Existing Conditions

Architecture

Form and Layout

The architecture of the building is simple in form on the outside, and slightly more complex in design for the façade and interior. The building retains a stepped shape form its two masses, the elongated rectangular parking garage, and the tall tubular glass tower of the same width. The glass façade and its curvature reflect a large amount of the sky toward street level as other high-rise building located to the North, Northeast and Northwest are relatively distant.

The entire façade of the tubular occupied space is a glass curtainwall, framed vertically and horizontally on the East North, and West sides, with only horizontal framing in the elliptical form at the Northeast corner of the building. To accentuate this cylindrical form, the exterior canopies over the two entrances to the Office lobby (as well as the entrance to the residential lobby) are sectioned to allow the glass curtainwall to extend from street level to the 17th floor uninterrupted.

The main entrance lobby serves only the upper office floors (10th through 17th) via 4 general purpose elevators located at the north end of the building. The residences are served by 2 separate elevators connected to an immediately adjacent, but physically separate, entrance lobby. The parking structure is accessible via hallway from any of the condominiums, and by two separate elevator banks located at the Northeast and Southeast corners of the Parking Garage.

The Parking Garage, spanning 300’ of the Basement through 9th floors from north to south, is congruent in layout and space allocation for every floor except the ground level where street access points, parking booths, and Retail spaces fill the area. The implication here is that no architectural “support” space was allocated on the Parking Garage end of the building for the first 9 floors. All of the mechanical, electrical, in-house support (trash removal, loading docks, etc.) are located within a 60’-80’ section of the North end of the building. While this works for the first 9 floors where the condominiums only occupy this section of the floor plate, at the 10th level diversion of all systems is to the core of the office tower, but with as little space allocated for mechanical and electrical equipment as possible.

Materials

Materials used throughout the building vary dependent on the space. The Parking Garage is made entirely of concrete, save the columns which are composite beams (which are about 80% concrete themselves). The exterior is constructed mainly of polished cut-white-stone precast concrete paneling while the interior is a rough broom-finished concrete floor with exposed concrete columns. Of architectural note are the large “window” spaces on the exterior façade of the parking garage. The windows are over 30’ high and over 20’ wide spanning multiple stories. These spaces, whether developed for an architectural appeal, or for required, yet un-powered, ventilation of the structure is much larger in scale, but comparable to the mullion-framed curtainwall of the remainder of the building. In these massive spaces are placed square wire-

mesh elements which act as negative windows, with the remaining open spaces acting as the negative framing. This architectural element was used to maximum extent in the lighting redesign, as will be shown in later sections.

The Office tower is architecturally incomplete to be designed by whatever tenant moves into a given floor space. The only architectural elements are the exterior façade, to be mentioned shortly.

The Office Lobby is the only non-residential space with specific architectural materials including 4 different marble floors (a bluish-black, a royal blue, a brick red, and a sandy white), wood finishes on particular wall elements, translucent glass framed in the same architectural aluminum mullion as the exterior (to be mentioned), chrome-plated knit-mesh accents, and polished aluminum metal framing for elevator openings. The Residential Lobby is the remaining space that the architect chose to have specific design control over. The walls are laden with a rough-quarried green and grey stone, tan carpeting and lighter mocha-brown painted walls. The flooring inside the residential elevator lobby becomes a blue-grey square foot quarried tile with white painted walls.

While much of the architecture wasn't developed specifically within the scope of the initial project, spaces analyzed, developed and further designed within this thesis either make distinct use of the current materiality or add to the space to modify the overtone and/or theme of individual spaces. All of this is done without drastically altering the form and current impression the building gives the surrounding area and residents.

Existing Lighting Systems

Façade

Current lighting systems vary, again, with the space. On the exterior, individual fluorescent tube fixtures are used under the canopies and overhangs, while metal halide fixtures are used to accentuate the precast panels of the Parking Garage.

Architecturally, and from a fundamental lighting standpoint, the Parking Garage is the only portion of the building capable of façade illumination. At the ground level and around the building were placed ground-recessed luminaires capable of uplighting the columns at the base, but ignoring the rest of the building. The only lighting element preventing the impression that the structure bleeds away into nothingness is the linear illumination of the 17th floor balcony with column uplighting and considerable linear fluorescent ceiling washing reflecting back down

toward the ground level. Other than these few elements, the building glows from the inside relative to office lights being used late at night, or left on due to poor building automation.

Parking

The interior of the Parking Garage has a very simple lighting solution developed for a maximum light level without the overuse of electricity. Fixtures within the parking garage were 175W metal halide vandal-resistant surface-mounted luminaires used for general illumination of the travel lanes, while the each floor's elevator lobbies contained recessed linear fluorescent fixtures for simple, all-purpose (and cheap) illumination. This very general space gets just about as complex as possible without unnecessary cost and over-design.

Lobby

The Office Lobby is the only space throughout the project that was intricately designed for lighting. The lobby itself has many "volumes" requiring separate lighting conditions and solutions. The first volume is the entrance from Jackson St. to the east. This small alcove of the entire U-shaped space has as its main architectural feature, the translucent glass grid framing the entrance to the Parking Garage Elevator lobby and the mid-height plaster wall with a wood-panel background full-height wall. This space contains two rows of recessed fluorescent downlights over the main travel path, and wall-mounted metal halide uplights on the "backside" of the mid-height wall.

Immediately to the north is the lobby's main open "court" currently void of all vegetation, furniture, and oftentimes, people. This elliptical open area is well-lit in the mornings from the daylight penetration, and otherwise lit by the sculptured art-piece luminaires hanging from the 16' ceiling.

To the west is the main entrance lobby from Wells St. to the North containing the security and check-in desk. This space, fluid with the elliptical area benefits from a number of the sculptured luminaires, but has suspended linear fluorescent luminaires, architecturally recessed into the ceiling by the suspended ceiling. (For all intents and purposes, these luminaires are 8" wide and 4' long recessed linear fluorescents) On the white-translucent glass wall behind the security desk track-light MR16s illuminate the upper ¼ of the wall (rather ineffectively).

The third volume extends from the western border of the previous volume south into the office elevator lobby with full-height walls beginning 20' from the northern border. Architecturally, the space has the same grid pattern translucent glass on the west wall as the east alcove, and the same wood paneling on the east wall in the same alcove. Similar sculptured art-piece luminaires hang in a line through the elevator lobby, and recessed downlights add greater illumination to the floor and walls. This space has somewhat limited illuminance due to the few number of luminaires in the space.

Remaining Spaces

Again, due to the lack of tenant fit-out description, office tower existing conditions do not exist. Similarly, under separate contract, the condominium units were developed with lighting relative to an individual buyer's preferences, without regard to power density, appearance of space, or consideration of façade. These spaces are not considered in the existing conditions, and only individual spaces in a faux tenant fit-out are used for the lighting thesis proposal.

Existing Electrical Systems

Office Tower

The existing electrical system distribution to the Office spaces is dependent on the office tenant fit-out for all electrical systems beyond the bus-tapped disconnect. It is assumed that all office low-voltage loads will be subfed from the low-voltage panel, which is fed through the high voltage panel connected to the bus duct. For this reason, a single disconnect has been illustrated for office load panel. All of the office floors are served by a single 2500A, 480/277Y V, 3Φ, 4-wire, bus duct. All office PTAC units (see Existing Mechanical) are served individually by the bus duct and not tied to the office power supply directly. The bus duct rises from the basement to the 17th floor through an initial bus duct riser adjacent to the Condominium riser, which angles and turns down-hall to the electrical rooms of each office floor from 10-17. This bus duct serves only the office tenants. The only office-specific loads not connected to the bus duct are the cooling towers which are served by the house panels for the 10th through 17th floors.

All other house electrical loads are served by house panels or standby panels connected directly to the Main switchboard or through automatic transfer switches to the Main switchboard. Low-voltage requirements for the house loads and emergency loads are supplied by low-voltage panels fed from each high-voltage panel though the appropriately sized transformer. Motors located on the roof including the 5-elevator office bank are all connected to the house standby panels. Emergency panels are connected indirectly to the Main switchboard through automatic transfer switches. Please see the Existing Electrical Riser in Appendix D for more specific details.

Also connected to the Main switchboard, but separate from the rest of the building, is the Retail distribution panel. This panel serves all of the retail locations simultaneously and is not redundant at all. This includes the absence of emergency and standby panels where the standbys are not required by law because of the single floor height.

Condominiums

The condominiums are served by a separate 1200A, 208/120Y V, 3Φ, 4-wire, bus duct extending from the basement through a separate bus duct riser passing through the electrical room on each floor from 1 through 9-Mezzanine. Each condominium is metered in the electrical room on each floor for individual consumption provided to each condominium loadcenter. The condominium house and standby panels are connected to a separately metered section of the condominium switchboard. There are no high voltage panels on the house or emergency branch circuits. The lone standby panel feeds the condominium elevators and therefore needs to feed through a transformer on the panel-side of the automatic transfer switch increasing the provided switchboard voltage to the required 480/277Y voltage for the elevators. During an emergency condition, the generated 480/277Y voltage meets the elevator's requirement and therefore bypasses the transformer. The emergency panels are connected indirectly to the condominium switchboard through a separate automatic transfer switch. Please see the Existing Electrical Riser in Appendix D for more specific details.

Parking Garage

The Parking Garage electrical distribution is fed entirely through panel P / HA and not any specific distribution switchboard as was the case in the other two occupancy types. This panel is sized large enough to subfeed the two additional Parking distribution panels, which in turn feed the low-voltage panels. The two elevator banks within the parking structure are fed from this panel, and the single emergency panel for the entire structure is indirectly fed from this panel through an automatic transfer switch connected to the emergency power distribution panel.

Building Electrical Utility Distribution

From these three individual systems, the utility provides a number of individual cable pulls and service entrance locations and voltages. These three systems are fed through their single main distribution points – the Main switchboard for the office tower and office-related mechanical equipment and elevators; the Condo switchboard for all of the condominium loads including the two elevators and condo mechanical loads, and the Parking distribution panel P / HA for all of the parking garage loads including the 4 elevators and all parking-related mechanical loads.

The Main switchboard is a double-ended, redundant transformer breaker-tied bus fed from the utility's 13.8kV Δ service entrance in the electrical vault. This is a building-owned transformer system with the advantage of reduced utility costs associated with quantity usage and service voltage. This also has the advantage of requiring thinner gauge high-voltage feeders eliminating the need for electrical bussing or large-radius cable angles.

The Condo switchboard is a single-service bussed switchboard with a sectioned metering and breaker separating the house loads from the individual condominium loads. This system sees no redundancy, and is fed from a utility-owner transformer in the electrical vault at a service voltage of 208/120Y V. This system has the advantage of being completely separate from the office tower for better isolation and non-contingency on failure of a single high-voltage service. The disadvantage is the increased service cost associated with the utility-provided transformer and lower service-voltage.

The Parking distribution panel is a simple distribution panelboard fed from a utility-owned transformer in the electrical vault providing a service voltage of 480/277Y V. This system can be metered completely separately by the utility company and is also completely isolated from the high-voltage service. The advantage again, is the separation for the owner entities that do exist, but the disadvantages are the costs associated with the utility installation of a transformer and the lower service voltage.

While, from the utility's standpoint, all of these services may be fed from probably two transformers within the electrical vault and there is less separation of the systems in actuality, the cost associated with buying transformers in excess of 3000kVA becomes an annoyance for the utility which gets passed down monetarily to the customer.

Existing Mechanical Systems

Office

The mechanical system for the office tower is specific to each floor. Each floor is serviced by a single Packaged Terminal Air Conditioning unit (PTAC). The mechanical layout of each floor is specific to the tenant fit-out, but each tenant can tie back to the PTAC system for all of their heating and cooling needs.

All of the PTACs are served by a single hot-water loop for heating and a single, but separate, condensate water loop for cooling. All PTACs are connected to this loop in parallel and all of them are sized equally except for the 17th floor which has a smaller serviced floor area.

The hot water (henceforth referred to as "heating loop") runs from the basement office steam-to-water heat exchangers at 190˚F to the heating loop pumps and up through an 8" diameter pipe (tapered as height increases) to the PTACs and is returned through a single 8" diameter pipe back at 178˚F to the heat exchangers.

The condensate water ("cooling loop") runs from the basement to the cooling loop pumps and up through 10" diameter pipe to each of the PTACs connected in parallel at 85˚F. From the PTACs, the 95˚F runs up to the 17th floor. At this point, a bypass valve allows up to 1000gpm to bypass the cooling towers based on a temperature of 40˚F or less (assumed to prevent freezing). All other cooling loop water is run through one of two cooling towers and then dropped back to the basement through a 10" diameter pipe back to the pumps.

For all retail and house heating or cooling loads the same office loops are used, run in the same parallel loop/circuit, where the loads are connected a second time in parallel. This gives the system the impression of just another large PTAC instead of many smaller mechanical heating and cooling elements.

Condominiums

The condominium heating and cooling solutions are very similar to the office tower, but with a slight difference. The heating loop is, again, begun in the basement at the condominium steam-to-water heat exchangers, pumped through the combined heating and cooling pumps at 81˚F (around the bypass valve depending on necessary capacity for heating or cooling), and up through a parallel circuit to each floor serving each of the water source heat pumps in the condominium units connected in a second parallel circuit. All of the fluid used in the heating and cooling loops in the condominium is a 40% ethylene glycol solution, however. The heating loop then returns the 75˚F water via bypass valve to the heat exchangers in the basement.

In the case of a cooling load, the same loop is utilized, except the initial bypass valve prevents the heat exchangers from seeing the loop. From the heating/cooling pumps, the 85˚F water flows up through the same parallel circuit into the same floor parallel-connected circuit of heat pumps, and up to the Evaporative Fluid Cooler on the roof. This closed system cooler reduces the temperature of the water from 95˚F to the initial 85˚F and returns it to the basement pumps. This single-pipe system with bypass is very logical for the condominium and it is questioned why it was not used in the office tower loops. The main reason assumed is the difference in entering and leaving water temperature for heating and cooling in the PTACs.

Parking Garage

The parking garage is served by simple hot water unit heaters at the 9-Mezzanine floor under the office structure (aka, not the 10th floor deck or open ceiling). This is to prevent excessive heat loss from the office tower's 10th floor slab. The only other mechanical systems above grade are located in the elevator lobbies and are simple electric cabinet unit heaters. Below grade and at ground level are the air handling units and fans specifically designed to supply outside air to the basement to remove carbon monoxide and additional air handling unit systems for the retail spaces mentioned previously (i.e. outdoor air supplies and ducting, air cooled condensing units, etc.)

Existing Structural System

Foundation, Parking Garage and Condominiums

Due to the architect's preference to limit the number of structural drawings made available for this thesis, information regarding the structural system is based on the 3 drawings provided and the verbal information gathered over the course of the thesis.

The building rests on simple concrete foundations 8' square and a building footing along the perimeter. The main structural system of the Parking Garage are composite steel columns on footers every 20' North and South and in two adjacent (2'8" separated) "rows" with 56'8" spacing between columns East and West. The 6" unbonded post tensioned floor slab rests upon post-tensioned beams only spanning between columns. Due to the difference in grade for the slabs at the parking garage midpoint, the slabs were split into two sections. The southernmost section is a one-way post-tensioned slab, while the northernmost section is a two-way post tensioned slab.

The condominium structural system, completely separated from the Parking Garage structural system from the footings to floor 9-Mezzanine, is made up of an irregularly patterned "grid" of columns spaced much closer together than the parking garage (read, "about every 15'") with a concrete wall supports for the southern third of the condominium section. The floor for the condominium section is an 8" thick unbonded two-way post-tensioned slab.

Office Tower

At floor 9-Mezzanine, the structural system of the building changes from a composite column and post-tensioned floor slab design to a composite steel moment frame with concrete on form deck for the floor system. The frame is connected directly to the column grid structural system developed in the lower 9 floors, and connects the Parking Garage and Condominium concrete sections. This steel frame continues up through the roof and the slab on deck flooring is consistent through the upper floors.

The entire structural system is, in essence an upside-down horseshoe as far as system interconnection is concerned. Based on the drawings, only this information could be obtained and no further explanation could be obtained for this system (and certainly no assumptions were going to be made).

Orientation, Daylight, and Environment

The orientation of the building is directly north and south. The "long" sides of the building face east toward the lake and west toward the rest of Milwaukee. The main office tower is located at the northernmost point. At a latitude of 43.03˚N and 87.99˚W longitude, the building receives a great deal of southern direct sun exposure. The building in essence "faces" north.

Daylight in the building is all relative to the altitude of the sun and the azimuth toward the surrounding, taller buildings. The US Bank Corp building, the largest in Milwaukee, is much taller than Cathedral Place, with the closer, Wisconsin Gas building also reaching well above Cathedral Place's roof line. For this reason sunlight comes in and out throughout the day depending on the time of year.

The environment in Milwaukee is moderate with cold brisk winters, and mild, moderately humid summers. The average winter low temperature is 18.9˚F with the average summer high being 71˚F. Over the course of the year, 25% of the days are clear, 25% are partly cloudy and 50% are cloudy. These weather conditions factor into the development of the building systems considerably.

Utility Services

Cathedral Place has a considerable electrical service for all of the power requirements and for cooling, but not for any heating. The heating systems utilize the grid steam utility provided to the downtown area for heating of water for the heating systems and potable hot water needs. Cathedral Place also has a small Natural Gas utility provided for the condominium and restaurant units as none of the heating systems require natural gas. All of the above utilities are provided by WE Energies Corp., a recent union of Wisconsin Electric Power Co. and Wisconsin Gas Co.