WMS TECHNOLOGY GAMING CENTER

BY

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OF

ENVIRONMENTAL SYSTEMS DESIGN

CHAPTER/REGIONAL TECHNOLOGY AWARD - SHORT FORM

1. Category (Check one and indicate New or Existing, if applicable)

- (●) Commercial Buildings — (●) New or ( ) Existing
- Institutional Buildings:
  - ( ) Educational Facilities — ( ) New or ( ) Existing
  - ( ) Other Institutional — ( ) New or ( ) Existing
- ( ) Health Care Facilities — ( ) New or ( ) Existing
- ( ) Industrial Facilities or Processes — ( ) New or ( ) Existing
- ( ) Public Assembly — ( ) New or ( ) Existing
- ( ) Residential (Single and Multi-Family)

2. Name of building or project: WMS Gaming Corporate Headquarters

City/State: Chicago, Illinois

3. Project Description: High Efficiency UFAD Office Building

Project Study/Design Period: 04/2009 to 03/2012
Begin date (mm/yyyy) — End date (mm/yyyy)

Percent Occupancy at time of submission: 75%

4. Entrant (ASHRAE member with significant role in project):

a. Name: Steinmetz (Last) Travis (First) James (Middle)

Membership Number: 8068905

Chapter: Illinois

Region: VI

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Chicago (City) IL (State) 60604 (Zip) USA (Country)

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e. Member's Role in Project: Lead Mechanical, Project Manager

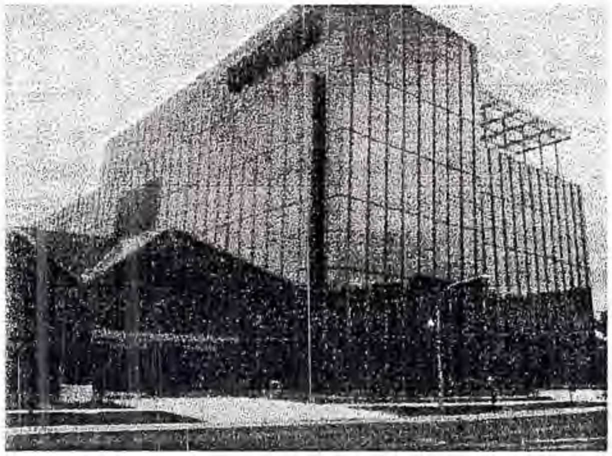
f. Member's Signature: ESD Travis Steinmetz, PE 2012.10.08 04:25:04 -05'00'

5. Engineer of Record: Michael Kuppinger PE (ESD)

By affixing my signature above, I certify that the information contained in this application is accurate to the best of my knowledge. In addition, I certify that I have discussed this entry with the owner and have received permission from the owner to submit this project to the ASHRAE Technology Awards Competition.

ASHRAE Technology Award Submission
WMS Gaming Corporate Headquarters
October 8, 2012

PROBLEM (OPPORTUNITY)



WMS Gaming's new Corporate Headquarters, located at 2718 W Roscoe Ave in Chicago, Illinois, is a new 120,000 ft^2, five story office building. The ground level includes a full service kitchen, dining room, lounge, fitness center, basketball court, and 100 occupant training room. The 2nd and 3rd floors are home to many of the company's technical employees, and include a combination of open and closed office space as well as conference rooms and other support areas. The 4th floor is home to the executive offices and includes an executive boardroom, video conference room, and multiple smaller meeting areas. A penthouse features a multi-use space with wet bar and outdoor seating area.

WMS Gaming is a designer, manufacturer, and distributor of electronic gaming devices for the casino industry. The headquarters is home to the design and corporate management functions of the company. As such, technology is highly integrated into all of the facets of the building. In 2009, the company launched a company-wide green initiative. In addition to the implementation of everyday green strategies throughout the company, came a commitment to seek LEED Platinum certification for major new facilities. The new corporate headquarters in Chicago was the first building under the company's green initiative to strive for this goal.

ESD's challenge was to design an HVAC system to meet the diverse requirements of the building, while balancing the demands of a highly technical facility with the need to provide an economical, energy efficient design. A major driver of the mechanical design was achieving an ambitious goal of reducing energy usage by 28% compared to a baseline building based on ASHRAE 90.1 (2004). Other requirements included minimizing impact of refrigerants, developing a measurement and verification plan, and maximizing user controllability.

CONCEPT

Energy Efficiency
Achieving the energy efficiency goals of the project required a combination of both common used and innovative energy saving measures. Electronically commutated motors were specified on all fractional power motors such as those found in fan powered terminal units and small exhaust fans. EC motors are 20-50% more efficient than their PSC counterparts. VFD drives were specified on larger motors including those on outdoor air handler fans, air column fans, and larger exhaust fans. Unique design elements included the use of evaporative condensing rooftop units and variable speed kitchen exhaust.

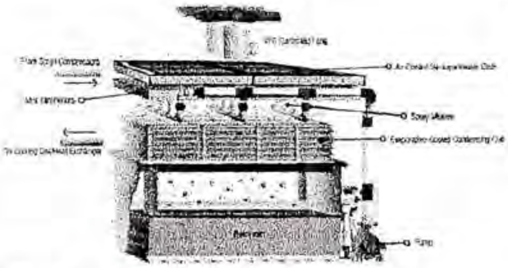


Figure 1: Evaporative Cooled Condenser

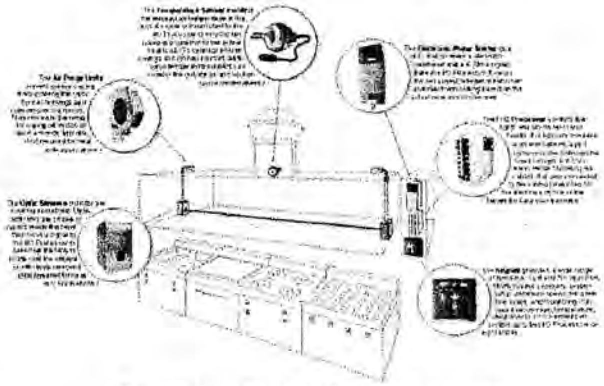


Figure 2: Variable Kitchen Exhaust

The largest sources of energy use in the mechanical system are the two, 150 ton, packaged rooftop units which provide ventilation and conditioning for the office space on the 1st through 4th floors. Packaged DX rooftop units were desirable for their space and maintenance benefits. Unfortunately, packaged DX systems are typically among the least efficient cooling methods available. In order to improve the efficiency of the units, evaporatively cooled condensers were utilized (Figure 1). The evaporative condensers operate at efficiencies 20-40% greater than standard air cooled condensers by rejecting heat to a wetted coil. The wetted coil allows refrigerant to be cooled to the ambient wet bulb, which is typically 15-25 degrees lower than dry bulb. Lower condensing temperatures translate to less compressor work to transfer the same amount of energy. Standard DX packaged equipment operates near 2 kW per ton, while the evaporative condensing rooftop units implemented at WMS headquarters operate at 1 kW per ton.

Another unique system implemented in the mechanical design is a variable speed kitchen exhaust system (Figure 2). Two exhaust fans (5hp and 7.5hp) are used to exhaust air from several exhaust hoods in both the kitchen and servery areas on the first floor. The design airflow of a kitchen exhaust hood is required to capture and remove smoke and grease created during certain types of cooking. There are many times during operational hours of the kitchen that grease and smoke may not be generated even though equipment under a given hood is in use. A variable exhaust system was specified which operates the exhaust fans at partial speed in the absence of smoke and steam. The fans increase speed proportionally as exhaust temperature increases. When sensors installed in the hood detect smoke or vapors, the exhaust fan is signaled to operate at design capacity. Fan energy is projected to be reduced by 90% annually compared to a constant volume system. The energy savings realized by operating the fans at reduced speed are significant, but alone would likely not justify the additional cost of the system. The majority of the savings are realized in the reduced makeup air requirement. Providing makeup air is an extremely energy intensive process. Utilizing a variable speed kitchen exhaust system ensures that no more outside air is heated or cooled than is necessary to maintain effective removal of smoke at the kitchen hoods. It is estimated the energy use related to the conditioning of outside air will be 50% less than that required by constant volume hoods.

Indoor Air Quality
The main rooftop air handling units are equipped with MERV 13 filters. These units serve office spaces on the 2^{nd}-4^{th} floors. It is in these areas that building occupants spend a majority of their time. A significantly shorter percentage of time is spent in specialty areas such as the fitness center, training center, and penthouse amenity space. In these areas, MERV 8 filtration is provided.

Carbon dioxide monitoring is provided at air handling unit returns, as well as individually in densely occupied spaces. Given modern ventilation requirements, CO_2 rarely accumulates to harmful levels; however, because it is continually generated within buildings by its occupants and diluted by the delivery of ventilation air, it can effectively be used as a tracer gas to gauge the ventilation effectiveness of the system. The BAS continuously monitors the CO_2 sensors. If CO_2 levels of the return air entering an AHU exceed 800ppm, the outside air quantity is proportionally increased to an adjustable, maximum CFM greater than the design minimum. In densely occupied spaces, local terminal units will provide increased volume of primary air when CO_2 levels exceed 1000ppm. A supervisory alarm is generated at the BAS whenever CO_2 levels exceed 900 ppm in any space.

The 2^{nd} – 4^{th} floors of the building utilize an under floor air distribution system. This system maximizes the ventilation effectiveness of the system. Air is delivered in a bottom to top direction, minimizing mixing and promoting the continuous removal of contaminants away from building occupants.

Innovation
The evaporatively cooled rooftop units represent an innovative method to improve the efficiency of standard DX cooling equipment. The specific equipment installed on this project has the added feature of a de-superheater coil above the wetted refrigerant coils. This unique feature prevents rapid evaporation at the condenser coil which would otherwise result in a greater amount of mineral deposits on the coil. Fewer deposits increase the efficiency of the coil and reduce the total quantity of water used by the system.

The variable kitchen exhaust system previously described represents an innovative method of reducing the make-up air requirement associated with the kitchen operation. Traditionally, large exhaust quantities have been prescribed to ensure adequate grease removal in ductwork. In part, for this reason, the AHJ initially rejected plans to implement the system. ESD worked with the city to explain that the system provided code required airflow in the presence of grease and vapors. In addition, studies performed by ASHRAE Technical Committee 5.10, Kitchen Ventilation, were presented to demonstrate that reduced exhaust volumes during periods of low particulate generation, had a negligible impact on the deposition of solids on exhaust ductwork. ESD was able gain approval from the AHJ for use of this innovative method of energy savings.

Operation & Maintenance
Considerations of the operations and maintenance of the building's mechanical systems played a significant role in shaping the design choices early in the project. The new headquarters is located on an existing campus with multiple existing buildings operated and occupied by the owner. This campus is currently maintained by minimum staff. The owner wished to implement systems which would not result in significantly increased maintenance requirements. The mechanical design incorporates packaged DX equipment which is less maintenance intensive than operating a chilled water plant.

An extensive building automation system is implemented in the design of the system. All HVAC equipment is connected to the BAS. At a minimum, operational status and alarms are monitored. In larger equipment, such as the main rooftop air handling units, set points can be adjusted remotely. An additional feature of the BAS is notifications that are generated when spaces drift outside of design parameters. These notifications will assist the building engineer in identifying and addressing problems before they cause discomfort to building occupants.

Cost Effectiveness

In order to maximize cost effectiveness of the mechanical systems, the design team took a practical approach. First, all LEED requirements were addressed. This included establishing minimum ventilation rates, selecting green refrigerants, and establishing overall energy savings targets. Next, the design team implemented low cost, high savings energy conservation measures. These included implementation of EC motors and VFD's. Finally, the most energy intensive systems were targeted for improvement. These included the main rooftop air handling units and the kitchen make-up unit. Using this approach allowed the design team to maximize the effectiveness of the owner's capital in achieving the projects energy saving objectives.

Environmental Impact

Through the use of both common and unique energy savings strategies implemented as part of the mechanical design, the building can be operated using less electricity, water, and natural gas. In addition to selecting more efficient equipment and operational strategies, the design team worked closely with the architect to select building materials with outstanding thermal performance. Heat transfer coefficients far exceeded baseline requirements.

	Proposed	Baseline
Wall Construction	U = 0.049	U = 0.084
Roof Construction	U = 0.033	U = 0.063
Slab Construction	U = 0.063	U = 0.087
Fenestration	U = 0.036	U = 0.057

ESD was able to help the project team understand that the most effective way to reduce energy consumption and minimize environmental impact is not by heating and conditioning air more effectively, but by minimizing the need to heat or condition air in the first place by implementing a high performance envelope.

SOLUTION

Commissioning activities concluded and the building was occupied in September of 2012. ESD developed a measurement and verification plan that will be put in place as day to day building operations begin in earnest. Gas and water use will be metered at the utility entrance. Equipment logs and a careful analysis of overall building operations will help determine mechanical contributions to this energy use. Electrically, energy measurements will be measured and quantified directly. Mechanical equipment is powered from dedicated, metered panels. Trend data will be logged and saved over the course of the next year. Through careful analysis of the measured data, ESD will assist in calibrating the actual and baseline energy models to closely match actual performance. This will allow the design team to estimate the energy savings attributed to the HVAC systems. We look forward to validating the contributions of the HVAC systems to the improved energy efficiency, indoor air quality, and an overall reduced environmental impact over the coming year.

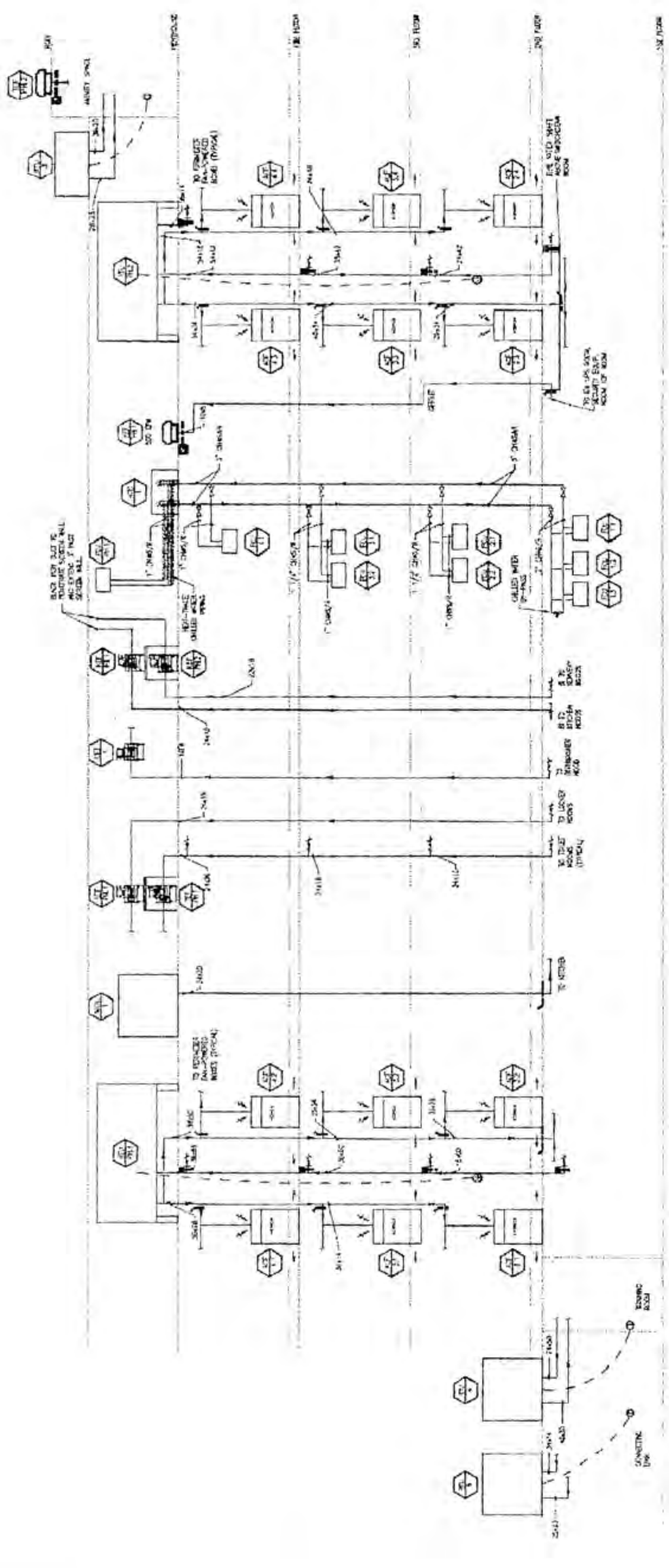


Figure 3: HVAC Schematic Diagram