THE NEW YORK TIMES BUILDING

620 EIGHTH AVENUE
NEW YORK, NEW YORK 10018

TECHNICAL REPORT TWO:
MECHANICAL SYSTEMS EXISTING CONDITIONS EVALUATION

AE 481W-Comprehensive Senior Project I
Building Mechanical & Energy Systems Option
IPD / BIM Senior Thesis

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EXECUTIVE SUMMARY

The New York Times Building (NYTB) is located on the west-side of Midtown Manhattan in New York City, New York. This 52-story building is 1.6 million square feet and offers high end office space and ground level retail. The following report provides a thorough description and evaluation of the mechanical systems existing conditions for the building. The report investigates certain requirements that influenced the design of the system including design objectives, site and cost influences, ventilation and load requirements and climatic conditions. Notable influences were the architectural components of the facade design including the use of a clear glazing and ceramic rods for passive external shading. Also, the New York Times Company's desire for a raised floor helped drive the decision to incorporate an under floor air distribution (UFAD) system. Cost was a driving factor as well. A $1 Million grant from the New York State Energy Research and Development Authority (NYSERDA) helped offset the initial investment in a cogeneration plant. Cost effectiveness also drove the decision to purchase steam from Consolidated Edison versus generating steam on site.

The NYTB's cooling load is served by a 6250 ton chilled water system while heating is provided via high-pressure steam purchased from the utility. Air distribution is achieved via variable air volume boxes for interior zones and fan powered boxes with heating coils for exterior zones. The floors occupied by the New York Times Company utilize an UFAD system, the first of its kind in a New York City high-rise. There is a cogeneration plant provides 1.4 MW of electricity for the building year-round. This report provides simplified schematics and control sequence descriptions of the existing mechanical systems. The descriptions include air distribution of a typical office floor, the chilled and condenser water system for the building, the cogeneration system, and the steam and heating hot water distribution system.

As part of an evaluation of the existing system, a breakdown of lost usable space, system first costs and a LEED evaluation was performed. In the lost usable space evaluation, spaces were broken down into mechanical, electrical and plumbing categories for each floor. A sum of the overall building-wide lost usable space was also determined, which includes dedicated MEP floors. The estimated lost usable space for each typical floor is 712 ft^2, which is 3.4% of the total typical floor area. Likewise, the estimated lost usable space for the entire building is 97,573 ft^2, which is 9.2% of the overall building floor area.

For the mechanical system first cost estimation, no concrete numbers where provided by the designer or contractors. However, an estimation of 17.49% of the overall building cost was made for the mechanical systems. Given a rough overall building cost of 1 billion dollars, the estimate for the mechanical systems was determined to be $174,000,000.

Building performance was evaluated under the LEED 2009 v.3 for new construction in both the "energy and atmosphere" and "indoor air quality" categories. In these categories there are a total of 40 possible credits which are applicable to mechanical systems. It was determined that 11 credits were clearly met, and another 8 credits would be attainable if more information was available. The NYTB was not designed to LEED specifications, and it is unclear as to whether the building would have received a certification. However, the performance evaluation results for the mechanical systems indicate that a LEED certification would have been difficult to attain for the existing design without additional measures.

BUILDING OVERVIEW

The New York Times building was designed to meet the plaNYC 2030 initiative, which strives to improve the built environment by reducing green house gas emissions by 30 percent. There were several integrated design approaches taken to meet these goals. Flack and Kurtz worked alongside architects Renzo Piano and FXFOWLE to provide Mechanical, Electrical, Plumbing, Fire protection and Telecommunications design for the core and shell. Flack and Kurtz also partnered with Gensler to design the interior fit-out. Using an integrated approach, a high performance facade was developed which uses low iron clear glass and ceramic rods for passive external shading.

The building cooling load is served by a 6250 ton chilled water system, which consists of five 1,200 ton centrifugal chillers and one 250 ton single stage absorption chiller. The chilled water is pre-cooled by the absorption chiller before it enters the centrifugal chillers. A natural gas-fired cogeneration plant with two parallel reciprocating engines provides the waste heat to run the absorption chiller. Both the chilled and condenser water system utilizes a variable flow primary pumping scheme, and a water-side economizer which provides "free cooling" and increased energy savings. Heating for the building is provided via high-pressure steam purchased from Consolidated Edison. Low-pressure steam is then distributed to each floor-by-floor air handler's heating coil. As an added cost, the New York Times Company also uses steam to humidify outdoor air.

Air distribution is achieved via variable air volume boxes for interior zones and fan powered boxes with heating coils for exterior zones. The floors occupied by the New York Times utilize an UFAD system. Swirl diffusers were installed to provide occupant control, while in high occupancy spaces perforated floor tiles provide a more visually pleasing layout. A traditional overhead ducted system was implemented on the Forest City Ratner floors. Demand controlled ventilation is achieved via carbon dioxide and VOC sensors located in the return ducts for each floor. Outdoor air is brought in through outdoor air units in the two mechanical penthouses on the 28th and 51nd floors, and then is distributed throughout the building.

The cogeneration plant provides 1.4 MW of electricity for the building year-round, and is located on the 5th floor roof of the podium building. With an efficiency of 85%, the plant provides 40% of the power needs of the New York Times Company. The plant waste heat is used in an absorption chiller to pre-cool the chilled water for the electrical chiller plant. Waste heat is also used to produce perimeter heating hot water in the winter months. The cogeneration plant's primary purpose is an uninterrupted power supply for critical spaces such as the New York Time's data center. The cogeneration plant is not connected to the grid for re-metering, but the site is backed up by on-site diesel generators.

DESIGN REQUIREMENTS

DESIGN OBJECTIVES & REQUIREMENTS

Several objectives and requirements drove the design of the NYTB's systems and controls. The New York Times Company and real estate developer Forest City Ratner Companies set to achieve high profile sustainability, enhanced indoor air quality, space optimization, flexibility and adaptability, and cost-effectiveness. To meet these needs, the mechanical designers worked closely with the architecture, interiors and lighting specialists to achieve the goals of the design intent. Among the most visible of the design requirements was a high performance envelope. Architecturally, a completely clear glass façade was desired to symbolize the transparency of the New York Times as a leader in the journalism industry. To allow for this entirely transparent façade, ceramic shading rods provided a sunscreen to reduce solar contribution to the cooling load and minimize glare on an occupant's computer screen. To enhance this, dimmable lighting and automated shades were a major design feature.

Contributing to the intent of a high profile sustainable office tower, an UFAD system was selected. Other requirements influenced this decision, including the fact that there was already a desire for a raised floor system to accommodate the telecommunication cables. Flexibility was of great importance to the New York Times Company and the UFAD system allowed for the rearrangement of diffusers as the needs of the occupants changed with time. The UFAD system would provide enhanced indoor air quality, a design requirement of the New York Times, by providing displacement ventilation as opposed to the more turbulent overhead systems. Another response to the requirement of enhanced IAQ was humidification for the New York Times floors. Demand controlled ventilation was achieved through CO2 and VOC sensors in each floor's return duct. This minimized the outdoor airflow while maintaining acceptable levels IAQ. Outdoor air was centrally dehumidified so that the floor by floor air handlers could operate with dry coils. This minimizes maintenance and long-term microbial growth, which can have significant impacts on IAQ. To further the effectiveness of this system, Neoprene sealant was used to prevent leaking during construction and CFD modeling was performed to optimally locate diffusers.

Aesthetics were a major factor in several of the design decisions. The decision to replace the swirl diffusers with perforated carpet tiles in the larger conference rooms was driven by aesthetic purposes. It was believed that too many diffusers in one area would be distracting to the eye. Also, aesthetics, along with shading criteria drove the design of the ceramic rods on the exterior of the façade.

Sustainability and cost effectiveness were major driving factors for the decision to incorporate a cogeneration plant to serve the NYTB. The NYTB's data center requires an enormous amount of electricity and the cogeneration plant provides that power with less pollutants per kWh compared to that of the grid. It reduces the need for power drawn from the grid, especially when it comes to the building's cooling load. Waste heat from the plant is supplied to an absorption chiller to reduce the load on the electric chiller plant. Also, the cogeneration plant is not connected to the grid but rather standalone with separate distribution. It is backed up however by onsite diesel generators and the grid.

ENERGY SOURCES & RATES FOR SITE

Table 1 describes the energy sources and rates for the NYTB.

To determine the electric rates, typical monthly utility bills from Consolidated Edison were used from January and July. The rate reflects an annual rate from the average of the monthly rates. Flat rates were used because the utility data does not go into that amount of detail. There are no specific on/off-peak conditions, but it is assumed that this monthly average reflects typical usage patterns. It was assumed the NYTB is a large consumer (250 KW). The monthly rate was based on the average of the total electric charge per KWh used for the large consumer bracket.

To determine the natural gas rates, typical monthly utility bills from Consolidated Edison were used from January and July. The rate reflects an annual rate from the average of the monthly rates and was based on a monthly gas bill from a typical commercial or industrial customer.

The steam rates were based on Consolidated Edison's published steam utility rates under the Service Classification 2 billed under Rate 2. The rate is given as an average of the seasonal billing period rates.

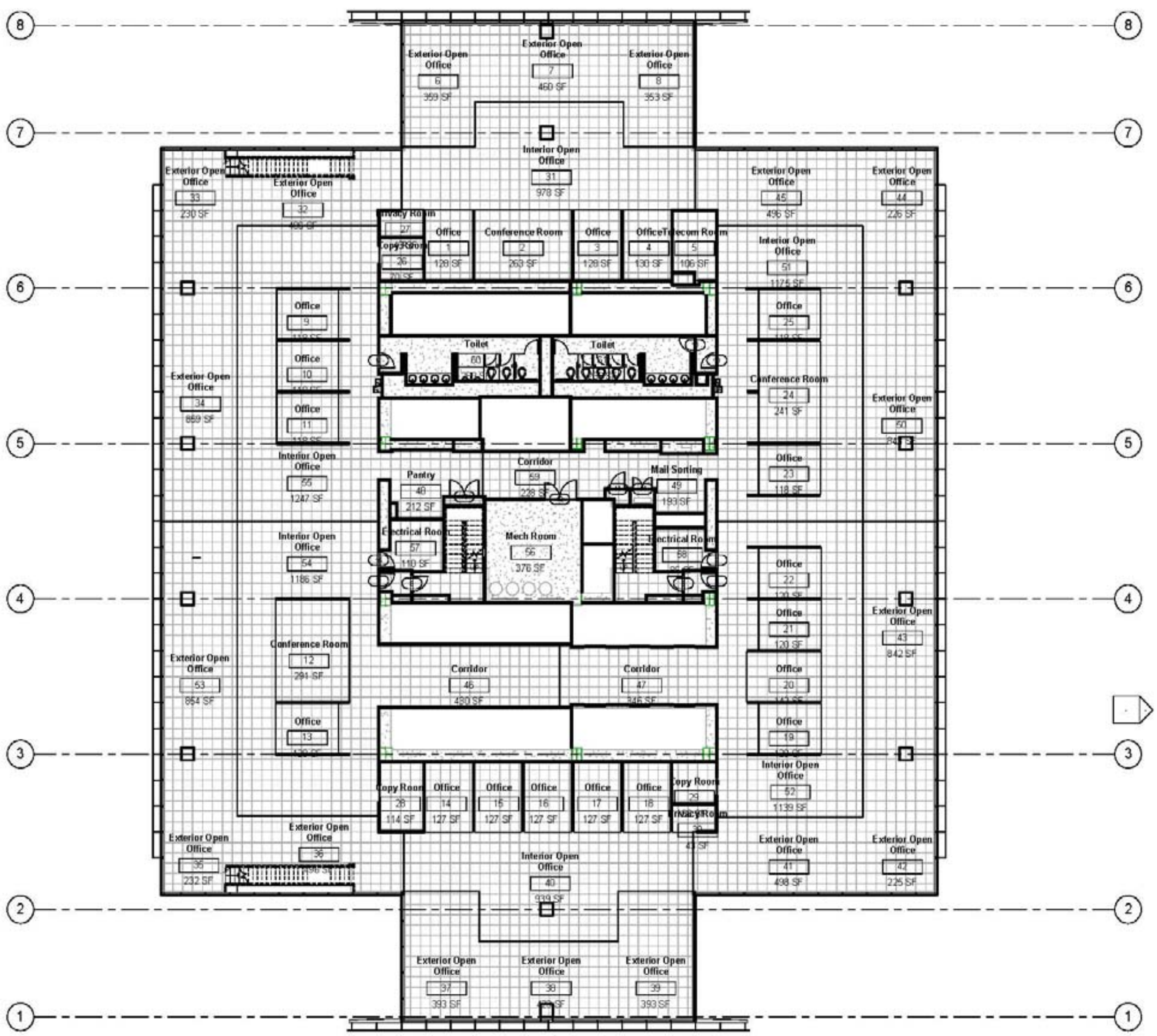
Table 1 - Utility rates

Utility	Yearly $/Unit	Reference
Natural Gas	$1.392/Ccf	New York State Public Service Commission
Electric	$0.249/kWh	New York State Public Service Commission
Steam	$18.36/Mlb	Consolidated Edison
Water	$2.31/per(748gals)	New York City Water Board

TYPICAL FLOOR PLAN

As seen below in Figure 1, the typical floor plan for the space occupied by the New York Times Company includes open office space, private offices, conference rooms, toilets, copy rooms, kitchen space, mechanical and electrical rooms, and a telecom room. For our building load and energy analysis, the building floor plate was divided into interior and exterior zones, with the interior zone beginning 15' from all exterior walls. Mechanical space and toilets were considered to be unconditioned with exhaust only.

Figure 1 - Typical Office Floor of the New York Times Building



EXTERNAL INFLUENCES ON DESIGN – SITE AND COST INFLUENCES

A driving cost factor for the cogeneration plant was a $1 Million grant from NYSERDA. Additional grants were available for the lighting control system but were not disclosed at the time of this report. Cost effectiveness drove the decision to purchase steam from Consolidated Edison versus generating steam on site.

DESIGN INDOOR & OUTDOOR AIR CONDITIONS

Table 2 provides the ASHRAE indoor and outdoor design conditions used in the energy simulation.

Table 2 - Outdoor and indoor design conditions. Source: ASHRAE Fundamentals (2005)

Outdoor Design Conditions (0.4% and 99.6%)					
Season	Dry Bulb (^{0}F)		Wet Bulb (^{0}F)		
Winter	15		-		
Summer	87		72		
Indoor Design Conditions					
Space Occupancy	Temperature (^{0}F)		Humidity	Drift points	
	Summer	Winter		Cooling	Heating
All Spaces	75	70	50 % RH	81	64

DESIGN VENTILATION REQUIREMENTS

The OA Ventilation Rates and Mechanical Exhaust rates were designed to ASHRAE Standard 62.1 (2004). A value of 5 CFM/person and 0.06 CFM / SF was used for all space types. Table 3 summarizes exhaust rates.

Table 3- Typical exhaust rates. Source: ASHRAE Standard 62.1 (2004)

Exhaust Rates	
Space Occupancy	Exhaust Rate (CFM/SF)
Copy Room	0.5
Electrical Rooms	0.5
Telecom	0.5
Space Occupancy	Exhaust Rate (CFM/fixture)
Toilets	70

DESIGN HEATING & COOLING LOADS

The results of the energy simulation performed by Trane Trace is provided by the following data based on the analysis of the eighth floor:

Peak cooling load: 63.2 tons @ 36,240 CFM of SA

Peak heating load: 517,000 Btu/hr @ 17,900 CFM of SA

Whole building extrapolation:

Peak cooling load: 3,160 tons

Peak cooling load: 25,850 MBH

Actual design loads for the building

Peak cooling load: 6,250 tons

Peak heating load: 40,000 MBH

Our calculated peak loads for both cooling and heating fall at approximately half of what the actual design peak loads as given by the mechanical engineer. This could be the result of the exclusion of the podium space, the data center, lobby, conditioned spaces on the mechanical floors, and future growth from our calculations, all of which were included in the actual design loads.

ANNUAL ENERGY CONSUMPTION ESTIMATION

The results of the energy simulation performed by Trane Trace are provided by the following data based on the analysis of the eighth floor:

Annual energy intensity: 84,200 BTU/SF/yr

Annual electric consumption: 274,761 kWh/yr

Annual district steam consumption: 8,144 Therms/yr

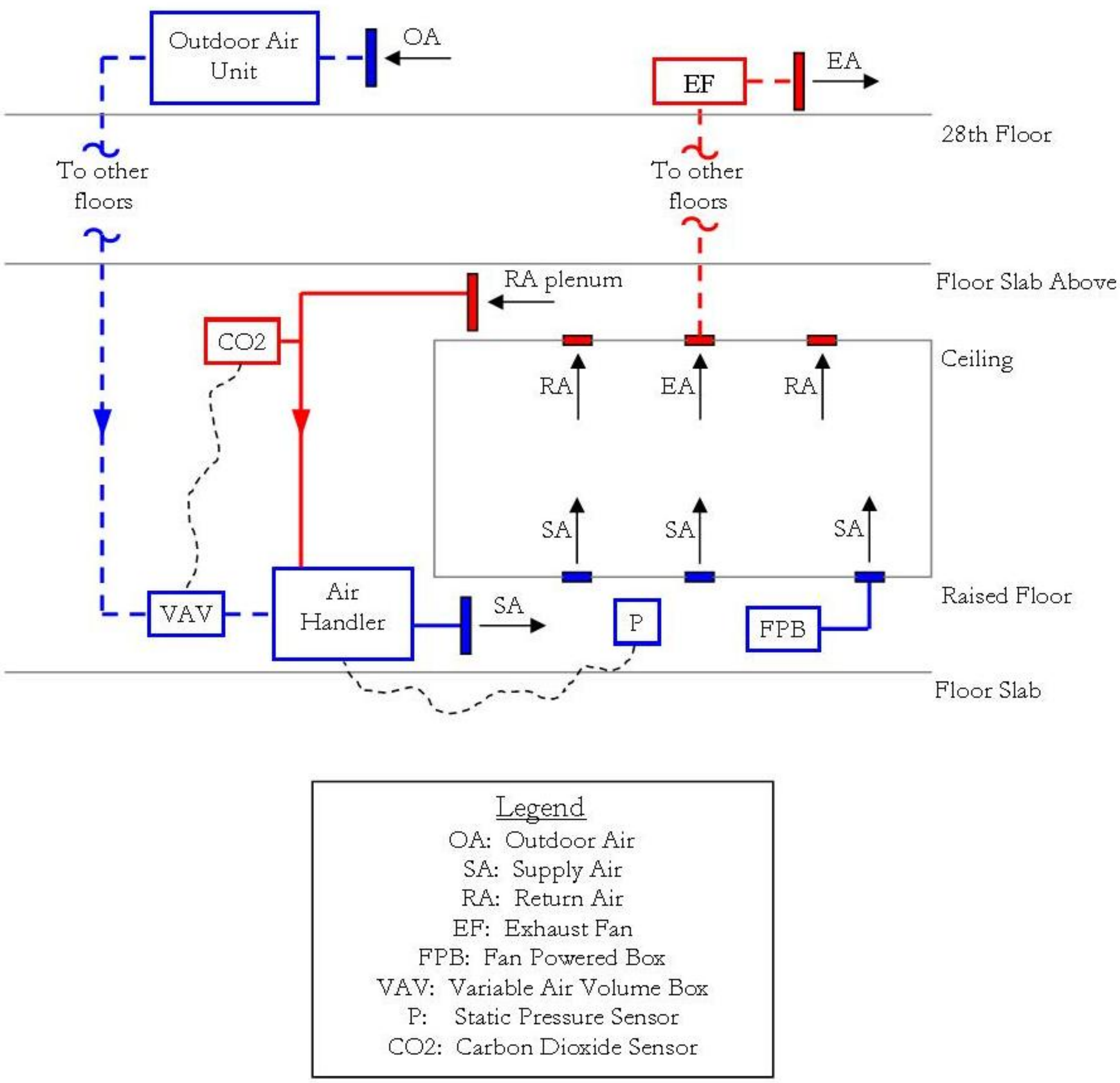
Annual domestic water consumption: 477,000 gallons/yr

SYSTEM CONFIGURATION

SCHEMATIC DRAWINGS OF EXISTING MECHANICAL SYSTEMS

DESCRIPTION OF SYSTEM OPERATION (SEQUENCE OF OPERATIONS)

Figure 2 - Typical Office Floor Airside Diagram



Typical Office Floor Airside Control

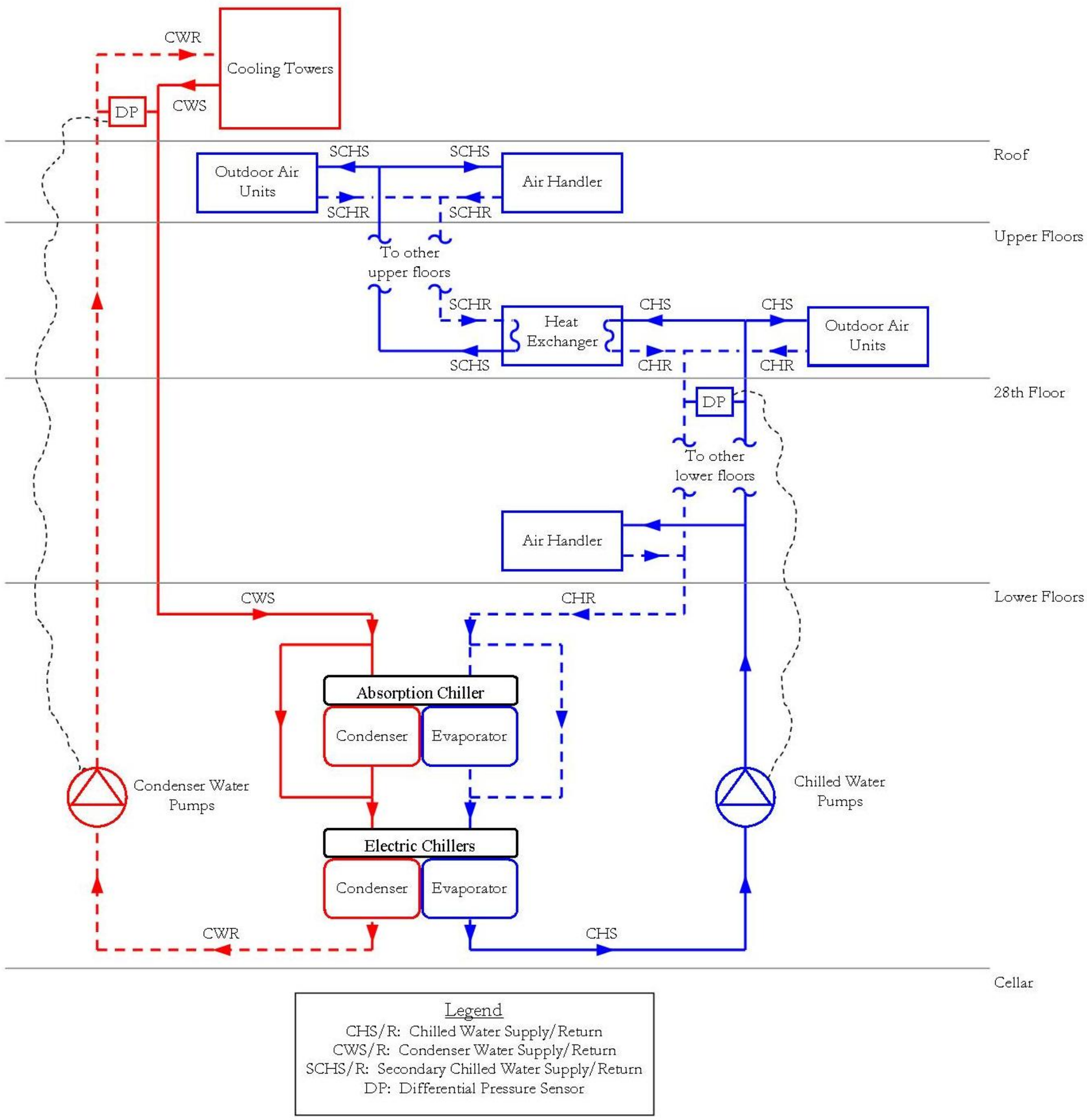
Figure 2 shows a simplification of the airside system which is typical for each of the office floors in the building occupied by The New York Times Company. The under floor plenum for each floor is served by a base building air handling unit, which has multiple zones of control and an overall capacity of 29,500 CFM. The outdoor ventilation air is supplied via a variable air volume box, which is fed from the main outdoor air handling units on the 28th and 51st floors. The typical capacity of a VAV box is 4000 CFM.

Static pressure sensors in the East and West air highways ensure that the base building air handling unit maintains a constant static pressure in the air highway of 0.1" WG (Adjustable). In each control zone there are multiple control dampers in the air highway discharges supplying primary air to the under floor plenums. These dampers are controlled in unison to maintain an under floor static pressure of 0.05"WG (Adjustable) in each zone. A temperature sensor in each zone will override the pressure control loop to maintain an appropriate temperature in the space.

A temperature sensor located in the fan coil discharge modulates the chilled water cooling coil control valve in order to maintain a constant discharge temperature of 60°F to the space during cooling mode. In heating mode, if the space temperature drops below the occupied set point of 70°F the perimeter fan powered boxes with heating coils will start and supply 84°F air to the space.

A carbon dioxide sensor located in the return air stream monitors CO_2 levels. If the CO_2 level increase to 1,000 PPM, the minimum outside air dampers will be opened to 100%. If the CO_2 levels continue to rise, the mixed air control loop will be overridden and the maximum outdoor air damper will be modulated open.

Figure 3 - Chilled Water and Condenser Water Diagram



Chilled Water System Control

Figure 3 shows a simplification of the chilled water system that serves the base building air handling units on each floor. The chilled water plant consists of five electric chillers, one absorption chiller, one electric future chiller, one air cooled chiller, six chilled water pumps and four plate and frame heat exchangers. There are three modes of operation for the chilled water system: mechanical cooling, pre-cooling, and free cooling. The mode of operation is determined by the building mechanical control system operator from his or her workstation.

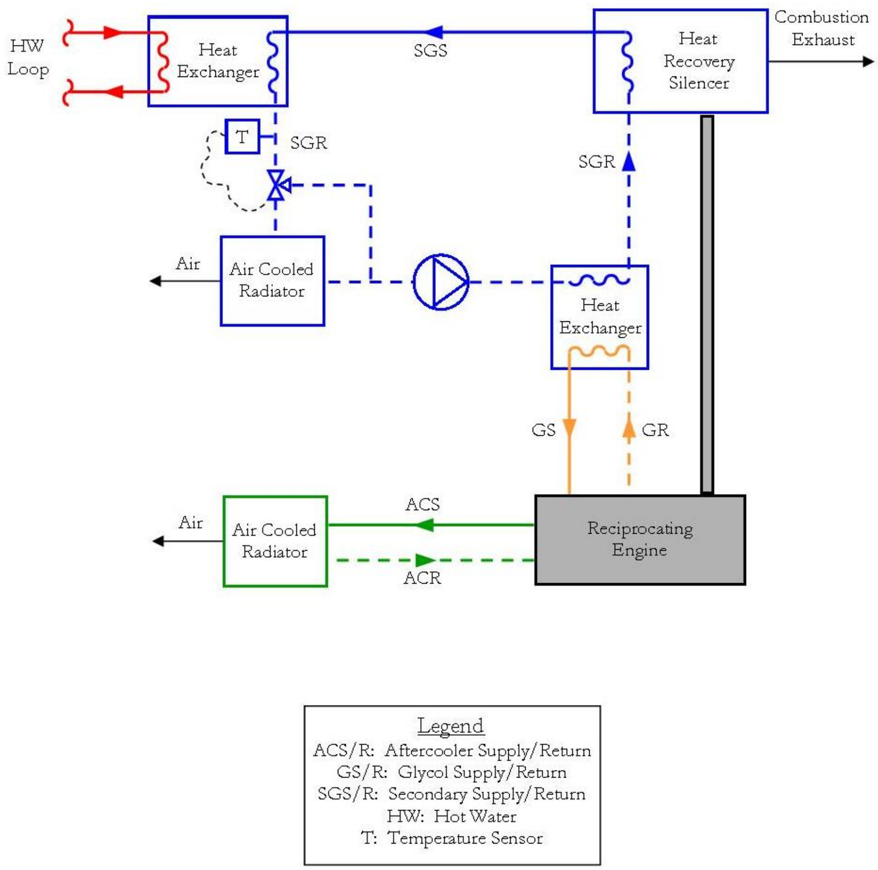
In mechanical cooling mode when a chiller comes online, the on-board chiller controls will maintain the chilled water temperature at an adjustable set point. If the chilled water discharge temperature cannot be maintained at the set point, a second chiller will be placed online manually by the building operator. Pre-cooling mode can be activated during mechanical cooling mode or as a pre-emptive to mechanical cooling start up. When free cooling mode is selected, the plate and frame heat exchangers are brought online in parallel with the chillers and are used to create chilled water. If the chillers are no longer needed they can be taken offline to limit energy consumption.

Chilled water pumps are placed in parallel, and they are brought online and are taken offline on the basis of modulating differential pressure. A differential pressure sensor is mounted on the 18th floor, and it maintains the system differential pressure at 40 ft. Pump speeds are modulated simultaneously to maintain this pressure using the minimum amount of pumps necessary.

Condenser Water System Control

Figure 3 shows a simplification of the condenser water system that serves the chilled water plant. The condenser water system consists of five chiller condensers, six condenser water pumps and four plate and frame heat exchangers. Also included are one two-cell and one three-cell cooling tower. Condenser water pumps are placed in parallel and are modulated simultaneously to maintain this pressure using the minimum amount of pumps necessary. Similar to the chilled water system, there are three modes of operation for the condenser water system: mechanical cooling, pre-cooling, and free cooling. During free mode the condenser water pumps are simply required to maintain the differential pressure. During pre-cooling and mechanical cooling modes the pumps are required to maintain a flow rate of 2400 GPM x the number of chillers online.

Figure 4 - Cogeneration Diagram

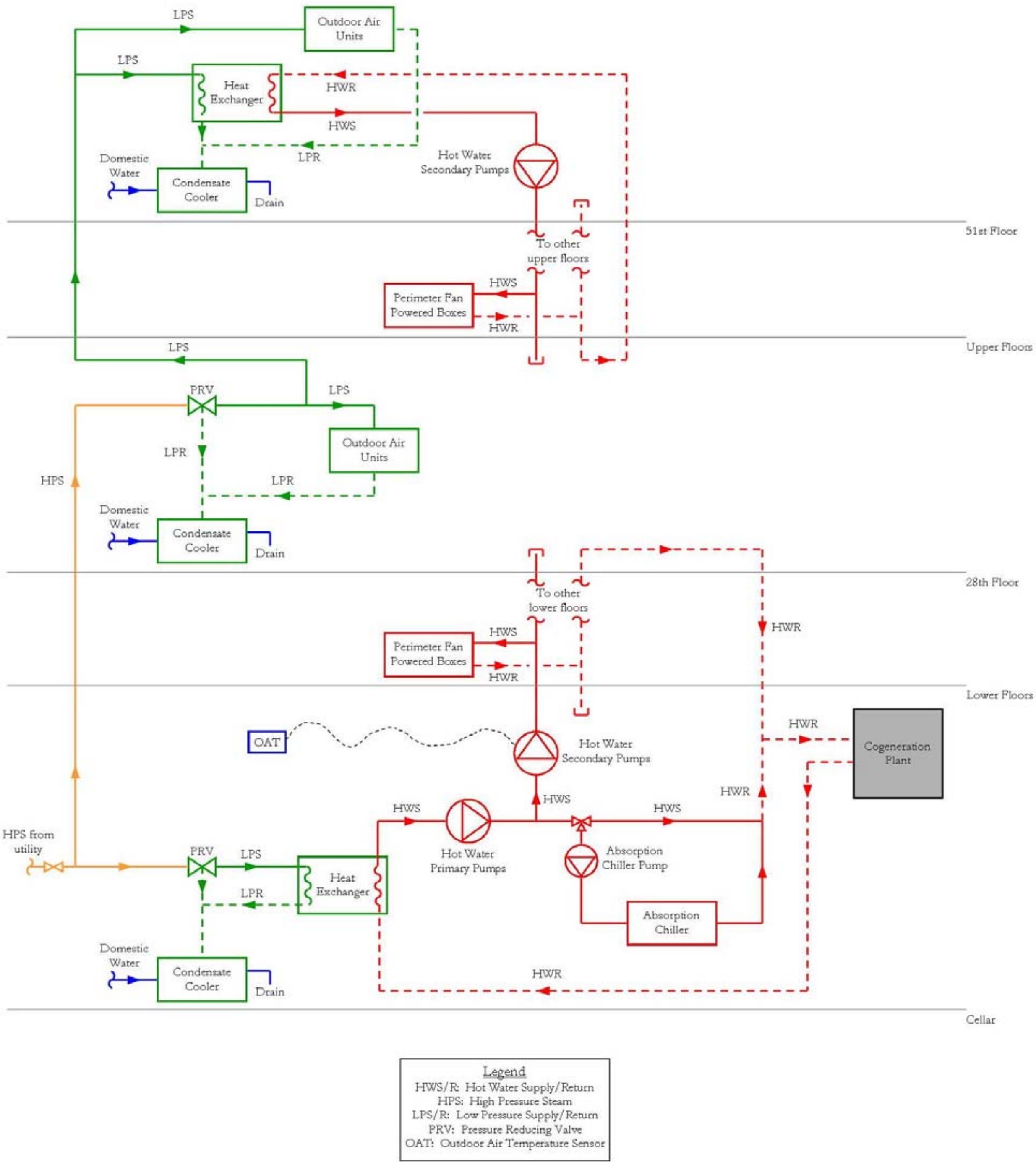


Cogeneration System Control

Figure 4 shows a simplification of the cogeneration system that serves the building heating hot water system, the absorption chiller, and generates electricity. The cogeneration plant consists of two natural gas driven reciprocating engines which produce 750 kW of power each, two heat recovery silencers, two primary plate and frame heat exchangers, two sets of generator radiators, and two circulation pumps. The primary purpose of the system is to create electricity, and the resulting heat is recovered as a byproduct.

During the typical heat recovery process glycol coolant circulates through both the generator and the heat recovery silencer and then is feed to the primary heat exchanger where it is used to create hot water for the building. When the temperature of the glycol coolant exiting the primary heat exchangers reaches 210°F the coolant will also be run through the radiator to reduce its temperature before reentering the generator. Temperature sensors maintain a constant temperature of 190.7°F for the hot water leaving the primary heat exchangers to serve the building or the absorption chiller.

Figure 5 - Heating Hot Water and Stream Diagram



Heating Hot Water Distribution Control

Figure 5 shows a simplification of the hot water distribution system that serves the building and the absorption chiller. During normal operation heat from the generation system is be used for heating the baseboard radiation circuits, and excess heat will be utilized by the absorption chiller. If the outside

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temperature drops below 60°F the hot water supply pumps will start and supply the baseboard radiation circuit with 140°F heating hot water. If the outside temperature falls below 0°F the heating hot water will be supplied at 195°F. As the demand for heating hot water diminishes, a three way valve will divert more hot water to the absorption chiller, via the absorption water pumps, where it is used to make chilled water for the cooling system. If the demand for heating hot water cannot be met by the heat rejected from the cogeneration system, district steam is used to produce additional supply.

TABLES – MAJOR EQUIPMENT

Table 4: Major Mechanical Equipment - AHU

EQUIPMENT	SERVICE	LOCATION	CAPACITY (CFM)
AHU-C-1	CELLAR EMR	CELLAR	2900
AHU-C-2	CELLAR MISC ROOMS	CELLAR	7500
AHU-C-3	WEST LOBBY PERIMETER	CELLAR	20000
AHU-C-4	TREE GARDEN PERIMETER	CELLAR	18000
AHU-C-5	CELLAR CORRIDOR WEST	CELLAR	4000
AHU-C-6	GROUND FLOOR SPU STAGE	CELLAR	14900
AHU-C-7	GROUND FLOOR AUDITORIUM	CELLAR	14900
AHU-C-8	CELLAR SPU ROOM	CELLAR	11000
AHU-C-9	GROUND FLOOR EAST LOBBY	CELLAR	8000
AHU-C-10	CELLAR CORRIDOR EAST	CELLAR	6000
AHU-2-1 TO AHU-13-1	TYPICAL TOWER FLOORS 2-13	FLOOR FAN ROOM	29500
AHU-14-1	CAFETERIA	14th FLOOR FAN ROOM	29500
AHU-15-1	15TH FLOOR CONFERENCE ROOM	15th FLOOR FAN ROOM	29500
AHU-16-1 TO AHU-27-1	TYPICAL TOWER FLOORS 16-27	FLOOR FAN ROOM	29500
AHU-28-1	FLOOR 28	28th FLOOR FAN ROOM	60000
AHU-29-1 TO AHU-50-1	TYPICAL TOWER FLOORS 29-50	FLOOR FAN ROOM	29500
AHU-51-1	FLOOR 52	52th FLOOR FAN ROOM	60000

Table 5: Major Mechanical Equipment - Cooling Towers

EQUIPMENT	LOCATION	TYPE	CAPACITY (GPM)
CT-53-1	FLOOR 53	INDUCED DRAFT CROSS FLOW	2700
CT-53-2	FLOOR 53	INDUCED DRAFT CROSS FLOW	2700
CT-53-3	FLOOR 53	INDUCED DRAFT CROSS FLOW	2700
CT-53-4	FLOOR 53	INDUCED DRAFT CROSS FLOW	2700
CT-53-5	FLOOR 53	INDUCED DRAFT CROSS FLOW	2700

Table 6: Major Mechanical Equipment - Chillers

EQUIPMENT	LOCATION	TYPE	CAPACITY (GPM)	TONS
CH-C-1	CELLAR MER	ELECTRIC CENTIFUGAL	1870	1200
CH-C-2	CELLAR MER	ELECTRIC CENTIFUGAL	1870	1200
CH-C-3	CELLAR MER	ELECTRIC CENTIFUGAL	1870	1200
CH-C-4	CELLAR MER	ELECTRIC CENTIFUGAL	1870	1200
CH-C-5	CELLAR MER	ELECTRIC CENTIFUGAL	1870	1200
ACH-C-1	CELLAR MER	HOT WATER ABSORBTION	750	250
CH-5-1	PODIUM ROOF	AIR COOLED PACKAGED LIQUID	480	200

Table 7: Major Mechanical Equipment - Pumps

EQUIPMENT	SERVICE	LOCATION	TYPE	CAPACITY (GPM)
CHWP-C-1	LOWRISE CHW	CELLAR MER	HOR SPLIT CASE	1870
CHWP-C-2	LOWRISE CHW	CELLAR MER	HOR SPLIT CASE	1870
CHWP-C-3	LOWRISE CHW	CELLAR MER	HOR SPLIT CASE	1870
CHWP-C-4	LOWRISE CHW	CELLAR MER	HOR SPLIT CASE	1870
CHWP-C-5	LOWRISE CHW	CELLAR MER	HOR SPLIT CASE	1870
CHWP-C-6	LOWRISE CHW	CELLAR MER	HOR SPLIT CASE	1870
CHWP-C-7	ABSORBTION CHW	CELLAR MER	END SUCTION	750
CHWP-C-8	ABSORBTION CHW	CELLAR MER	END SUCTION	750
CWP-C-1	BLDG CW	CELLAR MER	HOR SPLIT CASE	2400
CWP-C-2	BLDG CW	CELLAR MER	HOR SPLIT CASE	2400
CWP-C-3	BLDG CW	CELLAR MER	HOR SPLIT CASE	2400
CWP-C-4	BLDG CW	CELLAR MER	HOR SPLIT CASE	2400
CWP-C-5	BLDG CW	CELLAR MER	HOR SPLIT CASE	2400
CWP-C-6	BLDG CW	CELLAR MER	HOR SPLIT CASE	2400
CWP-C-7	ABSORBTION CW	CELLAR MER	HOR SPLIT CASE	1500
CWP-C-8	ABSORBTION CW	CELLAR MER	HOR SPLIT CASE	1500
CHWP-28-1	HIGHRISE CHW	FLOOR 28	HOR SPLIT CASE	2100
CHWP-28-2	HIGHRISE CHW	FLOOR 28	HOR SPLIT CASE	2100
CHWP-28-3	HIGHRISE CHW	FLOOR 28	HOR SPLIT CASE	2100
HWP-C-1	PRIMARY HOT WATER	CELLAR MER	END SUCTION	800
HWP-C-2	PRIMARY HOT WATER	CELLAR MER	END SUCTION	800
HWP-C-3	PRIMARY HOT WATER	CELLAR MER	END SUCTION	800
HWP-C-4	LOWRISE PERIMETER	CELLAR MER	END SUCTION	800
HWP-C-5	LOWRISE PERIMETER	CELLAR MER	END SUCTION	800
HWP-C-6	LOWRISE PERIMETER	CELLAR MER	END SUCTION	800
HWP-C-7	ABSORBTION HW	CELLAR MER	END SUCTION	485
HWP-C-8	ABSORBTION HW	CELLAR MER	END SUCTION	485
HWP-51-1	HIGHRISE HW	FLOOR 51 MER	END SUCTION	1100
HWP-51-2	HIGHRISE HW	FLOOR 51 MER	END SUCTION	1100
GMP-5-1	COGEN PLANT	FLOOR 5	ROTARY	1.5
GP-5-1	COGEN LOOP	FLOOR 6	END SUCTION	450
GP-5-2	COGEN LOOP	FLOOR 7	END SUCTION	450

SYSTEM EVALUATION

BREAKDOWN OF LOST USABLE SPACE

Table 8 describes the breakdown of floor and shaft area used for MEP services. It also includes the percent of total building area lost.

Table 8: Lost Usable Space

Typical Floor					
Program	Floor Number	Floor Area (SF)	Total Floor Area	% of Total Floor Area	Shaft Area
Mechanical	8 (Typ. Floor)	393	20895	1.88	201
Electrical	8 (Typ. Floor)	203	20895	0.97	37
Plumbing	8 (Typ. Floor)	0	20895	0.00	30
Telecom	8 (Typ. Floor)	116	20895	0.56	10
Total MEP	**-**	**712**	**20895**	**3.41**	**278**

Overall Building				
Program	Floor Number	Floor Area (SF)	Total Building Area	% of Total Building Area
MEP	49 Typical Floors	34888	1065645	3.27
MEP	28	20895	1065645	1.96
MEP	Cellar	20895	1065645	1.96
MEP	52	20895	1065645	1.96
Total MEP	**-**	**97573**	**1065645**	**9.16**

MECHANICAL SYSTEM FIRST COST (TOTAL+SQ FT)

Table 9 provides data compiled by the CM team of the BIM/IPD New York Times Thesis Project using D4Cost Estimation Software. Actual bidding document values were not provided by the owner at the time of this report.

Table 9: System Costs

SYSTEM	PERCENTAGE OF PROJECT COST	COST PER SQUARE FOOT	SYSTEM COST FOR TOTAL D4 ESTIMATED COST ($432,957,936)	SYSTEM COST PROJECTED FOR $1 BILLION PROJECT COST
Mechanical	17.49%	$50.48	$75,721,782	$174,900,000

Operating History of System

Due to confidentiality, access to utility bills and metering data was undisclosed, therefore comparison to actual operating history of the building was not performed for this report.

LEED

Energy and Atmosphere

The Energy and Atmosphere section of LEED 2009 presents guidelines and requirements for new construction and major renovations in order to help reduce energy consumption and harmful emissions associated with mechanical systems. This section includes three mandatory prerequisites and the opportunity to gain up to 35 possible points over 6 total credits. Though sustainability was a high priority in the design process, The NYTB was not designed to meet LEED requirements. Therefore, for many of the credits it is unclear whether they are met or not. Several of the credits, including credit 3, 5, and 6, would be achievable if plans for commissioning and green power were to be put in place. The following is a summary of all the credits in this section and their attainability. (See appendix 1 for credit checklist)

EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems
EA Prerequisite 2: Minimum Energy Performance
EA Prerequisite 3: Fundamental Refrigerant Management

All prerequisites are met.

EA Credit 1: Optimize Energy Performance (1-19 points)

-Demonstrate a percentage improvement of at least 12% in the proposed building performance rating compared with the baseline building performance rating.

It is unclear to what extent this credit is met. However, comparing our building to a typical large office building on an energy use per square foot basis gives us an estimated savings of 22%.

EA Credit 2: On-site Renewable Energy (1-7 points)

-Use on-site renewable energy systems to offset building energy costs.

This credit is not met.

EA Credit 3: Enhanced Commissioning (2 points)

-Begin commissioning process early in the design process and execute additional activities after systems performance verification is completed.

It is unclear whether this credit is met or not, but it would be attainable.

EA Credit 4: Enhanced Refrigerant Management (2 points)

-Select refrigerants and equipment than minimize or eliminate the emission of compounds that contribute to ozone depletion and climate change. The HVAC equipment must comply with the following formula for ozone depletion and global warming potential.

$LCGWP + LCOPD \times 10^5 \leq 100$

The combination of cooling equipment and refrigerants that were used produces a weighted factor of 31.67, which is less than the maximum of 100. (See appendix 2 for calculation matrix.)

EA Credit 5: Measurement and Verification (3 points)

-Provide for ongoing accountability of building energy consumption over time.

It is unclear whether this credit is met or not, but it would be attainable.

EA Credit 6: Green Power (2 points)

-Engage in at least a 2-year renewable energy contract to provide at least 35% of the building's electricity from renewable sources.

It is unclear whether this credit is met or not, but it would be attainable.

Indoor Air Quality

The Indoor Air Quality section of LEED 2009 presents guidelines and requirements for new construction and major renovations in order to help ensure a comfortable and healthy environment for building occupants. This section includes two mandatory prerequisites and the opportunity to gain up to 15 possible points over 15 total credits. However, only five of the credits directly pertain to mechanical systems. Though sustainability was a high priority in the design process, The NYTB was not designed to meet LEED requirements. Therefore, for many of the credits it is unclear whether they are met or not. The following is a summary of the five applicable credits in this section and their attainability. (See appendix 1 for credit checklist)

IAQ Perquisite 1: Minimum IAQ Performance

IAQ Perquisite 1: Environmental Tobacco Smoke Control

All prerequisites are met.

IEQ Credit 1: Outdoor Air Delivery Monitoring (1 point)

-Monitor CO2 concentrations from 3 to 6 feet above the floor within all densely occupied spaces (more than 25 people per 1,000 sqft).

The CO2 sensors are located within the return ducts, which does not comply with these requirements.

IEQ Credit 2: Increased Ventilation (1 point)

-Increase breathing zone outdoor ventilation rates to all occupied spaces by at least 30% above minimum rates required by ASHRAE Standard 62.1-2007.

Minimum outdoor air ventilation rates for the typical floor meet this requirement.

IEQ Credit 6.2: Controllability of Systems – Thermal Comfort (1 point)

-Provide individual comfort controls for at least 50% of building occupants.

There are individual comfort controls for all office spaces with the UFAD system.

IEQ Credit 7.1: Thermal Comfort – Design (1 point)

-Design heating, ventilating and air conditioning system and the building envelope to meet the requirements of ASHRAE Standard 55-2004.

The HVAC system was designed to meet the requirements of ASHRAE Standard 55

IEQ Credit 7.2: Thermal Comfort – Verification (1 point)

-Verify that heating, ventilating and air conditioning system and the building envelope to meet the requirements of ASHRAE Standard 55-2004.

It is unclear whether this credit is met or not, but it would be attainable.

OVERALL EVALUATION

In general terms, the mechanical systems in the NYTB are quite complex. The designers implemented a wide variety of unique systems in their pursuit of a high performance building that would become an icon for the New York Times Company and provide a benchmark for future sustainable high-rise projects. The use of emerging technologies such as UFAD and a cogeneration system show that the building was meant to be on the forefront of higher performance building design.

However, with such a variety of complex systems, which use untested technologies, it can be difficult to determine the actual effectiveness of the overall system. Also, without any information on building operating history it is nearly impossible to know how the building is performing in regards to energy consumption and operating costs. One disadvantage of a system with a variety of applications, such as cogeneration heat recovery, absorption cooling and several air distribution methods, is the need for highly trained maintenance staff.

The UFAD system also presents a concern. With the air plenum underneath the raised floor where dust can accumulate, indoor air quality can become an issue. This issue is further compounded in the large conference rooms on each floor, where air is diffused into the space via perforated carpet tiles. It is unclear how this concern was addressed in the design, but the under floor air distribution system will most likely become a point of further investigation as options for redesign are considered.

The cogeneration plant will also be a point of further investigation when considering redesign. It remains unclear whether the plant adds to the performance of the building or simply provides a backup power source for the critical data center space. Part of the future analysis in this area will involve a load profile investigation in order to determine if cogeneration is a sustainably realistic option as opposed to installing a conventional backup diesel generator.

The building facade presents what is most likely the highest point of concern in respect to building performance. With a high window to wall ratio and the use of highly transparent glazing, the exterior walls become a heat sink during the cooling months. In response to this concern, the designers wrapped the facade with ceramic rods in an attempt to provide shading for the fully transparent curtain wall. However, given the fact that New York City has nearly six times as many heating degree days as it does cooling degree days, it is a concern that these rods may do more harm to energy consumption during the heating season than they help during the cooling season. Therefore, this also will most likely become a point of further investigation as options for redesign are considered.

APPENDIX 1: LEED 2009 - CREDIT CHECKLIST

LEED 2009 for New Construction and Major Renovation

Project Checklist

New York Times Building

10/28/2009

8	20	7	**Energy and Atmosphere**		Possible Points:	35
Y			Prereq 1		Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2		Minimum Energy Performance	
Y			Prereq 3		Fundamental Refrigerant Management	
6	13		Credit 1		Optimize Energy Performance	1 to 19
					Improve by 12% for New Buildings or 8% for Existing Building Renovations	1
					Improve by 14% for New Buildings or 10% for Existing Building Renovations	2
					Improve by 16% for New Buildings or 12% for Existing Building Renovations	3
					Improve by 18% for New Buildings or 14% for Existing Building Renovations	4
					Improve by 20% for New Buildings or 16% for Existing Building Renovations	5
				X	Improve by 22% for New Buildings or 18% for Existing Building Renovations	6
					Improve by 24% for New Buildings or 20% for Existing Building Renovations	7
					Improve by 26% for New Buildings or 22% for Existing Building Renovations	8
					Improve by 28% for New Buildings or 24% for Existing Building Renovations	9
					Improve by 30% for New Buildings or 26% for Existing Building Renovations	10
					Improve by 32% for New Buildings or 28% for Existing Building Renovations	11
					Improve by 34% for New Buildings or 30% for Existing Building Renovations	12
					Improve by 36% for New Buildings or 32% for Existing Building Renovations	13
					Improve by 38% for New Buildings or 34% for Existing Building Renovations	14
					Improve by 40% for New Buildings or 36% for Existing Building Renovations	15
					Improve by 42% for New Buildings or 38% for Existing Building Renovations	16
					Improve by 44% for New Buildings or 40% for Existing Building Renovations	17
					Improve by 46% for New Buildings or 42% for Existing Building Renovations	18
					Improve by 48%+ for New Buildings or 44%+ for Existing Building Renovatioi	19
	7		Credit 2		On-Site Renewable Energy	1 to 7
					1% Renewable Energy	1
					3% Renewable Energy	2
					5% Renewable Energy	3
					7% Renewable Energy	4
					9% Renewable Energy	5
					11% Renewable Energy	6
					13% Renewable Energy	7
		2	Credit 3		Enhanced Commissioning	2
2			Credit 4		Enhanced Refrigerant Management	2
		3	Credit 5		Measurement and Verification	3
		2	Credit 6		Green Power	2

3	1	1	**Indoor Environmental Quality**	**Possible Points:**	**15**
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
	1		Credit 1	Outdoor Air Delivery Monitoring	1
1			Credit 2	Increased Ventilation	1
	NA		Credit 3.1	Construction IAQ Management Plan—During Construction	1
	NA		Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
	NA		Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
	NA		Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
	NA		Credit 4.3	Low-Emitting Materials—Flooring Systems	1
	NA		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
	NA		Credit 5	Indoor Chemical and Pollutant Source Control	1
	NA		Credit 6.1	Controllability of Systems—Lighting	1
1			Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
		1	Credit 7.2	Thermal Comfort—Verification	1
	NA		Credit 8.1	Daylight and Views—Daylight	1
	NA		Credit 8.2	Daylight and Views—Views	1

APPENDIX 2: ENHANCED REFRIGERATION MANAGEMENT

LEED 2009 - EA CREDIT 4 - CALCULATION MATRIX

Equation Calculator for USGBC LEED-NC v2.2, Energy & Atmosphere Credit 4

Orange = Fixed values | Turquoise = User entries | Yellow = Calculated values | Red = Ineligible result | Green = Eligible result

Job name	New York Times Building						
Job location	New York, New York						
Date and time of calculation	10/26/09 5:46 PM						
Unit tag(s)	CH-C-1	CH-C-2	CH-C-3	CH-C-4	CH-C-5	ACH-C-1	All
Refrigerant type	R-123_Trane_Centrifuga	R-123_Trane_Centrifuga	R-123_Trane_Centrifuga	R-123_Trane_Centrifuga	R-123_Trane_Centrifuga	Water	Qtotal
Equipment type	Centrifugal chiller	Centrifugal chiller	Centrifugal chiller	Centrifugal chiller	Centrifugal chiller	Absorption chiller	
Capacity, tons (Qunit)	1200.0	1200.0	1200.0	1200.0	1200.0	250.0	6250
Refrigerant charge, lb	2040.00	2040.00	2040.00	2040.00	2040.00	512.50	
Refrigerant charge, lb/ton (Rc)	1.70	1.70	1.70	1.70	1.70	2.05	
Leak rate, % of charge per year (Lr)	0.5%	0.5%	0.5%	0.5%	0.5%	2.0%	
Equipment life (Life)	23	23	23	23	23	23	
End-of-life refrigerant loss, % of charge (Mr)	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	
Global warming potential of refrigerant (GWPr)	76	76	76	76	76	0	
Ozone depletion potential of refrigerant (ODPr)	0.02	0.02	0.02	0.02	0.02	0.00	
Life-cycle direct global warming potential (LCGWP) $LCGWP = \frac{GWP_r \times R_c \times (L_r \times Life + M_r)}{Life}$	1.2	1.2	1.2	1.2	1.2	0.0	
Life-cycle ozone depletion potential (LCODP) $LCODP = \frac{ODP_r \times R_c \times (L_r \times Life + M_r)}{Life}$	0.00032	0.00032	0.00032	0.00032	0.00032	0.00000	
TSAC factor $LCGWP + 100{,}000 \times LCODP$	33.0	33.0	33.0	33.0	33.0	0.0	
TSAC factor × capacity $(LCGWP + 100{,}000 \times LCODP) \times Q_{unit}$	39588	39588	39588	39588	39588	0	197942

Weighted calculation

$$\frac{\left[\sum (LCGWP + 100{,}000 \times LCODP) \times Q_{unit}\right]}{Q_{total}} \leq 100$$

31.67

Credit? Yes

TRANE

Version 2.01 "Equation Calculator" for LEED-NC v2.2, EAc40 - November 2006

Trane, in providing this calculation tool, assumes no responsibility for the performance or desirability of any resulting system design. Design of the HVAC system is the prerogative and responsibility of the engineering professional.

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