FACILITIES & OPERATIONS
ARCHITECTURE, ENGINEERING AND CONSTRUCTION
UNIVERSITY OF MICHIGAN

DESIGN GUIDELINE 5.6
PARKING STRUCTURES

U-M Related Sections

Design Guidelines:

5.4 Telecommunications Rooms
5.7 Unit Substation Rooms
6.0 DG 140000 Elevators
6.0 DG 210000 Fire Protection
6.0 DG 260800 Basic Electrical Materials and Methods
6.0 DG 260513 Wires and Cables
6.0 DG 263000 Engine-Generator System
6.0 DG 265100 Interior Lighting
6.0 DG 265600 Exterior Lighting

U-M Master Specifications:

7.0 MS 142123 Electric Traction Elevators
7.0 MS 263000 Engine-Generator System
7.0 MS 261100 Unit Substation
7.0 MS 265600 Exterior Lighting

U-M LTP Specifications:

Parking Structure Painting (Obtain from Design Manager)

U-M Standard Details:

Bollard Details (Obtain from Design Manager)
Signage Details (Obtain from Design Manager)
27200007 Emergency Phone Wall Mount

General Design Requirements

The parking structure design shall incorporate the standard requirements of this Design Guideline and any Logistics, Transportation and Parking (LTP) requirements unique to the structure.

The U-M Design Manager shall assume the responsibility for coordinating the transfer of additional information required by the design professional to and from U-M Departments.

Identify the parking structure as an ‘Enclosed Parking Garage’ or a ‘Ramp Access Open Parking Garage’ in accordance with the currently adopted version of the **Michigan Building** Code. All separations from adjacent occupancies or structures shall be clearly identified.

Obtain approval from the City of Ann Arbor for all construction/impacts within the City of Ann Arbor right-of-way that support the parking structure.

Design parking structures to provide a 75-year life.

Driver visibility shall be free of blind spots at all turning points along the drive lanes.

Bumper blocks and wheel stops shall not be used.

As requested by LTP, provide motorcycle designated parking outside of gate-controlled parking areas. Verify the need for multi-modal (bicycle, motorcycle, moped, etc.) parking. Incorporate LTP requirements for multi-modal parking.

Parking spaces shall be 90 degrees to the drive lanes. Each space shall be striped on the floor with 4 inch wide yellow stripes, and shall be a minimum of 9 feet 0 inches wide when measured from center of stripe to center of stripe. Provide wider spaces for special access vehicles per LTP requirements. Review the need for wider spaces to accommodate special access vehicles with LTP.

Provide ADA-compliant accessible parking spaces as required by code and LTP. Accessible spaces shall be striped in yellow; no blue paint shall be used. Do not paint accessible parking symbols on the deck.

Accessible spaces shall be a minimum of 8'6" wide with 5' access aisles for regular vehicle spaces and 8' access aisles for van accessible spaces.

Accessible parking signage shall be furnished and installed directly by LTP.

Architectural Design equirements

Structure

Structures shall be designed with the following live load capacities, or meet the current applicable Code requirements for snow loads, whichever is greater:

Description	**Load**	
Roof, stair/elevator towers	30 psf	
Supported parking and drive areas:		
Roof, including snow	80 psf	Floors 45 psf
Tees	80 psf	Floors 45 psf
Beams	80 psf	Floors 45 psf
Columns	71 psf	Floors 36 psf
Concentrated wheel load	3,000 lb.	

Structure decks shall be either cast-in-place reinforced concrete or constructed with precast double tees with a minimum 4" top of tee or any other tested and approved technology for parking structures. If pre-cast construction is used, an overlay of 3" latex modified concrete or microsilica fume sand on top of the precast double tees shall be provided. This overlay shall not be designed as a structural member but as a protective overlay only, and shall be able to be replaced in the

future. Structural systems shall be evaluated during schematic design.

If cast-in-place construction is used, provide concrete penetrating sealer on the lower support levels and a multi-layer deck coating system on the roof. If pre-cast construction is used, provide a multi-layer deck coating system on all supported levels.

Reinforcing steel used for beams, deck or other horizontal elements shall be epoxy-coated.

If precast construction is used, provide galvanic anodes at the shear connectors.

Decks should have a clear span of at least 62 feet wide. At grade level and below and at levels with ADA parking, provide a minimum clearance of 8 feet 2 inches from the finished floor to the underside of any building component or pipe (including lighting fixtures and fire suppression sprinklers). Above grade level, provide a minimum clearance of 7 feet 6 inches to the underside of any building component and a minimum clearance of 7 feet 4 inches to any projecting or protruding object.

Discuss with the owner the option to provide additional stair towers in decks requiring only two. Provide estimated costs.

Interior

Provide an enclosed lobby at each elevator landing.

Elevator lobby doors shall be anodized aluminum with brushed finish and safety glass vision panels except as required by Code to be fire rated. Fire rated door assemblies shall be factory painted galvanized hollow metal with safety glass vision panels of the maximum allowable dimensions. Coordinate color with LTP paint specifications. Elevator lobby door hardware requirements are as follows:

- All doors shall have quarter panel kick plates (both sides of door) and closers.
- Exterior doors shall have panic device assemblies with locks and latches.
- Interior doors shall have push/pull hardware unless otherwise required by Code.

Provide safety glazing in lobbies and all other areas required by Code. Glazed openings shall be no less than 18 inches above the finished floor for maintenance purposes. Glazed openings shall be as large as practical to provide good visibility from the outside. Perimeter glazing should be designed to minimize solar heat gain.

Seal all floor penetrations on all levels water tight.

Where pre-tension or post-tension construction is used, provide cast-in-place or double-cored galvanized steel sleeves flush with floor levels and concrete-filled or covered. Provide block-outs or PVC sleeves for all wall and beam penetrations.

Finish on all walls, columns, and ceilings shall be white per LTP Painting Specifications. Accent colors to be coordinated with LTP for each stair tower. Mechanical and electrical equipment, electrical conduits, and conduit expansion joints shall not be field painted. Mask all unpainted equipment to avoid overspray. Water, gas and fire system lines shall be painted in code-required

standard colors.

Paint elevator shaft interior walls with white latex ceramic wall paint per LTP Painting Specifications to insulate the shaft against heat loss and moisture damage.

Painting of floors is not required, including stair landings, stair treads, and lobby floors. Concrete stair landings, stair treads and lobbies shall be deck-coated with approved traffic topping system and fine aggregate for slip protection. LTP will provide aggregate color and finish.

Protect vertical pipes, conduits and valves from vehicle damage. Protection methods shall include either steel covers painted safety yellow or galvanized steel pipe bollards filled with concrete.

Provide movable precast concrete bollards for use in controlling traffic. See the U-M Standard Details for bollard requirements.

Provide a telecommunications room. Refer to U-M Design Guidelines for room specifications.

Review with LTP whether to provide a toilet room. If selected, provide a non-public ADA accessible toilet room on the ground level.

Provide a parking structure maintenance room, preferably on the ground level. Maintenance room minimum requirements are:

- Room size minimum: 500 sq. ft.
- Room depth minimum: 18 ft.
- Roll-up door minimum: 9 ft. x 7 ft. (WxH) Obtain the door specification from LTP.
- Pedestrian Door: 42 inches wide.
- Plumbing: Utility tub and janitor's sink with hot and cold water.
- Power: 4 GFCI duplex receptacles and a separate 120 volt, 20 amp compressor circuit.
- Lighting: Ceiling LED lighting with occupancy sensor control.
- Heat: Heater with wall mounted thermostat to maintain room above 45 degrees F.

Entrances/Exits

If parking controls (including electronic signage, attendant booths, gates, vehicle detection loops, and Automated Vehicle Identification (AVI) equipment) are to be provided, the equipment will be furnished and installed by others and directly through LTP. Provide concrete housekeeping pads, safety bollards installed in the pads, power and communications conduits and wiring, and lighting in accordance with LTP requirements. If no parking controls are to be installed, provide conduits for power and communications for the future addition of parking controls.

If attendant booths are to be provided, they shall be a minimum of 5 feet by 7 feet and located on 6 inch concrete housekeeping pads. At least one booth shall be ADA accessible. Incorporate LTP booth and bollard cover specifications.

The structure shall have illuminated pedestrian entrances away from the drive lanes.

Signage

Provide an illuminated facility identification sign at each entrance and LED display signs over entrance and exit lanes in accordance with LTP requirements.

Facility and level identification, clearance bars, directional, traffic and parking control signage shall be provided by LTP.

Mechanical Design Requirements

Elevators

Overhead traction elevators with machine rooms shall be used.

Provide a secured ladder with slip resistant rungs to access the roof of each elevator machine room. On machine room roofs, provide appropriate fall protection as required by Occupational Safety and Health Administration regulations. Provide measures to secure ladders from unauthorized use.

Provide rigidized stainless steel wall panels and Class I fire-rated, slip-resistant rubber flooring in the elevator cars.

Elevator hoist ways shall be heated and cooled to maintain the temperatures specified by the elevator manufacturer. Elevator lobbies shall not be heated.

Heat and air condition elevator machine rooms to maintain an ambient temperature between 55 degrees F and 90 degrees F under all weather conditions. No heating or air conditioning equipment or piping shall be located in the machine rooms, except that which serves the rooms.

Provide stainless steel elevator door headers, frames, struts, and stainless steel or nickel-silver sills.

Provide floor drains in elevator lobbies, and slope floors downward from the room and elevator doors to the floor drains.

If the elevator(s) are considered part of the parking structure's "accessible path" or if the parking structure is classified by Code as a high rise structure, then the elevators, elevator HVAC, associated lighting and receptacles shall be connected to the emergency generator. Additionally, ingress and egress from and to the elevator and between the elevator machine room and the elevator must be "safe and reasonable" as defined by the Michigan Elevator Code.

Snow Melt System

Provide a snow melt system with the chute and control equipment on the roof. Provide a concrete housekeeping pad for the system and design the structure to support the additional weight.

The snow melt system shall be natural gas fired. Size the unit to service at least the entire roof level of the parking structure. Contact the system manufacturer for electrical, water, drainage and gas pressure requirements. Verify that required gas pressure is available. Connect a control panel "trouble" output contact to the DDC panel. Provide electric heat tracing for the water supply and drain lines that are exposed to air.

Enclose the snow melt system in a wire mesh fence with sliding gates for snow melt system operation and swing gates for personnel access to the control panel. Provide a level, skid-resistant

path for personnel to safely access the control panel.

Natural Gas Service

Coordinate with the local utility to provide a natural gas service large enough to serve the snow melter (that typically require 5 psi for a 40-ton system), generator, and any additional equipment requiring natural gas service. Confirm pressure requirements for all equipment.

Ventilation

For structure levels that require mechanical ventilation to control CO levels, provide variable speed fans controlled by CO sensors. Connect CO "high-high" alarm output contacts to the Building Automation System DDC panel.

Evaluate the need for ventilation in glass-enclosed stairways.

Controls

Unless one is available in a close-coupled building, provide a Building Automation System (BAS) Direct Digital Control (DDC) panel for connection to structure systems and equipment. Provide network connection to UM BAS system.

Additional Plumbing

Provide one standard hose bib on each parking level outside the stair and elevator towers. Hose bibs shall be drainable for winter.

Provide a dedicated 1½" washdown system on each floor with 1½" hose connections located such that all portions of the structure are within 100 feet of a hose connection.

Storm and Sanitary Drainage

Provide positive drainage on all decks. Provide trench drains at the bottom of ramps from the plaza or roof levels.

Horizontal drain lines shall be 4 inches minimum. Vertical drain lines shall be 6 inches minimum. Size drains lines to calculated flows. Heat trace and insulate horizontal drain lines only where best slopes cannot be achieved. Minimize the need for heat trace.

Elevator and stair tower roof drains shall discharge to storm drains via lines located inside of lobbies or the parking structure. Downspouts shall not discharge directly onto the roof level floor deck.

Roof level drains shall discharge to the storm sewer system. Drains on the lower supported levels and on grade shall discharge to the sanitary sewer system. Include installation of an oil separation system for waters to the sanitary sewer system.

The designer shall follow the Code and local requirements for floor drain connections to storm and sanitary, and pretreatment.

Provide a floor drain at the landing of each stair tower, on grade.

Drain system pipe shall be schedule 80 PVC. Floor drain bodies and covers shall be 12" round, hot dipped galvanized.

Trench drains shall be precast, pre-sloped fiberglass bodies. Trench drain covers shall be traffic rated HS20 and ADA compliant if in a pedestrian walking pathway.

Lobby drain bodies and covers shall be 6" round, hot dipped galvanized.

Fire Protection

Provide drainable standpipes with 2½ inch fire hose connections on each level at each egress stairway, with additional standpipes located throughout the structure such that all portions of the structure are within 100 feet of a standpipe hose connection, or as otherwise required by Code.

Standpipe risers shall be painted red.

Provide a fire department connection for the standpipe system as required by Code and NFPA 14. The fire department connection shall face the street, and shall be located within 100 feet of a fire hydrant. The fire hydrant shall be located such that a temporary meter, valve, and hose assembly can be connected for use by LTP for cleaning of the structure in accordance with University and City of Ann Arbor requirements.

For structures that require fire protection sprinklers, provide a dry pipe system. Include a nitrogen generator for charging the dry pipe system. Review options for compressed air source during design. The dry pipe sprinkler valve, nitrogen generator and air compressor (if needed) shall be located in the structure maintenance room. Provide a sprinkler system electrical failsafe contact that opens if the system becomes charged, and connect it to the DDC panel.

The fire protection system shall be designed with the capability of draining down a charged system into the sanitary sewer/oil separation system for proper disposal of water.

All exposed control valves for the fire protection system shall be lockable or within lockable tamper resistant boxes.

Provide drum drips if FSS piping is exposed to temperatures below freezing.

Electrical Design Requirements

Lighting

Provide the following horizontal light levels on the floor:

Area	Minimum	Average	Uniformity
Egress routes while on emergency power	Per Code	Per Code	Per Code
Elevator Lobbies	Per Code	Per IESNA	Per IESNA

Active interior drive lanes and parking spaces	2.0fc	-	10:1 max:min
Inactive interior drive lanes and parking spaces	0.4 fc	-	10:1 max:min
Daytime vehicle entrances and exits	50.0 fc	-	10:1 max:min
Nighttime vehicle entrances and exits	2.0 fc	-	10:1 max:min
Active stairways	5.0 fc	-	4:1 ave:min
Inactive stairways	2.5 fc		4:1 ave:min
Active lobbies	5.0 fc	-	5:1 max:min
Inactive lobbies	2.5 fc	-	5:1 max:min
Active top deck	0.6 fc	-	4:1 ave:min
Inactive top deck	0.2 fc	-	4:1 ave:min
Equipment room	-	20.0 fc	3:1 ave:min
Storage room	-	10.0 fc	3:1 ave:min

Note: Deviations from the light levels listed above may be necessary to meet the lighting power density (watts/sq.ft.) restrictions of ASHRAE 90.1.

Light reflectance from painted ceilings and walls shall be used during calculation of lighting levels.

Provide light levels in elevator lobbies, cars, machine rooms, and pits in accordance with the Michigan Elevator Code.

Normal lighting should have an average-to-minimum uniformity ratio of not more than 4:1. Deviations from this ratio may be necessary to meet restrictions set forth by ASHRAE 90.1

Provide exit signs to direct traffic toward exits and pedestrians toward stairs and pedestrian exit ways. Exit signs shall be vandal-resistant LED type. Do not provide battery-backed exit signs.

Select lighting fixture cut-off to minimize direct glare into driver's eyes and to limit the amount of light exiting the structure.

Fixtures shall be vandal-resistant, UL listed for wet locations, with gasketed, high impact polycarbonate lenses secured with vandal-resistant screws, and cold weather-rated drivers.

Fixtures should operate at 277 volts. Do not provide battery-backed emergency lights.

Lighting fixtures in stairways, lobbies, and elevators shall be vandal-resistant 4000 degrees K color temperature and cold weather rated (0 degrees F or less) drivers.

Lighting in stairways, elevator lobbies, maintenance rooms and the substation room shall be connected to emergency circuits.

Lighting fixtures shall be cord and plug connected, with cords secured to conduits. Provided photometric requirements can be met, lighting fixtures over parking spaces should be located at the drive lane end of the parking spaces such that the fixtures can be repaired or replaced even if parked vehicles are present.

Lighting fixtures on the roof deck shall be LED type, mounted on round, tapered, aluminum poles. Refer to U-M Master Specification 265600 for additional requirements. Minimum lighting levels shall be maintained, but fixture wattage and pole height may be reduced to minimize light trespass on surrounding areas.

Lighting Controls

Circuit the interior deck lighting fixtures in rows that parallel the outer walls. Provide daylighting and motion detection controls to turn off fixtures when the incoming daylight is adequate and reduce light levels when the facility is idle.

Provide photocell and motion detection controls to turn off the top deck lights when the daylight is adequate and reduce light levels when the facility is idle.

Provide daylighting and motion detection controls in lobbies and stairwells exposed to natural daylight to turn off unneeded lights when the incoming daylight is adequate or reduce light levels when areas are idle.

Power

Provide an indoor, single-ended, 13.2 kV–480Y/277 volt unit substation utilizing U-M Master Specification 261100. Locate the substation on a 4 inch minimum concrete housekeeping pad in a separate room complying with Design Guideline SBA5.7. Exception: If the parking structure is close coupled to a building having sufficient power to serve the parking structure, a secondary voltage feeder may be utilized. If this is done, the feeder shall have a separate meter installed of the type specified in Master Specification 261100.

Provide a natural gas fueled engine-generator in accordance with Design Guideline 263000 to supply emergency power. Propose a location indoors in a room or outdoors in an enclosure for approval by LTP. Size the generator large enough to provide power to all lighting, parking access controls, and sump pumps in the structure. UL924 relays must be cold-weather rated or placed in a heated cabinet or room.

Provide one 120V GFCI duplex electrical outlet in the elevator lobby on every level. Provide a hinged, lockable cover on the outlet.

Raceways

Conduit should be exposed, except conduits to parking controls and attendant booths shall be embedded. Horizontal conduit runs below structural beams and vertical conduit runs should be located near columns and away from drive lane areas. Conduits located where they may be struck by vehicles shall be guarded.

Exposed conduits shall be Schedule 80 PVC and embedded conduits shall be Schedule 40 PVC, both with matching fittings, expansion fittings, and weatherproof junction and outlet boxes. Structural support channels shall be hot-dipped galvanized steel hardware.

Exposed ½" and ¾" conduits shall be strapped to the structure with Carlon "Snap Strap" or equivalent sliding clamps every 3 feet maximum. Exposed 1" through 2" conduits shall be strapped to the structure with Carlon "Snap Strap" or equivalent sliding clamps every 5 feet maximum. Conduits 2" and smaller shall not be suspended on hangers. They shall be installed so no gaps exist between the conduits and the structure large enough for someone to grip the conduits and pull them down.

Exposed conduits larger than 2" shall be strapped with standard 2-hole PVC clamps, but the clamps shall be spaced off of the structure or hanger by a nylon or PVC washer under each hole of each clamp. The washers shall be thin enough so the 2-hole clamps continue to provide conduit support, but thick enough so the conduits slide through the clamps during conduit expansion and contraction.

Expansion fittings shall be provided in sufficient quantities to accommodate the expansion and contraction of a 120 degree F temperature change. Expansion fittings shall be provided within 3 feet of lighting fixtures and within 5 feet on both sides of bends and elbows. Expansion fittings shall be installed either expanded or contracted as appropriate for the specific temperature existing at the time of installation.

Drain holes ¼" in diameter shall be drilled in the bottom of exposed junction and outlet boxes.

Fire Alarm

Provide a fire alarm system only when and where required by Code. Provide fire alarm devices that are UL listed for the environment in which they will be located.

Fire alarm junction boxes, covers and fittings shall be painted red or installed in red conduit throughout. Exception: The fire alarm raceways exposed in finished areas may be painted to match wall color.

Sprinkler system water flow and trouble alarms must be monitored in accordance with Design Guideline 283100. In parking structures without a fire alarm system, the sprinkler water flow and trouble alarms shall be monitored directly through the campus MOSCAD system. Monitoring of water flow and trouble alarms in Hospital parking structures by the Michigan Medicine Facilities Control Center may also be acceptable, in accordance with direction received from the Design Manager.

Emergency Telephones, Elevator Telephones, and Data Connections

Provide DDC monitoring and alarms in the BAS Operations Center for snow melt system trouble, exhaust fan running and shutdown, CO “high-high” level, VSD trouble, generator running and trouble, automatic transfer switch transfer to generator power, loss of natural gas pressure, sprinkler system water flow and trouble, heat tracing trouble, and trouble from any other mechanical or electrical systems.

Provide U-M standard wall-mounted emergency telephones with integrated blue lights. Kiosk-

style telephones shall not be used. Provide power and communications conduits and wiring for the emergency telephones. The lights operate on 120V power. Consult the U-M Standard Details. Some redesign may be required because the existing standard details may not always apply. Installation locations shall provide for maximum visibility and accessibility.

Provide one communication line for each elevator that will serve as the emergency telephone service from the elevator to an outside monitored source. All communication lines must terminate in junction boxes in the elevator machine room.

Provide conduit and cable from the telecommunications room for data circuits to be used for gate control systems, programmable signage and other applications.

Provide conduit and cable from the telecommunications room to the substation for recording power meter communications.

Options

Consider and review with LTP and the Department of Public Safety & Security safety options that exceed code requirements, such as security cameras in stairwells and exterior glazings that provide full viewing within stairwells.

Review with LTP the installation of electric vehicle charging stations.