T R U M P

INTERNATIONAL HOTEL & TOWER

C H I C A G O

Mechanical Technical Assignment One
ASHRAE Standard 62.1 & 90.1 Compliance Evaluation

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EXECUTIVE SUMMARY

MECHANICAL SYSTEMS SUMMARY

The mechanical systems of Trump International Hotel & Tower in Chicago have been evaluated for compliance with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 62.1 – 2007 *Ventilation for Acceptable Indoor Air Quality* and Standard 90.1-2007 *Energy Standard for Buildings Except Low-Rise Residential Buildings*. This evaluation will determine if the mechanical system is able to provide proper ventilation, adequate air quality and meet minimum system efficiency set forth by the criteria described in ASHARAE Standards 62.1 and 90.1. The Ventilation Rate Procedure as described in Section 6 of ASHRAE Standard 62.1 was used to determine compliance with minimum ventilation requirements and is based upon floor areas, space utilization, occupancy and type of ventilation system. The layout and design of the ventilation system was analyzed for compliance with the criteria of Section 5 of ASHRAE Standard 62.1 to ensure clean outdoor air is supplied to building occupants, that contaminated air is exhausted, and the system is designed to maintain cleanliness of handled air.

Compliance with minimum criteria of ASHRAE Standard 90.1 is incomplete at the time of writing this report. System component efficiencies cannot be evaluated at this time because installed system efficiencies are not known. As further information on efficiencies and values of actual building components including the HVAC systems, service water heating, power, lighting, and electric motor efficiency are available, analyses will be performed. The exterior glazing of Trump Tower is nearly 100%, and therefore the Building Envelop Trade-Off Option will have to be used for compliance when further energy analyses are performed. In addition, no lighting power density complied with ASHRAE Standard 90.1 maximum values except mechanical room lighting.

Trump Tower is served by a central chilled water plant consisting of two 1175 ton and two 1225 ton electrical centrifugal chillers arranged for parallel operation located in the mechanical room on lower level 4. Heat from each condenser is rejected to the Chicago River by means of 25,000 total gpm of condenser water. On the air side, there are 8 Air Handling Units that provide conditioned air to the occupied spaces in Phase 1. Their location, capacity service, and ventilation compliance are summarized in Table 1.

Table 1: Summary of Ventilation Compliance of each Air Handling Unit

Location	AHU	Service	CFM	Min. OA	Required OA	Comply?
M1	M1.1	Lobby, Retail & Circulation	110,000	20,000	19960	yes
M1	M1.2	Lobby, Retail & Circulation	110,000	20,000	19960	yes
M1	M1.3	Chiller Room	8,000	4,000	N/A	N/A
M2	M2.1	Health Club And Night Spa	60,000	19,800	17142	yes
M2	M2.2	Hotel Amenities	100,000	20,000	18038	yes
M2	M2.3	Kitchen	Determined By Mech. Contractor		N/A	N/A
M3	M3.1	Hotel Corridor Make Up	28,200	28,200	21226	yes
M3	M3.3	Hotel Corridor Make Up	28,200	28,200	21226	yes

BUILDING SUMMARY

Trump International Hotel & Tower is a 92 story skyscraper rising over 1360' and houses of a variety of mixed use program spaces including retail, parking, a health club, hotel and condos. The total overall enclosed area will be more than 2,600,000 gross square feet, including 4 below grade levels. The building is divided into 7 primary occupancy zones divided by mechanical floors as shown in Figure 1.

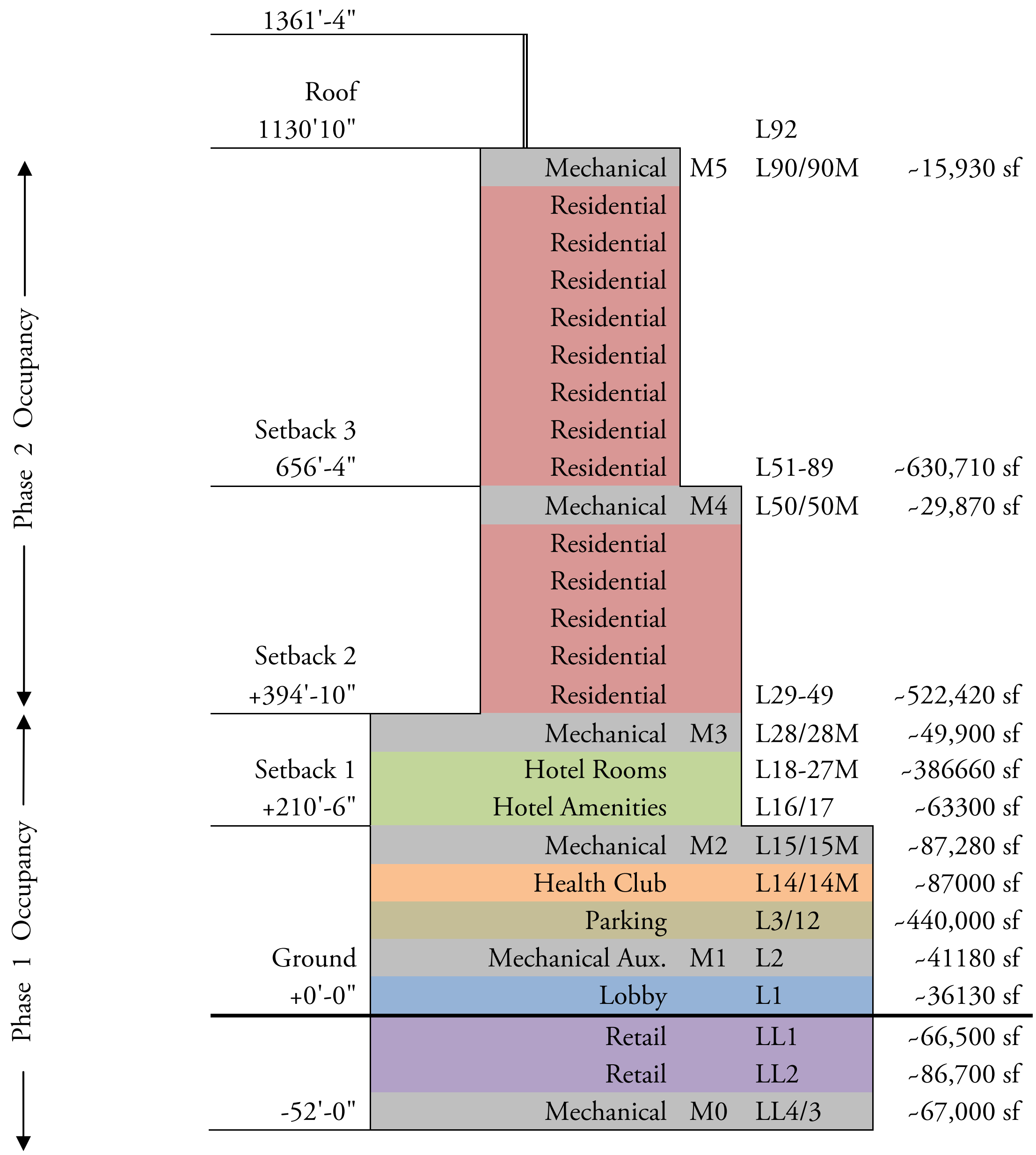

Figure 1: Primary Program Space and Approximate Floor Areas

VENTILATION RATE PROCEDURE

The data utilized herein were obtained from the relevant drawings and ASHRAE standards. It is of note that the mechanical delivery method is 'design assist'. It is of note that the mechanical delivery method is 'Design Assist.' The mechanical engineer has created the set of drawings to be used for pricing and the final mechanical design decisions will be made by the contractor and approved by the engineer through submittals. The area takeoffs, the mechanical system information and capacities obtained from this incomplete set of drawings have been used in the calculations herein and may not be accurate or representative of the actual installed systems and capacities.

SYSTEMS SELECTED FOR COMPLIANCE

The building was designed to be opened in two primary phases. Design firms and contractors had to address concerns protecting/separating hotel guests from the construction and making sure all building functions would operate flawlessly during the construction of the rest of the tower. Careful coordination of the various trades has allowed this phased occupancy. The first phase consists of the hotel, parking, health club and retail portion of the building below the residential condos. Strict separation of systems, spaces and occupancy circulation gave approved by the city of Chicago and this phase has been occupied since January 30, 2008. Phase two, the upper residential portions of the building is set to open in late 2009. In order to perform a more thorough and in-depth evaluation of the building systems, the second residential phase of occupancy will not be analyzed in the scope of this comprehensive senior thesis.

ASSUMPTIONS

- To maintain a concise report and to avoid redundancy, repeated and similar spaces were not uniquely evaluated for compliance with standard 62.1. In addition, the calculations for the Air Handling Units used a simplified block load estimation to avoid complexity.

- Architectural Interiors Drawings for each room provided the correct design occupancy value (Pz). In the event that the occupancy value could not be obtained from the drawings, Occupant Density values from Table 6-1 ASHRAE 62.1 were used to determine appropriate occupant densities.

- Zone floor areas (Az) were obtained from the Architectural Interiors Plans provided.

- The zone air distribution effectiveness (Ez) is assumed to be 1.0 because the system supplies cool air from the ceiling.

- Zone primary air flows (Vpz) were obtained from the mechanical plans provided as the amount of air being supplied through each diffuser in each zone.

- Occupancy diversity (D) is assumed to be a conservative value of 1.0 because the system population is not known. System compliance was derived from occupancy densities of space primary occupancy types.

- Mechanical rooms, restrooms, the vault, data rooms, elevator shafts, janitor closets, are exempt from these calculations because no outdoor air is supplied to those spaces. Any outdoor air requirements are assumed to be met by makeup air and overall building pressurization.

- The parking garage space was analyzed for compliance with minimum Exhaust Rates rather than with minimum ventilation air as per ASHRAE Standard 62.1.

- Space occupancies were correlated with their space utilization and assumptions had to be made for certain occupancy types.

SUMMARY OF COMPLIANCE

Most of the spaces within Trump Tower met the minimum ventilation requirements set forth by the ventilation rate procedure. There were a few spaces, however, which did not meet the minimum ventilation requirements of ASHRAE Standard 62.1 including a few administrative offices on the 2nd floor, the health club locker rooms and a studio on the 14th floor, as well as the employee cafeteria and a banquet hall on the 15th and 16th floor respectively. Please refer to Table 3 and Table 4 for a complete summary of compliance.

The parking garage floor ventilation systems comprise of four exhaust fans (two in the case of Level 3) removing 35,000 total CFM per floor of parking garage. With 44,410 GSF of garage space on each floor, ventilation exhausts greater than 0.80 CFM/SF of air. This exceeds the minimum exhaust rate of 0.75CMF/SF. Exhaust fans are located on the Plan West side of the building and air intake louvers to provide 35,000 CFM of makeup outdoor air are provided on the Plan East side of the building. This will ensure steady outdoor air flow across the parking garage floor.

DISCUSSION OF PROBLEM OR OPPORTUNITY AREAS

Several of the spaces did not meet ventilation requirements based upon the assumptions, calculations and data herein. The mechanical engineer may have utilized varied assumptions in their own calculation to determine the ventilation rate procedure compliance. For example, many of the office spaces had a single desk along with other furniture for visitors, small meetings, and clients. Several of the offices had four person tables shown on the drawings. In this calculation, the zone occupancy was determined by the number of chairs shown on the interior fit-out drawings and may not be representative of the actual space occupancy. All calculations and assumptions are based upon maximum occupancy and similarly, the occupancy of the locker rooms, cafeteria and banquet hall may not be as high as assumed for this calculation.

There is a significant supply of fresh air in the lobby spaces of the building where occupants will presumably be transient. Perhaps it is because those spaces have a significant void volume and supplying a significant CFM of ventilation air ensures the desired number of air changes. This would prevent stagnant pockets of air where undesirable concentrations of particulate matter, temperature differences and impurities can linger. In these spaces air is supplied from both the floor and the ceiling along the curtain wall, and is returned at the top of the atrium at the interior of the space. Returning the air at the ceiling will ensure removal of stagnant air but may cause short circuiting of the ceiling supplied ventilation. The significant volume of supply air should address this potential problem.

The parking garage levels are enclosed and pose particular problems for indoor air quality. They should have proper sensors to ensure adequate indoor air quality. These sensors should address the concerns of emission of monoxide from vehicular exhaust as well as gasoline fumes, nitrogen oxide, and carbon particulate matter from diesel engines. In addition, the spaces should be adequately sealed from other spaces by either physical seals or pressurization. If the exhaust fans were sized to be larger than the intake louvers, this would ensure air being drawn from other occupied spaces. The exhaust fans are sized to the same CFM as the intake louvers, however, which may prevent creating negative pressurization. If the garage vestibule and lobby areas are not positively pressurized, exhaust fumes may be able to enter these spaces.

Critical zones such as the indoor pool, require a high level of system reliability. It is crucial that the water vapor from the indoor pool be continuously controlled to prevent indoor air quality issues. Any proposed system, particular for the indoor pool space, must have a large mean time between failures and a short time for repairs. The system must be able to consistently function as designed throughout the lifetime of the system. The pool contributes an extremely large latent load and the temperature must be maintained a minimum of two degrees below the air temperature to prevent the latent load from becoming even larger. Also the locker rooms and any aerobic spaces should be kept comfortable and well ventilated to avoid build-up of odors. To adequately control these loads, a specialized natatorium dehumidification unit should be used separately from the conditioning system of the rest of the building.

AREA & SPACE CHARACTERISTIC TABLE

Table 2 (Continued on Next Page): Floor Program Use Matrix

Program Use	Floor Number	Floor Area	Void	Parking	Health Club	Retail	Hotel Rooms	Corridor	Mech
Mech. Mezz	M3M	14,750	20,400				320	900	13,530
Mechanical	M3	35,150					320	900	33,930
Hotel	PH-1	35,150					31,560	2,720	
Hotel	27	35,150					31,560	2,720	
Hotel	26	35,150					31,560	2,720	
Hotel	25	35,150					31,560	2,720	
Hotel	24	35,150					31,560	2,720	
Hotel	23	35,150					31,560	2,720	
Hotel	22	35,150					31,560	2,720	
Hotel	21	35,150					31,560	2,720	
Hotel	20	35,150					31,560	2,720	
Hotel	19	35,150					31,560	2,720	
Hotel	18	35,150					32,160	2,720	
Hotel Ammenities	17	28,140	7,010				24,680	3,000	
Hotel Ammenities	16	35,150					31,680	3,000	
Mech. Mezz	M2M	43,110	1,300				12,210	1,010	29,890
Mechanical	M2	44,410					980	1,010	42,420
Health Club	14-MZ	29,320	15,090	160	25,380		570	1,010	
Health Club	14	44,410		160	40,550		570	1,010	
Parking	12	44,410		39,980	0		570	1,010	
Parking	11	44,410		39,980	0		570	1,010	

Table 2 (Continued from Last Page): Floor Program Use Matrix

Parking	10	44,410		39,980	0		570	1,010	
Parking	9	44,410		39,980	0		570	1,010	
Parking	8	44,410		39,980	0		570	1,010	
Parking	7	44,410		39,980	0		570	1,010	
Parking	6	44,410		39,980	0		570	1,010	
Parking	5	44,410		39,980	0		570	1,010	
Parking	4	48,210		42,560	0		570	1,010	
Parking	3	46,570	1,640	42,190	0		570	1,010	
Mechanical	M1	39,770	1,640	4,030	0		570	1,010	34,160
Lobby Mezz.	MZ	22,540	8,530	4,030	0	10,750	4,350	5,720	Lobby
Ground Lobby	1	29,630	1,640	4,390	0	5,350	4,310	15,730	Lobby
Total Above Grade		1,161,660		417,360	65,930	16,100	434,020	74,320	153,930
Mezzanine	LL1	66,520	11,130	18,860	0	39,160	720	7,780	0
Lower Ground	LL2	86,700	0	16,800	0	38,360	1,700	23,340	6,500
Lower Level 3	LL3	28,780	19,660	9,060	0	0	0	18,080	1,640
Lower Level 4	LL4	38,190	0	0	0	0	0	1,450	36,740
Total Below Grade		220,190		44,720	0	77,520	2,420	50,650	44,880
Total Areas		1,381,850		462,080	65,930	93,620	436,440	124,970	198,810

OUTSIDE AIR REQUIREMENTS BY SPACE FOR EACH SYSTEM EVALUATED

Please refer to Table 3 & 4.

SUMMARY OF ZP VALUES FOR EACH SPACE

Please refer to Table 3 & 4. The maximum Zp value is highlighted and is 0.5 in the women's locker room in the health club on floor 14.

Table 3: Outside Air Requirements by Space

ASHRAE STANDARD 62.1 & 90.1 EVALUATION

AHU	Level	Zone	Function	Az (SF)	Pz	Ra	Rp	Ra*Az	Pz*Rp	Voz	Vpz	Zp	Ev	Min. OA	OA/Voz	Comply?	Notes
AHU M1.1,2	1	Entry Vestibule 1	Lobbies/prefunction	770	23	0.1	7.5	46	173	219	950	0.23	0.91	238	1.1	yes	
AHU M1.1,2	1	Hotel Lobby	Lobbies/prefunction	2090	63	0.1	7.5	125	473	598	9600	0.06	0.98	2400	4.0	yes	
AHU M1.1,2	1	Condo Lobby	Lobbies	2030	59	0.1	5	122	295	417	9140	0.05	0.98	2285	5.5	yes	
AHU M1.1,2	1	Entry Vestibule 3	Lobbies/prefunction	2110	63	0.1	7.5	127	473	599	4940	0.12	0.95	1235	2.1	yes	
AHU M1.1,2	1	NIC Tenant Buildout	Retail Sales	4920	74	0.1	7.5	590	555	1145	4000	0.29	0.89	1000	0.9	no	
AHU M1.1,2	1	Entry Vestibule 2	Lobbies/prefunction	580	17	0.1	7.5	35	128	162	3200	0.05	0.98	800	4.9	yes	
AHU M1.1,2	1	Lobby Lounge	Lobbies/prefunction	1030	31	0.1	7.5	62	233	294	3620	0.08	0.97	905	3.1	yes	
AHU M1.1,2	1	Mail Room	Shipping/Receiving	1160	12	0.1	0	139	0	139	1000	0.14	0.94	250	1.8	yes	
AHU M1.1,2	2	IT Manager Office	Office Space	120	1	0.1	5	7	5	12	150	0.08	0.97	38	3.1	yes	
AHU M1.1,2	2	Data Room	Computer (not printing)	160	1	0.1	5	10	5	15	0	--	--	0	0.0	no	1
AHU M1.1,2	2	Conference Room	Conference/meeting	400	18	0.1	5	24	90	114	390	0.29	0.88	98	0.9	no	
AHU M1.1,2	2	Spare Office	Office Space	130	1	0.1	5	8	5	13	150	0.09	0.97	38	2.9	yes	
AHU M1.1,2	2	Director Of Rooms	Office Space	200	9	0.1	5	12	45	57	180	0.32	0.87	45	0.8	no	
AHU M1.1,2	2	Conf. Service Managers	Office Space	200	2	0.1	5	12	10	22	200	0.11	0.96	50	2.3	yes	
AHU M1.1,2	2	Director of Conf.	Office Space	170	9	0.1	5	10	45	55	180	0.31	0.88	45	0.8	no	
AHU M1.1,2	2	CAT Managers	Office Space	210	2	0.1	5	13	10	23	260	0.09	0.97	65	2.9	yes	
AHU M1.1,2	2	Reserve Manager	Office Space	80	3	0.1	5	5	15	20	90	0.22	0.91	23	1.1	yes	
AHU M1.1,2	2	Reservations	Office Space	370	4	0.1	5	22	20	42	340	0.12	0.95	85	2.0	yes	
AHU M1.1,2	2	F&B Director	Office Space	160	5	0.1	5	10	25	35	150	0.23	0.91	38	1.1	yes	
AHU M1.1,2	2	Sales Manager	Office Space	290	4	0.1	5	17	20	37	340	0.11	0.96	85	2.3	yes	
AHU M1.1,2	2	Marketing Director	Office Space	130	7	0.1	5	8	35	43	150	0.29	0.89	38	0.9	no	
AHU M1.1,2	2	ADIOS	Office Space	90	3	0.1	5	5	15	20	140	0.15	0.94	35	1.7	yes	
AHU M1.1,2	2	General Manager	Office Space	250	9	0.1	5	15	45	60	220	0.27	0.89	55	0.9	no	
AHU M1.1,2	2	Controller	Office Space	140	7	0.1	5	8	35	43	120	0.36	0.86	30	0.7	no	
AHU M1.1,2	2	Assistant Controller	Office Space	90	3	0.1	5	5	15	20	90	0.23	0.91	23	1.1	yes	
AHU M1.1,2	2	Vault	Bank Vault/safe deposit	40	0	0.1	5	2	0	2	0	--	--	0	1.0	no	1
AHU M1.1,2	2	Account Workroom	Telephone/data entry	400	4	0.1	5	24	20	44	400	0.11	0.96	100	2.3	yes	
AHU M1.1,2	2	Acct Archive	Storage Rooms	650	0	0.1	0	78	0	78	1000	0.08	0.97	250	3.2	yes	
AHU M1.1,2	2	Corridor	Corridor	840	0	0.1	0	50	0	50	260	0.19	0.92	65	1.3	yes	
AHU M1.1,2	2	F&B Analysis	Office Space	110	3	0.1	5	7	15	22	90	0.24	0.90	23	1.0	yes	
AHU M1.1,2	2	Reception	Reception Area	1040	11	0.1	5	62	55	117	750	0.16	0.94	188	1.6	yes	

Notes:1. There is no direct ventilation supplied to this space

Table 4: Outside Air Requirements by Space

Exhaust Fan	Level	Zone	Function	Az (SF)			Exhaust				Min Required					Comply?	Notes
EF 3.1,2,3,4	3	Parking	Parking Garages	42190			35,000	0.83	CFM/SF		0.75	CFM/SF				yes	1,3
EF 4.1,2	4	Parking	Parking Garages	42560			35,000	0.82	CFM/SF		0.75	CFM/SF				yes	1,3
EF 5.1,2	5	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		0.75	CFM/SF				yes	1,3
EF 6.1,2	6	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		0.75	CFM/SF				yes	1,3
EF 7.1,2	7	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		0.75	CFM/SF				yes	1,3
EF 8.1,2	8	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		0.75	CFM/SF				yes	1,3
EF 9.1,0	9	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		0.75	CFM/SF				yes	1,3
EF 10.1,1	10	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		0.75	CFM/SF				yes	1,3
EF 11.1,2	11	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		1.75	CFM/SF				yes	1,3
EF 12.1,2	12	Parking	Parking Garages	39980			35,000	0.88	CFM/SF		2.75	CFM/SF				yes	1,3
M2.19	14	Indoor Pool	Swimming Pool	4150			5500	1.33	CFM/SF		0.48	CFM/SF				yes	2
AHU	**Level**	**Zone**	**Function**	**Az (SF)**	**Pz**	**Ra**	**Rp**	**Ra*Az**	**Pz*Rp**	**Voz**	**Vpz**	**Zp**	**Ev**	**Min. OA**	**OA/Voz**	**Comply?**	**Notes**
AHU M 2.1	14	Fitness Center	Health Club	2610	40	0.1	20	157	800	957	7600	0.13	0.95	1900	2.0	yes	
AHU M 2.1	14	Studio	Aerobics	680	15	0.1	20	41	300	341	1500	0.23	0.91	375	1.1	yes	
AHU M 2.1	14	Yoga Studio	Aerobics	760	12	0.1	20	46	240	286	800	0.36	0.86	200	0.7	no	2
AHU M 2.1	14	M. Lockers	Health Club	630	16	0.1	14	38	224	262	800	0.33	0.87	200	0.8	no	2
AHU M 2.1	14	W. Lockers	Health Club	680	16	0.1	12	41	192	233	470	0.50	0.80	118	0.5	no	2
AHU M 2.1	14	Reception	Reception Areas	720	6	0.1	5	43	30	73	300	0.24	0.90	75	1.0	yes	
AHU M 2.1	14	Corridor 1	Corridors	310	0	0.1	0	19	0	19	75	0.25	0.90	19	1.0	yes	
AHU M 2.1	14	Spa Treatment 1	Bedroom	210	2	0.1	5	13	10	23	160	0.14	0.94	40	1.8	yes	
AHU M 2.1	14	Spa Treatment 2	Bedroom	270	2	0.1	5	16	10	26	220	0.12	0.95	55	2.1	yes	
AHU M 2.1	14	Spa Treatment 3	Bedroom	290	4	0.1	5	17	20	37	300	0.12	0.95	75	2.0	yes	
AHU M 2.1	14	Spa Treatment 5	Bedroom	460	4	0.1	5	28	20	48	440	0.11	0.96	110	2.3	yes	
AHU M 2.1	14	Supplies	Storage Rooms	1200	0	0.1	0	144	0	144	750	0.19	0.92	188	1.3	yes	
AHU M 2.1	14	Overnight Spa Room	Bedroom	600	2	0.1	5	36	10	46	250	0.18	0.93	63	1.4	yes	
AHU M2.3	15	Employee Dining	Cafeteria	1220	90	0.2	7.5	220	675	895	2650	0.34	0.86	663	0.7	no	
AHU M2.2	16	Banquet Space 2	Restaurant/Dining	4320	150	0.2	7.5	778	1125	1903	5260	0.36	0.86	1315	0.7	no	
AHU M2.2	16	Prefunction Space	Restaurant/Dining	3210	100	0.2	7.5	578	750	1328	8423	0.16	0.94	2106	1.6	yes	
AHU M2.2	16	Serving Pantry	Restaurant/Dining	3260	50	0.2	7.5	587	375	962	4620	0.21	0.92	1155	1.2	yes	
DOA AHU	**Level**	**Zone**	**Function**	**Az**	**Pz**	**Ra**	**Rp**	**Ra*Az**	**Pz*Rp**	**Voz**	**Vpz**	**Zp**	**Ev**	**Min. OA**	**OA/Voz**	**Comply?**	**Notes**
AHU M3.1,2	17-27	Hotel	Bedroom	31,560	50	0.1	5	1894	250	2144	5110	0.42	0.83	5110	2.4	yes	1

Notes:
1. There is no direct ventilation supplied to this space
2. Negative pressurization draws make up air to meet ventilation requirements.
3. Negative pressurization in this space draws outside air through exterior louvers to meet ventilation requirements.

COMPARISON OF NOMINAL AND REQUIRED OUTSIDE AIR FOR EACH AHU

When considered on a space by space method, it appears several of the spaces are not provided with the required minimum ventilation air as prescribed by ASHRAE Standard 62.1. The engineer may have had varied assumptions as compared to those made in this report, such as the occupancy load within the space to create the compliance. The overall system, however, does balance and meets the minimum requirements. Many of the spaces are open to one another and much of the required ventilation air will be supplied through air transportation across zones and spaces. To determine required air flow, block loads were considered for each air handling unit based upon the primary function of the spaces served, and space populations were determined from occupant densities from ASHRAE Standard 62.1.

Table 5: Air Handling Unit Compliance Summary

AHU	Primary Function	Az (SF)	Pz	Ra	Rp	Ra*Az	Pz*Rp	Voz	Vpz	Comply?
M1.1, M1.2	Lobby	140,070	4202.1	0.06	7.5	8404	31516	39920	40000	yes
M2.1	Health Club	65,930	659.3	0.06	20	3956	13186	17142	19800	yes
M2.2	Hotel Ammenities	63,290	1898.7	0.06	7.5	3797	14240	18038	20000	yes
M3.1, 3.2	Hotel Make Up	386,650	3866.5	0.06	5	23199	19333	42532	56400	yes

SUPPORTING CALCULATIONS

Please see spreadsheet equations for all supporting calculations.

ASHRAE STANDARD 62.1 SECTION 5 COMPLIANCE

SUMMARY OF COMPLIANCE WITH AIR INTAKE SEPARATION

Table 6: Compliance With Minimum Air Intake Separation Distance

Air Intake Minimum Separation Distance	Minimum Distance	Actual Distance
Significantly contaminated exhaust	15	37
Noxious or dangerous exhaust	30	>>25
Vents, chimneys, and flues from combustion applicances and equipment	15	36
Garage entry, automobile loading area, or drive-in queue	15	43
Truck loading area or dock, bus parking/idling area	25	>>25
Driveway, street, or parking place 5	5	21
Thoroughfare with high traffic volume	25	>>25
Roof, landscaped grade, or other surface directly below intake	1	12
Garbage storage/pick-up area, dumpsters	15	17
Cooling tower intake or basin	15	N/A
Cooling tower exhaust	25	N/A

SOURCE OF EXTERIOR HUMIDITY

Humid air must only enter the building while being controlled. Sources of humidity in the outside air come from the close proximity of the building to the Chicago River and Lake Michigan. Evaporation from these large fresh water bodies will be a significant source of water vapor coming in contact with the building envelope. The 680,000 SF of curtain wall system on Trump Tower relies on a dry-seal gasket with pressure plates to prevent infiltration of moisture and vapor. The proper installation of these gaskets to create an adequate seal is imperative to prevent water vapor from condensing unintentionally on these surfaces.

INDOOR POOL AIR QUALITY AND CONDENSATION DISCUSSION

Indoor pools often create problems in other parts of the building whether it is an undesirable odor or the promotion of mold growth. Both of these are results of the high humidity and treatment of the water in the pool. If the water vapor condenses in the metal duct system or on any steel in the structure it can cause corrosion and mold growth. It is imperative that any ductwork supplying air below the dew point be insulated. Because the evaporation of the pool water also governs the thermal loads it is reasonable that the quality of the pool water is directly linked to that of the air. Two goals in mitigating indoor air quality problems as a result of the pool are maintaining clean water, for clean air; and maintaining a low average humidity, to reduce the likelihood of unwanted condensation.

For many years the conventional method for cleaning pool water has been through chlorine treatment. While accepted as general practice, this can create a dangerous or costly situation. When chlorine is combined with the organics such as sweat or urine it reacts with the ammonia, also a toxic chemical, and forms aldehydes, chloroform, chloramines, and other noxious chemicals. Many of these chemicals have been linked to asthma and chlorine byproducts in water have been linked to pregnancy complications (Nickmilder & Bernard). Also, the vapor byproducts are hard on the ventilation system requiring additional maintenance and reducing the life of some equipment.

High humidity in pool areas can lead to problems similar to those caused by chlorine. If the humidity is allowed to condense it can cause mold growth inside the walls of the facility. This could cause a weakened immune system or an allergic reaction depending upon the person breathing the spores produced by the mold colony. Unfortunately the only way to solve this problem is to remove the material containing the mold, which means a very costly construction process and a lot of useless waste.

ASHRAE STANDARD 90.1 COMPLIANCE

LIGHTING POWER DENSITY

All installed lighting equipments are evaluated for compliance with the requirements for maximum Lighting Power Density (LPD) using the space by space compliance path defined in Section 9 of ASHRAE 90.1. Emergency lighting, space & automatic shutoff controls, wiring, and other applicable requirements were assumed for compliance, as not enough information is known about these systems. As summarized in Table 7, none of the spaces comply with the ASHRAE Standard 90.1 maximum lighting power density except the mechanical room lighting.

Table 7 Lighting Power Density (W/SF)

Space Occupancy	90.1 Max.	Connected	Comply?
Hotel Rooms	1.1	3	no
Conference Area	1.3	2	no
Enclosed Offices	1.1	2	no
Retail	1.7	12	no
Restaurant Dining	1.3	3	no
Fitness Center	1.4	5	no
Lobbies	1.1	6	no
Mechanical Rooms	1.5	1.5	yes
Service Corridors	0.5	1.5	no
Toilets	0.9	1	no
Storage Rooms	0.8	1	no
Loading Dock Area	0.5	1.5	no

BUILDING ENVELOPE

Three types of glazing make up the 680,000 SF of curtain wall system enclosing Trump Tower: vision panels, spandrel panels, and lobby/retail glass. The vision panels consist of Viracon VRE 1-59 glazing with 53% visibility, a winter U-Value of 0.3 and a 0.33 solar heat gain coefficient . The spandrel panels consist of similar glazing backed with insulation and coated with Viracon V-175 opacifier film. The lobby/retail glazing is a Pilkington Optiwhite clear, low iron glazing. The curtain wall system relies on a dry-seal gasket with pressure plates to prevent infiltration of moisture and vapor.

The roofing systems consist of lightweight concrete with a 1/8” per foot drainage slope. The waterproofing membrane, developed by American Hydrotech, is installed on top the concrete under a layer of insulation. The entire system is locked down by 30” x 30” concrete pavers. Portions of the roof terrace setbacks will be occupied with green roof components covering the pavers. The insulative value of the vegitated roof can be estimated but is not known. The crown rooftop will not be occupied and will have exposed concrete pavers.

Trump Tower is nearly 100% glazing, well over the 50% maximum set forth by the Building Envelope Requirements per table 5.5 of ASHRAE Standard 90.1. Therefore, in future energy analysis of the building, the Building Envelope Trade-Off Method will be used for further evaluation.

SYSTEM COMPONENT EFFICIENCY

None of the actual installed system components are known as the engineer has only laid out a system for pricing purposes. Each of the mechanical schedules has a sized piece of equipment but the manufacturer is to be determined by the mehcanical contractor. At the time of writing this constrcution documents with mechanical schedules have not been developed and/or obtained. Therefore actual component efficiencies can not be calculated for compliance with ASHRAE Standard 90.1. This portion of this report will be updated as information becomes available.

Although system efficiencies are not known, components of the installed design system as well as the baseline system must comply with the requirements for minimum efficiency, installation, verification, labeling, controls, and all applicable requirements of Section 6 of Standard 90.1. All service hot water heating system components must comply with minimum requirements for efficiency, piping insulation, controls and other applicable requirements of section 7 of Standard 90.1. Specifically, the pool water heating system must comply with section 7.4.5. The baseline HVAC system for the Performance Rating Method of simulation is determined from Table G3.1.1A of Standard 90.1.

DISCUSSION OF COMPONENTS

Energy efficiency is not the driving force of the Trump Tower design. A luxurious guest experience is given precedence whether the client is staying at the hotel, enjoying a meal at the restaurant, or relaxing in the spa and health club. This is apparent by the decisions to provide such a high lighting power density and to ensure incredible views with the extraordinarily high percentage of relatively clear glazing. Perhaps, with an integrated design approach, luxurious spaces can be achieved while maintaining energy efficiency and compliance with ASHRAE Standard 90.1.

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