Howard County General Hospital

Columbia, Maryland

Photo Courtesy of Leach Wallace Associates

Casey Schardt

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Lighting/Electrical Option

Faculty Consultant: Dr. Mistrick

Howard County General Hospital

5755 Cedar Lane Columbia, MD 21044

Project Statistics

- 40,000 square foot, 3 story (2 above grade) addition to existing 230,000 square foot facility.
- Project also includes a Renovation of 30,000 square feet of the existing building.
- $20,000,000 Construction cost.
- Constructed between September 2000 and July 2003.

Project Team

Owner/Occupant: **Johns Hopkins Hospital System**
Architect: **Wilmot Sanz, Incorporated**
MEP Engineer: **Leach Wallace Associates**
Structural Engineer: **LPJ Qodesh, Incorporated**
Civil Engineer: **Joyce Engineering Group**
General Contractor: **Atlantic Builders Group**

Courtesy of Howard County General Hospital

Structural

- Cast in place concrete foundation with slab on grade on basement floor.
- Cast in place slab on deck with supported by steel columns, girders, and beams for first and second floors, and the roof.
- Roof slab is designed such that a third floor could be added on top it in the future.

Lighting

- Most lighting at 277 volts, with a few applications using 120 volts.
- Continuous glazing down the length of the building allows for utilization of daylight in some spaces.
- Many critical medical tasks require special lighting conditions.

Courtesy of Leach Wallace Associates

Architecture

- Will allow Howard County General Hospital to increase its capacity to serve the community.
- 47-bay emergency department
- 6-bed pediatric inpatient nursing unit
- a 17-bed neonatal intensive care unit, a 12-bed birthing department
- 16-bed intensive care unit
- Expanded imaging department
- Expanded facilities for maintenance and engineering.
- Upgrades to the mechanical and electrical systems.
- The architecture is intended to clarify the function of the spaces while adding emotion to them. *(courtesy of Wilmot Sanz)*

Mechanical

- Several new air handling units and hot water heating plant as part of a VAV HVAC system with hot water reheat.
- Existing chiller plant is to be expanded by 1,500 tons with three new chillers and cooling towers.
- Medical gas services, including oxygen, vacuum, medical air, and nitrous oxide.

Electrical

- New 2,500 KVA, 480Y/277V substation along with new emergency paralleling switchgear.
- Automatic transfer switching required for segregating emergency power into three branches: life safety, critical, and equipment.
- New fire alarm, nurse call, telecommunications, and security systems, with a complex centralized monitoring system. *(courtesy of Leach Wallace Assoc.)*

Table of Contents

Executive Summary

This report analyzes the design of the addition and renovation to Howard County General Hospital. It focuses primarily on the lighting and electrical portions of the design, but also takes into careful consideration the impact on all other aspects of the design, such as architecture, construction, energy concerns, and HVAC requirements.

The lighting study analyzes in detail three different spaces in the hospital. The lighting in these spaces was completely redesigned. The spaces include a lobby area, a nurse station, and a videoconferencing room. The design criteria were identified for each space, and unique solutions are presented.

The electrical study analyzes the performance of the existing design of the electrical distribution system. Recommendations are made that could improve this design and address certain problems that may arise. For example, an uninterruptible power supply (UPS) was designed to serve sensitive diagnostic imaging equipment, which has been known to shut down due to even very small power disturbances. Parts of the emergency power distribution system are redesigned, including a new generator. The circuits and panels for the second floor labor and delivery unit were analyzed, along with all equipment in the path back to the substation. The protective devices on this path were analyzed for coordination. A motor control center was also redesigned.

The lighting system throughout the building was analyzed and a new fixture is proposed to replace an existing one that will cut down on both construction costs as well as the life-cycle operational costs.

The impacts on the mechanical systems from the new lighting design and the addition of the UPS were analyzed to determine how these changes affect the HVAC system serving those areas.

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The Entire Architectural Engineering Faculty and Staff

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John Reese of Reese Engineering

Ed Wunderley of Burt Hill Kosar Rittleman Associates

Howard County General Hospital

Wilmot Sanz Architecture/Planning

Background

Howard County General Hospital is located in Columbia, Maryland. This project focuses on the recent addition to the hospital. The characteristics of the design of this project are outlined below.

General Project Data

- Building Name: Howard County General Hospital
- Location and Site: 5755 Cedar Lane, Columbia, MD 21044
- Building Occupant Name: Johns Hopkins Hospital System
- Function: Hospital
- Size: 40,000 square foot addition, 30,000 square foot renovation
- Stories: 3, 2 above grade
- Project Team:
    - Owner: Johns Hopkins Hospital System
    - Architect: Wilmot Sanz, Inc
    - MEP Engineer: Leach Wallace Associates
    - Structural Engineer: LPJ Qodesh, Inc.
    - Civil Engineer: Joyce Engineering Group
    - General Contractor: Atlantic Builders Group
    - Mechanical Contractor: Southern Mechanical
    - Electrical Contractor: Electrico, Inc.
- Dates of Construction: September 2000 – July 2003
- Total Construction Cost: $20,261,000
    - Total Electrical Construction Cost: $2,600,000
    - Total Mechanical Construction Cost: $7,495,000
- Project Delivery Method: Design-Bid-Build

Architecture

The addition and renovation is allow Howard County General Hospital to increase its capacity to serve the community by adding a new 47-bay emergency department, , a 6-bed pediatric inpatient nursing unit, a 17-bed neonatal intensive care unit, a 12-bed birthing department, a new 16-bed intensive care unit, an expanded imaging department, and expanded facilities for maintenance and engineering. The modernization also includes upgrades to the hospitals mechanical and electrical systems. The architecture is intended to clarify the function of the spaces while adding emotion to them.

The 1993 edition of the BOCA National Building Code governs the design of the building, as well as the Howard County Health Department.

The exterior walls are prefabricated concrete curtain walls supported by steel columns, with tinted glazing on both above grade levels. Steel joists support the steel decking on the flat roof.

Fire Protection

Structural steel and metal decking are protected by cementitious spray-on fireproofing. One and two hour rated fire partitions, and fire & smoke partitions are used in critical locations to isolate the spread of fires; for example in exits, stairwells, duct shafts, and corridors. Magnetic hold-open doors that close during a fire alarm are also used in many corridors. Fire retardant or resistant materials are used in many furnishings where possible.

The hospital is fully sprinklered throughout, based on Light Hazard Occupancy requirements. The sprinkler system is a Class I combination wet type automatic sprinkler-standpipe system. There are smoke detectors and dampers installed in the HVAC ductwork. These detectors will shut down the associated air handlers and/or operate the dampers. These detectors, along with sprinkler flow alarm switches, smoke detectors in the rooms, and manual pull stations are all connected to the building evacuation alarm system to alert the occupants in the event of a fire, and to alert the local Fire Department. The building alarm system includes alarm chimes, flashing lights, and indicators on the fire alarm control panel.

Transportation

The addition to the hospital is served by several nearby existing elevators. No new elevators are being installed. The existing building was designed to accommodate an expansion with the elevators located at the edge of the building. With the new addition, the elevators will now be in the core of the building.

Telecommunications

Nearly all rooms in the building feature telephone and data outlets. The telephone lines are integrated into the hospital's in-house telephone system. The data outlets allow computers to connect computers to the hospital's network, which is linked to the Johns Hopkins Hospital System's computer network.

Special Systems: Nurse Call System

Various types of nurse call terminals are provided in all areas where patients may require the assistance of a nurse. They send signals to nurse call control panels, and have an indicator light nearby to alert the nurses as to where the call came from. Some terminals also include intercom stations.

Special Systems: Hospital Paging Systems

Speakers for the paging system are installed in the ceilings throughout the hospital. Some phones, such as those for receptionists, are connected for transmitting over the paging system. Some areas, such as the Diagnostic Imaging Suite also have their own local paging systems.

Special Systems: Medical Gas System

The hospital has a system to distribute medical gases throughout the building to be used in specialized spaces such as operating rooms. These gases include oxygen, nitrous oxide, medical air, vacuum, and anesthesia evacuation.

Existing Electrical System

System Type and Utility Service

A secondary selective system is used to distribute incoming power from the utility. Though more costly than a radial system, this type of system allows for a continuous supply of power to essential systems required for the hospital. If either primary feeder is interrupted, the other can take over. It also allows for regular maintenance to be performed while still operating under normal power from the utility. This is particularly important since an interruption in service could be life-threatening for patients undergoing surgical procedures, or those relying on electrical life-support devices.

The facility is served by Baltimore Gas and Electric Company by a 13.2 kilovolt feeder to an existing outdoor switchgear located on the hospital's campus. The individual buildings are then fed from this switchgear. In the new West Addition, the voltage is stepped down to the building utilization voltage of 480/277 volts by two transformers with a wye configuration. The substation is 3 phase, 4 wires, and rated for 2500 kVA, 4000 Amps.

Emergency Power

The hospital is supplied by emergency power via existing on-site emergency generators. The main building has existing generator paralleling switchgear through which the emergency power is delivered to the building. Automatic transfer switches allow the essential systems to maintain power during an interruption of the power from the utility. The type of switches used are electrically operated and mechanically held. They are in NEMA 1 enclosures with manual operating handles allow for the operator to safely maintain the devices.

There are three different branches of emergency power found in the building: Life Safety Branch, Critical Branch, and Equipment Branch. The Life Safety Branch is to primarily supply power to egress lighting circuits. These circuits are found in all corridors, stairways, lobbies, and other large spaces or those used for egress during an emergency. Nurse call systems, fire alarms and other related devices are also on the Life Safety Branch so that they will remain powered during an emergency. The Critical Branch supplies power to a variety of essential systems in the building required for the hospital to continue to function and treat patients. This includes life-support systems, monitors, some computer systems, and surgical tools. The Critical Branch also includes some lighting circuits. Any switched lighting on emergency power is on the Critical Branch. For example, nurse stations must be provided with ample light at all times. Medical exam and surgical lights also must always be available when needed. Finally, the Equipment Branch contains primarily mechanical systems that need to maintain continuous power, and those essential during emergencies. For example, elevators are needed for use by fire fighters, and may be needed for egress. In addition, many HVAC devices need to remain functional to provide sufficient air quality. This is particularly important in operating room where large amounts of clean airflow are required to maintain a clean and comfortable environment.

Overcurrent Protection

The electrical system is protected from overcurrent by a variety of different devices, including fuses, fused safety switches, and circuit breakers.

Low voltage (600 amps or less) fuses are dual-element, U.L. class RK-5 current limiting time-delay type. Interrupting rating is 200,000 RMS symmetrical amperes. The size is described as NEMA class H. High voltage (601-6000 amps) fuses are NEMA class L, and also have an interrupting rating of 200,000 amperes.

Fused safety switches have current limiting "R" rejection feature fuses. They are rated to withstand a short circuit of at least 100,000 amps RMS. They are in heavy duty NEMA 1 steel enclosures (3R if outdoors), and can be equipped with at least two padlocks.

Enclosed circuit breakers are to be quick make, quick break, trip-free handle and calibrated for 40° C ambient temperature. They are common trip and have handles that indicate whether they are on or off.

Circuit breakers in panelboards are bolt-on type thermal magnetic tripping free of handle.

Layout

The new West Addition Substation is located on the ground (basement floor) of the building in the main electrical room located in the middle of the south side of the west addition. The motor control centers are located in the adjacent main mechanical room where most of the mechanical equipment for the building is located. The main electrical room also houses the automatic transfer switches, several large panelboards distributing power to the floors above, as well as transformers. The remainder of the panelboards and transformers are located in various electrical rooms on each floor of the building.

Lighting Systems

Nearly all of the lighting found in the building operates at 277 volts, with the exception of some specialty lighting, such as surgical task lighting, under-cabinet fixtures, dark room lights, and helicopter obstruction lights, which operate at 120 volts. The lighting fixtures are almost exclusively fluorescent, again with a few exceptions, including both high intensity discharge and incandescent. Metal halide fixtures are used outdoors in the parking area. The fluorescent ballasts found in the fixtures are electronic, Class P with A sound ratings. The ballasts are of high power factor (at least 0.95), ballast factor of at least 85%, and with a maximum total harmonic distortion of 10%. Dimming ballasts are dimmable to 1% for linear fluorescent fixtures, and 5% for compact fluorescent.