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BASIC PARKING INFORMATION REPORT

MINNESOTA STATE COLLEGES AND UNIVERSITIES

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TABLE OF CONTENTS

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INTRODUCTION AND PURPOSE

MnSCU continually has questions about how to improve parking at the various campuses. It would be helpful for MnSCU to have a "generic parking initiative" to refer to when the question of parking arises. The purpose of this report is to provide basic parking information and assist MnSCU in solving parking needs. The following is the Scope of Services included in this report:

SCOPE OF SERVICES

Walker Parking Consultants has developed a "generic parking initiative" providing basic parking information to assist MnSCU in solving parking problems. We included the following:

1. Guidelines on developing parking solutions.
2. Construction cost information for single and multiple tiered parking structures.
3. Project cost information for structured parking.
4. Maintenance and operation cost information.
5. Basic internal traffic flow options.
6. Pedestrian and vehicular circulation.
7. Suggested methods of improving traffic and parking at college campuses.
8. Structural system selection for parking facilities.
9. Items important to successful parking.

LEVEL OF SERVICE (LOS) APPROACH

There are many factors affecting the selection of the best functional design of a parking facility, including:

* Type of user
* Pedestrian needs
* Wayfinding
* Floor to floor height
* Dimensions of the site
* Parking geometry
* Peak hour volumes
* Flow capacity

To quantify these criteria a Level of Service approach has been developed to classify the design elements. This is similar to how traffic engineers design streets and intersections, that is:

LOS A = Most Comfortable Without Excessive Waste
LOS B = Very Good
LOS C = Average
LOS D = Minimally Adequate
LOS E = Maximum Flow Before Gridlock
LOS F = Not acceptable

FUNCTIONAL DESIGN

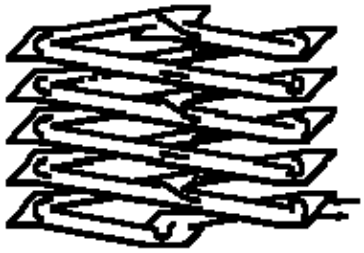
CIRCULATION AND ACCESS

Parking facilities are comprised of some combination of flat parking bays, sloped parking bays, flat drive aisles, or sloping drive isles (ramps) assembled to connect the levels to allow vehicles to traverse floor to floor. The basic functional systems are single thread (rise one level for each 360° turn) and double thread (rise one level for each 360° turn). Other systems include flat floors which are accessed by express ramps or helices, or some combination of sloped and flat bays.

Single - Threaded Helix
Two Way

PEDESTRIAN FLOW

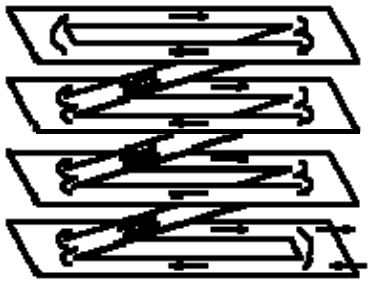
There are many factors associated with safe pedestrian flow, including visibility, lighting, travel distance, floor slopes, wayfinding, security, and parking aisle orientation. It is preferred to orient drive aisles toward the pedestrian destination. Otherwise, pedestrians will cut through parked vehicles, which is not a safe condition. Crossing aisles may be appropriate to direct pedestrians to stair and elevator towers. Flat floors are preferred rather than sloping floors. Bright uniform lighting with higher ceilings will enhance pedestrian visibility. Proper signage will direct pedestrians to their destination. Color coding floors and providing other visual and audio cues will assist pedestrians in returning to their vehicles. Walking distances vary with 300' considered LOS A and up to 1200' considered acceptable. Walking distances in an open parking lot may be longer for the same perceived LOS (1400' lot equals 1200' structure for LOS D)



Double - Threaded Helix
One Way

PARKING GEOMETRICS

Parking geometrics include stall width, drive aisle width, angle of park, and parking module. Car dimensions, door opening clearance, and vehicle movement into the parking space establish the dimensions.



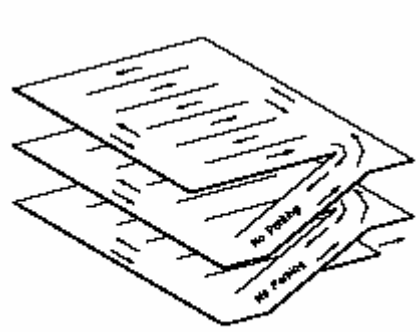
Three - Bay Side - By - Side

- Stall width
  - related primarily to door opening needs
  - 24 to 30" for high turnover
  - 20" minimum for low turnover
- Module
  - The module is the out-to out dimension of two rows of parked vehicles and the aisle between
  - based on comfort of turn into stall
- Stall width, module and angle are related

The design vehicle is typically established as the 85% vehicle which is currently the Ford Expedition (6'-7" wide by 17'-1" long). The following table provides the recommended stall width.

GEOMETRIC RECOMMENDATIONS

North America	LOS D	LOS C	LOS B	LOS A
Stall Width (ft)	8'3"	8'6"	8'9"	9'0"
Angle of Park	Module (ft)			
45	46.50	47.50	48.50	49.50
50	48.25	49.25	50.25	51.25
55	49.50	50.50	51.50	52.50
60	51.00	52.00	53.00	54.00
65	52.25	53.25	54.25	55.25
70	53.50	54.50	55.50	56.50
75	54.50	55.50	56.50	57.50
90	58.50	59.50	60.50	61.50



Single - Threaded Exterior Express Ramps

The parking geometrics selected will determine the number of parking spaces which can be developed on a specific site. By revising the level of service and parking geometrics, the university may be able to increase parking spaces in existing facilities.

For example, MCTC was able to gain 27 parking spaces by revising the stall width from 8'-6" to 8'-3". Metro State was also able to gain parking spaces by restriping. By utilizing today's LOS for parking geometrics, it may be possible to restripe and gain parking spaces, taking advantage of the dimensions for smaller cars and tighter turning radii. For example, a parking bay 54" wide, 9'-0" stall width and 60° angle of park can be restriped to 8'-3", 75° and gain 12 spaces in a 300' long bay. The LOS drops from A to D, but should be acceptable for student parking.

One caution is to confirm zoning requirements with the governing municipality before making the change. It may be necessary to obtain a variance or convince the building official to revise the zoning code to current standards.

CIRCULATION SYSTEMS

TRAFFIC FLOW

There are two basic types of traffic flow.

* One Way Traffic with angled parking
* Two Way Traffic with 90° parking

In determining the traffic flow best suited for a project, the following should be considered:

* Maximizing parking on site available (site dependent)
* Width of drive aisles (two way is wider)
* Visibility (better with two way)
* Pedestrian safety (wider aisles, safer for pedestrians)
* Wayfinding (one way simpler because flow is dictated)
* Parking maneuverability (easier with angled parking)
* Driving distance to find a space (less with two way)
* Driving distance to exit (less with one way)
* Traffic congestion (less with one way)
* Potential accidents (less with one way)

In summary, both systems have advantages and disadvantages and should be based on project and site specific criteria.

BUILDING SYSTEMS

LIGHTING

Lighting is critical for security and drivability of a parking structure. A well lit facility will have high lighting levels, uniform lighting throughout the facility, minimum glare, and built in energy conservation features such as photo cell and circuit controls. The light fixtures should be selected for a wet environment. In Minnesota High Pressure Sodium (HPS) or Metal Halide (MH) fixtures will provide the best light source for the least cost. MH is often preferred because the white light emitted provides better color rendition then the yellow light from HPS sources. Consideration may be given to provide cut off type fixtures to reduce light spill into neighborhoods.

SECURITY

Security design deals with minimizing the risks of incidents to people. Security is either passive or active. Passive security features are built in design elements such as openness (minimize hiding places), glass walls, glassbacked elevators, and good lighting levels. Active systems

include CCTV surveillance cameras, panic buttons, emergency telephones, two way intercoms, and security patrols. Blue lights with strobe effects are often provided. It is recommended that a security audit of the parking area be performed to determine the level of security that should be provided.

SIGNAGE AND GRAPHICS

Signage and graphics are features of wayfinding and are utilized to guide the user to/from his vehicle to/from his destination. Large letters, simple words, limited signs, and contrasting background are recommended, while letters on dark background provides the best visibility. The signs should have a reflective material to improve visibility.

SAFETY

Safety refers to prevention of injury to property and people. Examples include, tripping hazards, slipping on ice, pedestrian/vehicle conflicts, barrier rails, low clearance, obstacles, and vehicles striking vehicles or people. The parking facility should limit curbs, wheel stops, protruding elements, water ponding (ice), and any obstructions which limit visibility. Barriers should be painted yellow to warn people.

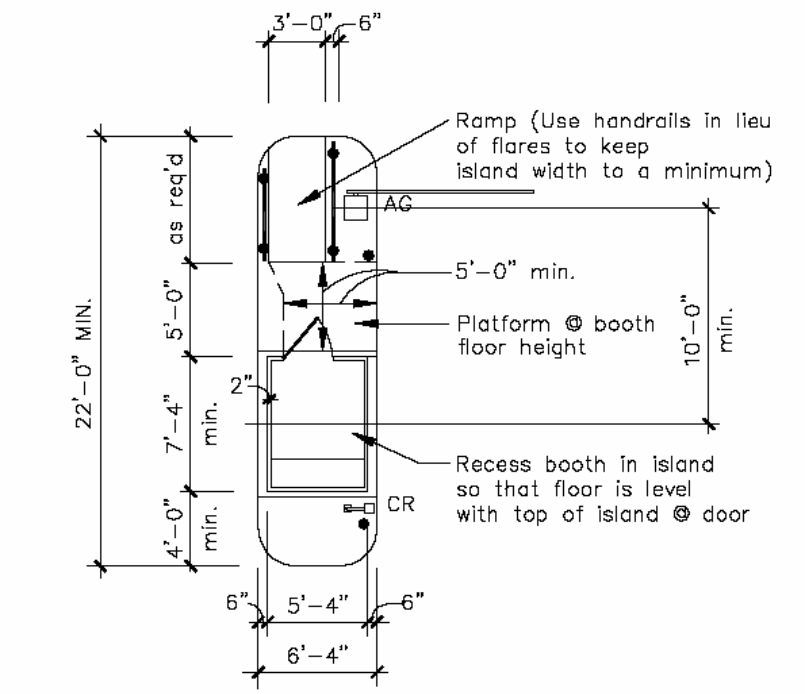
ACCESSIBLE DESIGN

The 1990 Americans with Disabilities Act (ADA) mandates significant parking facility design requirements, including:

* Number of spaces
* Location of spaces
* Geometric requirements
* Flow slopes
* Handicap accessibility
* Van accessibility
* Accessible routes to destination

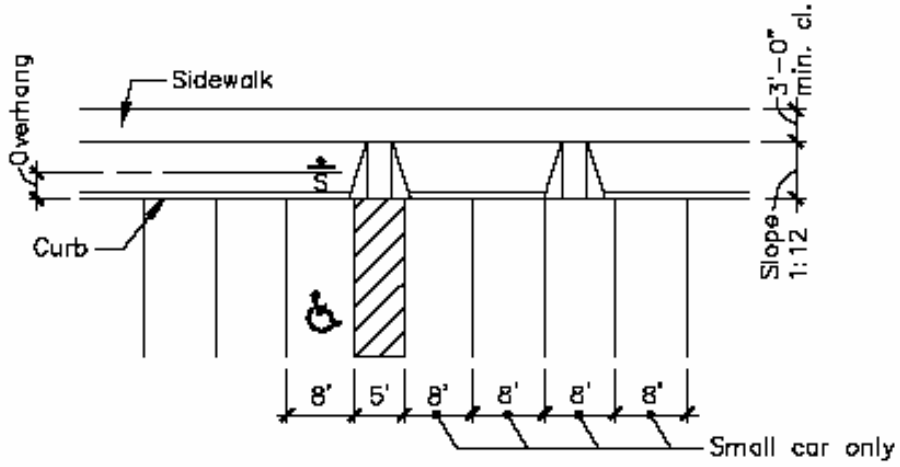
Care must be taken to assure compliance with ADA requirements. Some examples of ADA are shown below:

PARKING ACCESS AND REVENUE CONTROL (PARCS)

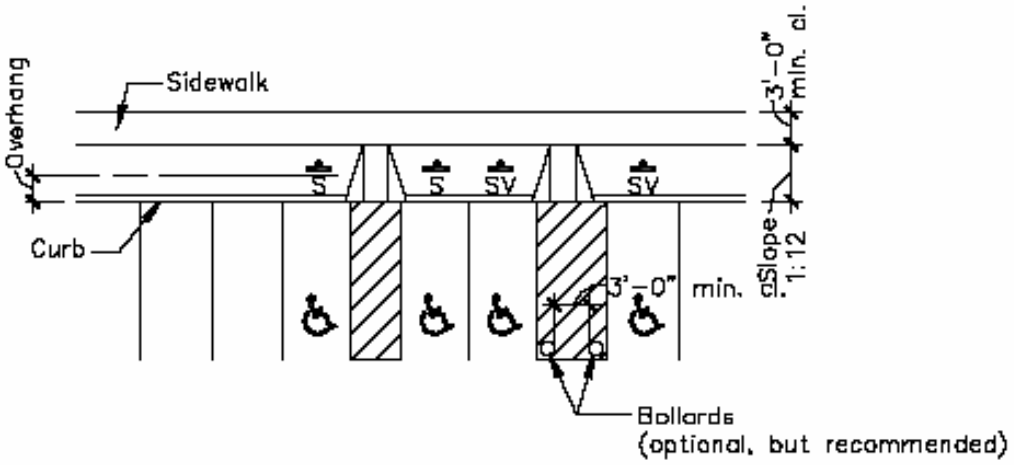


Exit With Accessible Booth; Card

ACCESSIBLE PARKING DESIGN



Initial Design/Construction



Accessible Design

S = Sign for Accessible Stall
SV = Sign for Van Accessible Stall

DOS AND DON'TS FOR ACCESSIBLE PARKING LAYOUT

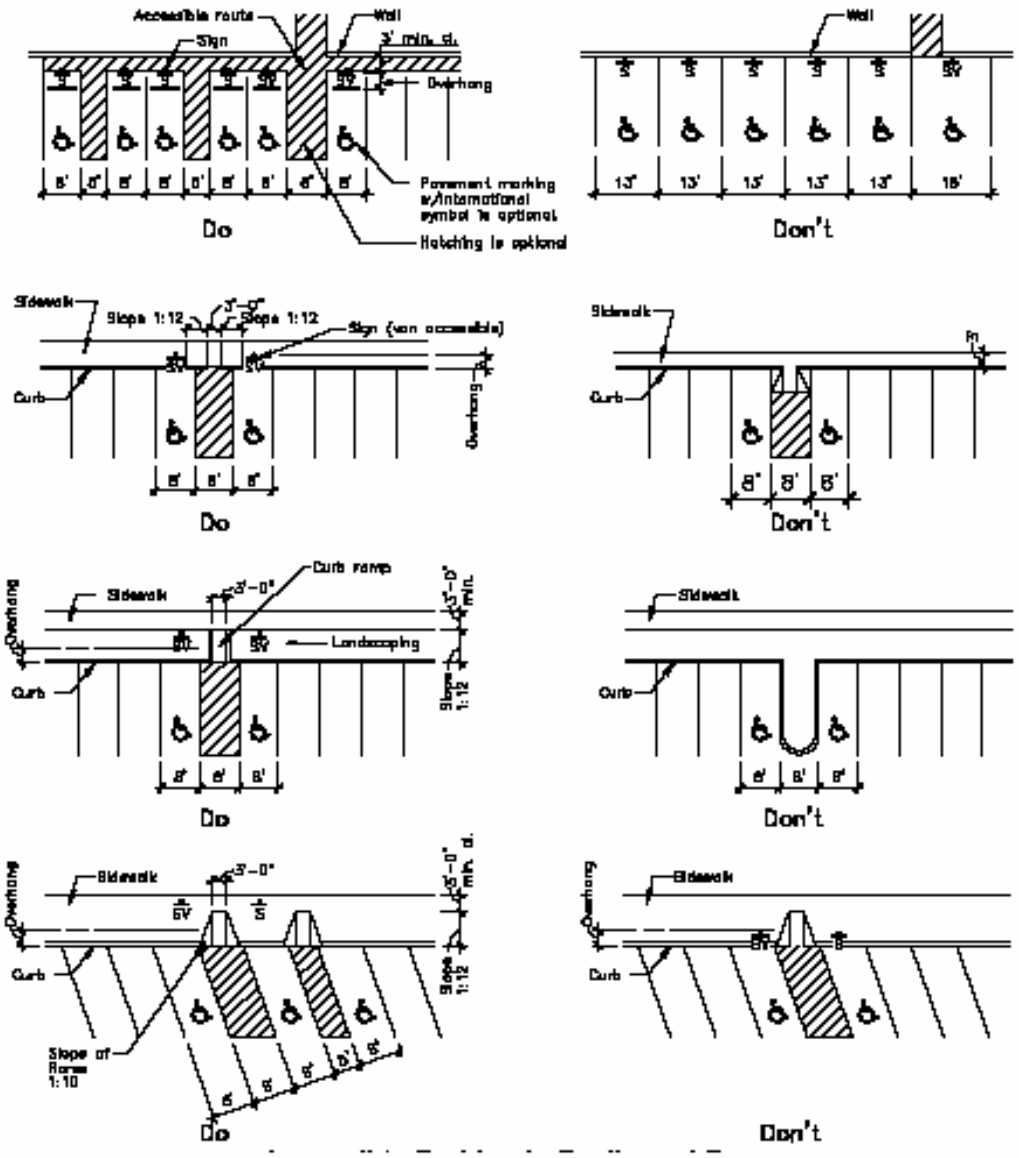


Figure 11-5. Dos and don'ts for accessible parking layout

DESIGN CRITERIA

In order to promote uniformity and clear design standards, several owners establish minimum design criteria for the development of their parking facilities. The following is the table of contents for the City of Minneapolis as an example of items covered for all the city parking facilities.

CITY OF MINNEAPOLIS PARKING FACILITIES July 15, 2002
DESIGN CRITERIA

TABLE OF CONTENTS

PARKING ACCESS AND REVENUE CONTROL SYSTEMS

The first consideration in parking and revenue control systems is the decision on what level of control is required. This can range from Level "0", which could be hang tags, permits, decals, to Level "3", which includes central cashiering, debit cards, credit cards, and pay on foot stations.

Level "0" controls provide very little access control and require more enforcement. However, the costs are very low.

Level "3" provides electronic controls and will limit vehicle access while providing the best "audit" control to maximize revenues. These systems however, are significantly more costly.

Each parking system should be evaluated considering access control requirements, type of user, cost of the system, type of existing system currently in place, familiarity of the user with local systems, serviceability of the system, and enforcement capabilities.

- Hang Tags / Decals
- Parking Meters
- Cashier
- Access Cards
- Pay and Display
- Multi Space Meters
- Credit Card
- Pay on Foot

STRUCTURAL SYSTEMS SELECTION

Parking structures are more like bridges then buildings. They are exposed to moving loads, extreme weather conditions, road salts and significant temperature variances. Because of this, it is important to select a structural system which meets design load requirements and minimizes long term maintenance.

There are primarily three structural systems appropriate for parking facilities:

* Cast-in-place post-tensioned concrete
* Precast prestressed concrete
* Structural steel with concrete floors

In addition, there are hybrid systems with some combinations of the above. There are several considerations in selecting the structural system including: skill of local contractors, material availability, construction cost, quality of construction, expected life, type of function, life cycle costs, and appearance. The structural system selection for each project should be based on the specific criteria for that location. The following table provides a comparison of the basic structural systems and can be used as a guideline to select the appropriate system.

STRUCTURAL SYSTEM SELECTION

	CIP P/T	PRECAST	STRUCTURAL STEEL WITH P/T FLOOR
DURABILITY	Site Labor Dependent	Better Quality Control in P/C Plant	Site Labor Dependent
DRAINAGE	Most Flexibility	Limited Floor Slope	Limited Floor Slope
EXPANSION JOINTS	Required at 300'	Required at 350'	Required at 300'
CONSTRUCTION ITEMS	More Bidders Winter Heat	Limited Bidders	More Bidders
SCHEDULE	More Time on Site	Less Time on Site	More Time on Site
MAINTENANCE	Minimum Joints Lower Maintenance	Many Joints Increased Maintenance	Painting Required Minimum Joints Higher Maintenance
CONSTRUCTION COST	Depends on time of construction and local contractors More Bidders	Depends on time of construction and local contractors Fewer Bidders	Depends on time of construction and local contractors Fewer Bidders
PERFORMANCE	Most open Best Light Distribution Least Floor Vibration	More Obstructions Lower Ceiling Most Floor Vibration	Better lighting
AESTHETICS	Most Flexible Architectural Treatment Cleanest Interior Look	Precast Panels Exposed Conduit	Flexible Architectural Treatment Clean Interior Look

MAINTENANCE PROGRAM

Because of the harsh exposure conditions parking facilities are subjected to, it is very important initiate a regular maintenance program to include structural, operations, and aesthetic categories.

The following table identifies the basic elements to be included in the maintenance program:
It is recommended that the regular maintenance program include

Table 18-1 Maintenance Category

Structural System	Operational	Aesthetics
1. Floors	1. Cleaning	1. Landscaping
2. Beams, columns, and bumper walls	2. Snow and ice control	2. Painting
3. Stair and elevator towers	3. Mechanical systems	3. General appearance
4. Joint sealant systems	4. Electrical systems	
5. Architectural sealants	5. Parking control equipment	
6. Exposed steel	6. Security systems	
7., Masonry	7. Signs (graphics) and striping	
8. Bearing	8. Inspection	
	9. Safety checks	

checklists to simplify and manage the program. These should be tailored for each project. Sample checklists are included as follows:

Table 18-3 Operational Maintenance Schedule

Item	Description	Frequency		
		Monthly	Annual	As Required
1.0	Cleaning Requirements			
	1.1 General cleaning	Perform		a
	1.2 Sweeping	Perform		a
	1.3 Remove ponded water			Perform
	1.4 Floor-surface flushdown		Perform	a
2.0	Snow removal and ice control		Perform	
3.0	Mechanical/electrical systems			
	3.1 Drainage system includes sediment trap)		Inspect	
	3.2 Elevators		Inspect	Perform
	3.3 Ventilation equipment		Inspect	
	3.4 Fire Protection		Inspect	
	3.5 General lighting		Inspect	
	3.6 Exit and emergency lighting		Inspect	a
	3.7 Emergency generator		Inspect	
	3.8 Parking equipment		Inspect	
	3.9 Security monitoring		Perform	a
	3.10 Safety checks		Perform	a
4.0	Graphics and striping			
5.0	Inspection (see structural-maintenance schedu			

[a]More frequent performance of this task is suggested.

Table 18-2 Structure Maintenance Schedule

Item	Description	Frequency	
		Annual	As Required
1.0	Concrete slabs		
	1.1 Visual inspection	Perform	
	A. Floor		
	B. Ceiling		
	C. Floor coatings	Perform	
	1.2 Delamination testing & patching		
	A. Floor		
	B. Ceiling		a
	1.3 Protective sealer application		
2.0	Beams, columns, bumper walls, and connectors	Perform	
	2.1 Visual inspection		
	A. Columns	Perform	
	B. Beams		
	C. Bumper walls		
	D. Connections		
	E. Snowchute		
	2.2 Delamination testing & patching		
	A. Columns	Perform	
	B. Beams		
	C. Bumper walls		
	D. Connections		
	E. Snowchute		
	2.3 Protective sealer application		b
3.0	Stairtowers		
	3.1 Visual inspection	Perform	
	A. Stairs & landings		
	B. Walls		
	C. Glass		
	3.2 Apply protective sealer to landings and stairs	Inspect	c
4.0	Joint-sealant systems		d
	4.1 Visual inspection & repairs	Perform	
	A. Expansion joints		
	B. Construction joints		
	C. Control joints		
	4.2 Crack routing and sealing	Inspect	Perform
5.0	Architectural sealants	Inspect	Perform
6.0	Exposed steel	Inspect	
7.0	Masonry	Inspect	Perform
8.0	Bearing pads	Inspect	Perform

[a]Reapply every 3-5 yr. Areas that are subject to more intense and severe exposure may require retreatment annually. Testing and inspection should be performed to determine degree of exposure. A traffic coating may be more cost-effective in areas of heavy leaking or floor deterioration.
[b]Apply sealer every 3 yr. on those structural members subject to frequent leaking and saltwater splash.
[c]Sealer application should be made every 3 yr.
[d]Budget for total replacement every 10 yr.
Adapted from "Parking Garage Maintenance Manual, First Edition." Parking Consultants' Council, National Parking Association, 1982.

Table 18-3 Operational Maintenance Schedule

Item	Description	Frequency		
		Monthly	Annual	As Required
1.0	Cleaning Requirements			
	1.1 General cleaning	Perform		a
	1.2 Sweeping	Perform		a
	1.3 Remove ponded water			Perform
	1.4 Floor-surface flushdown		Perform	a
2.0	Snow removal and ice control		Perform	
3.0	Mechanical/electrical systems			
	3.1 Drainage system includes sediment trap)		Inspect	
	3.2 Elevators		Inspect	Perform
	3.3 Ventilation equipment		Inspect	
	3.4 Fire Protection		Inspect	
	3.5 General lighting		Inspect	
	3.6 Exit and emergency lighting		Inspect	a
	3.7 Emergency generator		Inspect	
	3.8 Parking equipment		Inspect	
	3.9 Security monitoring		Perform	a
	3.10 Safety checks		Perform	a
4.0	Graphics and striping			
5.0	Inspection (see structural-maintenance schedu			

[a]More frequent performance of this task is suggested.

Table 18-4 Aesthetic Maintenance Schedule

Item	Description	Annual	As Required
1.0	Landscaping	Inspect	
1.1	Mow Grass		Perform
1.2	Prune Shrubs		Perform
1.3	Tend Flowerbeds		Perform
2.0	Painting	Inspect	
2.1	Clean and Paint		Perform
3.0	General Appearance	Inspect	
3.1	Take Corrective Action		Perform

Adapted from "Parking Garage Maintenance Manual, First Edition," Parking Consultants' Council, National Parking Association, 1982.

COST OF PARKING

The cost of parking includes capital costs and operational costs. The capital costs include construction costs (amount paid to the contractor) and soft costs (design fees, surveys, geotechnical investigation, construction testing, land acquisition, demolition, site preparation, and financing). During the planning and design phases of the project it is recommended to include design and construction contingencies to account for items not yet defined and unforeseen field conditions. It is suggested to include a 15% contingency at Schematic Design. The contingency can be reduced to 5% at the completion of Construction Documents. The project soft costs typically range from 20 to 30% of the construction costs exclusive of land.

For a parking facility in Minnesota, the following table provides the construction costs for various alternatives. This data is based on the costs of recently built facilities in the Upper Midwest area.

PARKING ALTERNATIVES	COST/ SQ. FT.	COST/ SPACE	OPER. EXP. COST/SP/YR*	REMARKS
1. Surface Lot				
Concrete	$5.50	$1,650	$80	• 300 SF/SP
Asphalt	$4.00	$1,200	$100	• Includes Curb, Gutter, Drainage, Lighting, Landscaping
2. Free-Standing Facility Open-Air, Long Span				
a) Two Levels	$19.00	$5,985	$220	• 315 SF/SP • Elevator • Footprint 112 x 300 • Brick Facade - Add $500/SP • Deep Foundations – added cost varies
b) Three Levels	$26.50	$8,350	$250	
c) Four Levels	$29.00	$9,130	$300	
d) Five Levels	$30.50	$9,610	$350	
3. Below Grade, Enclosed				
a) Two Levels	$35.00	$13,125	$400	• 350 – 400 SF/SP • No Building Above • Parking on Grade (top) Level
b) Three Levels	$48.00	$18,000	$400	
c) Four Levels	$62.00	$23,250	$400	
4. Add Level to Existing, Open-Air, Long Span	$36.00	$11,340		• 315 SF/SP
• Cashiering Expense not included. Cashiering Costs $100 - $150/SP/YR.				

PARKING NEEDS ANALYSIS

The first step in solving parking problems is to quantify the problem. This can be done by performing a parking supply/demand analysis to determine the actual parking required on campus. Once the parking needs are quantified, a site selection can be made based on number of parking spaces required, future campus growth projections, alternative transportation solutions, walking distance to the campus buildings, cost of site specific locations, vehicle access to the site, campus master plans, and other campus specific criteria.

There may be several sites to consider and there will likely be future campus developments which will impact the decision on the type of facility and preferred location.

Reviewing the management and operations of the parking system may result in recommendations that may solve parking problems. For example, reserving preferred parking spaces for car-poolers may decrease the number of parking spaces required.

DESIGNER SELECTION

There are several ways to proceed with solving parking problems. While the university parking staff has intimate knowledge of the campus situation, it is recommended to retain a parking consultant to help quantify the problem, develop potential solutions, and determine project costs for the various solutions. From this analysis, a recommendation can be made on which parking solution to further develop.

If a parking facility is recommended, the university could issue a Request for Proposal to select a designer to develop construction documents. Project bids can be solicited from qualified contractors. Because parking facilities are a unique building type, it is important to select qualified designers and contractors with parking structure experience.

In addition to the traditional design-bid-build approach, a design-build approach may be considered where the university selects a contractor/designer team. There are advantages and disadvantages to both approaches and these should be evaluated before the project moves into design.

In summary, parking facilities are truly a unique building type and the university will benefit from retaining experts in both design and construction.

APPROACH TO SOLVING PARKING PROBLEMS

- Supply Demand Analysis
- Site Alternatives
- Operational Analysis