Cathedral Place
Steven Puchek
Milwaukee, WI

# Executive Summary

The electrical systems existing conditions report analyzes the power distribution system of Cathedral Place from service entrance to end utilization based on the available information given in the construction documents.  The building was modeled using NEC demand load and calculations for all equipment, lighting, power systems, and emergency backup systems to determine the appropriate sizing and to compare these evaluations to the actual design.  Using accurate approximations for all of the building loads, and distributing the motor loads appropriately throughout the buildings panels, a thorough energy and demand usage was determined and finally compared to the actual electric load profile for the building over the last 24 months.

The following report analyzes the building from a conservative standpoint wherein slightly oversized values were consistently used to get a "worst-case scenario" of the building.  This applies mostly to the unit occupancy load approximations and the main distribution from the substation transformers at the main switchboard.  Other aspects of the electrical system including overcurrent protection, transformer configuration, building utilization voltages, and overall distribution were also analyzed as a whole, but were detailed on an individual basis through the calculated NEC building design load.  This analysis was found to be of considerable importance given the building's many multifunction spaces, various utility voltages, and separate metering and billing accounts.

After completion of the NEC building design load, it was found that 99% of the equipment was sized appropriately with the few exceptions occurring due to overestimation of building loads (office bus duct riser total load), oversized demand load (transformer T/LB) or a minor drafting error (Panel H/LA overcurrent).  While the system does provide for a redundancy at the service entrance, it was found that a single transformer working to provide electricity for the entire building would be working at near 100% capacity.  This being the case, a sizing factor for future expansion was not adequately accounted for in a single-transformer failure condition, but more than adequately provided for in normal operation.

For ease of reference, the bulk of the detailed information was placed in the NEC Building Design Load information section, or in the appendices at the end of the report.  The Appendix includes the rebuilt riser diagram for the whole building, two main switchboard single-line diagrams, motor schedule with load calculations, feeder schedule for panel references, utility rate structure for the current provider, and lamp and ballast data.  (Note:  the appendix includes/references two separate files included with this report for the single-line diagram and motor schedule due to their size and the constraints of printing the report at standard size.)

## Distribution System Type

The electrical system in Cathedral Place is mainly a dual primary radial service distributed through two main switchboards and one main panel. While this service does not provide electricity for the whole building, it is an accurate representation of the overall design. The electrical system is comprised of three separate utility entrances, all radial services. The service entrance in the electrical vault transforms condo and parking voltage levels to secondary utilization levels, while the office and retail areas are serviced directly through owner-purchased switchgear and transformers. Each of the main distribution centers serves one of the four main building uses (except the main switchboard which subfeeds the retail main distribution board). From the office and condo distribution boards a bus duct riser is tapped at each floor. The retail units and parking structure are fed with conductor pulls at the ground floor and first nine floors from their respective distribution panels.

From the primary service entrance(s) and the individual switchboards at the office and retail locations, the utilization areas are allocated space for a distribution panel and sufficiently sized for future use of the entire space. The condo units are tapped at each floor to a submain distribution where separate metering and loadcenter distribution occurs. On average each floor of the residential area has four units requiring service, and the submain distribution is estimated with that size in mind. Please see the building single line and riser diagrams to better understand the distribution system in Appendices A and B – “Puchek-Riser.pdf”

## Building Utilization Voltage

Considering the use of multiple main distribution panels/boards, service voltages provided occur at varying levels. The main service to the building is 13.2kV to the electrical vault serviced by the electric company. The electrical vault has direct pulls and transformed service for secondary service to the condos and parking structure.

The building’s main service – 13.2kV delta-connected – feeds directly into the owner’s switchgear, transformed to the secondary utilization voltage of 480/277V wye-connected at the integral substations and fed to the double-ended main switchboard (MAIN). The main switchboard is a keyed, bus-duct tied, dual service switchboard sized such that loss of power on one main feeder can be compensated by closing the keyed breaker tie and providing service through the single remaining feeder. The integral substations are 2000/2660kVA AA/FA delta-primary wye-secondary transformers with 15kV nominal ratings. The main board servicing the office and retail provides the secondary 480/277V high-voltage to all utilization points and stepped-down to 208/120V for all individualized low-voltage applications. This includes the subfed retail distribution panel (RT/DP) which itself subfeeds individual retail high-voltage panels with individual step-down transformers and low-voltage panels.

The condo main distribution board (C/MSB) is serviced at 208/120V directly from the electrical vault. The electric company provides the transformation equipment and the condo service, metered separately, and is charged at a differing rate for low-voltage secondary service. From this board, the bus duct is tapped at each floor and distributed via separately metered loadcenters providing the same 208/120V service. Since the transformation occurs in the electrical vault, it is assumed that the service was delta-connected and provided to the switchboard wye-connected.

The parking main distribution occurs through a single main distribution panel (P/HA). From this panel all parking loads are powered. Having a separate service, again metered separately, the provided voltage is 480/277V wye-connected from the electrical vault. Any required low-voltage secondary, like the retail and office sections, is stepped-down at the utilization point (floor) and distributed through the associated high-voltage equipment.

All actual utilization voltage are at 480/277V for the majority of the tenant, lighting, and mechanical loads or at 208/120V for the remaining loads especially those in the condo units. Service voltage varies, strictly speaking, but overall is “provided” at 13.2kV.

## Transformer Configuration

The two main transformers utilized in Cathedral Place are 15kV nominal, 13.2kV service delta-connected primary transformers rated at 2000kVA ambient, or 2660kVA forced-air cooled. They provide a redundant service to the main switchboard. These transformers were chosen and sized based on the estimated power consumption of the tenants throughout the building, and therefore had to be estimated.

The transformers providing power in the electrical vault are the property of the electric company and as such, ratings, configurations, and sizes could not be obtained for them. Like the main substation transformers, they had to be sized and estimated to provide service to an open tenant condo structure and were more than likely oversized for that reason. It is estimated that a single transformer decreases voltage from the 13.2kV delta connected to a wye-connected 480/277V, tapped to provide high-voltage service to necessary panels, and then again stepped-down by a wye-wye transformer to provide the 208/120V service for the condo units.

The remaining transformers are dry-type transformers located at various floors serving low-voltage panels or in the basement providing the same service. Of the twelve transformers specified in the riser diagram, four are integral with the low-voltage panel as indicated on the transformer schedule in Appendix D. These transformers range from 15kVA to 112.5kVA. All other transformers for tenants of the office and retail areas are provided by the tenants.

# Cathedral Place

Steven Puchek
Milwaukee, WI

## Emergency Power Systems

The emergency power system of Cathedral Place provides power for only the necessary building elements providing transportation and egress. Power to individual areas, tenants, floors, etc. is not maintained in the case of an emergency. Emergency power is provided only to elevators, a few necessary mechanical equipment motors, egress and stair lighting, and the entire fire command-center.

Emergency power is provided through the emergency panel (EMDP) from the 350kW diesel generator at the first floor. This panel serves the loads through automatic transfer switches located in the electrical/mechanical room in the basement rated at 100A, 200A, and 250A dependent on their load. Loads not normally in operation (such as fire pumps and controllers, jockey pumps, stair pressurization equipment, fuel pumps, etc) are also provided power from this generator.

Automatic transfer switches are of the double-throw mechanical transfer type with manual overrides. A time delay configuration and voltage relay prevents the switches from returning to normal positions when normal power hasn't been restored and also accounts for the delay in generator starting and load application preventing unstable electrical conditions to the generator motor.

### *Emergency Lighting*

For emergency lighting, all egress paths, main corridor lighting, etc. are fed from the ATS dual-serviced panels typical to a house branch circuit (emergency house panels HE/HA, etc.) All emergency lighting is fed from use-specific emergency panels (PE/HA, HE/HA, CE/HA for parking, house, and condo respectively) which are given normal power for operation during all conditions and emergency power for emergency conditions. They are, therefore, always operational. The emergency lighting is typical to the area it serves and varies between metal halide and fluorescent lamp fixtures all powered at high 277 voltage. The exit signs are LED backlit with battery-backup for worst-case scenario egress. For all detailed lamp and ballast data please see Appendix F for input wattages, power factors, etc.

## Overcurrent Protection Devices

Overcurrent protection throughout the electrical system of Cathedral Place varies by location, connection, and protection. Beginning at the service entrance, 125E fuses (125A rated) protect the service feeders from all fault conditions and overcurrent conditions. Disconnect switches are located in the switchgear for non-fault servicing. The main switchboard is protected at feeder entrance by two ground-fault protection 3000A circuit breakers (for A- and B-side). Likewise, the bus duct tie is connected and protected through the same size and type of breaker. From the switchboards and main panels for each use, circuit breakers of varying ampere ratings protect the panels that they subfeed. Beyond the entrance protection to these main distribution panels/boards, no panel has redundant entrance protection and all are therefore connected main lug only (MLO). Most mechanical equipment is protected with varying-amperage fusible disconnect switches fed from panels or directly connected to bus ducts. Smaller mechanical equipment requiring little servicing is otherwise connected through typical shunt-trip circuit breakers. For more detailed overcurrent protection sizing, locations, etc. see the panelboard tables and single-line diagrams in the NEC Building Design Load section and Appendices A and B.

## Wiring and Bus Ducts

Wiring throughout Cathedral Place is of a typical installation, and is relatively limited to the sizes shown on the feeder schedule in Appendix E. These are all based on a current rating and typically are 4-wire with a separate ground wire. Of particular note are the main distribution service wirings and main riser runs.

- Switchgear is served by an unknown wire-size but allocated (3) 4" conduits.
- Main switchboard (Main) is served by (3) #1 high voltage cables in 4" conduit.
- Retail is served by (3) 400MCM conductors with (3) 2/0 neutral conductors in (3) 3-1/2" conduits.
- Parking is of unknown wire size, but allocated (2) 4" conduits.
- Condo is also of unknown wire size, but are allocated (6) 4" conduits due to the decreased voltage.

The only two risers of importance are the bus ducts that serve the condos and office floors. The office bus duct is of particular concern because of its lengthy 17-floor run. The office bus duct is a 2500A rated bus sized up because of the run, and the condo bus duct is a 1200A rated bus serving a much higher power-density residential unit.

## Distribution Equipment Locations

Most of Cathedral Place's distribution equipment is located in the basement of the building in the Switchgear/Mechanical room. This room is as wide as the building and located at the north end. Within this room are panels, transformers, ATS's, switchboards, service entrances, and metering for the office and retail areas. Panels and Automatic Transfer Switches are located on the walls in this 3000+ square foot space with the transformers sitting on the ground. The main substation transformers and switchboards are located in the center of this room on the western half. Telecom raceway and entrances, as well as steam utilities and fire equipment are also located in this room, but are segregated and located at east "end" of the room with all electrical equipment at the west.

Utility service transformers and entrances are located in the electrical vault and penetrations through the walls serve the distribution equipment. Electrical closets on each floor house the bus ducts and conductor pulls, tenant transformers and panelboards, and house panelboards for emergency lighting, mechanical equipment, etc. This electrical closet is located to the east of the elevator core for floors 1-9 and northeast of the central stairs for floors 10-17 in the core. The parking structure's electrical "closet" is located in the basement as well adjacent to the electrical vault, but opposite of the switchgear room.

The emergency generator and emergency panel are located on the building's west side on the first floor. It is exposed to the elements, and housed in the parking garage area for safety concerns, and ease of replacement, servicing, fueling, and operational checking. For a better understanding of floor locations of equipment, please see the riser diagram in Appendix A.

## Motor Power Distribution

All mechanical equipment, elevators, etc. are fed directly from the panelboards specified in the core-and-shell design. The motors are all fed from panels respective to their usage area, namely the house panels (H/xx), condo panels (C/xx) and parking panels (P/xx) with the majority on the house and house standby panels. Elevators that are operational under emergency conditions are also fed by the emergency panel connected through the appropriate automatic transfer switch.

Motors loads that are provided by the tenants are connected to their fit-out supplied panels and fed by bus plug into the office riser, or connected directly to the retail distribution panel. Many of the motor loads are located in the basement on the "other half" of the switchgear/mechanical room. Almost all of the pumps (fire, jockey, heat pump water supply, potable water pumps, etc.) and two parking elevators are located in the basement while the cooling tower fans, EFC fan, and office elevators motors are located on the roof. All of the heaters and AC units are located at the floors that they serve, and the condo elevator motors are located at the 10$^{th}$ floor. No particular motor control center or building automation system exists that would otherwise control power flow to the motors throughout the building. For detailed information regarding the motor power requirements please see Appendix C.

## Typical Lighting Systems

The lighting systems in Cathedral Place are, like everything, specific to the use area in the building. The retail floor lighting is provided by the tenant, but for the most part will make extensive use of incandescents, low-voltage high CRI lighting solutions, and spotlights. All of these lamps will have heating element sources and cause very little harmonic distortion.

Lighting in the office floors is also by tenant design, but will much more likely be fluorescent or other high-output sources requiring ballasts. Depending on the lighting solution, the installation will more than likely use electronic ballasts introducing a small, but somewhat significant harmonic distortion to the electrical system. This affects the main distribution board only and the sum of all of the office tenant floors and retail areas.

In the condos, very little fluorescent lighting will most likely be used, and will have the same minimal impact as the lighting in the retail areas. Dimmable lights will be a more prominent design in the residential area but will not affect the overall electrical distribution system.

The parking structure, differing from all of the other spaces, is filled with metal halide and fluorescent lamp fixtures – all requiring ballasts. Since they will not be dimmed, and need to be extremely cost effective, they may have been provided with magnetic ballasts which introduce much greater harmonic distortion, especially among the metal halide fixtures.

The remaining fixtures powered by the house distribution equipment are typically of fluorescent or compact fluorescent nature, all requiring ballasts. For these lamps, ballasts with less than 10% total harmonic distortion, and having power factors greater than 0.95 were used. While these areas may cause significant contribution as a lighting system to the power distortion and overall power factor reduction, they only account for a very small area in the building's overall area. They are, however, tied to the same distribution board as the office tenant floors, and the system should be analyzed to account for the heavy ballast usage. More detailed lamp and ballast data can be found in Appendix F, while further lighting information can be found in the Existing Lighting Conditions Report – Tech 1.

## ASHRAE/IESNA 90.1 Shutoff

Shutoff requirements are only taken into consideration for the core-and-shell design and parking structure. The parking structure and façade lighting are controlled by time-clock and photocell sensors which run through lighting control relays in the basement to control when they turn on and off. When not in use or necessary, these fixtures will be shut off in accordance with ASHRAE 90.1. The core bathrooms and some of the mechanical rooms on each floor are controlled by occupancy sensors to turn off lights when those facilities are also not in use.

Considering the future tenant fit-out of the remainder of the building, one can only hope or assume that the shut-off requirements for time and occupancy are accounted for in the design.

## Power Factor Correction

Power factor correction through the use of capacitor banks at the service entrance or at each main distribution point, is not used in Cathedral Place as of completion of the building in March 2004. From the utility bills, it can be seen that the power factor dips to 0.859 only twice, and averages at 0.894 for the office portion. For the parking structure, the power factor is a constant 0.85.

## Important Design Considerations

Important design considerations for the building are typical of most buildings in the form of transient voltage surge suppression (analyzed and determined that there was little need for the core-and-shell design), voltage drop, power conservation, emergency power supply, uninterruptible power supply, and cost effectiveness.  TVSS protection was not used in the building because of the lack of tenant information or design.  For cost and logistical reasons, uninterruptible power supplies were likewise unnecessary.  Uninterruptible power supply would be the responsibility of the tenant depending on their power security, and data needs.

Emergency power supply went along with the uninterruptible power supply analysis and was determined to be a lesser necessity.  Emergency power was determined to be provided only for life-safety concerns and conditions and was not required to be as redundant or reliable as to provide power for the entire building.  This also factors into the cost effectiveness of the design.

Power conservation is of moderate concern in the space, was not specifically designed for overall.  Building automation does not exist, and a large glass façade was not designed around to prevent heat loss and reduce energy consumption.  Fluorescent lighting was used very consistently to reduce lighting costs and compact fluorescents are used almost exclusively where incandescents are typically found.

Voltage drop was of high concern to the design due to the location of the electrical equipment.  Since everything is located in the basement, 17 stories of bus duct riser is expensive, requires structural integration, and has to account for voltage drop over some initial 150+ foot runs.  Additionally, the length of the building, topping 365 feet has to come into account in wiring the parking structure, and the 120 foot length of the upper office floors.

## NEC Building Design Load

The following building design load was built off of the available mechanical equipment schedules, lighting load calculations from NEC 2002 code, receptacle counts and/or estimates, and in the case of retail and office tenants, square footage estimations of power consumption. For the condo units, basic loadcenter calculations were made based on researched power consumption of appliances and NEC requirements and demands.

From these loads, demand factors were appropriately used based on NEC code for the individual panelboards, load in the residential loadcenters, and feeder and breaker sizing. From all of this information, calculations were made and panels developed to get a basic idea of the flow through the power system. On the panels, breaker and feeder sizing were compared and checked, and the overall system analyzed. For references to tables and information not specifically listed below, please see the Appendices.

First, the residential loadcenter was estimated. Researching information for the appropriate appliances in an apartment and applying the appropriate load information, the load from a given residential unit was determined. For the most part, conservative approximations (higher rather than lower loads) were used. Appliance information was obtained from the GE website.

| Unit Panel | Condo (Typ) | | |
|---|---|---|---|
| Voltage | 208/120V<br>3P,4W | | |
| Breaker | 100A | | |
| Load | VA | Demand | Demand Load |
| | | | |
| Dishwasher | 1092 | 0.75 | 819 |
| Refrigerator | 1800 | 1 | 1800 |
| Disposal | 720 | 0.75 | 540 |
| Range | 8320 | 0.8 | 6656 |
| Range Hood | 250 | 0.75 | 187.5 |
| Kitchen Recept | 1500 | 1 | 1500 |
| Kitchen Recept | 1500 | 1 | 1500 |
| Washer/Dryer | 5000 | 1 | 5000 |
| Exhaust Fan per Bath | 300 | 0.75 | 225 |
| Water Heater | 3800 | 0.75 | 2850 |
| | | Total Demand Load | 21077.5 |
| | | Total Demand Current | 58.51 |

The demand factors applied are as follows:

- 2002 NEC 210.11(C) and 210.52(B) – two 1500VA receptacle branch circuits for kitchen
- 2002 NEC 220.17 – 4+ appliances not including ranges, clothes dryers, space heating, or air conditioning = 75%
- 2002 NEC 220.18 – Washer/Dryer cannot be less than 5000kVA
- 2002 NEC 200.19 – Range demand factor for 1 range = 80%

Using this general load center and having a list of the current tenant fit-out for residential units, the areas were used to determine the lighting loads using the 2002 NEC Table 220.3(A) General Lighting Loads by Occupancy

| Residential Lighting Load Calculation | | | | | |
|---|---|---|---|---|---|
| Unit | Area (sf) | NEC Design Load (VA/sf) | Load per Unit (VA) | Demand | Demand Load (VA) |
| 300 | 1848 | 3.0 | 5544 | A* | 3890.4 |
| 301 | 691 | 3.0 | 2073 | A* | 2073 |
| 302 | 1026 | 3.0 | 3078 | A* | 3027.3 |
| 303 | 1652 | 3.0 | 4956 | A* | 3684.6 |
| 400 | 1848 | 3.0 | 5544 | A* | 3890.4 |
| 401 | 691 | 3.0 | 2073 | A* | 2073 |
| 402 | 1026 | 3.0 | 3078 | A* | 3027.3 |
| 403 | 1652 | 3.0 | 4956 | A* | 3684.6 |
| 500 | 1848 | 3.0 | 5544 | A* | 3890.4 |
| 501 | 1719 | 3.0 | 5157 | A* | 3754.95 |
| 502 | 1652 | 3.0 | 4956 | A* | 3684.6 |
| 600 | 1848 | 3.0 | 5544 | A* | 3890.4 |
| 601 | 1719 | 3.0 | 5157 | A* | 3754.95 |
| 602 | 1652 | 3.0 | 4956 | A* | 3684.6 |
| 700 | 1848 | 3.0 | 5544 | A* | 3890.4 |
| 701 | 691 | 3.0 | 2073 | A* | 2073 |
| 702 | 1026 | 3.0 | 3078 | A* | 3027.3 |
| 703 | 1652 | 3.0 | 4956 | A* | 3684.6 |
| 800 | 1848 | 3.0 | 5544 | A* | 3890.4 |
| 801 | 1719 | 3.0 | 5157 | A* | 3754.95 |
| 803 | 1652 | 3.0 | 4956 | A* | 3684.6 |
| 900a | 2541 | 3.0 | 7623 | A* | 4618.05 |
| 902 | 1026 | 3.0 | 3078 | A* | 3027.3 |
| 903 | 1652 | 3.0 | 4956 | A* | 3684.6 |
| 1000 | 3335 | 3.0 | 10005 | A* | 5451.75 |
| 1001 | 2945 | 3.0 | 8835 | A* | 5042.25 |
| 1002 | 2985 | 3.0 | 8955 | A* | 5084.25 |
| All | 45792 | 3.0 | | Total | 98923.95 |

A* is the demand applied to apartment lighting as specified in the 2002 NEC code. 2002 NEC 220.12 with Table 220.11 states that the first 3000kVA + 0.35(Remaining kVA) can be the applied demand factor for dwelling units. The Demand Load was calculated as such.

With the average square footage for a residential unit in the 1800 range, the assumption that the studio apartments (301,401,701) offset the two-story apartments (1000,1001,1002) for general loadcenter calculations, and the previous table was applied to all apartment unit loads. From this, the next table was developed to approximate the total load on the condo bus duct and was applied to the panel calculation tables.

| Total Residential Calculation | | | | |
|---|---|---|---|---|
| Floor | Unit | Power Load (kVA) | Lighting Load (kVA) | Gross Load (kVA) |
| 2 | 300 | 21.08 | 3.89 | 24.97 |
| | 301 | 21.08 | 2.07 | 23.15 |
| | 302 | 21.08 | 3.03 | 24.10 |
| | 303 | 21.08 | 3.68 | 24.76 |
| 3 | 400 | 21.08 | 3.89 | 24.97 |
| | 401 | 21.08 | 2.07 | 23.15 |
| | 402 | 21.08 | 3.03 | 24.10 |
| | 403 | 21.08 | 3.68 | 24.76 |
| 4 | 500 | 21.08 | 3.89 | 24.97 |
| | 501 | 21.08 | 3.75 | 24.83 |
| | 502 | 21.08 | 3.68 | 24.76 |
| 5 | 600 | 21.08 | 3.89 | 24.97 |
| | 601 | 21.08 | 3.75 | 24.83 |
| | 602 | 21.08 | 3.68 | 24.76 |
| 6 | 700 | 21.08 | 3.89 | 24.97 |
| | 701 | 21.08 | 2.07 | 23.15 |
| | 702 | 21.08 | 3.03 | 24.10 |
| | 703 | 21.08 | 3.68 | 24.76 |
| 7 | 800 | 21.08 | 3.89 | 24.97 |
| | 801 | 21.08 | 3.75 | 24.83 |
| | 803 | 21.08 | 3.68 | 24.76 |
| 8 | 900a | 21.08 | 4.62 | 25.70 |
| | 902 | 21.08 | 3.03 | 24.10 |
| | 903 | 21.08 | 3.68 | 24.76 |
| 9 | 1000 | 21.08 | 5.45 | 26.53 |
| | 1001 | 21.08 | 5.04 | 26.12 |
| | 1002 | 21.08 | 5.08 | 26.16 |
| | | | Total Load on Condo Bus Duct | 668.02 |
| | | | NEC Demand Factor | 0.34 |
| | | | Total NEC Load | 227.13 |
| | | | Total Amperes | 630.44 |

The demand calculation for the total load is based off of the demand factor from 2002 NEC Table 220.32 – 26-27 dwelling units on same service branch = 0.34.

The total calculated load = 668.02 kVA, with the NEC Demand Load = 227.13 kVA.
The calculated amperage = 227.13/(3^0.5*.208) = 630.44 Amps.
Since the transformer providing this power is in the electrical vault, one can only assume it is sized appropriately, and the utility-provided conductors are sized accordingly.

Now that the condo unit section has been approximated with a high degree of accuracy (and conservatism), the rest of the building can be approximated and the loads applied to the relevant panels. The receptacles for the core-and-shell design throughout the structure were counted from the plans and the load applied to them (as 180VA each) the following table was developed.

| NEC Receptacle Calculations | | | |
|---|---|---|---|
| Floor | # Receptacles | Gross Load (VA) | Receptacle Approximation for Offices (VA) |
| Bsmt | 43 | 7740 | 0 |
| 1 | 49 | 8820 | 0 |
| 2 | 14 | 2520 | 0 |
| 3 | 14 | 2520 | 0 |
| 4 | 14 | 2520 | 0 |
| 5 | 14 | 2520 | 0 |
| 6 | 14 | 2520 | 0 |
| 7 | 14 | 2520 | 0 |
| 8 | 14 | 2520 | 0 |
| 9 | 14 | 2520 | 0 |
| 10 | 12 | 2160 | 22450 |
| 11 | 12 | 2160 | 22450 |
| 12 | 12 | 2160 | 22450 |
| 13 | 12 | 2160 | 22450 |
| 14 | 12 | 2160 | 22450 |
| 15 | 12 | 2160 | 22450 |
| 16 | 12 | 2160 | 22450 |
| 17 | 12 | 2160 | 11500 |
| | Subtotal Recept Load (kVA) | 54.00 | 168.65 |
| | NEC Demand (kVA) | 32.00 | 89.33 |
| | | Total Receptacle Load | 222.65 |
| | | Total NEC Demand Recept Load | 116.33 |

The Receptacle Approximation for Offices column was developed using the note listed at the bottom of the 2002 NEC Table 220.3(A) stating that without an exact determination of the receptacle load in an office space, an additional 1VA/sf can be applied to the lighting load calculations (next) to approximate the receptacle load. This number was applied to this chart to better separate the information. The subtotal row for the NEC Demand applies the (10kVA +

0.5(Remaining)) to each column separately, and the Total NEC Demand applies to the total receptacle load. Both are results of the same 2002 NEC 220.13 code.

The lighting load for the appropriate areas was developed next based off of 2002 NEC Table 220.3(A) and the results listed below.

| NEC Lighting Calculations w/o Condos | | | | |
|---|---|---|---|---|
| Floor | Occupancy Types | Area (sf) | Unit Load Lighting (VA/sf) | Gross Load (kVA) |
| Bsmt | Parking | 30750 | 0.5 | 15.38 |
| | Mechanical | 4875 | 0.5 | 2.44 |
| | Corridor | 1400 | 0.5 | 0.70 |
| | Storage | 2205 | 0.25 | 0.55 |
| 1 | Retail | 15825 | 3 | 47.48 |
| | Parking | 39650 | 0.5 | 19.83 |
| | Corridor | 1170 | 0.5 | 0.59 |
| | Lobby | 3720 | 1 | 3.72 |
| | Dock, Trash, etc. | 2740 | 0.5 | 1.37 |
| | Residential Lobby | 825 | 1 | 0.83 |
| 2 thru 8 | Parking | 231175 | 0.5 | 115.59 |
| | Mechanical | 1400 | 0.5 | 0.70 |
| | Corridor | 5600 | 0.5 | 2.80 |
| | Lobby | 4290 | 1 | 4.29 |
| 9 | Parking | 32700 | 0.5 | 16.35 |
| | Mechanical | 200 | 0.5 | 0.10 |
| | Corridor | 1525 | 0.5 | 0.76 |
| | Lobby | 330 | 1 | 0.33 |
| 10 thru 16 | Office | 157150 | 3.5 | 550.03 |
| | Mechanical | 3815 | 0.5 | 1.91 |
| | Corridor | 9590 | 0.5 | 4.80 |
| | Lobby | 2240 | 1 | 2.24 |
| | Bathrooms | 3150 | 0.5 | 1.58 |
| 17 | Office | 11500 | 3.5 | 40.25 |
| | Mechanical | 600 | 0.5 | 0.30 |
| | Corridor | 1070 | 0.5 | 0.54 |
| | Lobby | 320 | 1 | 0.32 |
| | Bathrooms | 450 | 0.5 | 0.23 |
| Roof | Mechanical | 1640 | 0.5 | 0.82 |
| | Corridor | 180 | 0.5 | 0.09 |
| | | | Total Lighting Load for Building | 836.87 |

All of the areas were taken from the plans and approximated using AutoCAD to obtain significantly accurate and round areas. The parking lighting area was approximated here and calculated, but not used in the panels because actual information provided in the plans was used instead. The two values were compared and the value used by counting was higher resulting in a more conservative answer. The counting method also includes bathrooms, mechanical areas, and the façade lighting, so the above numbers were also not included in the panelboard calculations. Comparing the counted lighting load and the added information from above (including a façade lighting load) the two answers are within 10% of each other, which is relatively accurate for actual and estimation calculation purposes.

Now that the Office power and lighting, Retail lighting, Condo power and lighting, and Parking power and lighting all have been calculated, the panels can be modeled and their sizes checked with the appropriate power consumptions and motor schedule data. For all motor schedule data refer to Appendix C.

All feeder sizing listed in the following tables does not have specific wire and conduit sizes. These have been listed in the feeder schedule in Appendix E based on the amperage listed in the table. Please reference these when looking for specifics on sizes. All wiring is THW or THHW and (conservatively) based on the ampacities listed in 2002 NEC Table 310.16.

# Cathedral Place

Steven Puchek
Milwaukee, WI

## Condo Panels

| Panel | C/LA | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 65k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 5.04 | | 1.25 | 6.30 | 52.46 | | ** | ** | OK | OK |
| Receptacles | 5.4 | | 0.593 | 3.20 | 26.67 | | ** | ** | OK | OK |
| WSHP-1.6 | 8.5 | Y | 2.5 | 21.25 | 58.98 | 8,10 | 35 | 30 | OK | OK |
| WSHP-1.8 | 6.5 | Y | 1 | 6.50 | 18.04 | 22,24,26 | 35 | 30 | OK | OK |
| CUH-1.4 | 0.08 | Y | 1 | 0.08 | 0.67 | 15 | 25 | 20 | OK | OK |
| C/LB | 15.07453 | | 1 | 15.07 | 41.84 | | 50 | 50 | OK | OK |
| | | Total KVA | | 52.41 | | | | | | |
| | | Total Current | | | 145.47 | | 225 | 225 | OK | OK |

| Panel | C/LB | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 8.4 | | 1.25 | 10.50 | 87.44 | | ** | ** | OK | OK |
| Receptacles | 4.5 | | 0.593 | 2.67 | 22.22 | | ** | ** | OK | OK |
| AC-10.1 | 0.5595 | Y | 2.5 | 1.40 | 3.88 | 10,12 | 25 | 15 | OK | OK |
| F-6.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 13 | 25 | 20 | OK | OK |
| F-7.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 15 | 25 | 20 | OK | OK |
| F-8.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 17 | 25 | 20 | OK | OK |
| F-9.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 21 | 25 | 20 | OK | OK |
| | | Total KVA | | 15.07 | | | | | | |
| | | Total Current | | | 41.84 | | 100 | 100 | OK | OK |

| Panel | CS/HA | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 22k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Elevator 6 | 26.11 | Y | 2.5 | 65.28 | 78.51 | 1,3,5 | 65 | 90 | OK | OK |
| Elevator 7 | 26.11 | Y | 1 | 26.11 | 31.41 | 7,9,11 | 65 | 90 | OK | OK |
| AHU-9.1 | 10.444 | Y | 1 | 10.44 | 12.56 | 2,4,6 | 35 | 30 | OK | OK |
| F-9.3 | 5.968 | Y | 1 | 5.97 | 7.18 | 8,10,12 | 35 | 20 | OK | OK |
| | | Total KVA | | 107.80 | | | | | | |
| | | Total Current | | | 129.66 | | 150 | 150 | OK | OK |

# Cathedral Place

Steven Puchek
Milwaukee, WI

| Panel | CE/LA | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 5.88 | | 1.25 | 7.35 | 61.20 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| CE/LB | 7.875 | | 1 | 7.88 | 21.86 | | 50 | 50 | OK | OK |
| | | Total KVA | | 15.23 | | | | | | |
| | | Total Current | | | 42.26 | | 50 | 50 | OK | OK |

| Panel | CE/LB | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 6.3 | | 1.25 | 7.9 | 65.6 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.0 | 0.0 | | ** | ** | OK | OK |
| | | Total KVA | | 7.9 | | | | | | |
| | | Total Current | | | 21.86 | | 50 | 50 | OK | OK |

# Cathedral Place

Steven Puchek
Milwaukee, WI

## House Panels

| Panel | H/HA | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 62.16 | | 1.25 | 77.70 | 280.38 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| H/LA | 73.66194 | | 1 | 73.66 | 88.60 | | 100 | 100 | OK | OK |
| | | | Total KVA | 151.36 | | | | | | |
| | | | Total Current | | 182.06 | | 200 | 200 | OK | OK |

| Panel | H/HB | | Bus | 400A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 18.72 | | 1.25 | 23.41 | 84.46 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| P-0.7 | 29.84 | Y | 2.5 | 74.60 | 89.73 | 44,46,48 | 65 | 90 | OK | OK |
| P-0.8 | 29.84 | Y | 1 | 29.84 | 35.89 | 50,52,54 | 65 | 90 | OK | OK |
| F-0.1 | 0.746 | Y | 1 | 0.75 | 0.90 | 55,57,59 | 25 | 15 | OK | OK |
| CP-0.1 | 2.238 | Y | 1 | 2.24 | 2.69 | 61,63,65 | 25 | 15 | OK | OK |
| AHU-1.1 | 2.238 | Y | 1 | 2.24 | 2.69 | 1,3,5 | 25 | 15 | OK | OK |
| AHU-1.2 | 2.238 | Y | 1 | 2.24 | 2.69 | 2,4,6 | 25 | 15 | OK | OK |
| ACCU-1.1 | 18.4 | Y | 1 | 18.40 | 22.13 | 8,10,12 | 35 | 30 | OK | OK |
| ACCU-1.2 | 18.4 | Y | 1 | 18.40 | 22.13 | 7,9,11 | 35 | 30 | OK | OK |
| WSHP-1.1 | 11.5 | Y | 1 | 11.50 | 13.83 | 13,15,17 | 25 | 20 | OK | OK |
| WSHP-1.7 | 11.5 | Y | 1 | 11.50 | 13.83 | 25,27,29 | 25 | 20 | OK | OK |
| WSHP-1.9 | 11.5 | Y | 1 | 11.50 | 13.83 | 31,33,35 | 25 | 20 | OK | OK |
| WSHP-1.10 | 15.5 | Y | 1 | 15.50 | 18.64 | 43,45,47 | 25 | 20 | OK | OK |
| Dom. Booster Pump | 17.3445 | Y | 1.5 | 26.02 | 31.29 | 56,58,60 | 65 | 50 | OK | OK |
| Trash Compactor | 2.238 | Y | 1 | 2.24 | 2.69 | 13,15,17 | 25 | 20 | OK | OK |
| | | | Total KVA | 250.36 | | | | | | |
| | | | Total Current | | 301.14 | | 400 | 400 | OK | OK |

| Panel | H/HC | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 35k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 46.82 | | 1.25 | 58.52 | 211.17 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| H/LB | 35.0654 | | 1 | 35.07 | 42.18 | | 50 | 50 | OK | OK |
| | | | Total KVA | 93.59 | | | | | | |
| | | | Total Current | | 112.57 | | 200 | 200 | OK | OK |

# Cathedral Place
Steven Puchek
Milwaukee, WI

| Panel | H/HD | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 35k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 16.16 | | 1.25 | 20.20 | 72.87 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| H/LC | 3.13245 | | 1 | 3.13 | 3.77 | | 40 | 40 | OK | OK |
| | | Total KVA | | 23.33 | | | | | | |
| | | Total Current | | | 28.06 | | 225 | 225 | OK | OK |

| Panel | H/LA | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 10k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 6.72 | | 1.25 | 8.40 | 69.95 | | ** | ** | OK | OK |
| Receptacles | 11.34 | | 0.593 | 6.72 | 56.00 | | ** | ** | OK | OK |
| CUH-0.2 | 0.08 | Y | 1 | 0.08 | 0.67 | 37 | 25 | 20 | OK | OK |
| CUH-0.3 | 0.08 | Y | 1 | 0.08 | 0.67 | 37 | 25 | 20 | OK | OK |
| CUH-0.4 | 0.08 | Y | 1 | 0.08 | 0.67 | 37 | 25 | 20 | OK | OK |
| UH-0.1 | 0.05 | Y | 1 | 0.05 | 0.42 | 5 | 25 | 20 | OK | OK |
| UH-0.2 | 0.05 | Y | 1 | 0.05 | 0.42 | 5 | 25 | 20 | OK | OK |
| AC-0.1 | 0.5595 | Y | 1 | 0.56 | 1.55 | 1,3 | 35 | 15 | OK | OK |
| CUH-0.1 | 0.08 | Y | 1 | 0.08 | 0.67 | 5 | 25 | 20 | OK | OK |
| F-1.3 | 0.24618 | Y | 1 | 0.25 | 2.05 | 7 | 25 | 20 | OK | OK |
| F-1.4 | 0.373 | Y | 1 | 0.37 | 3.11 | 9 | 25 | 20 | OK | OK |
| CUH-1.2 | 0.08 | Y | 1 | 0.08 | 0.67 | 15 | 25 | 20 | OK | OK |
| WSHP-0.1 | 5.7 | Y | 1 | 5.70 | 15.82 | 39,41 | 35 | 25 | OK | OK |
| CUH-1.4 | 0.08 | Y | 1 | 0.08 | 0.67 | 15 | 25 | 20 | OK | OK |
| CUH-1.5 | 0.08 | Y | 1 | 0.08 | 0.67 | 15 | 25 | 20 | OK | OK |
| Clearwater Pump | 1.119 | Y | 1.75 | 1.96 | 16.31 | 17 | 35 | 40 | OK | OK |
| Sanitary Pump | 1.119 | Y | 1.75 | 1.96 | 16.31 | 19 | 35 | 40 | OK | OK |
| Circulation Pump | 0.12682 | Y | 1 | 0.13 | 1.06 | 21 | 25 | 20 | OK | OK |
| Circulation Pump | 0.12682 | Y | 1 | 0.13 | 1.06 | 21 | 25 | 20 | OK | OK |
| Compressor A6.1 | 12.9 | Y | 2.5 | 32.25 | 89.52 | 2,4 | 65 | 50 | OK | OK |
| ACU-1.1 | 12.9 | Y | 1 | 12.90 | 35.81 | 38,40,42 | 65 | 50 | OK | OK |
| P-1.2 | 0.1865 | Y | 1 | 0.19 | 1.55 | 22 | 25 | 15 | OK | OK |
| P-1.1 | 0.1865 | Y | 1 | 0.19 | 1.55 | 22 | 25 | 15 | OK | OK |
| Coiling Door | 0.373 | Y | 1 | 0.37 | 1.04 | 51,53,55 | 25 | 15 | OK | OK |
| Coiling Door | 0.373 | Y | 1 | 0.37 | 1.04 | 51,53,55 | 25 | 15 | OK | OK |
| Overhead Door | 0.5595 | Y | 1 | 0.56 | 1.55 | 63,65,67 | 25 | 15 | OK | OK |
| | | Total KVA | | 73.66 | | | | | | |
| | | Total Current | | | 204.47 | | 200 | 200 | X | X |

# Cathedral Place

Steven Puchek
Milwaukee, WI

| Panel | H/LB | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 10k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 4.32 | | 0.593 | 2.56 | 21.33 | | ** | ** | OK | OK |
| F-10.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 11 | 25 | 20 | OK | OK |
| F-11.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 11 | 25 | 20 | OK | OK |
| ACU-9.1 | 12.9 | Y | 2.5 | 32.25 | 89.52 | 20,22 | 65 | 50 | OK | OK |
| | | Total KVA | | 35.07 | | | | | | |
| | | Total Current | | | 97.33 | | 100 | 100 | OK | OK |

| Panel | H/LC | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 10k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 4.32 | | 0.593 | 2.56 | 21.33 | | ** | ** | OK | OK |
| F-12.1 | 0.12682 | Y | 2.5 | 0.32 | 2.64 | 11 | 25 | 20 | OK | OK |
| F-13.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 11 | 25 | 20 | OK | OK |
| F-14.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 17 | 25 | 20 | OK | OK |
| | | Total KVA | | 3.13 | | | | | | |
| | | Total Current | | | 8.69 | | 100 | 100 | OK | OK |

| Panel | H/LD | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 10k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 6.48 | | 0.593 | 3.84 | 32.00 | | ** | ** | OK | OK |
| F-15.1 | 0.12682 | Y | 2.5 | 0.32 | 2.64 | 12 | 25 | 20 | OK | OK |
| F-16.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 12 | 25 | 20 | OK | OK |
| F-17.1 | 0.12682 | Y | 1 | 0.13 | 1.06 | 14 | 25 | 20 | OK | OK |
| | | Total KVA | | 4.41 | | | | | | |
| | | Total Current | | | 12.25 | | 225 | 225 | OK | OK |

| Panel | HE/HA | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 11.55 | | 1.25 | 14.4375 | 52.10 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0 | 0.00 | | ** | ** | OK | OK |
| HE/LA | 0.5337 | | 1 | 0.5337 | 0.64 | | 50 | 50 | OK | OK |
| | | Total KVA | | 14.9712 | | | | | | |
| | | Total Current | | | 18.01 | | 200 | 200 | OK | OK |

# Cathedral Place
Steven Puchek
Milwaukee, WI

| Panel | HE/HB | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 35k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 6.3 | | 1.25 | 7.88 | 28.42 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| HE/LB | 5.25 | | 1 | 5.25 | 6.31 | | 20 | 20 | OK | OK |
| | | Total KVA | | 13.13 | | | | | | |
| | | Total Current | | | 15.79 | | 225 | 225 | OK | OK |

| Panel | HE/LA | | Bus | 100A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 10k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0.9 | | 0.593 | 0.53 | 4.44 | | ** | ** | OK | OK |
| | | Total KVA | | 0.53 | | | | | | |
| | | Total Current | | | 1.48 | | 50 | 50 | OK | OK |

| Panel | HE/LB | | Bus | 100A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 10k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 4.2 | | 1.25 | 5.25 | 43.72 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| | | Total KVA | | 5.25 | | | | | | |
| | | Total Current | | | 14.57 | | 20 | 20 | OK | OK |

| Panel | HS/HA | | Bus | 600A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| F-0.2 | 1.492 | Y | 2.5 | 3.73 | 4.49 | 2,4,6 | 25 | 15 | OK | OK |
| F-1.5 | 1.492 | Y | 1 | 1.49 | 1.79 | 1,3,5 | 25 | 15 | OK | OK |
| HS/HB | 269.0421 | | 1 | 269.04 | 323.61 | | 600 | 600 | OK | OK |
| | | Total KVA | | 274.26 | | | | | | |
| | | Total Current | | | 329.89 | | 600 | 600 | OK | OK |

# Cathedral Place

Steven Puchek

Milwaukee, WI

| Panel | HS/HB | | Bus | 600A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 35k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Elevator 1 | 37.3 | Y | 2.5 | 93.25 | 112.16 | 2,4,6 | 85 | 125 | OK | OK |
| Elevator 2 | 37.3 | Y | 1 | 37.30 | 44.86 | 8,10,12 | 85 | 125 | OK | OK |
| Elevator 3 | 37.3 | Y | 1 | 37.30 | 44.86 | 14,16,18 | 85 | 125 | OK | OK |
| Elevator 4 | 37.3 | Y | 1 | 37.30 | 44.86 | 20,22,24 | 85 | 125 | OK | OK |
| Elevator 5 | 37.3 | Y | 1 | 37.30 | 44.86 | 26,28,30 | 85 | 125 | OK | OK |
| F-R.1 | 1.119 | Y | 1 | 1.12 | 1.35 | 3,4,7 | 25 | 15 | OK | OK |
| F-R.2 | 2.238 | Y | 1 | 2.24 | 2.69 | 27,29,31 | 25 | 15 | OK | OK |
| F-R.3 | 5.595 | Y | 1 | 5.60 | 6.73 | 9,11,13 | 25 | 20 | OK | OK |
| F-R.4 | 14.92 | Y | 1 | 14.92 | 17.95 | 15,17,19 | 65 | 60 | OK | OK |
| F-R.5 | 1.119 | Y | 1 | 1.12 | 1.35 | 21,23,25 | 25 | 15 | OK | OK |
| HS/LA | 1.6011 | | 1 | 1.60 | 1.93 | | 20 | 20 | OK | OK |
| | | Total KVA | | 269.04 | | | | | | |
| | | Total Current | | | 323.61 | | 600 | 600 | OK | OK |

| Panel | HS/LA | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 10k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 2.7 | | 0.593 | 1.60 | 13.33 | | ** | ** | OK | OK |
| | | Total KVA | | 1.60 | | | | | | |
| | | Total Current | | | 4.44 | | 20 | 20 | OK | OK |

| Panel | H/HE | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 35k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 20.99 | | 1.25 | 26.23 | 94.66 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| RTU--R.1 | 23.9 | Y | 1 | 23.90 | 28.75 | 4,6,8 | 50 | 35 | OK | OK |
| CT-R.1 | 29.84 | Y | 1 | 29.84 | 35.89 | 1,3,5 | 65 | 90 | OK | OK |
| CT-R.2 | 29.84 | Y | 2.5 | 74.60 | 89.73 | 7,9,11 | 65 | 90 | OK | OK |
| H/LD | 4.41333 | | 1 | 4.41 | 5.31 | | 20 | 20 | OK | OK |
| | | Total KVA | | 158.99 | | | | | | |
| | | Total Current | | | 191.23 | | 250 | 250 | OK | OK |

# Cathedral Place

Steven Puchek
Milwaukee, WI

## Parking Panels

| Panel | P/HB | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 35k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 4.2 | | 1.25 | 5.25 | 18.94 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| F-1.1 | 1.492 | Y | 1 | 1.49 | 1.79 | 32,34,36 | 25 | 15 | OK | OK |
| F-1.2 | 1.492 | Y | 1 | 1.49 | 1.79 | 38,40,42 | 25 | 15 | OK | OK |
| ECUH-1.1 | 4 | Y | 1 | 4.00 | 4.81 | 2,4,6 | 25 | 20 | OK | OK |
| ECUH-2.1 | 4 | Y | 1 | 4.00 | 4.81 | 2,4,6 | 25 | 20 | OK | OK |
| ECUH-3.1 | 4 | Y | 1 | 4.00 | 4.81 | 8,10,12 | 25 | 20 | OK | OK |
| ECUH-4.1 | 4 | Y | 2.5 | 10.00 | 12.03 | 8,10,12 | 25 | 20 | OK | OK |
| P/LB | 43.75101 | | 1 | 43.75 | 52.62 | | 100 | 100 | OK | OK |
| | | Total KVA | | 73.99 | | | | | | |
| | | Total Current | | | 88.99 | | 225 | 200 | OK | OK |

| Panel | P/HC | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 22k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 2.73 | | 1.25 | 3.41 | 12.31 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| ECUH-5.1 | 4 | Y | 1 | 4.00 | 4.81 | 14,16,18 | 25 | 20 | OK | OK |
| ECUH-6.1 | 4 | Y | 1 | 4.00 | 4.81 | 14,16,18 | 25 | 20 | OK | OK |
| ECUH-7.1 | 4 | Y | 1 | 4.00 | 4.81 | 20,22,24 | 25 | 20 | OK | OK |
| ECUH-8.1 | 4 | Y | 1 | 4.00 | 4.81 | 20,22,24 | 25 | 20 | OK | OK |
| ECUH-9.1 | 4 | Y | 1 | 4.00 | 4.81 | 26,28,30 | 25 | 15 | OK | OK |
| ECUH-9.2 | 4 | Y | 1 | 4.00 | 4.81 | 26,28,30 | 25 | 15 | OK | OK |
| ECUH-9.3 | 4 | Y | 1 | 4.00 | 4.81 | 2,4,6 | 25 | 15 | OK | OK |
| ECUH-5.2 | 4 | Y | 1 | 4.00 | 4.81 | 8,10,12 | 25 | 20 | OK | OK |
| ECUH-6.2 | 4 | Y | 1 | 4.00 | 4.81 | 8,10,12 | 25 | 20 | OK | OK |
| ECUH-7.2 | 4 | Y | 1 | 4.00 | 4.81 | 8,10,12 | 25 | 20 | OK | OK |
| ECUH-8.2 | 4 | Y | 1 | 4.00 | 4.81 | 32,34,36 | 25 | 20 | OK | OK |
| ECUH-9.4 | 4 | Y | 2.5 | 10.00 | 12.03 | 32,34,36 | 25 | 20 | OK | OK |
| P/LC | 3.43116 | | 1 | 3.43 | 4.13 | | 50 | 50 | OK | OK |
| | | Total KVA | | 60.84 | | | | | | |
| | | Total Current | | | 73.18 | | 225 | 200 | OK | OK |

# Cathedral Place

Steven Puchek
Milwaukee, WI

| Panel | P/LB | | Bus | 225A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 22k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 7.56 | | 0.593 | 4.48 | 37.33 | | ** | ** | OK | OK |
| CUH-1.1 | 0.05968 | Y | 1 | 0.06 | 0.50 | 4 | 25 | 20 | OK | OK |
| Clearwater Pump | 1.119 | Y | 1.75 | 1.96 | 16.31 | 17 | 35 | 40 | OK | OK |
| RTU-10.1 | 9.9 | Y | 2.5 | 24.75 | 68.70 | 4,6 | 50 | 35 | OK | OK |
| EUH-0.1 | 5 | Y | 2.5 | 12.50 | 34.70 | 6,8,10 | 25 | 20 | OK | OK |
| | | Total KVA | | 43.75 | | | | | | |
| | | Total Current | | | 121.44 | | 225 | 225 | OK | OK |

| Panel | P/LC | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 22k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 5.22 | | 0.593 | 3.10 | 25.78 | | ** | ** | OK | OK |
| UH-9.1 | 0.0373 | Y | 1 | 0.04 | 0.31 | 2 | 25 | 20 | OK | OK |
| UH-9.2 | 0.0373 | Y | 1 | 0.04 | 0.31 | 2 | 25 | 20 | OK | OK |
| UH-9.3 | 0.0373 | Y | 1 | 0.04 | 0.31 | 2 | 25 | 20 | OK | OK |
| UH-9.4 | 0.0373 | Y | 1 | 0.04 | 0.31 | 2 | 25 | 20 | OK | OK |
| UH-9.5 | 0.0373 | Y | 1 | 0.04 | 0.31 | 2 | 25 | 20 | OK | OK |
| UH-9.6 | 0.0373 | Y | 1 | 0.04 | 0.31 | 2 | 25 | 20 | OK | OK |
| UH-9.8 | 0.0373 | Y | 1 | 0.04 | 0.31 | 0 | 25 | 20 | OK | OK |
| UH-9.9 | 0.0373 | Y | 1 | 0.04 | 0.31 | 0 | 25 | 20 | OK | OK |
| UH-9.10 | 0.0373 | Y | 1 | 0.04 | 0.31 | 0 | 25 | 20 | OK | OK |
| | | Total KVA | | 3.43 | | | | | | |
| | | Total Current | | | 9.52 | | 100 | 100 | OK | OK |

| Panel | PE/HA | | Bus | 125A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 24.36 | | 1.25 | 30.45 | 109.88 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| | | Total KVA | | 30.45 | | | | | | |
| | | Total Current | | | 36.63 | | 70 | 60 | OK | OK |

# Cathedral Place

Steven Puchek
Milwaukee, WI

## Switchboards/Mains

| Panel | OFFICE BUS DUCT | | Bus | 2500A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| PTAC-10.1 | 74.6 | Y | 2.5 | 186.50 | 224.32 | Duct | 200 | ** | OK | |
| PTAC-11.1 | 74.6 | Y | 1 | 74.60 | 89.73 | Duct | 200 | ** | OK | |
| PTAC-12.1 | 74.6 | Y | 1 | 74.60 | 89.73 | Duct | 200 | ** | OK | |
| PTAC-13.1 | 74.6 | Y | 1 | 74.60 | 89.73 | Duct | 200 | ** | OK | |
| PTAC-14.1 | 74.6 | Y | 1 | 74.60 | 89.73 | Duct | 200 | ** | OK | |
| PTAC-15.1 | 74.6 | Y | 1 | 74.60 | 89.73 | Duct | 200 | ** | OK | |
| PTAC-16.1 | 74.6 | Y | 1 | 74.60 | 89.73 | Duct | 200 | ** | OK | |
| PTAC-17.1 | 74.6 | Y | 1 | 74.60 | 89.73 | Duct | 175 | ** | OK | |
| Office Tenant 1 | 90.485 | | 1 | 90.49 | 108.84 | | ** | ** | ** | ** |
| Office Tenant 2 | 90.485 | | 1 | 90.49 | 108.84 | | ** | ** | ** | ** |
| Office Tenant 3 | 90.485 | | 1 | 90.49 | 108.84 | | ** | ** | ** | ** |
| Office Tenant 4 | 90.485 | | 1 | 90.49 | 108.84 | | ** | ** | ** | ** |
| Office Tenant 5 | 90.485 | | 1 | 90.49 | 108.84 | | ** | ** | ** | ** |
| Office Tenant 6 | 90.485 | | 1 | 90.49 | 108.84 | | ** | ** | ** | ** |
| Office Tenant 7 | 90.485 | | 1 | 90.49 | 108.84 | | ** | ** | ** | ** |
| Office Tenant 8 | 46.205 | | 1 | 46.21 | 55.58 | | ** | ** | ** | ** |
| | | Total KVA | | 1388.30 | | | | | | |
| | | Total Current | | | 1669.87 | | 2500 | 2500 | OK | OK |

| Panel | CONDO BUS DUCT | | Bus | 1200A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Condo Load | 668.02 | | 0.34 | 227.13 | 630.44 | | 1200 | 1200 | OK | OK |
| | | Total KVA | | 227.13 | | | | | | |
| | | Total Current | | | 630.44 | | 1200 | 1200 | OK | OK |

| Panel | C/MSB | | Bus | 1200A/800A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 208/120V, 3P 4W | | A.I.C | 65k | | | | | | |
| Breaker | 1200A - 3P MCB, 800A - 3P MCB | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| P-0.1 | 5.595 | Y | 1 | 5.60 | 15.53 | 2,4,6 | 65 | 50 | OK | OK |
| P-0.2 | 5.595 | Y | 1 | 5.60 | 15.53 | 8,10,12 | 65 | 50 | OK | OK |
| EFC-R.1 | 22.38 | Y | 2.5 | 55.95 | 155.30 | 32,34,36 | 175 | 125 | OK | OK |
| CE/LA | 15.225 | | 1 | 15.23 | 42.26 | | 50 | 50 | OK | OK |
| CS/HA | 107.797 | | 1 | 107.80 | 299.21 | | 300 | 300 | OK | OK |
| C/LA | 52.40673 | | 1 | 52.41 | 145.47 | | 225 | 225 | OK | OK |
| CONDO BUS DUCT | 227.125593 | | 1 | 227.13 | 630.44 | | 1200 | 1200 | OK | OK |
| | | Total KVA | | 469.69 | | | | | | |
| | | Total Current | | | 1303.74 | | 2000 | 2000 | OK | OK |

# Cathedral Place

Steven Puchek
Milwaukee, WI

| Panel | RT/DP | | Bus | 1200A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Retail Load | 47.48 | | 3 | 142.43 | 171.31 | | 1000 | 1000 | OK | OK |
| | | Total KVA | | 142.43 | | | | | | |
| | | Total Current | | | 171.31 | | 1000 | 1000 | OK | OK |

| Panel | P/HA | | Bus | 600A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | 600A - 3P | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 14.91 | | 1.25 | 18.64 | 67.25 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Elevator 8 | 26.11 | Y | 2.5 | 65.28 | 78.51 | 20,22,24 | 65 | 90 | OK | OK |
| Elevator 9 | 26.11 | Y | 1 | 26.11 | 31.41 | 26,28,30 | 65 | 90 | OK | OK |
| Elevator 10 | 26.11 | Y | 1 | 26.11 | 31.41 | 32,34,36 | 65 | 90 | OK | OK |
| Elevator 11 | 26.11 | Y | 1 | 26.11 | 31.41 | 38,40,42 | 65 | 90 | OK | OK |
| ECUH-2.2 | 4 | Y | 1 | 4.00 | 4.81 | 2,4,6 | 25 | 20 | OK | OK |
| ECUH-3.2 | 4 | Y | 1 | 4.00 | 4.81 | 2,4,6 | 25 | 20 | OK | OK |
| ECUH-4.2 | 4 | Y | 1 | 4.00 | 4.81 | 2,4,6 | 25 | 20 | OK | OK |
| PE/HA | 30.45 | | 1 | 30.45 | 36.63 | | 70 | 60 | OK | OK |
| P/HB | 73.98501 | | 1 | 73.99 | 88.99 | | 225 | 200 | OK | OK |
| P/HC | 60.84366 | | 1 | 60.84 | 73.18 | | 225 | 200 | OK | OK |
| | | Total KVA | | 339.52 | | | | | | |
| | | Total Current | | | 408.38 | | 600 | 600 | OK | OK |

| Panel | EM/DP | | Bus | 600A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | MLO | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| HE/HA | 14.9712 | | 1 | 14.97 | 18.01 | | 200 | 200 | OK | OK |
| HS/HA | 274.2641 | | 1 | 274.26 | 329.89 | | 600 | 600 | OK | OK |
| CE/LA | 15.225 | | 1 | 15.23 | 18.31 | | 50 | 50 | OK | OK |
| CS/HA | 107.797 | | 1 | 107.80 | 129.66 | | 150 | 300 | OK | OK |
| PE/HA | 30.45 | | 1 | 30.45 | 36.63 | | 70 | 60 | OK | OK |
| | | Total KVA | | 442.71 | | | | | | |
| | | Total Current | | | 532.49 | | 600 | 600 | OK | OK |

# Cathedral Place

Steven Puchek
Milwaukee, WI

| Panel | MAIN SWBD | | Bus | 3000A | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 480/277V, 3P 4W | | A.I.C | 42k | | | | | | |
| Breaker | 2 - 3000A - 3P MCB | | | | | | | | | |
| Load Description | KVA | NEC Calc? | Demand Factor | Demand KVA | Demand Current | Motor Circuit | Feeder Size | Breaker | Feeder OK? | Breaker OK? |
| Lighting | 0 | | 1.25 | 0.00 | 0.00 | | ** | ** | OK | OK |
| Receptacles | 0 | | 0.593 | 0.00 | 0.00 | | ** | ** | OK | OK |
| P-0.3 | 74.6 | Y | 2.5 | 186.50 | 224.32 | 0 | 175 | 200 | OK | OK |
| P-0.4 | 74.6 | Y | 1 | 74.60 | 89.73 | 0 | 175 | 200 | OK | OK |
| OFFICE BUS DUCT | 1388.3 | | 0.85 | 1180.06 | 1419.39 | | 2500 | 2500 | OK | OK |
| RT/DP | 142.425 | | 1 | 142.43 | 171.31 | | 1000 | 1000 | OK | OK |
| H/HE | 158.98651 | | 1 | 158.99 | 191.23 | | 250 | 200 | OK | OK |
| H/HB | 250.359897 | | 1 | 250.36 | 301.14 | | 400 | 400 | OK | OK |
| H/HD | 23.3281301 | | 1 | 23.33 | 28.06 | | 225 | 225 | OK | OK |
| H/HC | 93.5860801 | | 1 | 93.59 | 112.57 | | 200 | 200 | OK | OK |
| H/HA | 151.36194 | | 1 | 151.36 | 182.06 | | 200 | 200 | OK | OK |
| HE/HA | 14.9712 | | 1 | 14.97 | 18.01 | | 200 | 200 | OK | OK |
| HS/HA | 274.2641 | | 1 | 274.26 | 329.89 | | 600 | 600 | OK | OK |
| | | Total KVA | | 2550.44 | | | | | | |
| | | Total Current | | | 3067.70 | | 3000 | 3000 | X | X |

There are only two panels whose protection sizing was not "OK" by having been sized correctly – Panel H/LA and the MAIN. It has been thoroughly checked and determined that from the motor schedule, one or both of the major loads on panel H/LA (compressor and ACU) should be on an H/Hx panel instead – attributing the mistake to a drafting error. This would drop off approximately 110A and bring the value well below the circuit breaker rating. For the MAIN switchboard, because the office bus duct was estimated using the area approximation, and the gross area of the office was used, the estimation might have been a bit high. The majority of the load occurs on this bus duct and it is reasonable to assume that my estimation method was different, and much more conservative, than the one used be the MEP firm.

In the case that a Feeder or Breaker size is listed as **, it is inferred that these occur on many separate circuits and are limited in size to a 20A breaker and distributed evenly and in such a manner that the protection and wire sizing is adequate. In the case where the breaker is not given, the overcurrent protection is provided by disconnects plugged directly into the office bus duct riser. They are all 200A fusible disconnect switches.

The demand factors applied to all of the panelboards are listed in the following table and are from 2002 NEC Tables 220.13 and 430.53(C).

| Load Criteria | Factor |
|---|---|
| | |
| Lighting (assume all continuous) | 1.25 |
| Motors | |
| First Motor | 2.5 |
| Remaining motors | 1 |
| Receptacles | 0.593 |
| Retail Load | 3 |
| Office Load | 0.85 |
| Condo Load | 0.34 |

The lighting and motor demand factors are typical. The receptacle demand factor was applied differently. Considering the previous calculation of the receptacle loads using the appropriate NEC method, the fraction of total connected receptacle load was calculated at 0.593. Since the receptacles are distributed unevenly throughout the panels (and applied in the same counted manner as the lighting), this general factor was used to distribute the demand load previously calculated through a number of panels.

The retail load, office load, and condo load were personal approximations made for the following reasons. The retail load only considered a calculated lighting load. Considering the restaurant and the spa, a greater amount of power would be used for cooking, tanning, etc. Thus a 3 times factor was applied to the lighting load to accommodate this significant increase. The office load was calculated with extreme conservatism, and thus, considering 15% circulation and partition areas, the lit area would only be 85%. Thus 0.85 was derived and applied. The Condo demand factor is straight from the previously mentioned value from 2002 NEC Table 220.32.

Taking all of the power requirements, analyzing the appropriate feeder and breaker sizes, the total power requirement was traced backwards to the MAIN board. Since all other boards lead to utility provided transformers, the only real necessary calculation is done on the two substations. Using a worst-case scenario approach, where only one transformer is active:

Total Calculated Load – 2550.44kVA
Total Calculated Amperage – 2550.44/(3^0.5*0.480) = 3067.70A
Xmfr Load Limit – 2660kVA
Xmfr Amperage Limit – 2660/(3^0.5*0.480) = 3199.48A

Both are right at the very highest limit, but do not exceed the values, and therefore are designed properly. This is also a worst-case scenario calculation with only one transformer is in operation via the bus duct tie in the double-ended MAIN. The two loads would typically split with approximately 1800kVA on one side, and 1200kVA on the other – both well below the 2660kVA, or still under the 2000kVA transformer limit.

The remaining transformers throughout the building were checked against the loads that are imposed upon them. The following table, with a similar calculation method, was completed.

| Transformer and Fed Panel Comparison | | | | | | |
|---|---|---|---|---|---|---|
| Designation | KVA | Voltage | | Feeds | Load | Reqm't |
| | | Primary | Secondary | | | |
| T/LA | 75 | 480 D | 120/208 Y | H/LA | 73.66 | OK |
| T/LB | 30 | 480 D | 120/208 Y | H/LB | 35.07 | X |
| T/LC | 30 | 480 D | 120/208 Y | H/LC | 3.13 | OK |
| T/LD | 30 | 480 D | 120/208 Y | H/LD | 4.41 | OK |
| TE/LA | 15 | 480 D | 120/208 Y | HE/LA | 0.53 | OK |
| TE/LB | 15 | 480 D | 120/208 Y | HE/LB | 5.25 | OK |
| TS/LA | 15 | 480 D | 120/208 Y | HS/LA | 1.60 | OK |
| TP/LB | 75 | 480 D | 120/208 Y | P/LB | 43.75 | OK |
| TP/LC | 15 | 480 D | 120/208 Y | P/LC | 3.43 | OK |
| TPE/LA | 15 | 480 D | 120/208 Y | DNE | | |
| TCE/LA-B | 15 | 480 D | 120/208 Y | CE/LA | 15.23 | X |
| TCS/HA | 112.5 | 208D | 277/480Y | CS/HA | 107.80 | OK |

The transformers are all sized correctly except T/LB and TCE/LA-B. TCE/LA-B is just marginally above the rated kVA, so may be neglected as having loads that are less than the demand factors. T/LB is 15% higher than the limit of the transformer and this was looked into. Upon researching the problem, it was determined that applying the 2.5 motor demand factor was the reason the kVA rating was exceeded. The largest motor is one of three, and is 100 times larger than either of the other two. Thus, the actual connected load is only approximately 15kVA without demand. With this knowledge we can state that the transformers are adequately sized.

## Utility Rate Structure

The rate structure for the building is split into three metered components and three separate categories. The office and retail section of the building is treated as one under the business customer name of Cathedral Place LLC. They are in the rate structure for Large Business Customers in the Cp1 category for Primary Time of Use billing. The parking structure is separately metered, and technically separately owned by the Redevelopment Authority of Milwaukee. They are also considered Large Business Customers but are in the Cg3 category for Secondary Demand/Time of Use billing. The condo units are treated as residential customers each separately metered and as such, cannot have their records requested.

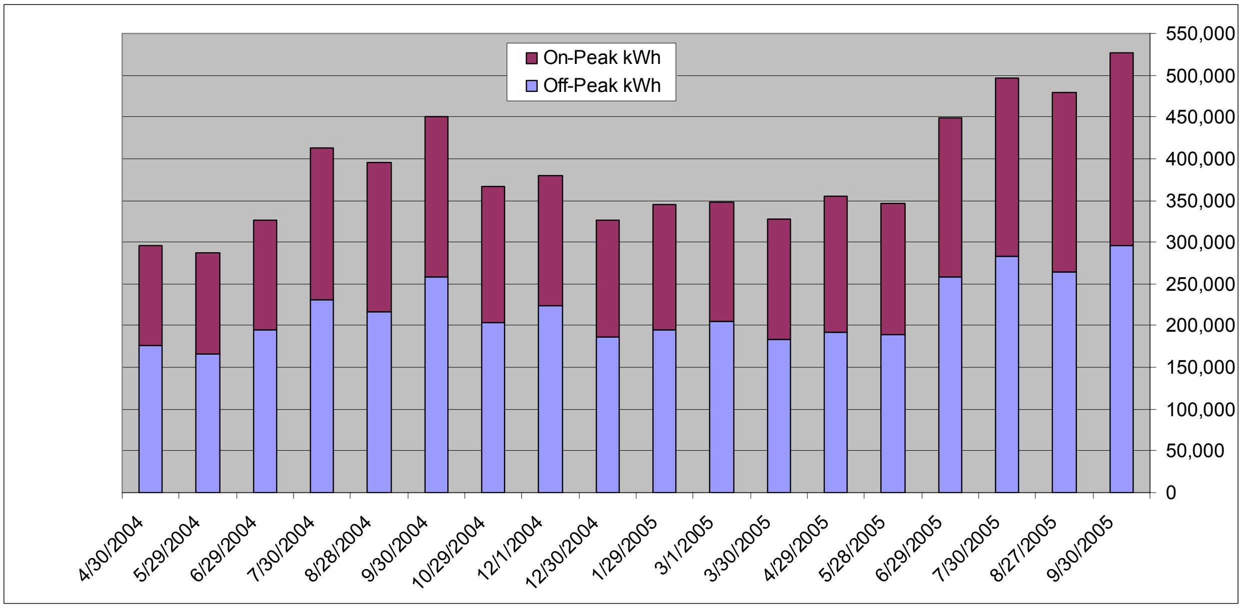
Upon receiving the billing for the past 24 months for both customers, the power consumption was realized and compared against the calculated load. The average use per day for the two combined is 13,498 kWh. Dividing this by the power factor and again by 8 for the average 8-hour work day results in 1895.7kVA use, which is much below the demand-connected 2550kVA, but reasonable considering the cycling of air handling units, and non-continuous use of elevators, etc.

For privacy purposes, the bill itself will not be included with this report, but a graph from the provided data can be seen below for both the demand since the building was occupied (April 2004) until the present. The actual rate structure from the electric company, WE-Energies, is listed in Appendix G for the two customers for whom data was obtainable.

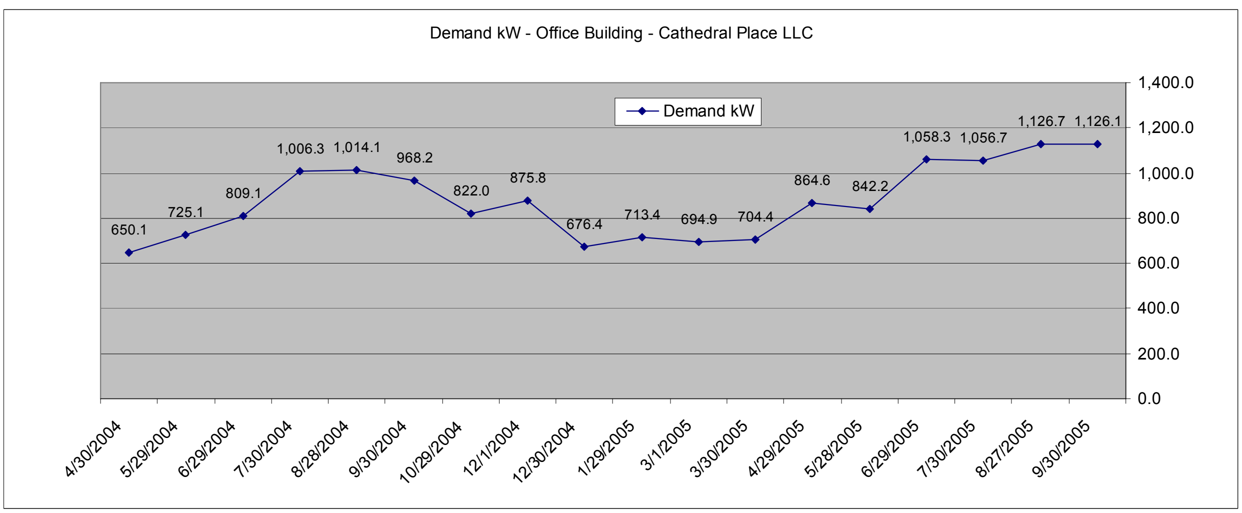
# Cathedral Place
Steven Puchek
Milwaukee, WI

*Cathedral Place LLC*

## Energy Use




## Demand

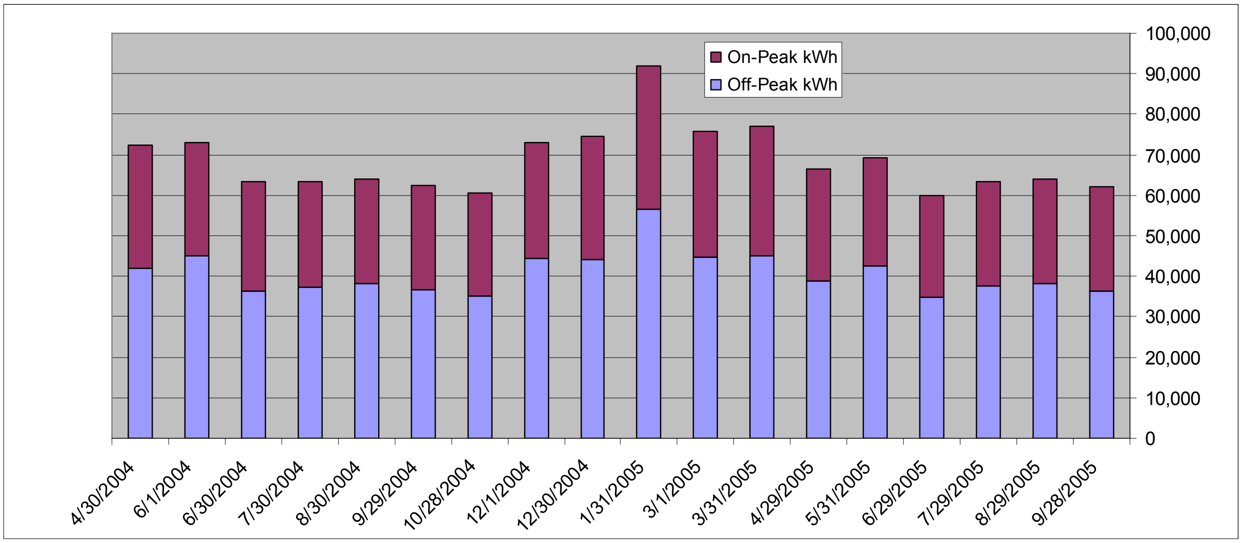


# Cathedral Place

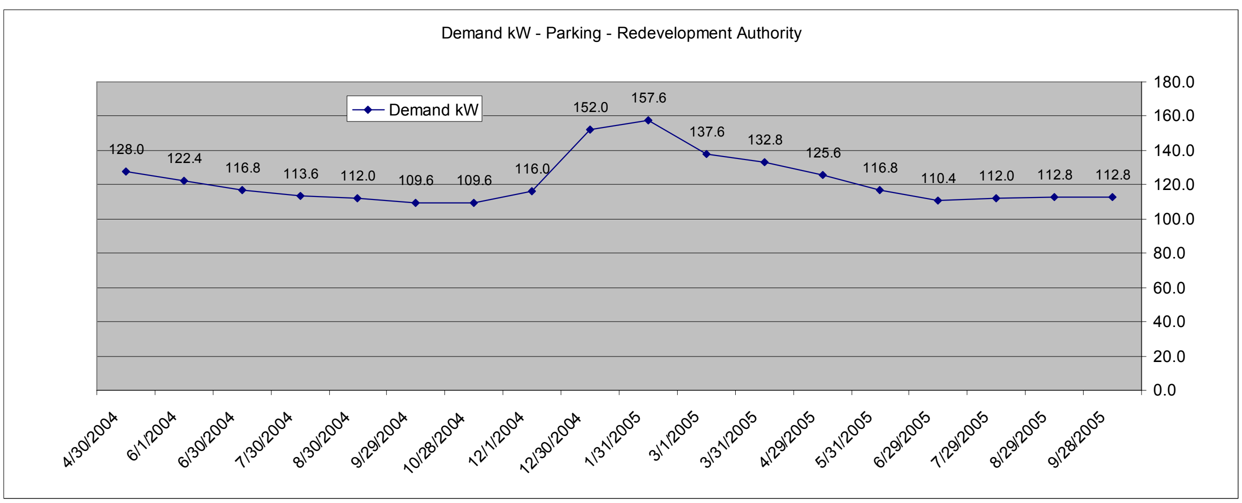
Steven Puchek
Milwaukee, WI

*Redevelopment Authority of Milwaukee*

## Energy Use




## Demand



# Cathedral Place

Steven Puchek
Milwaukee, WI

## Appendices

# Cathedral Place

Steven Puchek
Milwaukee, WI

## A & B– Single Line and Riser Diagrams

Due to the size of the diagram in width and for easier reading, please see the additional PDF named "Puchek-Riser.pdf". Because of the differing paper size, and to print this report without error, it has been included as a separate file.

## C – Mechanical Equipment Data

Mechanical Equipment Data worksheets from Excel are too large (wide) to place on these pages. Please refer to the Excel file "Puchek-Motors.pdf" and the Motor Schedule tab/worksheet for all motor data.

## D – Transformer Schedule

| Transformer and Fed Panel Comparison | | | | | | |
|---|---|---|---|---|---|---|
| Designation | KVA | Voltage | | Feeds | Load | Reqm't |
| | | Primary | Secondary | | | |
| T/LA | 75 | 480 D | 120/208 Y | H/LA | 73.66 | OK |
| T/LB | 30 | 480 D | 120/208 Y | H/LB | 35.07 | X |
| T/LC | 30 | 480 D | 120/208 Y | H/LC | 3.13 | OK |
| T/LD | 30 | 480 D | 120/208 Y | H/LD | 4.41 | OK |
| TE/LA | 15 | 480 D | 120/208 Y | HE/LA | 0.53 | OK |
| TE/LB | 15 | 480 D | 120/208 Y | HE/LB | 5.25 | OK |
| TS/LA | 15 | 480 D | 120/208 Y | HS/LA | 1.60 | OK |
| TP/LB | 75 | 480 D | 120/208 Y | P/LB | 43.75 | OK |
| TP/LC | 15 | 480 D | 120/208 Y | P/LC | 3.43 | OK |
| TPE/LA | 15 | 480 D | 120/208 Y | DNE | | |
| TCE/LA-B | 15 | 480 D | 120/208 Y | CE/LA | 15.23 | X |
| TCS/HA | 112.5 | 208D | 277/480Y | CS/HA | 107.80 | OK |

## E – Feeder Schedule

This feeder schedule applies to most references in the panelboards listed in the report by their ampacities. In the case where an ampacity is not listed, the next largest size was used (if comparison with the NEC ampacity table is done, this is necessary). #12 and #10 wire is specified by code to not exceed 25A and 35A respectively and as such is understood and not included in this table.

**Feeder Schedule**

| Feeder Ampacity | Conductor Size (kcmil) | | Conduit Size | |
|---|---|---|---|---|
| | Φ & N | Ground | (3) & (3G) | (4) & (4G) |
| 50 | #8 | #10 | 3/4" | 1" |
| 70 | #4 | #8 | 1-1/4" | 1-1/4" |
| 80 | #4 | #8 | 1-1/4" | 1-1/4" |
| 100 | #3 | #8 | 1-1/4" | 1-1/4" |
| 110 | #2 | #6 | 1-1/4" | 1-1/2" |
| 125 | #1 | #6 | 1-1/2" | 2" |
| 150 | 1/0 | #6 | 1-1/2" | 2" |
| 175 | 2/0 | #6 | 2" | 2" |
| 200 | 3/0 | #6 | 2" | 2-1/2" |
| 225 | 4/0 | #4 | 2" | 2-1/2" |
| 250 | 250 | #4 | 2-1/2" | 3" |
| 300 | 350 | #4 | 3" | 3" |
| 350 | 500 | #3 | 3" | 3-1/2" |
| 380 | 500 | #3 | 3" | 3-1/2" |
| 400 | (2) 3/0 | (2) #3 | (2) 2" | (2) 2-1/2" |
| 450 | (2) 4/0 | (2) #2 | (2) 2" | (2) 2-1/2" |
| 500 | (2) 250 | (2) #2 | (2) 2-1/2" | (2) 3" |
| 600 | (2) 350 | (2) #1 | (2) 3" | (2) 3" |
| 700 | (2) 500 | (2) 1/0 | (2) 3" | (2) 3-1/2" |
| 800 | (2) 600 | (2) 1/0 | (2) 3-1/2" | (2) 4" |
| 1000 | (3) 400 | (3) 2/0 | (3) 3" | (3) 3-1/2" |
| 1200 | (3) 600 | (3) 3/0 | (3) 3-1/2" | (3) 4" |
| 1600 | (4) 600 | (4) 4/0 | (4) 3-1/2" | (4) 4" |
| 2000 | (5) 600 | (5) 250 | (5) 3-1/2" | (5) 4" |

# Cathedral Place

Steven Puchek
Milwaukee, WI

## F – Lamp and Ballast Data

| Lamp | Wattage | Bulb | Initial Lumens | Mean Lumens | CRI | CCT | Life | Length | Socket | Position |
|---|---|---|---|---|---|---|---|---|---|---|
| LED | | | | | | | | | | |
| F32TBX / SPX30 | 32 | T4 | 2400 | 2064 | 82 | 3000 | 12000 | 5.6 | gx24q-3 | |
| F32T8 / SPX35 | 32 | T8 | 3100 | 2945 | 85 | 3500 | 30000 | 47.78 | Med Bipin | |
| F26TBX / SPX30 | 26 | T4 | 1800 | 1548 | 82 | 3000 | 12000 | 5 | gx24q-3 | |
| F26DBX / SPX35 | 26 | T4 | 1710 | 1548 | 82 | 3500 | 12000 | 6.5 | g24q-3 | |
| F25T8 / SPX35 | 25 | T8 | 2200 | 2090 | 85 | 3500 | 30000 | 35.78 | Med Bipin | |
| F17T8 / SPX35 | 17 | T8 | 1400 | 1340 | 85 | 3500 | 30000 | 23.78 | Med Bipin | |
| F13TBX / SPX30 | 13 | T4 | 900 | 770 | 82 | 3000 | 12000 | 4.2 | gx24q-1 | |
| F13BX / SPX30 | 13 | T4 | 900 | 770 | 82 | 3000 | 12000 | 5.2 | g24q-1 | |
| 70w MHT6 | 70 | T6 | 6700 | 5360 | 87 | 3000 | 12000 | 3.94 | G12 | Universal |
| 70w MH Coated | 70 | E17 | 5600 | 4480 | 90 | 3800 | 12000 | 5.43 | E26 Med | Universal |
| 50w MR16 NSP 12d | 50 | MR16 | 10000cp / 800 | 10000cp / 800 | 100 | 3000 | 4000 | 1.75 | Gu5.3 bipin | |
| 50w MR16 | 50 | MR16 | 3200cp / 800 | 3200cp / 800 | 100 | 3000 | 4000 | 1.75 | Gu5.3 bipin | |
| 35w MR16 / NSP 12d | 35 | MR16 | 8300cp / 500 | 8300cp / 500 | 100 | 3000 | 4000 | 1.75 | Gu5.3 bipin | |
| 35w MR16 | 35 | MR16 | 1650cp / 500 | 1650cp / 500 | 100 | 3000 | 4000 | 1.75 | Gu5.3 bipin | |
| 35w MH PAR20 | 35 | PAR20 | 2000 | 1600 | 81 | 3000 | 9000 | 3.75 | Medium | Universal |
| 250w MH Coated | 250 | BT28 | 20500 | 15500 | 70 | 3800 | 10000 | 8.31 | E39 Mogul | Universal |
| 175w MH Coated | 175 | BT28 | 13000 | 8400 | 70 | 3800 | 8250 | 8.31 | E39 Mogul | Universal |
| 175w MH / SPX35 | 175 | BT28 | 13600 | 9300 | 65 | 4200 | 8750 | 8.31 | E39 Mogul | Universal |
| 15mm Neon | 30 | 15mm | - | - | - | - | 65000 | - | - | |
| 150w CMH / T6 / G12 | 150 | T6 | 12700 | 10160 | 90 | 4200 | 9000 | 4.125 | G12 | Universal |
| 150w A19 | 150 | A19 | 2050 | 2050 | 100 | 2850 | 2500 | 4.5 | Medium | |
| 100w MH Coated | 100 | E17 | 8100 | 6400 | 85 | 3000 | 12000 | 5.43 | E26 Med | Universal |

| Lamp | Ballast | # lamps | Voltage | Input Wattage | BF | pf | THD | Min Temp |
|---|---|---|---|---|---|---|---|---|
| F32TBX / SPX30 | ICF-2S26-H1-LD@277 | 1 | 277 | 36 | 0.98 | 0.98 | 10% | (-)18C |
| F32T8 / SPX35 | VCN-132-MC | 1 | 277 | 30 | 0.98 | 0.98 | 10% | (-)18C |
| F26TBX / SPX30 | RCF-2S26-H1-LD-QS | 1 | 120 | 29 | 1.1 | 0.98 | 10% | (-)18C |
| F26DBX / SPX35 | ICF-2S26-H1-LD@277 | 1 | 277 | 27 | 1 | 0.98 | 10% | (-)18C |
| F25T8 / SPX35 | IOP-2P32-SC@277V | 1 | 277 | 28 | 1.05 | 0.97 | 10% | (-)29C |
| F17T8 / SPX35 | IOP-1P32-SC@277V | 1 | 277 | 16 | 0.9 | 0.97 | 10% | (-)29C |
| F13TBX / SPX30 | RCF-2S13-M1-LS-QS | 1 | 120 | 16 | 1 | 0.96 | 10% | (-)18C |
| F13BX / SPX30 | ICF-2S13-H1-LD@277 | 1 | 277 | 16 | 1 | 0.96 | 10% | (-)18C |
| 70w MHT6 | 71A5281 | 1 | 277 | 94 | 0.95 | 0.9 | <30% | (-)30C |
| 70w MH Coated | 71A5281 | 1 | 277 | 94 | 0.95 | 0.9 | <30% | (-)30C |
| 35w MH PAR20 | 71A5037BP | 1 | 277 | 48 | 0.95 | 0.9 | <30% | (-)30C |
| 250w MH Coated | 71A5730 | 1 | 277 | 295 | 0.95 | 0.9 | <30% | (-)30C |
| 175w MH Coated | 73B5580 | 1 | 277 | 210 | 0.95 | 0.9 | <30% | (-)30C |
| 15mm Neon | ANI-7530 | 33ft | 7.5kv | 90 | 1 | | | |
| 150w CMH / T6 / G12 | 71A5482 | 1 | 277 | 185 | 0.95 | 0.9 | <30% | (-)30C |
| 100w MH Coated | 71A5337BP | 1 | 277 | 118 | 0.95 | 0.9 | <30% | (-)30C |

# Cathedral Place

Steven Puchek
Milwaukee, WI

## G – Utility Rate Data Specifics

# Primary Time-of-Use (Cp1)

### Overview

This rate plan is available to customers with service at approximately 3,810 volts or higher and who own their own transformation equipment.

### How It Works

On-peak option hours are 8 a.m. to 8 p.m. or 10 a.m. to 10 p.m. The monthly minimum charge is the facilities charge plus either the charge for 300 kilowatts (kW) of billed demand or the minimum demand charge stated in a customer contract, whichever is greater, plus the customer maximum demand charge.

### Facilities Charge

**All voltages:** $525 per month

### Energy and Demand Charges

**Primary voltages less than 12,470 volts**

| | Base charge | Fuel Cost Adjustment | Transmission Adjustment | Effective Rate |
|---|---|---|---|---|
| On-peak energy (cents per kWh) | 3.706 | 1.346 | 0.170 | 5.222 |
| Off-peak energy (cents per kWh) | 2.285 | 0.492 | 0.027 | 2.804 |
| On-peak demand (dollars per kW) | 9.45 | 0.34 | 0.44 | 10.23 |
| Customer maximum demand (dollars per kW) | 0.80 | | | |

**Primary voltages between 12,470 volts and 138,000 volts**

| | Base charge | Fuel Cost Adjustment | Transmission Adjustment | Effective Rate |
|---|---|---|---|---|
| On-peak energy (cents per kWh) | 3.597 | 1.346 | 0.170 | 5.113 |
| Off-peak energy (cents per kWh) | 2.241 | 0.492 | 0.027 | 2.76 |
| On-peak demand (dollars per kW) | 9.23 | 0.34 | 0.44 | 10.01 |
| Customer maximum demand (dollars per kW) | 0.76 | | | |

**Primary voltages greater than 138,000 volts**

| | Base charge | Fuel Cost Adjustment | Transmission Adjustment | Effective Rate |
|---|---|---|---|---|
| On-peak energy (cents per kWh) | 3.519 | 1.346 | 0.170 | 5.035 |
| Off-peak energy (cents per kWh) | 2.071 | 0.492 | 0.027 | 2.59 |
| On-peak demand (dollars per kW) | 9.00 | 0.34 | 0.44 | 9.78 |
| Customer maximum demand (dollars per kW) | 0.00 | | | |

# Cathedral Place

Steven Puchek
Milwaukee, WI

## Secondary Demand/Time-of-Use

### Overview

Customers using 30,000 or more kilowatt-hours (kWh) per month for any three months within a 12-month period are assigned to this plan.

### How It Works

We charge a lower rate for electricity during times of low energy demand (off-peak) and a higher rate when demand is high (on-peak).

Off-peak hours include evenings from 9 p.m. to 9 a.m., weekends and holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. On-peak hours include daytime hours from 9 a.m. to 9 p.m.

Customers using less than 300,000 kWh in a year and exceeding 30,000 kWh in only one month may be removed from CG3 prices.

### Charges

In the Secondary Demand/Time-of-Use plan, you are charged for facilities, energy and demand.

The **Facilities Charge** is a fixed service charge.
Facilities Charge (one meter) is $46.50 per month (each additional meter $4 per month)

The **Energy Charge** is the total electricity used during the billing period and is split between on-peak and off-peak.

- On-peak 4.272 cents per kWh
- Off-peak 2.825 cents per kWh

The **Demand Charge** is for your highest level of demand between 9 a.m. and 9 p.m. weekdays during the billing period.

- On-peak Demand Charge $10.44 per kW
- Customer Demand Charge 70 cents per kW

The on-peak demand charge is discounted in months when demand is used for shorter times during the on-peak period. If on-peak use hours (on-peak energy use divided by highest on-peak demand) are less than 100, the on-peak demand charge of $10.44 is discounted by 5.82 cents per kW for the difference between 100 and the on-peak hours used during the month.

**Fuel Adjustment:**

- On Peak Energy Charge 1.388 cents per kWh
- Off Peak Energy Charge 0.494 cents per kWh
- On Peak Demand Charge $0.31 per kW

**Transmission Adjustment:**

- On Peak Energy Charge 0.194 cents per kWh
- Off Peak Energy Charge 0.028 cents per kWh
- On Peak Demand Charge $0.40 per kW

# Cathedral Place

Steven Puchek
Milwaukee, WI

## H – File List for Faculty Review

For Faculty review of the report, the following files have been used, but not included online to prevent alterations by anyone other than myself.

Files are located on my P: Drive under P:\Thesis\Tech 2 folder.

They include:

| | |
|---|---|
| Schedules.xls | - Main excel worksheets of all panelboards, motor schedules, loadcenter calculations, area unit load approximations, feeder schedule, transformer schedule, etc. |
| Riser.dwg | - Riser Diagram and Single Line Diagram for switchgear and main switchboard |
| Tech 2.doc | - Original Document |
| Fixture Schedule | - Lamp and Ballast schedule used in Tech 1 |
| Cathedral.ele.xls | - Cathedral Place bill and usage profile from WE Energies |
| Redevelopment authority.ele2.xls | - Redevelopment Authority bill and usage profile from WE Energies |
| WE-E Rates | - Rate list for the two services provided |