a fraction of primary SA	Xs	gm	 Mps PS + Mas As Vou / Vps 	- 328 0.05			
Initial Calculations for Individual zones OA rate per unit area for zone	Raz	cimisi			0.06	0.06	0.12
OA rate per person	망	dimip			5.00	5.00	
Local supply air to zone (at condution being analyzed) Unused OA regid to breathing zone	Sar Naz	am am	 Rpz Pz + Raz Az 		237.6	33000 74.3	200 16.2
Unused OA requirement for zone	7 \scale{1}{22}	đm			238	74	3 5
Fraction of zone supply not directly recirc, from zone Fraction of zone supply from fully mixed primary air	Fb		- Ep + (1-Ep)Er		1.00	1.00	1.00
Fraction of zone OA not directly redirect from zone Unused OA traction required in summy air to zone	7 2		 1-(1-Ez)(1-Ep)(1-Er) Voz / Votz 		1.00	1.00	1.00
Unused OA fraction required in primary air to zone	85		 Voz / Vpz 	•	0.10	0.02	0.08
Zone Mentilation Efficiency Zone Mentilation Efficiency (Ann & Method)	Evz		 (Fa + FbXs - FcZ) / Fa 		96.0	103	0.97
System Ventilation Efficiency (App A Method)	7		- min (Evz)	96.0	1	ł	1
Ventilation System Efficiency (Table 6.3 Method)	ų		 Value from Table 6.3 	- 1.05			
Minimum outdoor air Intake airtiow	λ.	đ	 Writ / Pir 	-			
OA Intake regid as a fraction of primary SA	≺ v,	1	 Vot / Vps 	- 0.06			
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Ś	en M	 Vou / Ev 	- 311	30.89		
OA Intake regid as a fraction of primary SA (Table 6.3 Method)	۲		 Vot / Vps 	- 0.05	0.09		
OA Temp at which Min OA provides all cooling OAT below which OA Intake flow is a minimum		Deg F	 - {(Tp-dTsf)-(1-Y)'(Tr+dTrf 	-226			
THE PROPERTY OF A DESCRIPTION OF A DESCR	l	. 6					

Building: System Tan/Name:	Kroc Center RTU 5	anter			
Operating Condition Description: Units (select from pull-down list)	Ventilation IP	tion			
Inputs for System Floor area served by system	Name	st Units		System	⊒
Population of area served by system (including diversity) Design primary supply fan ainflow rate	등 P 등	α m	100% diversity	7,20	
OA req'd per unit area for system (Weighted average) OA req'd per person for system area (Weighted average) Inputs for Potentially Critical zones	Ras Rps	ofm/sf		0,4	0 Potentially Critical Zones
Zone Name Zone Tag	Zone ti	tie turns po	Zone the turns purple Italic for critical zone(s)		C101 enter name
Space type		Select fix	Select from pull-down list		Swimming Office space
Floor Area of zone	R	al constant	an par som not		(poor or econy 4,590
Design population of zone	2		(default value listed; may be overridden)	erridden)	0
Design total supply to zone (primary plus local recirculated) Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan?	Vdzd	ofm Select fiv	ofm Select from pull-down list or leave blank if N/A	INA	7,200 ITU
Inputs for Operating Condition Analyzed	q				75% 75
Percent of total design airflow rate at conditioned analyzed	05	*		100%	10
An discribution effectiveness at conditioned analyzed	7 17	Celectili	Select from pull-down list		100
Results Ventilation System Efficiency	Ð			1.00)
Outdoor air intake required for system Outdoor air per unit floor area	Vot/As	cimisi		2203	
Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Ypd Vol Ps	alm)p		#DIV/01 31%	¥
Detailed Calculations Initial Calculations for the System as a whole					
Primary supply air flow to system at conditioned analyzed Uncorrected OA requirement for system	동	an an	 VpdD6 Rns Ds + Ras As 	- 7200	.8
Uncorrected OA regid as a fraction of primary SA	X8 202	ŝ	 Vou / Vps 		- 1
OA rate per unit area for zone	Raz	clinisf			0.48 0.06
OA rate per person Total supply air to zone /at condition being analyzed)		alm/p			
Unused OA regit to breathing zone		an an	 Rpz Pz + Raz Az VhziFz 	• •	2203.2 0.0
Fraction of zone supply not directly redro. from zone	2	1	 Ep + (1-Ep)Er 	•	
Fraction of zone supply from fully mixed primary all Fraction of zone OA not directly resting from zone	77		- Ep	• •	
Unused OA fraction required in supply air to zone	22.5		 Voz / Vdz Voz / Vdz 	'	
£ _	ť		 Voz / Vpz 	'	
Zone Ventilation Efficiency (App A Method)	Evz		 (Fa + FbXs - FcZ) / Fa 	•	1.00 1.31
System Ventilation Emilency (App A Method)	2		 min (Evz) Value from Table 6.3 	1.00	
Minimum outdoor air Intake airtiow	9		 Value IIOIII Lable 0.0 		
Outdoor Air Intake Flow required to System	Ś	afm	 Viou / Ev Viot / Vioc 	- 2203	- 65
Outdoor Air Intake Flow required to System (Table 6.3 Method)	Se .	an B	- Vou / Ev	- 2610	
OA Temp at which Min OA provides all cooling	1	7		ĥ	ĥ
			0-F		

Building: Svetan TanNama:	Kroc Center	enter					
Operating Condition Description: Units (select from pull-down list)	Ventilation IP	tion					
Inputs for System	Name	Units			System		
Prior area served by system (including diversity)	{	109	100% diversity	versity	4390		
OA req'd per unit area for system area (Weighted average) OA req'd per unit area for system area (Weighted average) OA req'd per person for system area (Weighted average)	Ras Rps	cimisi cimisi			0.48		
Zone Name Zone Tag	Zone ti	tie turns p	Zone the turns purple italic for critical zone(s)	al zone(s)		Gymnasium enter name C101 enter tag	tag
Space type		1 pales	Select from pull-down list			Swimming Office space	eoede
Floor Area of zone	R	SI (1997)	and been seen to a			4,590	
Design population of zone	2	٦	(default value listed; may be overridden)	id; may be ow	emidden)		0
Induction Terminal Unit, Dual Fan Dual Duat over reterminater Fan? Induction Terminal Unit, Dual Fan Dual Duat or Transfer Fan?		Select 1	on: Select from pull-down list or leave blank if N/A	yr leave blank	I' N/A		
Inputs for Operating Condition Analyzed Percent of total design airflow rate at conditioned analyzed	5	%			100%	100%	100%
Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed	5	Select 1	Select from pull-down list			1.88	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Finitely an inscitution suppry an at containanted analyzed. Results	f					81001	
	{ 🖓				1.00		
Outdoor all make required for aysient	Vot/As				0.48		
Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Ypd Ypd	aim p			#DIV/0! 31%		
Initial Calculations for the System as a whole	ł	ł					
Entry Provide the system at conditioned analyzed UncorrectedOA requirement for system	√o⊔	am am	 VpdDs Rps Ps + Ras As 	s As	- 7200 2203		
Uncorrected OA regid as a fraction of primary SA Initial Calculations for Individual zonas	Xs		 Vou / Vps 				
OA rate per unit area for zone OA rate per person	Raz	c/m/p				0.48	5.00
Total supply air to zone (at condition being analyzed) Unused OA perid to breathing zone		an an	 Roz Pz + Raz Az 	2 A.2	•	7200	8.
Unused OA requirement for zone	√oz	ofm 1	- Voz/Ez		'	2203	
Fraction of zone supply not directly recirc. from zone Fraction of zone supply from fully mixed primary air	52		- Ep + (1-Ep)Er	4	• •	1.00	1.0
Fraction of zone OA not directly redire, from zone	12		 1-(1-Ez)(1-Ep)(1-Er) 	p)(1-Er)	•	1.00	1.00
Unused OA fraction required in primary air to zone	85		- Voz / Vpz		•	0.31	0.00
System Ventilation Efficiency Zone Ventilation Efficiency (App A Method)	Evz		 (Fa + FbXs - FcZ) / Fa 	FcZ)/Fa	•	1.00	1
System Ventilation Emclency (App A Method)	ų		 min (Evz) 		- 1.00		
Ventilation System Efficiency (Table 6.3 Method) Minimum outdoor air Intake airflow	P		 Value from Table 6.3 	able 6.3	- 0.84		
Outdoor Air Intake Flow required to System	Ś	ďm	 Vou / Ev 		- 2203		
Outdoor Air Intake Province of powers 544 (Table 6.3 Method)	`ğ.	a a	Vou / Ev		2610		
OA Temp at which Min OA provides all cooling					ń		
OTH OTHER REPORT OF THERE HOLE OF THE REPORT	I	. 644	1 (see - 4 - 10	And a state of the state of the			

OAT below which OA Intake flow is @ minimum	y SA stem (Table 6.3 Method) y SA (Table 6.3 Method)		System / animation Emidency (App A Method) System Ventilation Emidency (App A Method) System Ventilation System Emidency (Table 5.3 Method)	OA rate per uninuminan zones OA rate per person Total supply all to zone (at condition being analyzed) Unused OA requirement for zone Fraction of zone supply not directly recirc. from zone Fraction of zone oA not directly recirc. from zone Fraction of zone oA not directly recirc. from zone Unused OA fraction required in supply air to zone Unused OA fraction required in supply air to zone Unused OA fraction required in primary air to zone	<u>whole</u> sm at conditioned analyzed r system tion of primary SA	Results Ventilation System Efficiency Outdoor air initiate required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air	Percent of total design anflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness a conditioned analyzed Primary air fraction of supply air at conditioned analyzed	Space type Floor Area of zone Design population of zone Design total supply to zone (primary plus local recirculated) Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan? Local recirc. alr % representative of ave system return air	Inputs for System Floor area served by system Population of area served by system (including diversity) Design primary supply fan almow rate OA regrd per unit area for system (including diverage) OA regrd per person for system area (including diverage) Inputs for Potentially Critical zone Zone Name Zone Tag	Building: System Tag/Name: Operating Condition Description: Units (select from pull-down list)
	×ĕ≺	Vot	Evz Ev	Zd F B S S S S S S S S S S S S S S S S S S	Vou Vou	Ev Vot Vot/As Vot/Ps	ዲ ካን	타 성경	Name As Ps Ps Ras Ras Rps	Kroc Center RTU 7 Ventilation
Deg F	dim	dim		dm/si dm dm dm	dîm	cfm cfm/sf cfm/p cfm	Select 1	Select 1 Select 1 Select 1	e lunits dmvs dmvb	anter
•		•			 < π<		rom pul	rom pul (defau		
((Tp-dTsf)-(1-Y)"(Tr+dTff	Vot / Vps Vou / Ev Vot / Vps	Vou / Ev	(Fa + FbXs - FcZ) / Fa min (Evz) Value from Table 6.3	Rpz Pz + Raz Az Vbz/Ez Ep + (1-Ep)Er 1-(1-Ez)(1-Ep)(1-Er) Voz / Vdz Voz / Vpz	VpdDs Rps Ps + Ras As Vou / Vps		% Select from pull-down list	Select from pull-down list sf (default value listed; may be overridden) dm (default value listed; may be overridden) Select from pull-down list or leave blank if N/A	Name Units As sf Ps P Ps P Ros official and showing the set of the	
•		•	•••		•••			erridde	9	
48	nta nta	1430	0.85		2000 1211 0.61	0.85 1430 0.63 28.1 71%	100%	3	System 2260 51 2,000 0.09 20.0	
			1.39	0.12 0.00 97.2 1.00 1.00 0.21			100% 1.00	× 800	Potent Storage	
			0.85	0.06 20.00 1440 1092.2 1.09 1.00 1.00 0.76 0.76			100% 1.00	Health club/aerobics room 1270 50.8 1270 1270 50.8 1270 75%	Potentially Critical Zonee ape Aerobics s	
			1.39	0.12 100 21.6 1.00 1.00 0.22 0.22			100% 1.00	Storage rooms 180 170 170 175%	Storage C104	

OAT below which OA Intake flow is @ minimum	Outdoor Air Intake Flow required to System OA Intake req12 as a fraction of primary SA Outdoor Air Intake Flow required to System (Table 6.3 Method) OA intake req12 as a fraction of primary SA (Table 6.3 Method) OA Temp at which Min OA provides all cooling	3	Initially supply an now to system as contautorised analyzed Uncorrected OA requirement for system Uncorrected OA requirement for system OA rate per unit area for zone OA rate per person Total supply air to zone (at condition being analyzed) Unused OA requirement for zone Fraction of zone supply not directly recto, from zone Fraction of zone supply not directly recto, from zone Fraction of zone OA not directly recto, from zone Unused OA fraction required in supply air to zone Unused OA fraction required in supply air to zone Unused OA fraction required in primary air to zone	Ventilation System Efficiency Outdoor air Intake required for system Outdoor air per unit floor area Outdoor air per person served by system (including diversity) Outdoor air as a % of design primary supply air Outdoor air as a % of design primary supply air Detailed Calculations	Inputs for Operating Condition Analyzed Percent of total design airflow rate at conditioned analyzed Air distribution type at conditioned analyzed Zone air distribution effectiveness at conditioned analyzed Primary air fraction of supply air at conditioned analyzed	Zone Tag Space type Floor Area of zone Design population of zone Design total supply to zone (primary plus local rectroulated) Induction Terminal Unit, Dual Fan Dual Duct or Transfer Fan? Local rectro, air % representative of ave system return air	Inputs for System Floor area served by system Population of area served by system (including diversity) Design primary supply fan airflow rate OA req1 per unit area for system (Weighted average) OA req1 per person for system area (Weighted average) OA req1 per person for system area (Weighted average) Zone Name	Building: System Tag/Name: Operating Condition Description: Units (select from pull-down list)
	<mark>≺ s</mark> ≺ s	ev z	22 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Ev VotiAs Ypd	មូល ខ្ល	ዋ ፈያ <u>ጽ</u>	Name As Ps Ps Ps Ps Ps	Kroc Center RTU 9 Ventilation
Deg F	9 9		chu chu chu chu chu chu chu chu chu chu	dm dm/s dm	% Select f	sf Selectri Selectri	units sr ofm ofm ofm ofm	enter
 {(Tp-dTsf)-(1-Y)"(Tr+dTrf 	 Vlou / Ev Vlot / Vps Vlou / Ev Vlot / Vps 	 (Fa + FbXs - FcZ) / Fa min (Evz) Value from Table 6.3 	- Rypurs - Ryps Ps + Rats As - Vou / Vps - Ryp: Pz + Ratz Az - Vps/Pz - Ep + (1-Ep)Er - Ep + (1-Ep)(1-Er) - Voz / Vpz - Voz / Vpz		% Select from pull-down list	Select from pull-down list sf (default value listed; may be overridden) ofm Select from pull-down list or leave blank if N/A	Name Units As of P Ps P Vpsd dm Ras dmvsf Rps dm/p	
•		•••				erridden) If N/A	Sya	
6	370 0.14 354 0.14	0.80	0,111 0,111	0.80 370 8.1 14%	<u></u>		System 1170 2.600 5.0 M	
	15.67 0.04	1.08 1.02	0.06 0.06 5.00 5.00 740 1440 24.7 1426 1.00 1.00 1.00 1.00 1.00 1.00 0.03 0.10		100% 100%	E110 E111, 112 Office space Conference/m C eeting 230 1,45 23 1,45 23 1,45 23 1,45 23 1,40 17 17 17 17 17 140 17 17 17 18 140 17 17 18 140 17 18 140 17 18 18 18 18 18 18 18 18 18 18 18 18 18	Potentially Critical Zones Meet Mgmt. Multi-Purpose A & B	
		0.80	0.06 5.00 130.2 130.2 1.00 1.00 1.00 0.31		100% 1.00	E113, 114 Conference/m eeting 420 21 420 ITU 75%	198 Team Lockers	

OAT below which OA Intake flow is @ minimum	Outdoor Air Intake Flow required to System (Table 6.3 Method) OA Intake req'd as a fraction of primary SA (Table 6.3 Method) OA Tamp at which Min OA provides all cooling	Outdoor Air intake Flow required to System OA intake req'd as a fraction of primary SA	Ventilation System Efficiency (Table 5.3 Method) Minimum outdoor air Intake airflow	Zone Ventilation Efficiency (App A Method) System Ventilation Efficiency (App A Method)	System Ventilation Efficiency	Unused OA fraction required in supply air to zone	Fraction of zone OA not directly redire, from zone	Fraction of zone supply from fully intxed primary all	Fraction of zone suboly not directly redro. from zone	Unused OA requirement for tops	Total supply air to zone (at condition being analyzed)	OA rate per unit area for zone OA rate per person	Initial Calculations for Individual zones	Uncorrected OA regid as a fraction of primary SA	Primary supply air flow to system at conditioned analyzed	Detailed Calculations Initial Calculations for the System as a whole	Outdoor all as a % of design primary supply air	Outdoor air per unit floor area	Outdoor air intake required for system	Negulia Ventilation System Efficiency	Primary air traction or supply air at conditioned analyzed	Zone all distribution effectiveness at conditioned analyzed	Air distribution type at conditioned analyzed	Inputs for Operating Condition Analyzed	Local rectro, air % representative of ave system return air	Design total supply to zone (primary plus local rediroulated) Induction Terminal Unit: Dual Fan Dual Duct or Transfer Fan?	Design population of zone	Floor Area of zone	Space type	Zone Tag	Zone Name	OA regid per person for system area (weighted average) Inputs for Potentially Critical zones	OA req'd per unit area for system (Weighted average)	Population of area served by system (including diversity) Design primary supply fan ailflow rate	Floor area served by system	Innuite for Sustem	Units (select from pull-down list)	System Tag/Name:	Bullding:
	×ĕ	≺ √ot	Q	EV Z	-{	3 6	17	Ð	Fa	Noz		Raz	i	X age	N ps		Ypd 7	VotiAs	√ot	Ð	g	98	5	2	Ψ	Vdzd	នរ	43			Zone th	db	Ras	Ş Sed	As	Name	lb Annon	RTU 10	Kroc Center
Deg F	B	dm							1	am m	am	alm/sf		1	alm		din y		dim				» Select1	P.		Select f	υs	st peletti	Dalaat		0e turns p	amp	clim/st	а т m	ឡ (1116	linths	000	tion	enter
 - {(Tp-dTsf)-(1-Y)'(Tr+dTff 	 Vou / Ev Vot / Vps 	 Vou / Ev Vot / Vps 	 Value from Table 6.3 	 (Fa + FbXs - FcZ) / Fa min (Evz) 		 V0Z / V0Z 		• 中·	 B0 + (1-E0)Er 	 Rpz Pz + Raz Az Unalization 	1			 Vou / Vbs 	 VpdDs Pre De L Pa 							-	Select from pull-down list		and part of the second second	ofm Select from pull-down list or leave blank if N/A	(default value listed; may be overridden)	st Select II of II pull-down list			Zone the turns purple italic for critical zone(s)			TUU% diversity					
Y)'(Ti+dTi			able 6.3	FcZ)/Fa			9)(1-Er)		-	ZAZ				0.00	Δe											r leave blar	d; may be (al zone(s)			versity	L				
•	••	• •	ł	• •		• •	•	•	• •	• •				• •	• •								Г			nk If N/A	overridder					Γ			e y	22			
cn	1245 0.27	1142 0.25	0.81	0.89									l	0.22	4530		25%	0.25	1142	0.89	$\left \right $	ТТ	8	2002			J	Т	S	2	-	0	0.09	4,530	4500	stam			
				1.01	ļ	0.21	1.00	1.00		141.1	660	5.00									100%	1.00	8	TeUUF	75%	8	22.75	455	eeting conterence/m		VAV \$1.10 \								
				1.02		0.20	1.00	1.00	1 1 1 1 1	141.1	700	5.00									scnnt	1.00	S	100eL	75%	2	22.75	45	conference/m (D105	VAV \$1.11	Potent							
				1.08		0.14	1.00	1.00		44.6	320	5.00									100%	1.00	8	100sc	75%	2	4	410	Office space N	129	51.11 VAV \$1.12 VAV	lally Critical Zo							
				0.89		0.34	1.00	1.00	1.0	457.2	1360	7.50									100%	1.00	SO	100eL	75%	1360	50.8	1070	Mall common areas	109	\$1.13	nes							
				1.07		0.10	1.00	1.00	1	229.2	1490	0.12									100%	1.00	SD SD	100%	75%	1490		1010	roome	D130, 131, 132, 135, 136	VAV \$1.14								

Appendix B

Fixture A B C D E Total Watt/Fixture Total Watts A1 11 5 2 18 45 810 A1G 7 2 9 445 405 A2 13 2 6 21 66 1386 A3 4 4 453 212 B1 22 22 250 5500 B2 266 266 250 6500 B4 12 12 120 1440 B5 10 10 120 1200 BF 1 1 120 120 120 C1 8 10 8 26 28 1848 C3 6 6 66 28 1448 C3 6 2 2 240 480 D11 2 2 2 240 480 D11 3
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A2 13 2 6 21 66 1386 A3 4 4 53 212 B1 22 22 250 5500 B2 26 26 26 26 6500 B4 12 12 12 120 1440 B5 10 10 120 1200 120 BF 1 1 120 120 120 BF2 1 1 120 120 120 C1 8 10 8 26 28 728 C2 60 6 66 28 1848 C3 6 6 66 28 1848 C3 6 2 2 162 162 D10 3 3 180 540 D11 2 2 2 240 480 D14 4 3 13 105 315 D2 10 3 3 105 315 140<
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B1 22 26 26 26 26 26 26 26 5500 B4 12 12 12 120 1440 B5 10 10 10 120 1200 BF 1 1 10 120 1200 BF2 1 1 120 120 120 C1 8 10 8 26 28 728 C2 60 6 66 28 1848 66 28 1848 C3 6 6 6 90 540 D1 2 2 1 1 6 27 162 D10 3 3 13 70 910 910 910 D2 10 3 13 70 910 910 D2L 3 3 35 210 910 910 910 D2S 6 6
B2 26 26 26 250 6500 B4 12 12 12 120 1440 B5 10 10 10 120 1200 BF 1 1 10 120 1200 BF2 1 1 1 120 120 C1 8 10 8 26 28 728 C2 60 6 6 28 1848 C3 6 6 90 540 D1 2 2 1 1 6 27 162 D10 3 3 13 180 540 D11 2 2 2 240 480 D14 4 4 35 140 D2 10 3 13 70 910 D2L 3 3 105 315 15 D2S 6 6 35
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D5 36 36 45 1620 D6 15 15 17 255 D8 1 1 180 180 D9 4 4 90 360 F1 87 23 17 4 9 140 35 4900 F1D 18 8 26 35 910 F2 15 7 22 35 770 F3D 7 7 35 245
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D8 1 1 180 180 D9 4 4 90 360 F1 87 23 17 4 9 140 35 4900 F1D 18 8 26 35 910 F2 15 7 22 35 770 F3D 7 7 35 245
D9 4 4 90 360 F1 87 23 17 4 9 140 35 4900 F1D 18 8 26 35 910 F2 15 7 22 35 770 F3D 7 7 35 245
F1 87 23 17 4 9 140 35 4900 F1D 18 8 26 35 910 F2 15 7 22 35 770 F3D 7 7 35 245
F1D 18 8 26 35 910 F2 15 7 22 35 770 F3D 7 7 35 245
F2 15 7 22 35 770 F3D 7 7 7 35 245
F3D 7 7 35 245
F4 6 9 10 4 31 35 1065
H1 20 20 324 6480
H2 21 21 240 5040
K1 2 1 3 6 45 270
K1 Z 1 3 0 43 270 K1E 8 6 6 5 3 28 45 1260
L1 3 3 90 270
L2 2 2 90 180
L3 1 1 45 45
M1 19 8 33 1 12 73 60 4380
M1D 6 6 6 60 360
MIG 4 2 6 6 60 360
M2 27 19 46 34 1564
M2G 7 7 34 238
M3 18 12 30 45 1350
N 28 28 70 1960

N2			4			4	79	316
Q1				14	18	32	820	26240
Q2				2		2	820	1640
Q4			2	19	23	44	60	2640
R		1				1	66	66
S1	8	3	9	3	1	24	28	672
S1A			3		2	5	45	225
S2	4	10	6	11		31	88	2728
S2A					9	9	88	792
S3					2	2	27	54
T1		76				76	75	5700
T2		4				4	300	1200
T3	13					13	150	1950
T4		4	15			19	34	646
U1				2		2	28	56
U2		3				3	22	66
V6		1				1	85	85
W1				6	16	22	45	990
X1		1	6	6	6	19	5	95
X2	20	11	8			39	5	195
X3	1					1	10	10
XW			3			3	5	15
Y		4		4	4	12	10	120
YW			12			12	10	120

Total Lighting Wattage:	104998
Building SF:	92000

Total W/SF:	1.14
Required W/SF:	1.2
Compliance:	Yes